INFORMATION SHEET

PRESIDING: Finley, Beatty, Brown-Bland, Dockham, Patterson, Clodfelter
PLACE: Dobbs Building, Raleigh, North Carolina
DATE: November 9, 2017 (Volume 3)
TIME: 9:00 a.m. to 12:30 p.m.
DOCKET NO.: EC-23, Sub 50
COMPANIES: Blue Ridge Electric Membership Corporation
Charter Communications Properties, LLC
DESCRIPTION: Blue Ridge Electric Membership Corporation, Petitioner, v. Charter Communications Properties, LLC, Respondent.

APPEARANCES

FOR BLUE RIDGE ELECTRIC MEMBERSHIP CORPORATION:
Pressly M. Millen, Esq.
Charlotte Mitchell, Esq.
Debbie W. Harden, Esq.
Matthew F. Tilley, Esq.

Gardner F. Gillespie, Esq.
J. Aaron George, Esq.
Marcus W. Trathen, Esq.

WITNESSES
Wilfred Arnett (Cont'd.)
Gregory Booth
Micheal Mullins

EXHIBITS
WA Exhibits 1-23 --/A
Rebuttal WA Exhibits 24-33 --/A
Rebuttal WA Exhibits 34-35 --/A
(Filed under seal.)
Exhibits GLB-1 - GLB-8 I/A
Exhibits GLB-1R - GLB 2R I/A
Respondent's Cross Exhibit 1 --/A
Respondent's Cross Exhibits 2-6 I/A
Charter Communications Properties, LLC's Responses to Blue Ridge Electric Membership Corporation's First Set of Data Requests --/A
Exhibits MM 1-14 I/--
(Filed under seal.)
Exhibit MM 15 I/--
Exhibits MM 16-17 I/--
(Filed under seal.)
Exhibit MM 18 I/--

EMAIL COPIES ORDERED: Trathen, Gillespie, Mitchell, Harden, Tilley, Millen
CONFIDENTIAL: Trathen, Gillespie, Mitchell, Harden, Tilley Millen

REPORTED BY: Linda Garrett
TRANSCRIBED BY: Linda Garrett
DATE TRANSCRIBED: December 2, 2017

TRANSCRIPT PAGES:146
PREFILED PAGES: 147

NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE 11|8|17
DOCKET #: EC-23, SUB 50
NAME OF ATTORNEY PRESS MILLEN
TITLE
FIRM NAME WOMBLE BOND DICKINSON
ADDRESS 555 FAYETTEVILLE ST, SUITE 1100
CITY RALEIGH
ZIP 27601

APPEARING FOR: BLUE RIDGE EMC

APPLICANT ____ COMPLAINANT ✓ INTERVENO R ____
PROTESTANT ____ RESPONDENT ____ DEFENDANT ____

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APPEARANCE SLIP

DATE 11/8/17
DOCKET #: EC23, SUB 50
NAME OF ATTORNEY MATTHEW TILLEY
TITLE
FIRM NAME WOMBLE BOND DICKINSON
ADDRESS
CITY CHARLOTTE
ZIP

APPEARING FOR: BLUE RIDGE EMC

APPLICANT ____ COMPLAINANT ✓ INTERVENO R ____
PROTESTANT ____ RESPONDENT ____ DEFENDANT ____

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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE ~~[illegible]~~ 11/8/17
DOCKET #: EC23, SUB 50
NAME OF ATTORNEY DEBBIE HARDEN
TITLE PARTNER
FIRM NAME WOMBLE BOND DICKINSON
ADDRESS ONE WELLS FARGO CENTER, SUITE 3500, 301 SOUTH COLLEGE ST
CITY CHARLOTTE NC, ~~[illegible]~~
ZIP 28202-6037

APPEARING FOR: BLUE RIDGE EMC

APPLICANT ______ COMPLAINANT ✓ INTERVENO R ______
PROTESTANT ______ RESPONDENT ______ DEFENDANT ______

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Signature: Debbie H Harden
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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE 11/8/17
DOCKET #: EC23, SUB50
NAME OF ATTORNEY CHARLOTTE MITCHELL
TITLE
FIRM NAME LAW OFFICE CHARLOTTE MITCHELL
ADDRESS PO BOX 26212
CITY RALEIGH, NC
ZIP 27611

APPEARING FOR: BLUE RIDGE ELECTRIC MEMBERSHIP CORPORATION

APPLICANT ____ COMPLAINANT ✓ INTERVENO R ____
PROTESTANT ____ RESPONDENT ____ DEFENDANT ____

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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE 11-8-17
DOCKET #: EC-22 Sub 50
NAME OF ATTORNEY Gardner Gillespie, Aaron George
TITLE
FIRM NAME Sheppard Mullin
ADDRESS 2099 Pennsylvania Ave NW Suite 100
CITY Washington, D.C.
ZIP 20006

APPEARING FOR: Charter Communications

APPLICANT ______ COMPLAINANT ______ INTERVENO R ______
PROTESTANT ______ RESPONDENT ✓ DEFENDANT ______

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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE 11-8-17
DOCKET #: EC-23, Sub 50
NAME OF ATTORNEY Marcus Trathen
TITLE
FIRM NAME Brooks Pierce
ADDRESS PO Box 1800
CITY Raleigh NC 27602
ZIP

APPEARING FOR: Charter Communications

APPLICANT ____ COMPLAINANT ✓ INTERVENOR ____
PROTESTANT ____ RESPONDENT ✓ DEFENDANT ____

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I/A

EXHIBIT GLB-1

CURRICULUM VITAE OF GREGORY L. BOOTH

October 11, 2017

RESUME OF GREGORY L. BOOTH, PE, PLS
President
PowerServices, Inc.
Gregory L. Booth, PLLC

Gregory L. Booth is a registered professional engineer with engineering, financial, and management services experience in the areas of utilities, industry private businesses and forensic investigation. He has been representing over 300 clients in some 40 states for more than 50 years. Mr. Booth was inducted into the North Carolina State University Electrical and Computer Engineering Alumni Hall of Fame in November of 2016 based on his accomplishments in the field of engineering.

Mr. Booth has been accepted as an expert before state and federal regulatory agencies, including the Federal Energy Regulatory Commission, the Delaware Public Service Commission, the Florida Public Service Commission, the Minnesota Department of Public Service Environmental Quality Board, the Massachusetts Attorney General Department of the Advocacy, the New Jersey Board of Public Utilities, the North Carolina Utilities Commission, the Pennsylvania Public Utility Commission, the Rhode Island Public Utilities Commission, and the Virginia State Corporation Commission. He has been accepted as an expert in both state and federal courts, including Colorado, Delaware, Florida, District of Columbia, Missouri, New York, North Carolina, Oklahoma, Pennsylvania, South Carolina, Virginia, West Virginia, Wisconsin and numerous Federal Court jurisdictions. Mr. Booth has provided expert witness services on over 500 tort case matters, and over 50 regulatory matters. Investigation and testimony experience includes areas of wholesale and retail rates, utility acquisition, territorial disputes, electric service reliability, right-of-way acquisition and impact of electromagnetic fields and evaluation of transmission line options for utility commissions.

Additionally, Mr. Booth has extensive experience serving as an expert witness before state and federal courts on matters including property damage, forensic evaluation, fire investigations, fatality, and areas of electric facility disputes and Occupational, Safety and Health Administration violations and investigations together with National Electrical Code and National Electrical Safety Code and Industry Standard compliance.

The following pages provided are the education and experience from 1963 through the present, along with courses taught and publications.

RESUME OF
GREGORY L. BOOTH, PE, PLS

Mr. Booth is a Registered Professional Engineer with engineering, financial, and management experience assisting local, state, and federal governmental units; rural electric and telephone cooperatives; investor owned utilities, industrial customers and privately owned businesses. He has extensive experience representing clients as an expert witness in regulatory proceedings, private negotiations, and litigation.

PROFESSIONAL EDUCATION: NORTH CAROLINA STATE UNIVERSITY; Raleigh NC, Bachelor of Science, Electrical Engineering, 1969

PROFESSIONAL HONORS: Inducted into North Carolina State University Department of Electrical and Computer Engineering Alumni Hall of Fame in November 2016.

REGISTRATIONS: Registered as Professional Engineer in Alabama, Arizona, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Kansas, Maryland, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, North Carolina, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Texas, Commonwealth of Virginia, West Virginia, and Wisconsin
Professional Land Surveyor in North Carolina
Council Record with National Council of Examiners for Engineering and Surveying

EXPERIENCE:

1963-1967
Technician
Booth & Associates

Transmission surveying and design assistance, substation design assistance; distribution staking; construction work plan, long-range plan, and sectionalizing study preparation assistance for many utilities, including Cape Hatteras EMC, Halifax EMC, Delaware Electric Cooperative, Prince George Electric Cooperative, A&N Electric Cooperative; assistance generation plant design, start-up, and evaluations.

1967-1973
Project Engineer
Booth & Associates

Transmission line and substation design; distribution line design; long-range and construction work plans; rate studies in testimony before State and Federal commissions; power supply negotiations; all other facets of electrical engineering for utility systems and over 30 utilities in 10 states.

1973-1975
Professional Engineer
Associates
1975-1994
Executive Vice President
Booth & Associates

Directed five departments of Booth & Associates, Inc.; provided engineering services to electric cooperatives and other public Booth & power utilities in 23 states; provided expert testimony before state regulatory commissions on rates and reliability issues; in accident investigations and tort proceedings; transmission line routing and designs; generation plant designs; preparation and presentation of long-range and construction work plans; relay and sectionalizing studies; relay design and field start-up assistance; generation plant designs; rate and cost-of-service studies; reliability studies and analyses; filed testimony, preparation and teaching of seminars; preparation of nationally published manuals; numerous special projects for statewide organizations, including North Carolina EMC. Work was provided to over 130 utility clients in 23 states, PWC of the City of Fayetteville, NC, Cities of

Wilson, Rocky Mount and Greenville are among the utilities in which I have provided engineering services in North Carolina during this time frame. Services to industrial customers include Texfi Industries, Bridgestone Firestone, Inc and many others.

1994-2004 President Booth & Associates	Responsible for the direction of the engineering and operations of Booth & Associates, Inc. for all divisions and departments. The engineering work during this time frame has continued to be the same as during 1974 through 1993 with the addition of greater emphasis on power supply issues, including negotiating power supply contracts for clients; increased involvement in peaking generation projects; development of joint transmission projects, including wheeling agreements, power supply analyses, and power audit analyses. The work during this time frame includes providing services to over 200 utility clients across the United States, including NCEMC and NRECA.
2004-Present President Gregory L. Booth, PLLC	Providing engineering and management services to the electric industry, including planning and design. Providing forensic engineering, product evaluation, fire investigations and accident investigation, serving as an expert witness in state and federal regulatory matters and state and federal court.
2005-Present President PowerServices, Inc.	Providing engineering and management services to the electric industry, including planning and design and utility acquisition. Providing forensic engineering, product evaluation, fire investigations and accident investigation, serving as an expert witness in state and federal regulatory matters and state and federal court.

WORK AND EXPERTISE:

ELECTRIC UTILITIES:
(more than 300 clients)

- All aspects of utility planning, design and construction, from generation, transmission, substation and distribution to the end user.
- Utility acquisition expert, including providing condition assessment, system electrical and financial valuation, electrical engineering assessment, initial Work Plan and integration plans, acquisition loan funds, testimony, assessment and consulting services for numerous electric utility acquisitions. Utility clients for acquisition projects include Winter Park, FL acquisition of Progress Energy, FL, system in the City limits, A & N Electric Cooperative acquisition of the Delmarva Power & Light Virginia jurisdiction, Shenandoah Valley Electric Cooperative acquisition of Allegheny Energy Virginia jurisdiction, Rappahannock Electric Cooperative acquisition of Allegheny Energy Virginia jurisdiction, and numerous other past and currently active electric utility acquisitions.
- System studies, including long-range and short-range planning, sectionalizing studies, transmission load flow studies, system stability studies (including effects of imbalance and neutral-to-earth voltage), environmental analyses and impact studies and statements, construction work plan, power requirements studies, and feasibility studies.

- Fossil, hydro, microgrid, wind, and solar generation plan analysis, design, and construction observation.
- Transmission line design and construction observation through 230 kV overhead and underground.
- Switching station and substation design and construction observation through 230 kV.
- Distribution line design and staking, overhead and underground.
- Design of submarine cable installations. (Transmission and distribution)
- Supervisory control and data acquisition system design, installation and operation assistance.
- Load management system design, installation and operation assistance.
- Computer program development.
- Load research and alternative energy source evaluation.
- Field inspection, wiring, and testing of facilities.
- Relay and energy control center design.
- Mapping and pole inventories.
- Specialized grounding for abnormal lightning conditions.
- Ground potential rise protection.
- Protective system/relay coordination.
- Grid Modernization Plan development, regulatory testimony, and implementation
- Pole Attachment Agreements, rate design, and testimony

UTILITY OPERATIONS:

- Storm assessment services.
- Regulatory testimony on storm response.
- Storm Response Plan development.
- Operations, including outage management and Call Centers.
- Outage management and operations enhancement services and testimony.

GENERATION DESIGN / FAILURE ANALYSES:

- Intermediate and peaking generation (gas and oil fired through 400 MW).
- Peaking generation (diesel and gas through 10,000 kW)
- Wind generation.
- Solar (PV) generation.
- Hydroelectric generation.
- Microgrid, including energy storage.

TELECOMMUNICATION: UTILITIES:

- Subscriber and trunk carrier facilities design.
- Stand-by generation and DC power supplies
- DC-AC inverters for interrupted processor supplies.
- Plant design and testing.
- Fiber optics and other transmission media.
- Microwave design.
- Pole attachment designs and make-ready design.
- Pole Attachment Agreements and rental rates calculations.
- Regulatory testimony.

FINANCIAL SERVICES:

- Long-term growth analyses and venture analyses.
- Lease and cost/benefit analyses.
- Capital planning and management.
- Utility rate design and service regulations.
- Cost-of-Service studies.
- Franchise agreements.
- Corporate accounting assistance.
- Utility Commission testimony (State and Federal)

FORENSIC ENGINEERING:

- Compliance with NESC, NEC, OSHA, IEEE, ANSI, ASTM and other codes and industry standards.
- Equipment and product failure and analysis and electrical accident investigation (high and low voltage equipment).
- Stray voltage, electrical shocking, and electrocution investigations.
- Building code investigations.
- New product evaluation.
- MCC, MDP failure analysis and arc flash analysis
- Electrical fire analysis

INDUSTRIAL/ELECTRICAL ENGINEERING:

- Building design (commercial and industrial).
- Building code application and investigation. (NFPA and NEC)
- Electric thermal storage designs for heating, cooling, and hot water.
- Standby generation and peaking generation design.
- Electric service design (residential, commercial, and industrial).

INSTRUCTIONAL SEMINARS AND TEXT:

- Seminars taught on arc flash hazards and safety, including National Electrical Safety Code regulations for utilities.
- Courses taught on Distribution System Power Loss Evaluation and Management.
- Courses taught on Distribution System Protection.
- Text prepared on Distribution System Power Loss Management.
- Text prepared on Distribution System Protection.
- Seminars taught on substation design, NESC capacitor application, current limiting fuses, arresters, and many others electrical engineering subjects.
- Courses taught on accident investigations and safety.
- Courses taught on Asset Management.
- Courses taught on OSHA and Construction Safety.

TESTIMONY AS AN EXPERT:

- Concerning rate and other regulatory issues before Federal Energy Regulatory Commission and state commissions in Delaware, Florida, Maryland, Massachusetts, Minnesota, New Jersey, North Carolina, Pennsylvania, Rhode Island, and Virginia.
- Concerning property damage or personal injury before courts in Colorado, District of Columbia, Florida, Maryland, Minnesota, Missouri, New Jersey, New York, North Carolina, Oklahoma, Pennsylvania, South Carolina, Texas, Virginia, West Virginia, and Wisconsin.

FIELD ENGINEERING:

- Transmission line survey and plan and profile.
- Distribution line staking.
- Property surveying.
- Relay and recloser testing.
- Substation start-up testing.
- Generation acceptance and start-up testing.
- Ground resistivity testing.
- Work order inspections.
- Operation and maintenance surveys.
- Building inspection and service facility inspection.
- Construction Management
  - Generation
  - Transmission
  - Substation
  - Distribution
  - Building Electrical Installations
  - GSA construction projects
  - NASA construction projects
  - University construction projects

PROFESSIONAL ORGANIZATIONS:

a. National Society of Professional Engineers (NSPE)
b. Professional Engineers in Private Practice (PEPP)
c. National Council of Examiners for Engineering & Surveying (NCEES)
d. Professional Engineers of North Carolina (PENC)
e. National Fire Protection Association (NFPA)
f. Associate Member of the NRECA
g. NRECA Cooperative Network Advisory Committee (NRECA-CRN)
h. The Institute of Electrical and Electronics Engineers (IEEE) (Distribution sub-committee members on reliability)
i. American Standards and Testing Materials Association (ASTM)
j. Occupational Safety and Health Administration (OSHA) Certification
k. American Public Power Association (APPA)
l. American National Standards Institute (ANSI)

FEDERAL AND STATE

REGULATORY TESTIMONY

CASE LIST

October 11, 2017

ACTIVE AND HISTORIC REGULATORY CASES BY GREGORY L. BOOTH, PE, PLS

Commonwealth of Virginia State Corporation Commission

Rappahannock Electric Cooperative, 247 Industrial Court, Fredericksburg, VA 22408

Case No. PUE-2009-0010 (HE)

2007

Delmarva Power & Light System Acquisition Purchase for A & N Electric Cooperative, Post Office Box 290, 21275 Cooperative Way, Tasley, VA 23441 and Old Dominion Electric Cooperative, 4201 Dominion Boulevard, Glen Allen, VA 23060

Case Nos. PUE-2007-00060, 00061, 00062, 00063, and 00065 (HE)

2009

Potomac Edison/Allegheny Energy System Acquisition Purchase for Shenandoah Valley Electric Cooperative, 147 Dinkel Ave., Hwy 257, Mt. Crawford, VA 22841

Case No. PUE-2009-00101 (HE)

2011

Virginia, Maryland & Delaware Association of Electric Cooperatives Commonwealth of Virginia at the relation of the State Corporation Commission in the Matter of Determining Appropriate Regulation of Pole Attachments and Cost Sharing in Virginia

Case No. PUE-2011-00033 (HE)

2013

Northern Virginia Electric Cooperative Pole Attachment Dispute with ComCast

PUE-2013-00055 (HE)

Delaware Public Service Commission

Delaware Electric Cooperative, Inc., Retail Rate Case and Reliability Cases

(HE)

Federal Energy Regulatory Commission

Public Works Commission of the City of Fayetteville, NC v. Carolina Power & Light Company

ER76-, ER77-, ER78, ER81-344, ER84- (HE)

2000

North Carolina Electric Membership Corporation v. Duke Energy Corporation and Duke Electric Transmission

ER01-282-000 and ER01-283-000 (HE)

ACTIVE AND HISTORIC REGULATORY CASES BY GREGORY L. BOOTH, PE, PLS

Federal Energy Regulatory Commission

2000

North Carolina Electric Membership Corporation v. Virginia Electric Power Company dba North Carolina Power

EL90-26-00-000 (HE)

2015

Application for Authorization Pursuant to Section 203(a)(1)(A) and 203(a)(2) of the Federal Power Act and Request for Waivers of Certain Filing Requirements

Dkt EC15-___-000

Florida Public Service Commission (PSC)

2007

Municipal Utility Underground Consortium Pre-Filed Testimony for Storm Hardening and Undergrounding Assessment

Docket Nos. 07023-EI, 080244-EI, and 080522-EI (HE)

2007

Gulf Power Company's Storm Hardening Plan Pre-filed Testimony on Behalf of City of Panama City Beach, Florida

Florida PSC Docket No. 070299-EI (HE)

Maine Office of the Public Advocate

2016

Efficiency Maine Trust Request for Examination of Voltage Optimization Pilot Program Docket No. 2016-00162

Dkt. 2016-00162

2017

Investigation into the Designation of Non-Transmission Alternative (NTA) Coordinator

Docket No. 2016-00049 (WT)

2017

Investigation of Inclusion of Acadia Substation Investment in Rates Pertaining to Emera Maine

Docket No. 2017-00018

HE = Hearing
WT = Written Testimony

Massachusetts Department of Public Utilities

2012

Massachusetts Office of Attorney General Commonwealth of Massachusetts Department of Public Utilities Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid Review for Storm Response and Recovery of 2008 Storm Costs

DPU 11-56 (WT) (HE)

2012

Massachusetts Office of Attorney General Western Massachusetts Electric Company, Northeast Utilities System, Review for Recovery of Storm Costs

DPU 11-102/DPU 11-102A (WT) (HE)

2013

Massachusetts Office of Attorney General Nstar Review for Recovery of Storm Costs

DPU 13-52 (WT) (HE)

2014

Massachusetts Office of Attorney General National Grid Solar Generation Phase II Program Assessment

D.P.U. 14-01 (WT)

2014

Massachusetts Office of Attorney General Western Massachusetts Electric Company, Review of Storm Recovery Reserve Cost Adjustment "SRRCA"

D.P.U. 13-135 (WT) (HE)

2016

MA Elec. Co. and Nantucket Elec. Co. d/b/a National Grid, Fitchburg Gas and Electric Light Co. d/a/a Unitil and NSTAR Elec. Co. and Western MA Elec. Co. d/b/a Eversource for Approval by the DPU of their Grid Modernization Plan

DPU 15-120, 15-121, 15-122/15-123 (HE)

2017

Nstar Electric Company and Western Massachusetts Electric Company d/b/a Eversource Energy Petition for Approval of a Performance-Based Ratemaking Mechanism and General Distribution Revenue Change

DPU 17-05 (WT) (HE)

HE = Hearing
WT = Written Testimony

Massachusetts Department of Public Utilities

2017

Petition of Massachusetts Electric Company and Nantucket Electric Company each d/b/a National Grid for Pre-Approval of Enhanced Vegetation Management Pilot Program

DPU 17-92

Minnesota Department of Public Service/Environmental Quality Board

Transmission Line Assessment Minnesota Department of Public Service and Minnesota Environmental Quality Board

(HE)

New Hampshire Public Utilities Commission

2004

City of Bedford v. Public Service of New Hampshire

New Jersey Public Service Commission

Sussex Rural Electric Cooperative Retail Rate Cases

(HE)

2004

New Jersey Board of Public Utilities, Focused audit of the planning, operations and maintenance practices, policies and procedures of Jersey Central Power & Light Company

Docket No. EX02120950 (HE)

2015

Jersey Central Power & Light Company ("JCP&L") and Mid-Atlantic Interstate Transmission, LLC ("MAIT") FERC 7 Factor Test Evaluation

BPU Docket No. EM15060733 (WT)

2016

Atlantic City Electric Company for Approval of Amendments to its Tariff to Provide for an Increase in Rates and Charges For Electric Service Pursuant to NJSA 48:2-21 and JJSA 48:2-21.1

DPU Docket No. ER16030252 OAL Docket No. PUC 5556-16

North Carolina Utilities Commission

Larry Eaves, et. al. v. Town of Clayton

(HE)

North Carolina Utilities Commission

Poly-Loc v. Town of Tarboro

(HE)

1990

Delora Dennis, et. al. v. Haywood EMC

E-7, Sub 474, EC-10, Sub 37, E013, Sub 151 (HE)

2001

Wake EMC Right of Way Acquisition

(TE)

2002

Progress Energy Carolinas, Inc., v. E.M. Harris, Jr. Family Limited Partnership, Edward M. Harris, III and wife Pamela M. Harris, Gene K. Harris and wife Linda Harris, Camille H. Cunnup and husband Timothy J. Cunnup Siler City Transmission Line Issues

General Court of Justice Superior Court Division, File No. 03 CVS SP 251, 252, 253, 254, 255 (WT) (HE)

2004

John Wardlaw, et. al. Interveners v. Progress Energy Carolinas

Docket No. E-2, Sub 855 (HE)

2011

Frontier Communications of the Carolinas, Inc. v. Blue Ridge Mountain Electric Membership Corporation

11-CVS-17175

2017

Jones-Onslow Electric Membership Corporation; Surry-Yadkin Electric Membership Corporation; Carteret-Craven Electric Membership Corporation; Union Electric Membership Corporation, d/b/a Union Power Cooperative v. Time Warner Cable Southeast, LLC

NCUC Docket Nos. EC-43 5888, EC-49 555, EC55 570 and EC-39 S44

2017

Blue Ridge Electric Membership Corporation v. Charter Communications Properties, LLC

Docket No EC-23, SUB 50

ACTIVE AND HISTORIC REGULATORY CASES BY GREGORY L. BOOTH, PE, PLS

Pennsylvania Public Utility Commission

2004

Investigation regarding the Metropolitan Edison Company Pennsylvania Electric Company and Pennsylvania Power Company Reliability Performance

Docket No. I-00040102 (WT) (HE)

2006

Investigation regarding Pennsylvania Rural Electric Association / Allegheny Electric Cooperative Rates

Docket Nos. R-00061366, R-0061367, et. al. (WT) (HE)

2007

Wellsboro Electric Company participants Included C&T Enterprises, Inc., comprised of Wellsboro Electric Company, Claverack Rural Electric Cooperative, Inc., Tri-County Rural Electric Cooperative, Inc., and Citizens Electric

Docket No. P-2008-2020257 (WT) (HE)

2014

PREA 2014 Intervention Assistance, Analysis of Service Reliability Concerns Regarding West Pennsylvania Power Company, Pennsylvania Electric Company, Metropolitan Edison Company (First Energy Company)

Docket Nos. R-2014-2428742, -2428743, -2428744, -248745 (WT)

2014

Pennsylvania Rural Utility Commission West Penn Power Company, Pennsylvania Electric Company, Pennsylvania Power Company and Metropolitan Edison Company

R-2014-2428742, R-2014-2428743, R-2014-2428744, R-2014-2428745 (WT)

2015

MAIT and PENELEC for Authorizing the Transfer of Certain Transmission Assets from MET-Ed & PENELEC to MAIT

A-2015-2488903 (cons.)

Rhode Island Public Utilities Commission

1997

Testimony before the Rhode Island Utilities Commission, on behalf of Rhode Island Division of Public Utilities and Carriers, May 15, 1997

Docket No. 2489 (WT) (HE)

Rhode Island Public Utilities Commission

2003

Testimony before the Rhode Island Utilities Commission on behalf of Rhode Island Division of Public Utilities and Carriers, December 2003

Docket No. 2930 (WT) (HE)

2004

Issuance of Advisory Opinion to Energy Facility Siting Board Regarding The Narragansett Electric Company's Application to Relocate Transmission Lines Between Providence and East Providence, 2004

Docket No. 3564 (WT) (HE)

2006

Issuance of Advisory Opinion to Energy Facility Siting Board Regarding the Narragansett Electric Company d/b/a National Grid's Application to Construct and Alter Major Energy Facilities, 2006

Docket No. 3732 (WT) (HE)

2007

Issuance of Advisory Opinion to RIDPUC in the Matter of the Joseph Allard Fatality Involving Verizon and National Grid

2008

Issuance of Advisory Opinion to Energy Facility Siting Board Regarding the Narragansett Electric Company d/b/a National Grid's Application to Construct and Alter Major Energy Facilities, 2008

Docket No. 4029 (WT) (HE)

2010

Rhode Island Division of Public Utilities and Carriers Narragansett Tariff Investigation

Docket No. R.I.P.U.C. 4065

2010

National Grid Proposed Electric Infrastructure, Safety and Reliability Plan for FY 2012 Submitted Pursuant to R.I.G.L. § 39-1-27.7.1

Docket No. 4218 (WT) (HE)

2012

National Grid Electric FY 2013 Electric Infrastructure, Safety and Reliability Plan

Docket No. 4307 (WT) (HE)

Rhode Island Public Utilities Commission

2012

National Grid Hurricane Irene Response Assessment, 2012

Docket No. D-11-94 (WT) (HE)

2012

Public Utilities Commission Review of Storm Contingency Funds of Electric Utilities

Docket No. 2509 (WT) (HE)

2012

Commission's Investigation Relating to Stray and Contact Voltage

Docket No. 4237 (WT)

2012

Rhode Island Public Utilities Commission Interstate Reliability Assessment

Docket No. 4360 (WT) (HE)

2012

National Grid Electric Infrastructure, Safety, and Reliability Plan for 2014

Docket No. 4382 (WT) (HE)

2014

National Grid Electric Infrastructure, Safety, and Reliability Plan 2015 Proposal

Docket No. 4473 (WT) (HE)

2014

National Grid's FY 2016 Electric Infrastructure, Safety and Reliability Plan

Docket No. 4539 (WT) (HE)

2015

Division's Investigation into Verizon's Vegetation Management Practices

2015

Wind Energy Development, LLC (WED) and ACP Land, LLC Petition for Dispute Resolution Relating to Interconnection

Docket No. 4483 (WT)

HE = Hearing
WT = Written Testimony

Rhode Island Public Utilities Commission

2015

National Grid Electric Infrastructure, Safety, and Reliability Plan FY 2017

Docket No. 4592 (WT) (HE)

2016

PUC Advisory Opinion Regarding Need of The Narragansett Electric Co. d/b/a National Grid to Construct and Alter Certain Transmission Components in the Towns of Portsmouth and Middletown (Aquidneck Island Reliability Project)

Docket No. 4614

2016

National Grid Electric Infrastructure, Safety, and Reliability Plan FY 2018

Docket No. 4682 (WT)

2017

National Grid Electric Infrastructure, Safety, and Reliability Plan FY 2019

CURRENT & HISTORICAL

CLIENT

LISTS

October 11, 2017

Partial List of Historical Electrical Utility Clients

Client Name	*City*	*State*
4 CES/CEEC	Seymour Johnson AFB	NC
A&N Electric Cooperative	Parksley	VA
ACRES International Corporation	Grand Forks	ND
Action Sensors, Inc.	Wendell	NC
Adams Rural Electric Cooperative	West Union	OH
AFL Telecommunications		NC
Alaska 220 Communications	Anchorage	AK
Alachua, City of	Alachua	FL
Alabama Power Company	Birmingham	AL
Albemarle Electric Membership Corporation	Hertford	NC
Alcoa Fujikura, Ltd.	Spartanburg	SC
Allegheny Electric Cooperative	Harrisburg	PA
Alleghany Power Energy	Greensburg	PA
Altahama Electric Membership Corporation	Lyons	GA
Alternative Energy Corporation	RTP	NC
American Public Power Association	Washington	DC
American Telecommunications	Raleigh	NC
Apex Communications, LLC	Wynne	AR
Apex, Town of	Apex	NC
Arkansas Electric Cooperative, Inc.	Little Rock	AR
AT&T	Durham	NC
Atlantic Power Generation	Charlotte	NC
Ayden, Town of	Ayden	NC
Bailey & Dixon	Raleigh	NC
Baker, Jenkins, Jones & Daly	Ahoskie	NC
BARC Electric Cooperative	Millboro	VA
Barnhill Contracting Company	Tarboro	NC
Bath Electric, Gas & Water	Bath	NC
Battle, Winslow, Scott & Wiley	Rocky Mount	NC
Beckwith Power Systems	North Versailles	PA
Bedford, City of	Bedford	VA
Belhaven, Town of	Belhaven	NC
Bellsouth Mobility DCS	Raleigh	NC
Bennettsville, City of	Bennettsville	SC
Benson, Town of	Benson	NC
Biltmore Dairy Farms, Inc.	Asheville	NC
Black Creek, Town of	Black Creek	NC
Blountstown, City of	Blountstown	FL
Blue Ridge Electric Cooperative	Pickens	SC
Blue Ridge Electric Membership Corporation	Lenoir	NC
Boulder, City of	Boulder	CO
Brantley & Wilkerson, PC	Montgomery	AL
Brunswick Electric Membership Corporation	Shallotte	NC

Client Name	*City*	*State*
Burlington-Northern Railroad	St. Paul	MN
Burroughs Wellcome Company	RTP	NC
Bushnell, City of	Bushnell	FL
Calpine Operations Services (Calpine Power)		
Cape Hatteras EMC	Buxton	NC
Carolina Power & Light	Raleigh	NC
Carroll Electric Cooperative	Carrollton	OH
Carteret Craven Electric Cooperative	Morehead City	NC
Central Electric Cooperative, Inc.	Parker	PA
Central Electric Membership Corporation	Sanford	NC
Central Georgia Electric Membership Corporation	Jackson	GA
Central Virginia Electric Cooperative	Lovingston	VA
Centura Bank	Rocky Mount	NC
Charter Communications	Holly Ridge	NC
Chattahoochee, City of	Chattahoochee	FL
Cherry Hospital – DHR	Goldsboro	NC
Choptank Electric Cooperative	Denton	MD
Claverack Rural Electric Cooperative	Wysox	PA
Clayton, Town of	Clayton	NC
Clemson University	Clemson	SC
Clewiston, City of	Clewiston	FL
CNA Insurance Companies	Rockville	MD
Cobb Electric Membership Corporation	Marietta	GA
Coconut Creek, City of	Coconut Creek	FL
Columbus Water Works	Columbus	GA
Community Electric Cooperative	Windsor	VA
Cornelius & Huntersville	Huntersville	NC
Continental Cooperative Services	Harrisburg	PA
Cornice Engineering, Inc.	Pagosa Springs	CO
Craig-Botetourt Electric Cooperative	New Castle	VA
CP&L Area Cooperatives		NC
Crawford & Company	Raleigh	NC
Crescent Electric Membership Corporation	Statesville	NC
C&T Enterprises		PA
Dalton Utilities	Dalton	GA
Danvers, Town of	Danvers	MA
Danville, City of	Danville	VA
Davidson Water Cooperative	Welcome	NC
Delaware County Electric Cooperative	Delhi	NY
Delaware Division of Parks & Recreation	Dover	DE
Delaware Electric Cooperative	Greenwood	DE
Depcom Power		
Dover, City of	Dover	DE
Drexel, Town of	Drexel	NC
Duke Energy Progress	Raleigh	NC
East Carolina University	Greenville	NC

Client Name	*City*	*State*
East Kentucky Power Cooperative	Winchester	KY
Easton Utilities Commission	Easton	MD
Eden, City of	Eden	NC
Edenton, Town of	Edenton	NC
Edgecombe Martin County Electric Membership Corp.	Tarboro	NC
Electric Cooperative of SC	Cayce	SC
Electricities of NC, Inc.	Raleigh	NC
Elizabeth City, City of	Elizabeth City	NC
EMC Technologies	Raleigh	NC
EnergyUnited	Statesville	NC
Enfield, Town of	Enfield	NC
Enron Wind Corporation	Tehachapi	CA
Exelon Business Services		
Farmville, Town of	Farmville	NC
Flint Energies	Warner Robins	GA
Florida Keys Electric Cooperative Association, Inc.	Tavernier	FL
Florida Municipal Electric Association	Tallahassee	FL
Florida Municipal Power Agency	Orlando	FL
Fort-Bragg – USA	Fort Bragg	NC
Fort Lauderdale, City of	Fort Lauderdale	FL
Fort Meade, City of	Fort Meade	FL
Fort Pierce Utilities	Fort Pierce	FL
Four County Electric Membership Corporation	Burgaw	NC
Fox Islands Electric Cooperative	Vinalhaven	ME
French Broad Electric Membership Corporation	Marshall	NC
Fremont, Town of	Fremont	NC
Georgia Consumers Utility Council	Atlanta	GA
Georgia Power	Union City	GA
Gillette, City of	Gillette	WY
Great River Energy	Maple Grove	MN
Green Cove Springs, City of	Green Cove Springs	FL
Greenville Utilities	Greenville	NC
Greer, SC Comm. Of Public Works	Greer	SC
Greystone Power Corporation	Douglasville	GA
Groton Utilities	Groton	CT
Guernsey-Muskingum Electric Cooperative	New Concord	NH
Habersham Electric Membership Corporation	Clarksville	GA
Halifax Electric Membership Corporation	Enfield	NC
Hancock-Wood Electric Cooperative	N. Baltimore	OH
Harkers Island Electric Membership Corporation	Harkers Island	NC
Harnett County Wastewater	Lillington	NC
Harron Communications	Frazer	PA
Hart Electric Membership Corporation	Hartwell	GA
Havana, Town of	Havana	FL
Haynes Electric Utility Company	Asheville	NC
Haywood Electric Membership Corporation	Waynesville	NC

Client Name	*City*	*State*
Hertford, Town of	Hertford	NC
High Point, City of	High Point	NC
High Point, Regional Hospital	High Point	NC
Hobgood, Town of	Hobgood	NC
Hookerton, Town of	Hookerton	NC
Jacksonville Beach, City of	Jacksonville Beach	FL
Joe Wheeler Electric Membership Corporation	Trinity	AL
Jones-Onslow Electric Membership Corporation	Jacksonville	NC
Jupiter Inlet Colony	Jupiter Inlet	FL
Kenergy	Owensboro	KY
Keys Energy Services	Key West	FL
Kinston, City of	Kinston	NC
LaGrange, Town of	LaGrange	NC
Laurinburg, City of	Laurinburg	FL
Lee County Electric Cooperative		FL
Lewes, DE Board of Public Works	Lewes	DE
Lewis County Rural Electric Cooperative	Lewiston	MO
Lexington Utilities	Lexington	NC
Lexington, City of	Lexington	NC
Lookout Windpower, LLC		PA
Louisburg, Town of	Louisburg	NC
Lucama, City of	Lucama	NC
Lumbee River MEC	Red Springs	NC
Lumberton, City of	Lumberton	NC
Lynches River Electric Cooperative	Pageland	SC
Madison, Borough of	Madison	NJ
Maine Department of Public Advocate		ME
Maine Public Service Company	Presque Isle	ME
Manassas, City of	Manassas	VA
Martinsville, City of	Martinsville	VA
Massachusetts Office of the Attorney General		MA
Mebane, City of	Mebane	NC
Mecklenburg Electric Cooperative	Chase City	VA
Middle Georgia Electric Membership Corporation	Rochelle	GA
Milford, City of	Milford	DE
Minnesota DPS	St. Paul	MN
Mississippi Power	Gulfport	MS
Mitchell Electric Membership Corporation	Camilla	GA
MN Planning/Environmental	St. Paul	MN
Monroe, City of	Monroe	NC
Morganton, City of	Morganton	NC
Municipal Gas Group	Wilson	NC
National Rural Telecom Cooperative	Herndon	VA
National Spinning Co., Inc.	Washington	NC
New Bern, City of	New Bern	NC
Newberry, City of	Newberry	NC

Client Name	*City*	*State*
New Enterprise Rural Electric Cooperative	New Enterprise	PA
New Hampshire Electric Cooperative	Plymouth	NH
North Carolina AT&T State University	Greensboro	NC
North Carolina Association of Electric Cooperatives	Raleigh	NC
North Carolina Eastern Municipal Power Agency	Raleigh	NC
North Carolina Electric Membership Corporation	Raleigh	NC
North Carolina League of Municipalities	Raleigh	NC
North Carolina Rural Telecommunications Cooperative	Enfield	NC
North Carolina State University	Raleigh	NC
North Georgia Electric Membership Corporation	Dalton	GA
North Miami, City of	Miami	FL
Northern Neck Electric Cooperative	Warsaw	VA
Northern Virginia Electric Cooperative	Gainesville	VA
Northfield Electric Department	Northfield	VT
Northwest Public Power Association	Vancouver	WA
Northwestern Rural Electric Cooperative Association	Cambridge Springs	PA
NRECA	Arlington	VA
Ohio Rural Electric Cooperative, Inc.	Columbus	OH
Old Dominion Electric Cooperative	Glen Allen	VA
Ostego Electric Cooperative	Hartwick	NY
Palm Beach, Town of	Palm Beach	FL
Panama City Beach	Panama City	FL
Pee Dee Electric Cooperative	Darlington	SC
Pee Dee Electric Membership Corporation	Wadesboro	NC
Pennsylvania Rural Electric Association	Harrisburg	PA
Perkasie, Borough of	Perkasie	PA
Piedmont Electric Membership Corporation	Hillsborough	NC
Pineville, Town of	Pineville	NC
Pitt & Greene Electric Membership Corporation	Farmville	NC
Pompano Beach, City of	Pompano Beach	FL
Potomac Electric Power Company	Washington	DC
Prince George Electric Cooperative	Waverly	VA
Progress Energy	Raleigh	NC
PWC of the City of Fayetteville	Fayetteville	NC
Quincy, City of	Quincy	FL
Randolph Electric Membership Corporation	Asheboro	NC
Rappahannock Electric Cooperative	Fredericksburg	VA
REA Energy Cooperative (SW Central)	Indiana	PA
Red Springs, Town of	Red Springs	NC
RI Division of Public Utilities and Carriers	Warwick	RI
Roanoke Electric Cooperative	Rich Square	NC
Robersonville, Town of	Robersonville	NC
Rocky Mount, City of	Rocky Mount	NC
Roxboro, City of	Roxboro	NC
Rutherford Electric Membership Corporation	Forest City	NC
Sacramento Municipal Utility District	Sacramento	CA

Client Name	*City*	*State*
Salem, City of	Salem	VA
Sandhills Utility Services, LLC	Red Springs	NC
Santee Cooper	Myrtle Beach	SC
Satilla Rural Electric Membership Corporation	Alma	GA
Sawnee Electric Membership Corporation	Cumming	GA
South Carolina Association of Municipal Power Systems	Columbia	SC
Scotland Neck, Town of	Scotland Neck	NC
Seaford, Town of	Seaford	DE
Selma, Town of	Selma	NC
Seneca, City of	Seneca	SC
Sharpsburg, Town of	Sharpsburg	NC
Shenandoah Valley Electric Cooperative	Mt. Crawford	VA
SMECO	Hughesville	MD
Smithfield, Town of	Smithfield	NC
Snapping Shoals Electric Membership Corporation	Covington	GA
Somerset Rural Electric Cooperative	Somerset	PA
South Daytona, City of	South Daytona	FL
South Mississippi Electric Power Association	Hattiesburg	MS
South River Electric Membership Corporation	Dunn	NC
Southport, City of	Southport	NC
Southside Electric Cooperative	Crewe	VA
Stantonsburg, Town of	Stantonsburg	NC
Starke, City of	Starke	FL
Steuben Rural Electric Cooperative	Bath	NY
STS Hydro Power Limited	Northbrook	IL
Sullivan County Rural Electric Cooperative	Forksville	PA
Sulphur Springs Valley Electric Membership Corp.	Willcox	AZ
Sumter Electric Cooperative		FL
Surry-Yadkin Electric Membership Corporation	Dobson	NC
Sussex Rural Electric Cooperative	Sussex	NJ
Talquin Electric Cooperative, Inc.	Quincy	FL
Tarboro, Town of	Tarboro	NC
Tideland Electric Membership Corporation	Pantego	NC
Tri-County Electric Membership Corporation	Dudley	NC
Tri-County Electric Membership Corporation	Lafayette	TN
Tri-County Rural Electric Cooperative	Mansfield	PA
TVPPA	Chattanooga	TN
UNC – Asheville	Asheville	NC
UNC – Chapel Hill	Chapel Hill	NC
UNC – Charlotte	Charlotte	NC
UNC – Greensboro	Greensboro	NC
Union Electric Membership Corporation	Monroe	NC
United Electric Cooperative	DuBois	PA
US Generating Company	Bethesda	MD
VA, MD & DE Association of Electric Cooperatives	Glen Allen	VA
Valley Rural Electric Cooperative	Huntington	PA

Client Name	*City*	*State*
Vanceburg, City of	Vanceburg	KY
Vero Beach, City of	Vero Beach	FL
Wake Electric Membership Corporation	Wake Forest	NC
Wake Forest, Town of	Wake Forest	NC
Walstonburg, Town of	Walstonburg	NC
Warren Electric Membership Corporation	Youngsville	PA
Washington Electric Cooperative	E. Montpelier	VT
Washington Electric Membership Corporation	Sandersville	GA
Washington, City of	Washington	NC
Waynesville, Town of	Waynesville	NC
Wellsboro Electric Company	Wellsboro	PA
West Virginia Power Company	Lewisburg	WV
Western Carolina University	Cullowhee	NC
Wilmington, City of	Wilmington	NC
Wilson, City of	Wilson	NC
Windsor, Town of	Windsor	NC
Winter Park, City of	Winter Park	FL
Winterville, Town of	Winterville	NC

Partial List of Historical Industrial Clients

Client Name	*City*	*State*
AT&T	Durham	NC
Atlantic Power Generation	Charlotte	NC
Beckwith Power Systems	North Versailles	PA
Black & Decker	Tarboro	NC
Bridgestone/Firestone (BFS)	Wilson	NC
Burroughs Wellcome Company	RTP	NC
Caswell Center	Kinston	NC
Centura Bank	Rocky Mount	NC
Centex Construction	Atlanta	GA
Charter Communications	Surf City	NC
Cherry Hospital – DHR	Goldsboro	NC
Clapp Research Associates	Raleigh	NC
Clark Substations, LLC	Calera	AL
Cornice Engineering, Inc.	Pagosa Springs	CO
Data Comlink, Inc.	Sandersville	GA
Design Dimensions, Inc.	Raleigh	NC
Dolan and Dolan	Newton	NJ
Dupaco	Kinston	NC
Drucker & Falk	Raleigh	NC
E&R Construction	Kinston	NC
Empire of Carolina	Tarboro	NC
Farmville Water and Wastewater Systems	Farmville	NC
Frigidaire	Kinston	NC
Fontaine Fifth Wheel	Birmingham	AL
Fonville-Morrisey	Raleigh	NC
Fort Bragg	Fort Bragg	NC
General Electric	Fairfield	CT
Glenoit Industries	Tarboro	NC
Goldsboro, City of	Goldsboro	NC
Cherry Hospital DHR	Goldsboro	NC
Gregory Poole Power Systems	Raleigh	NC
Harris Development Corp.	Wilson	NC
Hesco, Incorporated	Smithfield	NC
High Point Regional Hospital	High Point	NC
Honeywell	Fort Bragg	NC
Jag Management, Inc.	Raleigh	NC
KCI Technologies, Inc.	Raleigh	NC
Kelly Springfield Tire Co.	Fayetteville	NC
Kinston City Hall	Kinston	NC
Larry A. Blattenberger, Inc.	Martinsburg	PA
Lenior, City of	Lenoir	NC
Lenoir Memorial Hospital	Kinston	NC
Lewes, DE, City of	Lewes	DE
Maida Vale, LLC	Raleigh	NC

Client Name	*City*	*State*
National Fruit Product Company		VA
NC Department of Human Resources	Raleigh	NC
NC Department of Transportation	Raleigh	NC
NC Division of Mental Health	Raleigh	NC
NC Licensing Board – General Contractor	Raleigh	NC
NC School of Deaf	Raleigh	NC
NC State Construction Office	Raleigh	NC
New Hanover County	Wilmington	NC
North Hills PBX	Raleigh	NC
Nucor Steel	Charlotte	NC
Pitt County Memorial Hospital	Greensville	NC
Pope Air Force Base	Pope AFB	NC
Power Delivery Associates	Smyrna	GA
PS & W Engineering	Cary	NC
Rail-Veyor Global Technologies, Inc.		
Raleigh, City of	Raleigh	NC
Rocky Mount City Hall	Rocky Mount	NC
Sara Lee Corporation	Tarboro	NC
Seymour-Johnson Air Force Base	Goldsboro	NC
Talisman Partners, Inc. (now Earthtech)	Englewood	CO
Tantalus Systems, Corp.	Burnaby, BC	Canada
Tarboro Elementary School	Tarboro	NC
Tarboro High School	Tarboro	NC
Tarboro Water and Wastewater Systems	Tarboro	NC
Teligent, Inc.	Alpharetta	GA
Texfi Industries	Fayetteville	NC
The West Co.	Kinston	NC
Time Warner Cable	Newport	NC
Transco	Charlottesville	VA
US Postal Services (GSA)	Raleigh	NC
Utility Engineering Services	Jackson	TN
Volvo Data North America	Greensboro	NC
Wake County Parks & Recreation	Raleigh	NC
West Company	Kinston	NC
Western North Carolina School for the Deaf	Morganton	NC
Williams Energy Group	Tulsa	OK
Zenith Controls, Inc.	Chicago	IL

Partial List of Historical Law Firm Clients

Client Name	*City*	*State*
Abrams & Abrams, P.A.	Raleigh	NC
Abrams & Abrams, PA	Raleigh	NC
Adams, Hendon, Carson, Crow & Saenger, P.A.	Asheville	NC
Allen & Gooch	Lafayette	LA
Andrews Law Group	Tampa	FL
Bailey & Dixon LLP	Raleigh	NC
Baker & Abraham, PC	Boston	MA
Baker Law Firm, PA	Wilmington	NC
Baker, Jenkins, Jones & Daly PA	Ahoskie	NC
Baker, Jenkins, Jones, Murray, Askew & Carter, PA		
Balch & Bingham LLP	Birmingham	AL
Barnes Law Firm, LLC	Kansas City	MO
Barr, Murman, Tonelli, Slother & Sleet	Tampa	FL
Bartimus, Frickleton, Robertson & Gorny	Leawood	KS
Bartimus, Frickleton, Robertson & Goza, P.C.	Leawood	KS
Beasley Allen	Montgomery	AL
Beaver, Holt, Richardson, Sternlicht, Burge & Glazier, PA	Fayetteville	NC
Berkley Net Underwriters, LLC	Woodbridge	VA
Berman & Simmons	Lewiston	ME
Berman | Sobin | Gross | Feldman & Darby, LLP	Gaithersburgh	MD
Beskind and Rudolph, P.A.	Chapel Hill	NC
Bordas, Bordas & Jividen	Wheeling	WV
Breit Drescher Imprevento & Walker	Virginia Beach	VA
Bretz & Young, L.L.C	Hutchinson	KS
Brian G. Miller Co., P.A.	Columbus	OH
Britcher, Leone and Roth, LLC	Glen Rock	NJ
Buck, Danaher, Ryan & McGlenn	Elmira	NY
Campbell Campbell Edwards and Conroy	Boston	MA
Campbell, Campbell Edwards & Conroy	Boston	MA
Carey Leisure & Neal	Clearwater	FL

Client Name	*City*	*State*
Carolina Adjusters	Smithfield	NC
Chappell, Smith and Arden	Columbia	SC
Civille & Tang, PLLC	Hagatna	GU
Coleman, Bernholz, Dickerson, Bernholz, Gledhill, Hargrave	Chapel Hill	NC
Colombo Law	Columbus	OH
Copeland, Cook, Taylor & Bush, PA	Ridgeland	MS
Couch & Taibi	Durham	NC
Cozen O' Connor	Charlotte	NC
Crisp, Davis, Page & Currin, LLP	Raleigh	NC
Crisp, Page & Currin LLP	Raleigh	NC
Daniel & Daniel	Yanceyville	NC
Daniel, Medley & Kirby, P.C.	Danville	VA
David A. Vukelja, PA	Ormond Beach	FL
Davis & Lumsden PA	Beaufort	NC
DeVore & Acton, PA	Charlotte	NC
Devore, Acton & Stafford, PA	Charlotte	NC
Dickie, McCamey & Chilcote, P.C.	Charlotte	NC
Dollar Burns & Becker	Kansas City	MO
Dugan, Brinkmann, Maginnis & Pace	Philadelphia	PA
Edmonds Cole Law Firm, PC	Oklahoma City	OK
Edward M. Ricci Law Firm	West Palm Beach	FL
Edwards, Kirby & Holt, LLP	Raleigh	NC
Eppes & Plumblee, P.A.	Greenville	SC
Ervin & Gates	Charlotte	NC
Faulkner & Boyce, PC	New London	CT
Federal Reserve Bank of Richmond, VA	Richmond	VA
Fiore, Krause, Crogan & Lopez	Owings Mills	MD
Forensic Engineering, Inc.	Raleigh	NC
Frank M. Wilson, PC	Montgomery	AL
Freidman, Sissman & Heaton	Memphis	TN
Friday, Eldredge & Clark	Little Rock	AZ

Client Name	*City*	*State*
Frohilich, Gordon & Beason Law Firm	Port Charles	FL
Gallivan, White & Boyd, P.A.	Greenville	SC
Gary Harris Attorneys At Law	Orlando	FL
Glascock, Gardy & Salvage	Suffolk	VA
Godin Geretty & Puntillo	Kenosha	WI
Godwin, Morris, Laurenzi & Bloomfield	Memphis	TN
Gough, Skipworth, Summers, Eves & Travett	Rochester	NY
Granger, Santry, Mitchell & Heath PA	Tallahassee	FL
Grossman, Roth & Partridge	Sarasota	FL
Habush, Habush, Davis & Rottier, SC	Rhinelander	WI
Hall Ansley, P.C.	Springfield	MO
Harrison, White, Smtih & Coggins, P.C.	Spartanburg	SC
Haynsworth Sinkler Boyd, P.A.	Greenville	SC
Hedrick & Blackwell, LLP	Wilmington	NC
Hedrick, Eatman, Gardner & Kincheloe	Charlotte	NC
Herzfeld & Rubin, P.C.	New York	NY
Hogue, Hill, Jones, Nash & Lynch	Wilmington	NC
Holden & Carr	Tulsa	OK
Holt Sherlin LLP	Raleigh	NC
Hoover Penrod, PLC	Hanrrisonburg	VA
Hutchens Law Firm	Fayetteville	NC
Hux, Livermon & Armstrong, LLP	Enfield	NC
Irigonegaray & Associates	Topeka	KS
Jacquart & Lowe, S.C.	Milwaukee	WI
James McElroy & Diehl, P.A.	Charlotte	NC
Jensen, McGrath, & Podgorny, PA	Research Triangle Park	NC
Jernigan Law Firm	Raleigh	NC
Joel H. Holt, Esq., PC	Christiansted	VI
John Gehlhausen Attorney at Law	Lamar	CO
Johnson & Ward	Atlanta	GA
Jose G. Rodriguez, PA	West Palm Beach	FL

Client Name	*City*	*State*
Kaplan, Gilpin & Associates, LLC	Charlotte	NC
Kassel Law	Columbia	SC
Katzman, Wasserman, Bennardini & Rubinstein, PA	Plantation	FL
Kaufman & Canoles	Richmond	VA
Key & Tatel	Roanoke	VA
Kilpatrick Stockton LLP	Raleigh	NC
La Capra Associates, Inc.	Boston	MA
Langdon & Emison	Lexington	MO
Langdon and Emison	Lexington	MO
Lanzotti & Rau LLC	Cape Girardeau	MO
Larry Leake Attorney At Law	Marshall	NC
Law Offices of Peter A. Jouras, Jr.	Overland Park	KS
Law Offices of Rohn and Carpenter, LLC	Christiansted	VI
Law Offices of William M. Jeter, PLLC	Memphis	TN
LeClair Ryan	Glen Allen	VI
Levinson Axelrod, P.A.	Edison	NJ
Lichtenstein Fishwick PPL	Roanoke	VA
Lucas, Bryant & Denning, PA	Selma	NC
Lytal, Reiter, Ivey & Fronrath	West Palm Beach	FL
Maher & Associates	Towson	MD
Margolis and Velassco	Chicago	IL
Mark C. Tanenbaum, PA	Charleston	SC
Mark C. Tanenbaum, PA	Charleston	SC
Martin and Jones, PLLC	Raleigh	NC
Martin, Jean & Jackson	Ponca City	OK
Massachusetts Attorney General Office	Boston	MA
McAngus Goudelock & Courie	Raleigh	NC
McAngus, Goudelock & Courie, LLC	Raleigh	NC
McCoy, Weaver, Wiggins, Cleveland & Raper	Fayetteville	NC
McCoy, Weaver, Wiggins, Cleveland & Raper PLLC	Fayetteville	NC
McGougan, Wright, Worley, Harper & Bullard, LLP	Tabor City	NC

Client Name	*City*	*State*
McGuire Woods, LLP	Richmond	VA
McNess, Wallace & Nurick LLC	Harrisburg	PA
Michael F. Amezaga, P.A.	West Palm Beach	FL
Michie Hamlett Lowry Rasmussen & Tweel PLLC	Charlottesville	VA
Miles & Stockbridge, PC	Baltimore	MD
Montgomery & Larson, LLP	West Palm Beach	FL
Moore & Van Allen, PLLC	Durham	NC
Morton and Gettys	Rock Hill	SC
Narron, O'Hale, Whittington & Woodruff PA	Benson	NC
Nelson, Mullins, Riley & Scarborough LLP	Raleigh	NC
Nexsen Pruet	Greensboro	NC
Odem & Groves PC	Charlotte	NC
Offices of David B. Mishael, PA	Miami	FL
Offices of Ronald C. Jessamy, PLLC	Washington	DC
Orr & Reno, P.A.	Concord	NH
Panter, Panter & Sampedro	Miami	FL
Parker Poe	Raleigh	NC
Parker Poe Law Firm	Spartanburg	SC
Parr Richey Obremskey Frandsen & Patterson	Lebanon	IN
Patla, Staus, Robinson & Moore, P.A.	Asheville	NC
Patrick C. Fire Law Offices	Boardman	OH
Patrick H. Dekle, P.A.	Tampa	FL
Patterson, Dilthey, Clay, Bryson & Anderson, LLP	Raleigh	NC
Patterson, Dilthey, Clay, Cranfill, Sumner & Hartzog	Raleigh	NC
Patterson, Harkavy & Lawrence LLP	Raleigh	NC
Penry Riemann PLLC	Raleigh	NC
Peter Perlman Law Offices PSC	Lexington	KY
Peters, Murdaugh, Parker, Eltzroth & Detrick	Hampton	SC
Peters, Murdough, Parker, Eltsroth & Detrick	Hampton	SC
Pittman, Germany, Roberts & Welsh LLP	Jackson	MS
Podgorny Law, PA	Durham	NC

Client Name	*City*	*State*
Pope & Tart	Dunn	NC
Poyner & Spruill, LLP	Rocky Mount	NC
Pulley, Watson, King & Lischer, P.A.	Durham	NC
Ragsdale Liggett	Raleigh	NC
Rainwater Holt & Sexton, PA	Little Rock	AR
Randles, Mata & Brown, LLC	Kansas City	MO
Reid, Lewis Deese & Nance	Fayetteville	NC
Ricci & Leopold, P.A.	Palm Beach Gardens	FL
Richardson, Patrick, Westbrook & Brickman, LLC	Barnwell	SC
Robert D. Douglass Attorney at Law	Indiana	PA
Rountree Losee, LLP	Wilmington	NC
Sandler & Marchesini, PC	Philadelphia	PA
Sanford Thompson, PLLC	Raleigh	NC
Saperston & Day, PC	Buffalo	NY
Scherffius, Ballard, Still & Ayers, LLP	Atlanta	GA
Schoen Walton Teleken & Foster, LLC		
Schultz Law, LLC	Conshohocken	PA
Schwed, Adams, Sobel & McGinley, P.A.	Palm Beach Gardens	FL
Scott T. Kimmel Attorney at Law	Lighthouse Point	FL
Searcy, Denney, Scarola, Barnhart & Shipley, PA	W. Palm Beach	FL
Shapiro, Cooper, Lewis & Appleton, PC	Virginia Beach	VA
Silverstein, Silverstein & Silverstein, PA	Aventura	FL
Simon & Bocksch	Miami	FL
Simon Passanante, PC	St. Louis	MO
Simpson Boyd & Powers	Decatur	TX
Smith & Duggan LLC	Lincoln	MA
Smith & Duggan, LLP	Boston	MA
Smith, Anderson, Blount, Dorsett, Mitchell & Jernigan, LLP	Raleigh	NC
Smith, Helms, Muliss & Moore	Raleigh	NC
Smith, Helms, Mulliss & Moore, LLP	Charlotte	NC
Smith, Patterson, Follin, Curtis, James & Haravey	Greensboro	NC

Client Name	*City*	*State*
Sommer, Olk Schroeder & Payant	Rhinelander	WI
Sommer, Olk, Schroeder & Payant, LLP	Rhinelander	WI
Spivey Law Firm	Ft. Myers	FL
Stites & Hopkins	Kansas City	MO
Stoner, Bowers, Gray & McDonald, P.A.	Lexington	NC
Strassburger McKenna Gutnick & Gefsky	Pittsburgh	PA
Sumrel ,Sugg, Carmichael, Hicks & Hart	New Bern	NC
Taraska, Grower, Unger & Ketcham, PA	Orlando	FL
Taylor, Day, Grimm, Boyd & Johnson	Jacksonville	FL
The Accurso Law Firm	Kansas City	MO
The Becker Law Firm	Cleveland	OH
The Chandler Law Group	Charlottsville	VA
The Kuhlman Law Firm, LLC	Kansas City	MO
The Redfearn Law Firm, P.C.	Independence	MO
The Wilbur C. Smith, III Law Firm, LLC	Fort Myers	FL
Thompson, Smyth & Cioffi, LLP	Raleigh	NC
Throp, Fuller & Slifkin, P.A.	Raleigh	NC
Timothy D. Welbourne Attorney at Law	Wilkesboro	NC
Troutman Sanders LLP	Raleigh	NC
Turner & Sweeny	Kansas City	MO
Twiggs, Abrams, Strickland & Trehy, P.A.	Raleigh	NC
Twiggs, Abrams, Strickland & Trey, PA	Raleigh	NC
Vandeventer Black LLP	Raleigh	NC
W. Osmond Smith III Attorney at Law	Yanceyville	NC
Walters Bender Strohbehn & Vaughan, PC	Kansas City	MO
Ward & Smith, PA	Greenville	NC
Warren & McGraw, LLC	Blue Bell	PA
Warshafsky, Rotter, Tarnoff & Block, S.C.	Milwaukee	WI
Warshauer Poe & Thornton, PC	Atlanta	GA
Whitacker, Mudd, Luke & Wells, LLC	Birmingham	AL
Whitesides & Kenny	Gastonia	NC

Client Name	*City*	*State*
Wilkins Frohlich, PA	Port Charlotte	FL
Williams & Connolly LLP	Washington	DC
Williamson & Lavecchia LC	Richmond	VA
Wilson, Frame, Metheney Attorneys & Counselors at Law	Morgantown	WV
Wilson, Garber & Small	Orlando	FL
Winner, Wixson & Pernitz	Madison	WI
Womble Carlyle Sandridge & Rice	Winston-Salem	NC
Womble Carlyle Sandridge & Rice LLP	Raleigh	NC
Wyatt Law Firm	San Antonio	TX
Young & Adams, Attorneys at Law	Boca Raton	FL
Young, Moore & Henderson, P.A.	Raleigh	NC
Zurich North America	Charlotte	NC

Partial List of Historical Insurance Firms

Client Name	*City*	*State*
Electric Insurance Company	Beverly	MA
Federated Rural Electric Insurance Corporation	Lenexa	KS
Federated Rural Insurance Corporation	Lenexa	KY
Nationwide Insurance	Durham	NC
St. Paul Fire and Marine Insurance Company	Charlotte	NC
VML Insurance Programs	Richmond	VA
Zurich American Insurance Company	Charlotte	NC

SEMINARS,

PRESENTATIONS

& PUBLICATIONS

October 11, 2017

Seminars/Presentations and Publications

North Carolina Association of Municipal Electrical Systems (NCAMES)

Date	*Location*	*Presentation/Seminar/Class Title*
1987	Annual Meeting	System Losses Overview
1990	Annual Meeting	NESC – Clearance & Liabilities
1992	Annual Meeting	CL Fuses Presentation
1993	Annual Meeting	NESC Revisions/Partial Review
1996	Annual Meeting May 13, 1996 Greensboro, NC	NESC 1997 Proposals/Partial Review
1997	Annual Meeting Charlotte, NC	Overhead High Voltage Line Safety Act
May 16-18, 2000	39th Annual Conference Raleigh, NC	Protective Relaying Principles Presentation
May 2000	Annual Meeting	Distribution System Protective Coordination Principles
May 2006	Annual Meeting	Asset Management Strategic Planning and Long-Range Planning
May 2007	Annual E & O Conference	Arc Flash Hazard and the NESC (Protection Assessment) Summary Presentation
April 2008	Annual E & O Conference Concord, NC	Long-Range Planning and Distribution Protection
May 2009	Annual Meeting	Economic System Improvements

National Rural Electric Cooperative Association (NRECA)

Date	*Location*	*Presentation/Seminar/Class Title*
July 18-20, 1983	St. Louis, MI	Store, Deter, Delay or Interrupt
Nov. 16, 1989		Report on Distribution Improvements that pay off through Lower Power Loss
1991	Annual Meeting	Distribution System Loss Management
1992		Distribution Loss Seminar
June 24-26, 1992	San Antonio, TX	Distribution System Loss Workshop
Sept. 23-24, 1993	Herndon, VA	Cost Effective Management of System Planning & Purchasing
January 2000		Recloser Actuator Engineering Analysis Update
February 2001	TechAdvantage Meeting	ABCs of System Planning
February 2002	TechAdvantage Meeting	Economic Conductor Sizing
August 2006	CRN Member Summit - Cooperative Research Council Meeting	Asset Management Strategic Planning Reliability and Trends

American Public Power Association (APPA)

Date	*Location*	*Presentation/Seminar/Class Title*
October 6-7, 1986	Kansas City, MI	Distribution Line Loss Seminar & Manual
Sept. 28-30, 1987	Raleigh, NC	Distribution Line Loss Seminar & Manual
April 11-13, 1988	Colorado Springs, CO	Distribution Line Loss Seminar & Manual
June 24, 1988		National Distribution Improvements Pay Off through Power Losses
October 12-14, 1988	Minneapolis, MN	Distribution Line Loss Guide

North Carolina Electric Membership Corporation & North Carolina Association of Electric Cooperatives (NCEMC & NCAEC)

Date	*Location*	*Presentation/Seminar/Class Title*
October 1986		NCAEC – Distribution System Loss Evaluation
October 30, 1986	Greenville Utilities Commissions	NCAEC – Reduce Losses in Distribution Systems
November 13, 1986	Crescent UMC Statesville, NC	NCAEC – Reduce Losses in Distribution Systems
1993	Operations Conference	1993 NESC Revisions Partial Review
December 12, 1996	Nash Community College, Rocky Mount, NC	NCAEC – Advanced Lineman Training NESC Introduction
June 1999	E & O Conference	Distribution Protective Coordination Workshop
June 2000	E & O Conference	NCAEC – Proposed changes to 1997 NESC
June 2001	E & O Conference	NCAEC – The NESC
December 5-6, 2001	System Engineer's Workshop	NCAEC -- The NESC
June 2002	E & O Conference	NCAEC – Overview of 2002 NESC Changes
September 2002	NCEMC Manager's Conference, Sunset Beach, NC	NCEMC – Overview 2002 NESC Changes

Date	*Location*	*Presentation/Seminar/Class Title*
June 2007	2007 E & O Conference	NCAEC - Arc Flash Hazard and the NESC (Protection Assessment) Summary Presentation
December 6, 2007	System Engineers Workshop	NCAEC - Arc Flash Hazard and the NESC (Protection Assessment) 7 Hour Seminar and Manual
June 2008	2008 E & O Conference	NCAEC - Two Presentations: Arc Flash Hazard Update and The National Electrical Code and How it Applies to Utilities
August 2008	2008 Safety Coordinator's Workshop	NCEMC - Arc Flash Hazard Update
December 2008	2008 System Engineers' Workshop	NCAEC - Arc Flash Hazard Assessment Findings
December 2010	2010 System Engineers' Workshop	NCAEC – Power Quality
December 2011	2011 System Engineers' Workshop	NCAEC - National Electrical Safety Code Update
June 2013	2013 E&O Conference	Stray Voltage and Contact Voltage
December 2014	2014 System Engineers' Workshop	NCAEC-Pole Attachment – Joint Use
March 14-15, 2017	Rocky Mount, NC	Incident Investigation Training for Utility Professionals

North Carolina Electric Municipal Power Association (NCEMPA)
& ElectriCities of North Carolina, Inc.

Date	*Location*	*Presentation/Seminar/Class Title*
1983	Wake Tech. College Raleigh, NC	Distribution System Protective Coordination School and Manual
1985	Wake Tech. College Raleigh, NC	Distribution System Protection School
June 17, 1987	ElectriCities	NESC & Municipal Electric System Safety Seminar
Sept. 28-30, 1988	Raleigh, NC	Distribution System Loss Evaluation Manual
November 1990	ElectriCities	NESC Course Manual
Dec. 11-12, 1991	ElectriCities	NESC
November 1992	ElectriCities	NESC Course Manual
Nov. 17-18, 1993	Raleigh, NC	NESC School
Nov. 16-17, 1994	ElectriCities	NESC Seminar
November 13, 1996	ElectriCities	1997 NESC Course
December 11, 2007	City of Wilson, North Carolina	Arc Flash Hazard and the NESC (Protection Assessment) 4 Hour Workshop for Municipalities
December 2007	City of Lexington, NC	Arc Flash Hazard Assessment and the NESC 8 hour Workshop and Manual

Other

Date	*Location*	*Presentation/Seminar/Class Title*
May 1988	SC Public Service Authority-Santee Cooper	NESC Training Guide
November 14, 1989	City of Bennettsville, SC	Value of System Planning
1990	Joe Wheeler EMC Hartselle, AL	NESC
May 1990	Northeast Assoc. of Electric Cooperatives	Power Quality Presentation & Distribution Cost Trends Presentation
May 22-24, 1990	New England Statewide	NARC
Dec. 10-11, 1990	Lexington, NC	NESC School
Dec. 26, 1990	City of Kinston, NC	NESC Course
1993	Davidson Electric Membership Cooperative Lexington, NC	NESC Course Manual Partial Review
Jan. 12-14, 1993	Rappahannock Electric Cooperative Fredericksburg, VA	Distribution System Loss Management Workshop
June 18-19, 1993	Joe Wheeler EMC Hartselle, AL	NESC School
July 2000	CP&L Raleigh, NC	CP&L Accident Investigation Workshop

Date	*Location*	*Presentation/Seminar/Class Title*
June 2000	SCAMPS Annual Meeting	Distribution System Protective Coordination Principles
June 2001	SCAMPS Annual Meeting	Accident Investigation and Avoidance Issues
February 2002	SCAMPS Columbia, SC	2002 NESC Workshop and Manual
July 2002	Florida Municipal Electric Association Orlando, FL	2002 NESC and Manual
April 2003	Old Dominion Electric Cooperative	Load Research Relevance to Distribution Planning
April 2004	Virginia, Maryland & Delaware Association of Electric Cooperatives	• System Grounding Presentation • Capacitor Placement & Power Factor Correction • System Planning
May 2004	Virginia, Maryland & Delaware Association of Electric Cooperatives	Interval Data and Construction Work Plan Design
January 2008	PREA State College, PA	Arc Flash Hazard and the NESC (Protection Assessment) Summary Presentation
April 15, 2008	Virginia, Maryland & Delaware Association of Electric Cooperatives	Arc Flash Hazard and the NESC (Protection Assessment) 7 Hour Workshop and Manuals
July 13, 2009	SCAMPS Annual Meeting	Maximizing Utility Resources Through Best Practices
April 29, 2010	PREA CEO Meeting, State College, PA	NERC Compliance Monitoring & Enforcement Presentation (Summary)
June 24, 2010	PREA 2010 Workshop, State College, PA	NERC Compliance Monitoring & Enforcement Presentation (Detailed)

Date	***Location***	***Presentation/Seminar/Class Title***
May 5, 2011	Virginia, Maryland & Delaware Association of Electric Cooperatives	Pole Attachment Review
August 29, 2012	LeClair Ryan Webinar	Energy Audits
November 20, 2012	Schultz Law Webinar	Subrogation of Workers' Comp. Claims Involving Electrical Contact Injuries
December 7, 2012	PWC of the City of Fayetteville, NC	Why Follow Engineering Design and the NESC Linemen Presentation
August 20, 2013	RESMA Lobbying Clinic, Virginia	Pole Attachment Dispute Discussion
January 19, 2015	PWC of the City of Fayetteville, NC	Arc Flash Risk Assessment – Industrial and Commercial Facilities
April 30, 2015	Northwestern Rural Electric Cooperative Association	Joint Use Pole Attachment – PA & Regional Issues
May 6-7, 2015	Virginia, Maryland & Delaware Association of Electric Cooperatives	Joint Use Pole Attachment – VA & Regional Issues
November 30, 2016	Rappahannock Electric Cooperative, VA	2017 NESC Update

Distribution System Loss Evaluation Seminars

Date	*Location*
September 30 – October 2, 1991	Marco Island, FL
November 15, 1991	Albuquerque, NM
November 18, 1991	St. Louis, MI
November 22, 1991	Charlotte, NC
January 15, 1992	Jones Onslow EMC Jacksonville, NC
May 11-13, 1992	Nashville, TN
September 30 – October 2, 1992	Northwest Public Power Association Seattle, WA
October 4-7, 1992	District Manager's Conference San Antonio, TX
November 12, 1992	Four County EMC Burgaw, NC
July 18-21, 1993	Materials Management Conference Hilton Head, SC
October 13-16, 1993	Northwest Public Power Authority Portland, OR
June 15-17, 1994	North Carolina Association of Electric Cooperatives E&O Conference Sunset Beach, NC
October 18, 1994	North Carolina Electric Membership Cooperative Raleigh, NC

Date	*Location*
October 23-26, 1994	NRECA E&O Conference Jacksonville, FL
January 17, 1995	United EC Dubois, PA
November 20 – December 1, 1995	Minneapolis, MN
December 14-15, 1995	Nashville, TN
May 22-24, 1996	San Antonio, TX
June 12-14, 1996	Denver, CO
April 22-23, 1997	Minneapolis, MN
	North Carolina Alternative Energy Corporation Distribution System Loss Reduction Manual and Courses
May 9, 2000	Lewis County REC Lewistown, MI

National and State Publications

Date	*Publications*
1983	North Carolina Alternative Energy Corporation Distribution System Loss Reduction Manual and Courses
1983	Distribution System Protective Coordination Manual ElectriCities of North Carolina
1986	Distribution System Loss Evaluation Manual American Public Power Association
1991	Distribution System Loss Management Manual – NRECA (2 manuals, 6 National Workshops and Manuals)
1994	Distribution System Loss Reduction Manual Tennessee Valley Public Power Association, Research & Development
1998	Distribution Protective Coordination Workshop and Manual ElectriCities of North Carolina
June 1999	Distribution Protective Coordination Workshop and Manual
2000	Improving Distribution System Performance
2001	National Electrical Safety Code Workshop Materials
2001	Evaluation of Recloser Actuators – NRECA
2003	Power Loss Management Manual for the Deregulated Utility Environment NRECA-CRN
2004	Power Loss Management Manual for the Deregulated Utility Environment NRECA-CRN Computer Based Training CD and Power Loss Management Interactive CD Publication

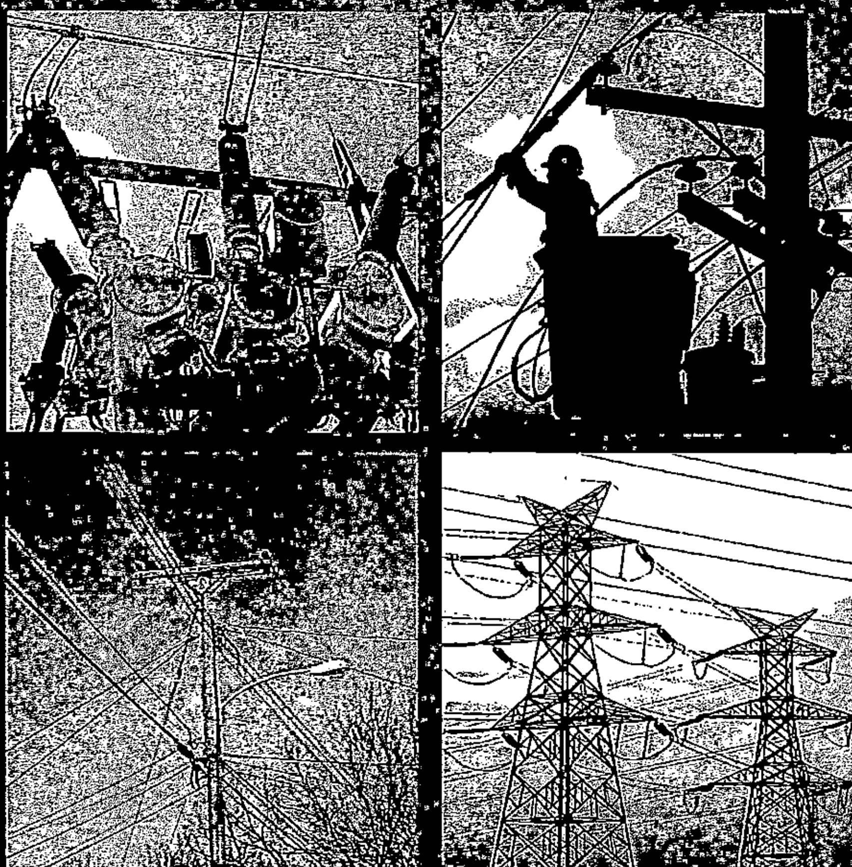
Date	*Publications*
2004	Virginia, Maryland & Delaware Association of Electric Cooperatives • System Grounding Materials • Capacitor Placement & Power Factor Correction Materials • System Planning Materials
2004	Interval Data and Construction Work Plan Design Materials
2007	Arc Flash Hazard and the NESC (Protection Assessment) Seminar Materials

I/A

EXHIBIT GLB-2

2017 National Electrical Safety Code® (NESC®)

C2-2017



NESC

100TH ANNIVERSARY EDITION

IEEE

3 Park Avenue, New York, NY 10016-5997, USA

Accredited
Standards
Committee
C2-2017

National Electrical Safety Code®

Secretariat
Institute of Electrical and Electronics Engineers, Inc.

Approved 26 April 2016
American National Standards Institute

2017 Edition

Abstract: This Code covers basic provisions for safeguarding of persons from hazards arising from the installation, operation, or maintenance of (1) conductors and equipment in electric supply stations, and (2) overhead and underground electric supply and communication lines. It also includes work rules for the construction, maintenance, and operation of electric supply and communication lines and equipment. The Code is applicable to the systems and equipment operated by utilities, or similar systems and equipment, of an industrial establishment or complex under the control of qualified persons. This Code consists of the introduction, definitions, grounding rules, list of referenced and bibliographic documents, and Parts 1, 2, 3, and 4 of the 2017 Edition of the National Electrical Safety Code.

Keywords: communications industry safety; construction of communication lines; construction of electric supply lines; electrical safety; electric supply stations; electric utility stations; high-voltage safety; operation of communications systems; operation of electric supply systems; power station equipment; power station safety; public utility safety; safety work rules; underground communication line safety; underground electric line safety

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3 Park Avenue, New York, NY 10016-5997, USA

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Section 1.
Introduction to the National Electrical Safety Code®

The National Electrical Safety Code (NESC®) is American National Standard C2. It is a consensus standard that has been prepared by the National Electrical Safety Code Committee under procedures approved by the American National Standards Institute (ANSI). The membership of the NESC Committee is composed of national and international organizations and is certified by ANSI as having an appropriate balance of the interests of members of the public, utility workers, regulatory agencies, and the various types of private and public utilities.

The NESC is used in whole or in part by statute, regulation, or consent as the standard (or basis of the standard) of safe practice for public and private utilities in the United States, as well various jurisdictions and industries in other countries.

010. Purpose

A. The purpose of the NESC is the practical safeguarding of persons and utility facilities during the installation, operation, and maintenance of electric supply and communication facilities, under specified conditions.

   NOTE: NESC rules are globally recognized and intended to provide a practical standard of safe practices that can be adopted by public utilities, private utilities, state or local utility commissions or public service commissions, or other boards or bodies having control over safe practices employed in the design, installation, operation, and maintenance of electric supply, communication, street and area lighting, signal, or railroad utility facilities.

B. NESC rules contain the basic provisions, under specified conditions, that are considered necessary for the safeguarding of:

   1. The public,
   2. Utility workers (employees and contractors), and
   3. Utility facilities.

C. This Code is not intended as a design specification or as an instruction manual.

011. Scope

A. Covered

   See Figure 011-1.

   The NESC covers:

   1. Supply and communication facilities (including metering) and associated work practices employed by a public or private electric supply, communications, railway, trolley, street and area lighting, traffic signal (or other signal), irrigation district or other community owned utility, or a similar utility in the exercise of its function as a utility.
   2. The generation, transmission, and distribution of electricity, lumens, communication signals, and communication data through public and private utility systems that are installed and maintained under the exclusive control of utilities or their authorized representatives.
   3. Utility facilities and functions of utilities that either (a) generate energy by conversion from some other form of energy such as, but not limited to, fossil fuel, chemical, nuclear, solar, mechanical, wind or hydraulic or communication signals, or accept energy or communication signals from another entity, or (b) provide that energy or communication signals through a delivery point to another entity.

4. Street and area lights that provide a supply of lumens where these facilities are supplied from the line side of the service point by underground or overhead conductors maintained and/or installed under the exclusive control of utilities (including their authorized contractors or other qualified persons).
5. Utility facilities and functions on the line side of the service point supplied by underground or overhead conductors installed and/or maintained under exclusive control of utilities located on public or private property in accordance with legally established easements or rights-of-way, contracts, other agreements (written or by conditions of service), or as authorized by a regulating or controlling body.

   NOTE: Agreements to locate utility facilities on property may be required where easements are either (a) not obtainable (such as locating utility facilities on existing rights-of-way of railroads or other entities, military bases, federal lands, Native American reservations, lands controlled by a port authority, or other governmental agency), or (b) not necessary (such as locating facilities necessary for requested service to a site).
6. Wiring within a supply station or in an underground facility that is (a) installed in accordance with Part 1 or Part 3 of this Code and maintained under the exclusive control of utilities and (b) necessary for the operation of the supply station or underground facility.
7. Utility facilities installed, maintained, and controlled by utilities on surface or underground mine sites, including overhead or underground distribution systems providing service up to buildings or outdoor equipment locations on the line side of the service point.
8. Similar systems to those listed above that are under the exclusive control of qualified persons and authorized by a regulating or controlling body, including those associated with an industrial complex or utility interactive system.

B. Not covered

See Figure 011-1.

NESC rules do not cover:

1. Utilization equipment or premises wiring located beyond utility service points to buildings or outdoor installations, or
2. Underground mine wiring or installations in ships, railway rolling equipment, aircraft, or automotive equipment, or
3. Luminaires not installed or maintained under exclusive control by utilities, or
4. Industrial complex or utility interactive systems that are not controlled exclusively under utilities or qualified persons or are located on the premises wiring side of the service point.

   NOTE: The National Electrical Code® (NEC®) (NFPA 70®, 2011 Edition) covers utilization wiring requirements beyond the service point and luminaires that are not controlled exclusively by utilities.[1]

[1]Information on references can be found in Section 3.

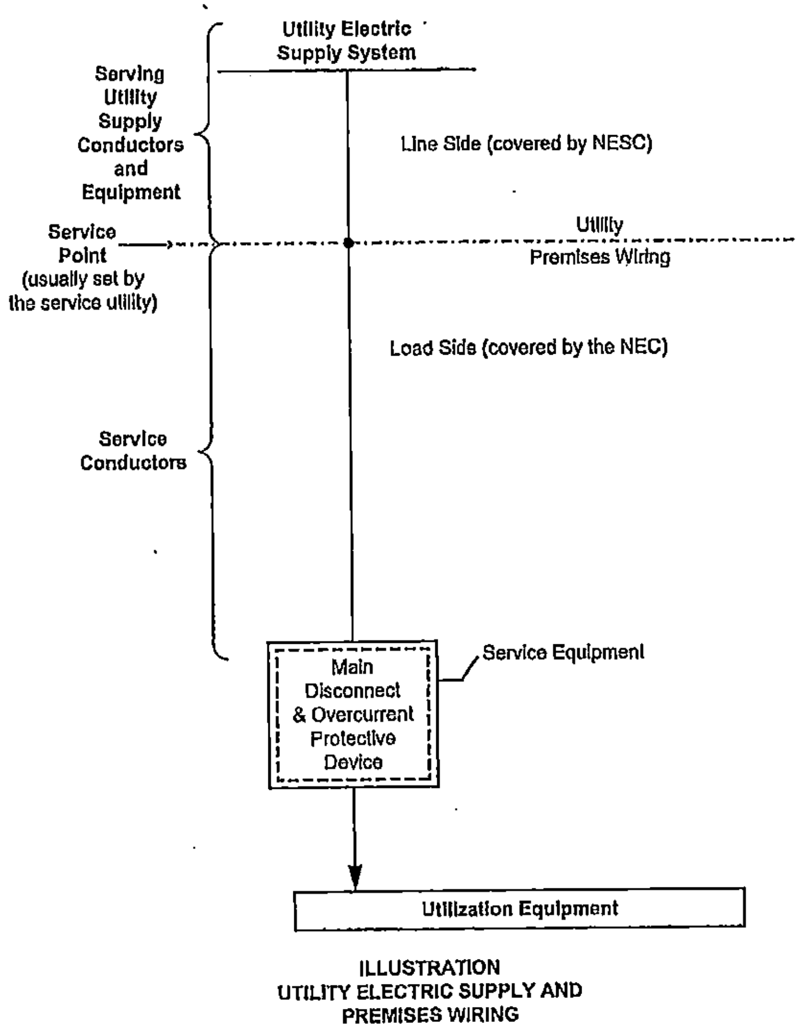


Figure 011-1—Service point—General illustration of what is covered and not covered by the NESC

C. Types of requirements

1. These rules specify:

   a. Loadings and factors related to required strength of utility structures and supported facilities;

   b. Clearances and spacings between: (1) facilities of different utilities, (2) facilities of same utility, and (3) utility facilities and public facilities;

   c. Grounding; and

   d. Other requirements related to the safeguarding of persons and facilities, including associated safe work practices, to be employed by a utility in the exercise of its function as a utility up to the service point.

2. Utilities operating under the NESC are required to maintain control over the system up to the service point such that:

   a. The system is designed to meet the requirements of specified conditions, and

b. The personnel installing, maintaining, and operating the system and its components are qualified to do so, are adequately supervised, use appropriate tools, and follow safe work procedures.

012. General rules

A. All electric supply and communication lines and equipment shall be designed, constructed, operated, and maintained to meet the requirements of these rules.

B. The utilities, authorized contractors, or other entities, as applicable, performing design, construction, operation, or maintenance tasks for electric supply or communication lines or equipment covered by this Code shall be responsible for meeting applicable requirements.

C. For all particulars not specified, but within the scope of these rules, as stated in Rule 011A, construction and maintenance should be done in accordance with accepted good practice for the given local conditions known at the time by those responsible for the construction or maintenance of the communication or supply lines and equipment.

013. Application

A. New installations and extensions

1. These rules shall apply to all new installations and extensions, except that they may be waived or modified by the administrative authority. When so waived or modified, safety shall be provided in other ways.

   EXAMPLE: Alternative working methods, such as the use of barricades, guards, or other electrical protective equipment, may be implemented along with appropriate alternative working clearances as a means of providing safety when working near energized conductors.

2. Types of construction and methods of installation other than those specified in the rules may be used experimentally to obtain information if:

   a. Qualified supervision is provided,

   b. Equivalent safety is provided, and

   c. On joint-use facilities, all affected joint users are notified in a timely manner.

B. Existing installations

1. Where an existing installation meets, or is altered to meet, these rules, such installation is considered to be in compliance with this edition and is not required to comply with any previous edition.

2. Existing installations, including maintenance replacements, that currently comply with prior editions of the Code, need not be modified to comply with these rules.

   EXCEPTION 1: For safety reasons, the administrative authority may require compliance with these rules.

   EXCEPTION 2: When a structure is replaced, the current requirements of Rule 238C shall be met, if applicable.

3. Where conductors or equipment are added, altered, or replaced on an existing structure, the structure or the facilities on the structure need not be modified or replaced if the resulting installation will be in compliance with either (a) the rules that were in effect at the time of the original installation, or (b) the rules in effect in a subsequent edition to which the installation has been previously brought into compliance, or (c) the rules of this edition in accordance with Rule 013B1. When an existing installation is brought into compliance with a subsequent edition, earlier editions no longer apply.

Part 2.
Safety Rules for the Installation and Maintenance of Overhead Electric Supply and Communication Lines

Section 20.
Purpose, scope, and application of rules

200. Purpose

The purpose of Part 2 of this Code is the practical safeguarding of persons during the installation, operation, or maintenance of overhead supply and communication lines and their associated equipment.

201. Scope

Part 2 of this Code covers supply and communication conductors and equipment in overhead lines. It covers the associated structural arrangements of such systems and the extension of such systems into buildings. The rules include requirements for spacing, clearances, and strength of construction. They do not cover installations in electric supply stations except as required by Rule 162A.

NOTE 1: Part 4 contains the approach distances and work rules required of supply and communication employers and their employees working on or near supply and communication lines and equipment.

NOTE 2: The approach distances to energized parts, and other requirements applicable to the activities of utility or non-utility construction personnel, and others in close proximity to existing supply lines are governed by the Occupational Health and Safety Administration (OSHA), federal, state, or local statutes or regulations.

202. Application of rules

The general requirements for application of these rules are contained in Rule 13. However, when a supporting structure is replaced, the arrangement of equipment shall confirm to the current edition of Rule 238C.

Section 21.
General requirements

210. Referenced sections

The Introduction (Section 1), Definitions (Section 2), References (Section 3), and Grounding methods (Section 9) shall apply to the requirements of Part 2.

211. Number 211 not used in this edition.

212. Induced voltages

Rules covering supply-line influence and communication-line susceptiveness have not been detailed in this Code. Cooperative procedures are recommended in the control of voltages induced from proximate facilities. Therefore, reasonable advance notice should be given to owners or operators of other proximate facilities that may be adversely affected by new construction or changes in existing facilities.

NOTE: Additional information about supply-line influence and communication-line susceptiveness may be obtained from IEEE Std 776™-1992 [B39] and IEEE Std 1137™-1991 [B51].

213. Accessibility

All parts that must be examined or adjusted during operation shall be arranged so as to be accessible to authorized persons by the provision of adequate climbing spaces, working spaces, working facilities, and clearances between conductors.

214. Inspection and tests of lines and equipment

A. When in service

1. Initial compliance with rules

   Lines and equipment shall comply with these safety rules when placed in service.

2. Inspection

   Lines and equipment shall be inspected at such intervals as experience has shown to be necessary.

   NOTE: It is recognized that inspections may be performed in a separate operation or while performing other duties, as desired.

3. Tests

   When considered necessary, lines and equipment shall be subjected to practical tests to determine required maintenance.

4. Inspection records

   Any conditions or defects affecting compliance with this Code revealed by inspection or tests, if not promptly corrected, shall be recorded; such records shall be maintained until the conditions or defects are corrected.

5. Corrections

   a. Lines and equipment with recorded conditions or defects that would reasonably be expected to endanger human life or property shall be promptly corrected, disconnected, or isolated.

b. Other conditions or defects shall be designated for correction.

B. When out of service

1. Lines infrequently used

Lines and equipment infrequently used shall be inspected or tested as necessary before being placed into service.

2. Lines temporarily out of service

Lines and equipment temporarily out of service shall be maintained in a safe condition.

3. Lines permanently abandoned

Lines and equipment permanently abandoned shall be removed or maintained in a safe condition.

215. Grounding of circuits, supporting structures, and equipment

A. Methods

Grounding required by these rules shall be in accordance with the applicable methods given in Section 9.

B. Circuits

1. Common neutral

A conductor used as a common neutral for primary and secondary circuits shall be effectively grounded.

2. Other neutrals

Primary line, secondary line, and service neutral conductors shall be effectively grounded.

EXCEPTION 1: Circuits designed for ground-fault detection and impedance-current-limiting devices.

EXCEPTION 2: Primary circuits designed with a single point grounded neutral. This type of neutral conductor is not an effectively grounded neutral conductor.

3. Other conductors

Line or service conductors, other than neutral conductors, that are intentionally grounded, shall be effectively grounded.

4. Surge arresters

Where the operation of surge arresters is dependent upon grounding, they shall be effectively grounded.

5. Use of earth as part of circuit

a. Supply circuits shall not be designed to use the earth normally as the sole conductor for any part of the circuit.

b. Monopolar operation of a bipolar HVDC system is permissible for emergencies and limited periods for maintenance.

C. Non-current-carrying parts

1. General

Metal or metal-reinforced supporting structures, including lamp posts; metal conduits and raceways; cable sheaths; messengers; metal frames, cases, and hangers of equipment; and metal switch handles and operating rods shall be effectively grounded. For the purpose of this rule metallic stand-off brackets or straps, metal crossarm braces, metal through-bolts, etc., are not considered to be metal frames, cases, or hangers of equipment and therefore not required to be effectively grounded.

For the purpose of this rule, a wood structure with metal-reinforcing trusses installed at its base for strength purposes is not considered to be a metal-reinforced structure and therefore not required to be effectively grounded.

231. Clearances of supporting structures from other objects

Supporting structures, support arms, anchor guys, and equipment attached thereto, and braces shall have the following clearances from other objects. The clearance shall be measured between the nearest parts of the objects concerned.

A. From fire hydrants

Not less than 1.2 m (4 ft).

EXCEPTION 1: Where conditions do not permit, a clearance of not less than 900 mm (3 ft) is allowed.

EXCEPTION 2: Clearances in Rule 231A may be reduced by agreement with the local fire authority and the pole owner.

B. From streets, roads, and highways

1. Where there are curbs: supporting structures, support arms, anchor guys, or equipment attached thereto, up to 4.6 m (15 ft) above the road surface shall be located a sufficient distance behind the curb to avoid contact by ordinary vehicles using and located on the traveled way.
2. Where there are no curbs, supporting structures should be located a sufficient distance from the roadway to avoid contact by ordinary vehicles using and located on the traveled way.
3. Location of overhead utility installations on roads, streets, or highways with narrow rights-of-way or closely abutting improvements are special cases that must be resolved in a manner consistent with the prevailing limitations and conditions.
4. Where a governmental authority exercising jurisdiction over structure location has issued a permit for, or otherwise approved, specific locations for supporting structures, that permit or approval shall govern.

C. From railroad tracks

Where railroad tracks are parallel to or crossed by overhead lines, all portions of the supporting structures, support arms, anchor guys, and equipment attached thereto less than 6.7 m (22 ft) above the nearest track rail shall have horizontal clearances not less than the values required by Rule 231C1 or 231C2 for the situation concerned.

NOTE: See Rule 234I.

1. Not less than 3.6 m (12 ft) from the nearest track rail.

   EXCEPTION 1: A clearance of not less than 2.13 m (7 ft) may be allowed where the supporting structure is not the controlling obstruction, provided sufficient space for a driveway is left where cars are loaded or unloaded.

   EXCEPTION 2: Supports for overhead trolley-contact conductors may be located as near their own track rail as conditions require. If very close, however, permanent screens on cars will be necessary to protect passengers.

   EXCEPTION 3: Where necessary to provide safe operating conditions that require an uninterrupted view of signals, signs, etc., along tracks, the parties concerned shall cooperate in locating structures to provide the necessary clearance.

   EXCEPTION 4: At industrial sidings, a clearance of not less than 2.13 m (7 ft) shall be permitted, provided sufficient space is left where cars can be loaded or unloaded.
2. The clearances of Rule 231C1 may be reduced by agreement with the railroad(s).

232. Vertical clearances of wires, conductors, cables, and equipment aboveground, roadway, rail, or water surfaces

A. Application

The vertical clearances specified in Rule 232B1 apply under the following conductor temperature and loading conditions, whichever produces the largest final sag:

1. 50 °C (120 °F), no wind displacement

2. The maximum conductor temperature for which the line is designed to operate, if greater than 50 °C (120 °F), with no wind displacement
3. 0 °C (32 °F), no wind displacement, with radial thickness of ice, if any, specified in Table 230-1 for the zone concerned

EXCEPTION: The conductor temperature and loading condition for trolley and electrified railroad contact conductors shall be 15 °C (60 °F), no wind displacement, final sag, or initial sag in cases where these facilities are maintained approximately at initial sags.

NOTE: The phase and neutral conductors of a supply line are normally considered separately when determining the sag of each due to temperature rise.

B. Clearance of wires, conductors, cables, equipment, and support arms mounted on supporting structures

NOTE: Neither horizontal nor diagonal clearances are specified in this rule. As a result, Rule 012C requires good practice for the given local conditions.

1. Clearance to wires, conductors, and cables

The vertical clearance of wires, conductors, and cables aboveground in generally accessible places, roadway, rail, or water surfaces, shall be not less than that shown in Table 230-1.

2. Clearance to unguarded rigid live parts of equipment

The vertical clearance above ground, roadway, or water surfaces for unguarded rigid live parts such as potheads, transformer bushings, surge arresters, and short lengths of supply conductors connected thereto, which are not subject to variation in sag, shall be not less than that shown in Table 232-2. For clearances of drip loops of service drops, see Table 230-1.

3. Clearance to support arms, switch handles, and equipment cases

The vertical clearance of switch handles, equipment cases, support arms, platforms, and braces that extend beyond the surface of the structure shall be not less than that shown in Table 232-2. These clearances do not apply to internal structural braces for latticed towers, X-braces between poles, and pole-type push braces.

4. Street and area lighting

a. The vertical clearance of street and area lighting luminaires shall be not less than that shown in Table 232-2. For this purpose, grounded luminaire cases and brackets shall be considered as effectively grounded equipment cases; ungrounded luminaire cases and brackets shall be considered as a rigid live part of the voltage contained.

EXCEPTION: This rule does not apply to post-top mounted luminaires with effectively grounded or entirely dielectric cases.

b. Insulators, as specified in Rule 279A, should be inserted at least 2.45 m (8 ft) from the ground in metallic suspension ropes or chains supporting lighting units of series circuits.

C. Additional clearances for wires, conductors, cables, and unguarded rigid live parts of equipment

Greater clearances than specified by Rule 232B shall be provided where required by Rule 232C1.

1. Voltages exceeding 22 kV

a. For voltages between 22 and 470 kV, the clearance specified in Rule 232B1 (Table 232-1) or Rule 232B2 (Table 232-2) shall be increased at the rate of 10 mm (0.4 in) per kilovolt in excess of 22 kV. For voltages exceeding 470 kV, the clearance shall be determined by the method given in Rule 232D. All clearances for lines over 50 kV shall be based on the maximum operating voltage.

EXCEPTION: For voltages exceeding 98 kV ac to ground or 139 kV dc to ground, clearances less than those required above are permitted for systems with known maximum switching-surge factors (see Rule 232D).

b. For voltages exceeding 50 kV, the additional clearance specified in Rule 232C1a shall be increased 3% for each 300 m (1000 ft) in excess of 1000 m (3300 ft) above mean sea level.

c. For voltages exceeding 98 kV ac to ground, either the clearances shall be increased or the electric field, or the effects thereof, shall be reduced by other means as required to limit the steady-state current due to electrostatic effects to 5 mA rms if the largest anticipated truck, vehicle, or equipment under the line were short-circuited to ground. The size of the anticipated truck, vehicle, or equipment used to determine these clearances may be less than but need not be greater than that limited by federal, state, or local regulations governing the area under the line. For this determination, the conductors shall be at a final sag at 50 °C (120 °F).

D. Alternate clearances for voltages exceeding 98 kV ac to ground or 139 kV dc to ground

The clearances specified in Rules 232B and 232C may be reduced for circuits with known switching-surge factors, but shall be not less than the alternate clearance, which is computed by adding the reference height from Rule 232D2 to the electrical component of clearance from Rule 232D3.

1. Sag conditions of line conductors

The vertical clearance shall be maintained under the conductor temperature and loading condition given in Rule 232A.

2. Reference heights

The reference height shall be selected from Table 232-3.

3. Electrical component of clearance

a. The electrical component (D) shall be computed using the following equations. Selected values of D are listed in Table 232-4.

$$D = 1.00\left[\frac{V \cdot (PU) \cdot a}{500K}\right]^{1.667} bc \quad \text{(m)}$$

$$D = 3.28\left[\frac{V \cdot (PU) \cdot a}{500K}\right]^{1.667} bc \quad \text{(ft)}$$

where

V = maximum ac crest operating voltage to ground or maximum dc operating voltage to ground in kilovolts
PU = maximum switching-surge factor expressed in per-unit peak voltage to ground and defined as a switching-surge level for circuit breakers corresponding to 98% probability that the maximum switching surge generated per breaker operation does not exceed this surge level, or the maximum anticipated switching-surge level generated by other means, whichever is greater
a = 1.15, the allowance for three standard deviations
b = 1.03, the allowance for nonstandard atmospheric conditions
c = 1.2, the margin of safety
K = 1.15, the configuration factor for conductor-to-plane gap

b. The value of D shall be increased 3% for each 300 m (1000 ft) in excess of 450 m (1500 ft) above mean sea level.

c. For voltages exceeding 98 kV ac to ground, either the clearances shall be increased or the electric field, or the effects thereof, shall be reduced by other means as required to limit the steady state current due to electrostatic effects to 5 mA, rms, if the largest anticipated truck, vehicle, or equipment under the line were short-circuited to ground. The size of the anticipated truck, vehicle, or equipment used to determine these clearances may be less than but need not be greater than that limited by federal, state, or local regulations governing the area under the line. For this determination, the conductors shall be at a final sag at 50 °C (120 °F).

4. Limit

The alternate clearance shall be not less than the clearance given in Table 232-1 or Table 232-2 computed for 98 kV ac to ground in accordance with Rule 232C.

m

Table 232-1—
Vertical clearance of wires, conductors, and cables above ground, roadway, rail, or water surfaces
(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems. See Rules 232A, 232B1, 232C1a, and 232D4.)

Nature of surface underneath wires, conductors, or cables	Insulated communication conductors and cable; messengers; overhead shield/surge-protection wires; effectively grounded guys; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to 0 to 300 V ⑥⑪⑮; neutral conductors meeting Rule 230E1; supply cables meeting Rule 230C1 (m)	Noninsulated communication conductors; supply cables of 0 to 750 V meeting Rule 230C2 or 230C3 (m)	Supply cables over 750 V meeting Rule 230C2 or 230C3; open supply conductors, 0 to 750 V ③; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to over 300 V to 750 V ⑥⑭⑮ (m)	Open supply conductors, over 750 V to 22 kV; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to 750 V to 22 kV ⑥⑭⑮ (m)	Trolley and electrified railroad contact conductors and associated span or messenger wires ①	
					0 to 750 V to ground (m)	Over 750 V to 22 kV to ground (m)
Where wires, conductors, or cables cross over or overhang						
1. Track rails of railroads (except electrified railroads using overhead trolley conductors) ②⑯㉒	7.2	7.3	7.5	8.1	6.7 ④	6.7 ④
2. Roads, streets, and other areas subject to truck traffic ㉑	4.7	4.9	5.0	5.6	5.5 ⑤	6.1 ⑤
3. Driveways, parking lots, and alleys ㉑	4.7 ⑦⑬	4.9 ⑦⑬	5.0 ⑦	5.6	5.5 ⑤	6.1 ⑤
4. Other areas traversed by vehicles, such as cultivated, grazing, forest, and orchard lands, industrial sites, commercial sites, etc. ㉑	4.7	4.9	5.0	5.6	—	—
5. Spaces and ways subject to pedestrians or restricted traffic only ⑨	2.9	3.6 ⑧	3.8 ⑧	4.4	4.9	5.5

m

Table 232-1— *(continued)*
Vertical clearance of wires, conductors, and cables above ground, roadway, rail, or water surfaces

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems.
See Rules 232A, 232B1, 232C1a, and 232D4.)

Nature of surface underneath wires, conductors, or cables	Insulated communication conductors and cable; messengers; overhead shield/surge-protection wires; effectively grounded guys; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to 0 to 300 V [6][14][15]; neutral conductors meeting Rule 230E1; supply cables meeting Rule 230C1 (m)	Noninsulated communication conductors; supply cables of 0 to 750 V meeting Rule 230C2 or 230C3 (m)	Supply cables over 750 V meeting Rule 230C2 or 230C3; open supply conductors, 0 to 750 V [3]; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to over 300 V to 750 V [6][14][15] (m)	Open supply conductors, over 750 V to 22 kV; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to 750 V to 22 kV [6][14][15] (m)	Trolley and electrified railroad contact conductors and associated span or messenger wires [1]: 0 to 750 V to ground (m)	Trolley and electrified railroad contact conductors and associated span or messenger wires [1]: Over 750 V to 22 kV to ground (m)
6. Water areas not suitable for sailboating or where sailboating is prohibited [21]	4.0	4.4	4.6	5.2	—	—
7. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area of [17][18][19][20][21]						
a. Less than 0.08 km²	5.3	5.5	5.6	6.2	—	—
b. Over 0.08 to 0.8 km²	7.8	7.9	8.1	8.7	—	—
c. Over 0.8 to 8 km²	9.6	9.8	9.9	10.5	—	—
d. Over 8 km²	11.4	11.6	11.7	12.3	—	—
8. Established boat ramps and associated rigging areas; areas posted with sign(s) for rigging or launching sail boats	Clearance aboveground shall be 1.5 m greater than in 7 above, for the type of water areas served by the launching sites					
Where wires, conductors, or cables run along and within the limits of highways or other road rights-of-way but do not overhang the roadway						
9. Roads, streets, or alleys	4.7 [22]	4.9	5.0	5.6	5.5 [5]	6.1 [5]
10. Roads where it is unlikely that vehicles will be crossing under the line	4.1 [18][17]	4.3 [10]	4.4 [10]	5.0	5.5 [5]	6.1 [5]

NOTE: The clearance values shown in this table are computed by adding the applicable Mechanical and Electrical (M & E) value of Table A-1 to the applicable Reference Component of Table A-2a of Appendix A.

①Where subways, tunnels, or bridges require it, less clearance above ground or rails than required by Table 232-1 may be used locally. The trolley and electrified railroad contact conductor should be graded gradually from the regular construction down to the reduced elevation.

②For wires, conductors, or cables crossing over mine, logging, and similar railways that handle only cars lower than standard freight cars, the clearance may be reduced by an amount equal to the difference in height between the highest loaded car handled and 6.1 m, but the clearance shall not be reduced below that required for street crossings.

③Does not include neutral conductors meeting Rule 230E1.

④In communities where 6.4 m has been established, this clearance may be continued if carefully maintained. The elevation of the contact conductor should be the same in the crossing and next adjacent spans. (See Rule 225D2 for conditions that must be met where uniform height above rail is impractical.)

⑤In communities where 4.9 m has been established for trolley and electrified railroad contact conductors 0 to 750 V to ground, or 5.5 m for trolley and electrified railroad contact conductors exceeding 750 V, or where local conditions make it impractical to obtain in the clearance given in the table, these reduced clearances may be used if carefully maintained.

⑥These clearance values also apply to guy insulators.

⑦Where vehicles exceeding 2.45 m in height are not normally encountered nor reasonably anticipated, service drop(s) clearances over residential driveways only may be reduced to the following:

		(m)
(a)	Insulated supply service drops limited to 300 V to ground	3.8
(b)	Insulated drip loops of supply service drops limited to 300 V to ground	3.2
(c)	Supply service drops limited to 150 V to ground and meeting Rule 230C1 or 230C3	3.6
(d)	Drip loops only of service drops limited to 150 V to ground and meeting Rule 230C1 or 230C3	3.0
(e)	Insulated communication service drops	3.5

⑧These clearance values for service drops to residential buildings only may be reduced to the following:

		(m)
(a)	Insulated supply service drops limited to 300 V to ground	3.2
(b)	Insulated drip loops of supply service drops limited to 300 V to ground	3.2
(c)	Supply service drops limited to 150 V to ground and meeting Rule 230C1 or 230C3	3.0
(d)	Drip loops only of supply service drops limited to 150 V to ground and meeting Rule 230C1 or 230C3	3.0

⑨Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horses or other large animals, vehicles, or other mobile units exceeding a total height of 2.45 m, are prohibited by regulation or permanent terrain configurations, or are otherwise not normally encountered nor reasonably anticipated.

⑩Where a supply or communication line along a road is located relative to fences, ditches, embankments, or other terrain features so that the ground under the line would not be expected to be traveled except by pedestrians, the clearances may be reduced to the following values:

		(m)
(a)	Insulated communication conductor and communication cables	2.9
(b)	Conductors of other communication circuits	2.9
(c)	Supply cables of any voltage meeting Rule 230C1 and neutral conductors meeting Rule 230E1	2.9
(d)	Insulated supply conductors limited to 300 V to ground	3.8
(e)	Insulated supply cables limited to 150 V to ground meeting Rule 230C2 or 230C3	3.1
(f)	Effectively grounded guys, insulated guys meeting Rules 279A1 and 215C2 exposed to 0 to 300 V	2.9

⑪No clearance from ground is required for anchor guys not crossing tracks, rails, streets, driveways, roads, or pathways.

⑫This clearance may be reduced to 4.0 m for communication conductors and guys.

⑬Where this construction crosses over or runs along (a) alleys, non-residential driveways, or parking lots not subject to truck traffic, or (b) residential driveways, this clearance may be reduced to 4.6 m.

⑭The portion(s) of span guys between guy insulators and the portion(s) of anchor guys above guy insulators that are not effectively grounded shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

⑮The portion of anchor guys below the lowest insulator meeting Rules 279A1 and 215C2a may have the same clearance as effectively grounded guys.

⑯Adjacent to tunnels and overhead bridges that restrict the height of loaded rail cars to less than 6.1 m, these clearances may be reduced by the difference between the highest loaded rail car handled and 6.1 m, if mutually agreed to by the parties at interest.

⑰For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high-water level.

⑱For uncontrolled water flow areas, the surface area shall be that enclosed by its annual high-water mark. Clearances shall be based on the normal flood level; if available, the 10-year flood level may be assumed as the normal flood level.

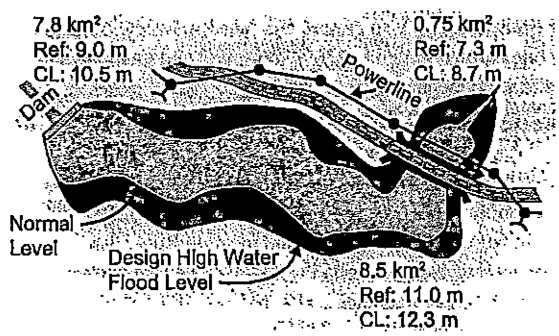
⑲The clearance over rivers, streams, and canals shall be based upon the largest surface area of any 1.6 km long segment that includes the crossing. The clearance over a canal, river, or stream normally used to provide access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

⑳Where a bridge or other overwater obstruction restricts vessel height to less than the applicable reference height given in Table 232-3, the required clearance may be reduced by the difference between the reference height and the overwater obstruction height for the area of the body of water over which the line crosses, except that the reduced clearance shall be not less than that required for the surface area on the line-crossing side of the obstruction.

EXAMPLE: If an 8.5 km^2 lake (over 8.0 km^2; reference height 11.0 m) consists of 7.8 km^2 (0.8 to 8.0 km^2; reference height 9.0 m) on one side of a bridge and 0.75 km^2 (0.08 to 8.0 km^2; reference height 7.3 m) on the other side of the bridge, the required line clearance must be not less than that required for an over 8.0 km^2 lake as required by Table 232-1 unless the bridge height above design high water is less than the reference dimension of 11.0 m.

If the line is placed on the 0.75 km^2 side and the bridge height above design high water is less than 11.0 m, but more than 7.3 m, the required line clearance is reduced from that required by a lake of over 8.0 km^2 by the difference between the bridge clearance and 11.0 m. If the bridge height above design high water is less than 7.3 m, the required clearance remains at that required for a 0.8 to 8.0 km^2 lake. See following figure.

Similarly, if the line is placed on the 7.8 km^2 side and the bridge height above design high water is less than 11.0 m, but more than 9.0 m, the required line clearance is reduced from that required by a lake of over 8.0 km^2 by the difference between the bridge clearance and 11.0 m. If the bridge height above design high water is less than 9.0 m, the required clearance remains at that required for a 0.8 to 8.0 km^2 lake.



Power line on small lake side of bridge

㉑Where the U.S. Army Corps of Engineers, or the state, or surrogate thereof has issued a crossing permit, clearances of that permit shall govern.

㉒See Rule 234I for the required horizontal and diagonal clearances to rail cars.

㉓For the purpose of this rule, trucks are defined as any vehicle exceeding 2.45 m in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.

㉔Communication cables and conductors may have a clearance of not less than 4.6 m where poles are back of curbs or other deterrents to vehicular traffic.

㉕This footnote not used in this edition.

㉖When designing a line to accommodate oversized vehicles, these clearance values shall be increased by the difference between the known height of the oversized vehicle and 4.3 m.

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Oct 16 2017

ft

Table 232-1— Vertical clearance of wires, conductors, and cables above ground, roadway, rail, or water surfaces

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems. See Rules 232A, 232B1, 232C1a, and 232D4.)

Nature of surface underneath wires, conductors, or cables	Insulated communication conductors and cable; messengers; overhead shield/surge-protection wires; effectively grounded guys; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to 0 to 300 V ⑥ ⑭ ⑮; neutral conductors meeting Rule 230E1; supply cables meeting Rule 230C1 (ft)	Noninsulated communication conductors; supply cables of 0 to 750 V meeting Rule 230C2 or 230C3 (ft)	Supply cables over 750 V meeting Rule 230C2 or 230C3; open supply conductors, 0 to 750 V ③; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to over 300 V to 750 V ⑥⑭⑮ (ft)	Open supply conductors, over 750 V to 22 kV; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to 750 V to 22 kV ⑥⑭⑮ (ft)	Trolley and electrified railroad contact conductors and associated span or messenger wires ①	
					0 to 750 V to ground (ft)	Over 750 V to 22 kV to ground (ft)
Where wires, conductors, or cables cross over or overhang						
1. Track rails of railroads (except electrified railroads using overhead trolley conductors) ② ⑯ ㉒	23.5	24.0	24.5	26.5	22.0 ④	22.0 ④
2. Roads, streets, and other areas subject to truck traffic ㉓	15.5	16.0	16.5	18.5	18.0 ⑤	20.0 ⑤
3. Driveways, parking lots, and alleys ㉓	15.5 ⑦ ⑩	16.0 ⑦ ⑩	16.5 ⑦	18.5	18.0 ⑤	20.0 ⑤
4. Other areas traversed by vehicles, such as cultivated, grazing, forest, and orchard lands, industrial sites, commercial sites, etc. ⑱	15.5	16.0	16.5	18.5	—	—
5. Spaces and ways subject to pedestrians or restricted traffic only ⑨	9.5	12.0 ⑧	12.5 ⑧	14.5	16.0	18.0
6. Water areas not suitable for sailboating or where sailboating is prohibited ㉑	14.0	14.5	15.0	17.0	—	—

Table 232-1— *(continued)*
Vertical clearance of wires, conductors, and cables above ground, roadway, rail, or water surfaces

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems.
See Rules 232A, 232B1, 232C1a, and 232D4.)

Nature of surface underneath wires, conductors, or cables	Insulated communication conductors and cable; messengers; overhead shield/ surge-protection wires; effectively grounded guys; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to 0 to 300 V [6] [11] [15]; neutral conductors meeting Rule 230E1; supply cables meeting Rule 230C1 (ft)	Noninsulated communication conductors; supply cables of 0 to 750 V meeting Rule 230C2 or 230C3 (ft)	Supply cables over 750 V meeting Rule 230C2 or 230C3; open supply conductors, 0 to 750 V [3]; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to over 300 V to 750 V [6] [14] [15] (ft)	Open supply conductors, over 750 V to 22 kV; ungrounded portions of guys meeting Rules 215C2 and 279A1 exposed to 750 V to 22 kV [6] [14] [15] (ft)	Trolley and electrified railroad contact conductors and associated span or messenger wires [1]: 0 to 750 V to ground (ft)	Trolley and electrified railroad contact conductors and associated span or messenger wires [1]: Over 750 V to 22 kV to ground (ft)
7. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area of [17] [18] [19] [20] [21]						
a. Less than 20 acres	17.5	18.0	18.5	20.5	—	—
b. Over 20 to 200 acres	25.5	26.0	26.5	28.5	—	—
c. Over 200 to 2000 acres	31.5	32.0	32.5	34.5	—	—
d. Over 2000 acres	37.5	38.0	38.5	40.5	—	—
8. Established boat ramps and associated rigging areas; areas posted with sign(s) for rigging or launching sail boats	Clearance aboveground shall be 5 ft greater than in 7 above, for the type of water areas served by the launching site					
Where wires, conductors, or cables run along and within the limits of highways or other road rights-of-way but do not overhang the roadway						
9. Roads, streets, or alleys	15.5 [24]	16.0	16.5	18.5	18.0 [5]	20.0 [5]
10. Roads where it is unlikely that vehicles will be crossing under the line	13.5 [10] [12]	14.0 [10]	14.5 [10]	16.5	18.0 [5]	20.0 [5]

NOTE: The clearance values shown in this table are computed by adding the applicable Mechanical and Electrical (M & E) value of Table A-1 to the applicable Reference Component of Table A-2a of Appendix A.

①Where subways, tunnels, or bridges require it, less clearance above ground or rails than required by Table 232-1 may be used locally. The trolley and electrified railroad contact conductor should be graded gradually from the regular construction down to the reduced elevation.

②For wires, conductors, or cables crossing over mine, logging, and similar railways that handle only cars lower than standard freight cars, the clearance may be reduced by an amount equal to the difference in height between the highest loaded car handled and 20 ft, but the clearance shall not be reduced below that required for street crossings.

③Does not include neutral conductors meeting Rule 230E1.

④In communities where 21 ft has been established, this clearance may be continued if carefully maintained. The elevation of the contact conductor should be the same in the crossing and next adjacent spans. (See Rule 225D2 for conditions that must be met where uniform height above rail is impractical.)

⑤In communities where 16 ft has been established for trolley and electrified railroad contact conductors 0 to 750 V to ground, or 18 ft for trolley and electrified railroad contact conductors exceeding 750 V, or where local conditions make it impractical to obtain the clearance given in the table, these reduced clearances may be used if carefully maintained.

⑥These clearance values also apply to guy insulators.

⑦Where vehicles exceeding 8 ft in height are not normally encountered nor reasonably anticipated, service drop(s) clearances over residential driveways only may be reduced to the following:

		(ft)
(a)	Insulated supply service drops limited to 300 V to ground	12.5
(b)	Insulated drip loops of supply service drops limited to 300 V to ground	10.5
(c)	Supply service drops limited to 150 V to ground and meeting Rule 230C1 or 230C3	12.0
(d)	Drip loops only of service drops limited to 150 V to ground and meeting Rule 230C1 or 230C3	10.0
(e)	Insulated communication service drops	11.5

⑧These clearances values for service drops to residential buildings only may be reduced to the following:

		(ft)
(a)	Insulated supply service drops limited to 300 V to ground	10.5
(b)	Insulated drip loops of supply service drops limited to 300 V to ground	10.5
(c)	Supply service drops limited to 150 V to ground and meeting Rule 230C3	10.0
(d)	Drip loops only of supply service drops limited to 150 V to ground and meeting Rule 230C3	10.0

⑨Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horses or other large animals, vehicles, or other mobile units exceeding a total height of 8 ft are prohibited by regulation or permanent terrain configurations, or are otherwise not normally encountered nor reasonably anticipated.

⑩Where a supply or communication line along a road is located relative to fences, ditches, embankments, or other terrain features so that the ground under the line would not be expected to be traveled except by pedestrians, the clearances may be reduced to the following values:

		(ft)
(a)	Insulated communication conductor and communication cables.	9.5
(b)	Conductors of other communication circuits	9.5
(c)	Supply cables of any voltage meeting Rule 230C1 and neutral conductors meeting Rule 230E1	9.5
(d)	Insulated supply conductors limited to 300 V to ground	12.5
(e)	Insulated supply cables limited to 150 V to ground meeting Rule 230C2 or 230C3	10.0
(f)	Effectively grounded guys, insulated guys meeting Rules 279A1 and 215C2 exposed to 0 to 300 V	9.5

⑪No clearance from ground is required for anchor guys not crossing tracks, rails, streets, driveways, roads, or pathways.

⑫This clearance may be reduced to 13 ft for communication conductors and guys.

⑬Where this construction crosses over or runs along (a) alleys, non-residential driveways, or parking lots not subject to truck traffic, or (b) residential driveways, this clearance may be reduced to 15 ft.

⑭The portion(s) of span guys between guy insulators and the portion(s) of anchor guys above guy insulators that are not effectively grounded shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

⑮The portion of anchor guys below the lowest insulator meeting Rules 279A1 and 215C2a may have the same clearance as effectively grounded guys.

⑯Adjacent to tunnels and overhead bridges that restrict the height of loaded rail cars to less than 20 ft, these clearances may be reduced by the difference between the highest loaded rail car handled and 20 ft, if mutually agreed to by the parties at interest.

⑰For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high-water level.

⑱For uncontrolled water flow areas, the surface area shall be that enclosed by its annual high-water mark. Clearances shall be based on the normal flood level; if available, the 10-year flood level may be assumed as the normal flood level.

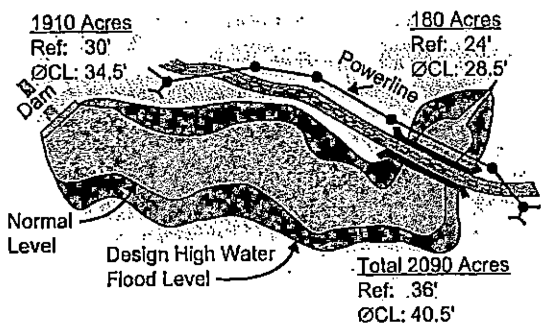
⑲The clearance over rivers, streams, and canals shall be based upon the largest surface area of any 1 mi long segment that includes the crossing. The clearance over a canal, river, or stream normally used to provide access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

⑳Where a bridge or other overwater obstruction restricts vessel height to less than the applicable reference height given in Table 232-3, the required clearance may be reduced by the difference between the reference height and the overwater obstruction height for the area of the body of water over which the line crosses, except that the reduced clearance shall be not less than that required for the surface area on the line-crossing side of the obstruction.

EXAMPLE: If a 2090 acre lake (over 2000 acres; reference height 36 ft) consists of 1910 acres (200 to 2000 acres; reference height 30 ft) on one side of a bridge and 180 acres (20 to 200 acres; reference height 24 ft) on the other side of the bridge, the required line clearance must be not less than that required for an over 2000 acre lake as required by Table 232-1 unless the bridge height above design high water is less than the reference dimension of 36 ft.

If the line is placed on the 180 acre side and the bridge height above design high water is less than 36 ft, but more than 24 ft, the required line clearance is reduced from that required by a lake of over 2000 acres by the difference between the bridge clearance and 36 ft. If the bridge height above design high water is less than 24 ft, the required clearance remains at that required for a 20 to 200 acre lake. See following figure.

Similarly, if the line is placed on the 1910 acre side and the bridge height above design high water is less than 36 ft, but more than 30 ft, the required line clearance is reduced from that required by a lake of over 2000 acres by the difference between the bridge clearance and 36 ft. If the bridge height above design high water is less than 30 ft, the required clearance remains at that required for a 200 to 2000 acre lake.



Power line on small lake side of bridge

㉑Where the U.S. Army Corps of Engineers, or the state, or surrogate thereof has issued a crossing permit, clearances of that permit shall govern.

㉒See Rule 234I for the required horizontal and diagonal clearances to rail cars.

㉓For the purpose of this rule, trucks are defined as any vehicle exceeding 8 ft in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.

㉔Communication cables and conductors may have a clearance of not less than 15 ft where poles are back of curbs or other deterrents to vehicular traffic.

㉕This footnote not used in this edition.

㉖When designing a line to accommodate oversized vehicles, these clearance values shall be increased by the difference between the known height of the oversized vehicle and 14 ft.

m

Table 232-2—
Vertical clearance of equipment cases, support arms, platforms, braces and unguarded rigid live parts above ground, roadway, or water surfaces

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems.
See Rules 232A, 232B2, 232B3, 232C1a, and 232D4.)

Nature of surface below	Nonmetallic or effectively grounded support arms, switch handles, platforms, braces, and equipment cases (m)	Unguarded rigid live parts of 0 to 750 V and ungrounded cases that contain equipment connected to circuits of not more than 750 V (m)	Unguarded rigid live parts of over 750 V to 22 kV and ungrounded cases that contain equipment connected to circuits of over 750 V to 22 kV (m)
1. Where rigid parts overhang			
a. Roads, streets, and other areas subject to truck traffic ④	4.6	4.9	5.5
b. Driveways, parking lots, and alleys	4.6	4.9 ⑥	5.5
c. Other areas traversed by vehicles such as cultivated, grazing, forest, and orchard lands, industrial areas, commercial areas, etc. ③	4.6 ①	4.9	5.5
d. Spaces and ways subject to pedestrians or restricted traffic only ⑤	2.8 ①	3.6 ①	4.3
2. Where rigid parts are along and within the limits of highways or other road rights-of-way but do not overhang the roadway			
a. Roads, streets, and alleys	4.6 ⑦	4.9	5.5
b. Roads where it is unlikely that vehicles will be crossing under the line	4.0 ①	4.3 ②	4.9
3. Water areas not suitable for sailboating or where sailboating is prohibited ⑧	4.1	4.4	5.0
4. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area of ⑧ ⑨ ⑩ ⑪ ⑫			
a. Less than 20 acres	5.2	5.5	6.1
b. Over 20 to 200 acres	7.6	7.9	8.5
c. Over 200 to 2000 acres	9.4	9.8	10.4
d. Over 2000 acres	11.3	11.6	12.2

m

Table 232-2— *(continued)*
Vertical clearance of equipment cases, support arms, platforms, braces and unguarded rigid live parts above ground, roadway, or water surfaces
(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems.
See Rules 232A, 232B2, 232B3, 232C1a, and 232D4.)

Nature of surface below	Nonmetallic or effectively grounded support arms, switch handles, platforms, braces, and equipment cases (m)	Unguarded rigid live parts of 0 to 750 V and ungrounded cases that contain equipment connected to circuits of not more than 750 V (m)	Unguarded rigid live parts of over 750 V to 22 kV and ungrounded cases that contain equipment connected to circuits of over 750 V to 22 kV (m)
5. Established boat ramps and associated rigging areas; areas posted with sign(s) for rigging or launching sail boats	Clearance aboveground shall be 1.5 m greater than in 4 above, for the type of water areas served by the launching site		

NOTE: The clearance values shown in this table are computed by adding the applicable Mechanical and Electrical (M & E) value of Table A-1 to the applicable Reference Component of Table A-2a of Appendix A.

①For insulated live parts limited to 150 V to ground, this value may be reduced to 3.0 m.

②Where a supply line along a road is limited to 300 V to ground and is located relative to fences, ditches, embankments, etc., so that the ground under the line would not be expected to be traveled except by pedestrians, this clearance may be reduced to 3.6 m.

③When designing a line to accommodate oversized vehicles, these clearance values shall be increased by the difference between the known height of the oversized vehicle and 4.3 m.

④For the purpose of this rule, trucks are defined as any vehicle exceeding 2.45 m in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.

⑤Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback or other large animals, vehicles, or other mobile units exceeding 2.45 m in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.

⑥This clearance may be reduced to the following values for driveways, parking lots, and alleys not subject to truck traffic:

	(m)
(a) Insulated live parts limited to 300 V to ground	3.6
(b) Insulated live parts limited to 150 V to ground	3.0

⑦Effectively grounded switch handles and supply or communication equipment cases (such as fire alarm boxes, control boxes, communication terminals, meters or similar equipment cases) may be mounted at a lower level for accessibility, provided such cases do not unduly obstruct a walkway.

NOTE: See also Rule 234J2c.

⑧Where the U.S. Army Corps of Engineers, or the state, or surrogate thereof has issued a crossing permit, clearances of that permit shall govern.

⑨For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high-water level.

⑩For uncontrolled water flow areas, the surface area shall be that enclosed by its annual high-water mark. Clearances shall be based on the normal flood level; if available, the 10-year flood level may be assumed as the normal flood level.

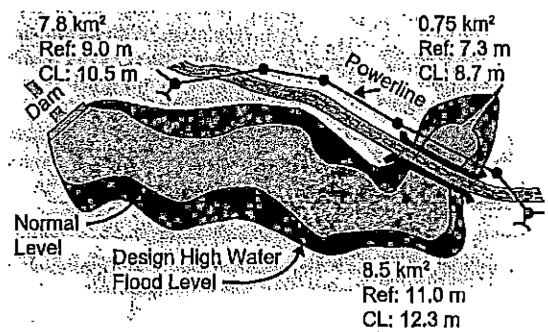
⑪The clearance over rivers, streams, and canals shall be based upon the largest surface area of any 1.6 km long segment that includes the crossing. The clearance over a canal, river, or stream normally used to provide access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

⑩Where a bridge or other overwater obstruction restricts vessel height to less than the applicable reference height given in Table 232-3, the required clearance may be reduced by the difference between the reference height and the overwater obstruction height for the area of the body of water over which the line crosses, except that the reduced clearance shall be not less than that required for the surface area on the line-crossing side of the obstruction.

EXAMPLE: If an 8.5 km^2 lake (over 8.0 km^2; reference height 11.0 m) consists of 7.8 km^2 (0.8 to 8.0 km^2; reference height 9.0 m) on one side of a bridge and 0.75 km^2 (0.08 to 8.0 km^2; reference height 7.3 m) on the other side of the bridge, the required line clearance must be not less than that required for an over 8.0 km^2 lake as required by Table 232-1 unless the bridge height above design high water is less than the reference dimension of 11.0 m.

If the line is placed on the 0.75 km^2 side and the bridge height above design high water is less than 11.0 m, but more than 7.3 m, the required line clearance is reduced from that required by a lake of over 8.0 km^2 by the difference between the bridge clearance and 11.0 m. If the bridge height above design high water is less than 7.3 m, the required clearance remains at that required for a 0.8 to 8.0 km^2 lake. See following figure.

Similarly, if the line is placed on the 7.8 km^2 side and the bridge height above design high water is less than 11.0 m, but more than 9.0 m, the required line clearance is reduced from that required by a lake of over 8.0 km^2 by the difference between the bridge clearance and 11.0 m. If the bridge height above design high water is less than 9.0 m, the required clearance remains at that required for a 0.8 to 8.0 km^2 lake.



Power line on small lake side of bridge

ft

Table 232-2— Vertical clearance of equipment cases, support arms, platforms, braces and unguarded rigid live parts above ground, roadway, or water surfaces

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems. See Rules 232A, 232B2, 232B3, 232C1a, and 232D4.)

Nature of surface below	Nonmetallic or effectively grounded support arms, switch handles, platforms, braces, and equipment cases (ft)	Unguarded rigid live parts of 0 to 750 V and ungrounded cases that contain equipment connected to circuits of not more than 750 V (ft)	Unguarded rigid live parts of over 750 V to 22 kV and ungrounded cases that contain equipment connected to circuits of over 750 V to 22 kV (ft)
1. Where rigid parts overhang			
a. Roads, streets, and other areas subject to truck traffic ④	15.0	16.0	18.0
b. Driveways, parking lots, and alleys	15.0	16.0 ⑥	18.0
c. Other areas traversed by vehicles such as cultivated, grazing, forest, and orchard lands, industrial areas, commercial areas, etc. ③	15.0 ⑦	16.0	18.0
d. Spaces and ways subject to pedestrians or restricted traffic only ⑤	9.0 ⑦	12.0 ①	14.0
2. Where rigid parts are along and within the limits of highways or other road rights-of-way but do not overhang the roadway			
a. Roads, streets, and alleys	15.0 ⑦	16.0	18.0
b. Roads where it is unlikely that vehicles will be crossing under the line	13.0 ⑦	14.0 ②	16.0
3. Water areas not suitable for sailboating or where sailboating is prohibited ⑧	13.5	14.5	16.5
4. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area of ⑧⑨⑩⑪⑫			
a. Less than 20 acres	17.0	18.0	20.0
b. Over 20 to 200 acres	25.0	26.0	28.0
c. Over 200 to 2000 acres	31.0	32.0	34.0
d. Over 2000 acres	37.0	38.0	40.0

ft

Table 232-2— *(continued)*
Vertical clearance of equipment cases, support arms, platforms, braces and unguarded rigid live parts above ground, roadway, or water surfaces

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems.
See Rules 232A, 232B2, 232B3, 232C1a, and 232D4.)

Nature of surface below	Nonmetallic or effectively grounded support arms, switch handles, platforms, braces, and equipment cases (ft)	Unguarded rigid live parts of 0 to 750 V and ungrounded cases that contain equipment connected to circuits of not more than 750 V (ft)	Unguarded rigid live parts of over 750 V to 22 kV and ungrounded cases that contain equipment connected to circuits of over 750 V to 22 kV (ft)
5. Established boat ramps and associated rigging areas; areas posted with sign(s) for rigging or launching sail boats	Clearance aboveground shall be 5 ft greater than in 4 above, for the type of water areas served by the launching site		

NOTE: The clearance values shown in this table are computed by adding the applicable Mechanical and Electrical (M & E) value of Table A-1 to the applicable Reference Component of Table A-2a of Appendix A.

①For insulated live parts limited to 150 V to ground, this value may be reduced to 10 ft.

②Where a supply line along a road is limited to 300 V to ground and is located relative to fences, ditches, embankments, etc., so that the ground under the line would not be expected to be traveled except by pedestrians, this clearance may be reduced to 12 ft.

③When designing a line to accommodate oversized vehicles, these clearance values shall be increased by the difference between the known height of the oversized vehicle and 14 ft.

④For the purpose of this rule, trucks are defined as any vehicle exceeding 8 ft in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.

⑤Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback or other large animals, vehicles, or other mobile units exceeding 8 ft in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.

⑥This clearance may be reduced to the following values for driveways, parking lots, and alleys not subject to truck traffic:

	(ft)
(a) Insulated live parts limited to 300 V to ground	12
(b) Insulated live parts limited to 150 V to ground	10

⑦Effectively grounded switch handles and supply or communication equipment cases (such as fire alarm boxes, control boxes, communication terminals, meters, or similar equipment cases) may be mounted at a lower level for accessibility, provided such cases do not unduly obstruct a walkway.

NOTE: See also Rule 234J2c.

⑧Where the U.S. Army Corps of Engineers, or the state, or surrogate thereof has issued a crossing permit, clearances of that permit shall govern.

⑨For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high-water level.

⑩For uncontrolled water flow areas, the surface area shall be that enclosed by its annual high-water mark. Clearances shall be based on the normal flood level; if available, the 10-year flood level may be assumed as the normal flood level.

⑪The clearance over rivers, streams, and canals shall be based upon the largest surface area of any 1 mi long segment that includes the crossing. The clearance over a canal, river, or stream normally used to provide access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

⑫Where a bridge or other overwater obstruction restricts vessel height to less than the applicable reference height given in Table 232-3, the required clearance may be reduced by the difference between the reference height and the overwater obstruction height for the area of the body of water over which the line crosses, except that the reduced clearance shall be not less than that required for the surface area on the line-crossing side of the obstruction.

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Witness: Gregory L. Booth, PE
Exhibit GLB-2
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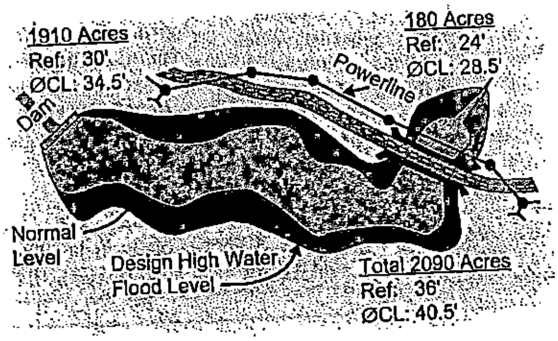
EXAMPLE: If a 2090 acre lake (over 2000 acres; reference height 36 ft) consists of 1910 acres (200 to 2000 acres; reference height 30 ft) on one side of a bridge and 180 acres (20 to 200 acres; reference height 24 ft) on the other side of the bridge, the required line clearance must be not less than that required for an over 2000 acre lake as required by Table 232-1 unless the bridge height above design high water is less than the reference dimension of 36 ft.

If the line is placed on the 180 acre side and the bridge height above design high water is less than 36 ft, but more than 24 ft, the required line clearance is reduced from that required by a lake of over 2000 acres by the difference between the bridge clearance and 36 ft. If the bridge height above design high water is less than 24 ft, the required clearance remains at that required for a 20 to 200 acre lake. See following figure.

Similarly, if the line is placed on the 1910 acre side and the bridge height above design high water is less than 36 ft, but more than 30 ft, the required line clearance is reduced from that required by a lake of over 2000 acres by the difference between the bridge clearance and 36 ft. If the bridge height above design high water is less than 30 ft, the required clearance remains at that required for a 200 to 2000 acre lake.



Power line on small lake side of bridge

Table 232-3—Reference heights
(See Rule 232D2.)

Nature of surface underneath lines	(m)	(ft)
a. Track rails of railroads (except electrified railroads using overhead trolley conductors) ①	6.7	22
b. Streets, alleys, roads, driveways, and parking lots	4.3	14
c. Spaces and ways subject to pedestrians or restricted traffic only ②	3.0	10
d. Other land, such as cultivated, grazing, forest, or orchard, that is traversed by vehicles	4.3	14
e. Water areas not suitable for sailboating or where sailboating is prohibited	3.8	12.5
f. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with unobstructed surface area ③ ④		
(1) Less than 0.08 km^2 (20 acres)	4.9	16
(2) Over 0.08 to 0.8 km^2 (20 to 200 acres)	7.3	24
(3) Over 0.8 to 8 km^2 (200 to 2000 acres)	9.0	30
(4) Over 8 km^2 (2000 acres)	11.0	36
g. In public or private land and water areas posted for rigging or launching sailboats, the reference height shall be 1.5 m (5 ft) greater than in f above, for the type of water areas serviced by the launching site		

①See Rule 234I for the required horizontal and diagonal clearances to rail cars.

②Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback or other large animals, vehicles, or other mobile units exceeding 2.45 m (8 ft) in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.

③For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high-water level. For other waters, the surface area shall be that enclosed by its annual high-water mark, and clearances shall be based on the normal flood level. The clearances over rivers, streams, and canals shall be based upon the largest surface area of any 1600 m (1 mi) long segment that includes the crossing. The clearance over a canal or similar waterway providing access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

④Where an overwater obstruction restricts vessel height to less than the applicable reference height, the required clearance may be reduced by the difference between the reference height and the overwater obstruction height, except that the reduced clearance shall not be less than that required for the surface area on the line-crossing side of the obstruction.

Table 232-4—Electrical component of clearance in Rule 232D3a

[This clearance shall be increased at the rate of 1% per 100 m (330 ft) in excess of 450 m (1500 ft) above mean sea level.
Increase clearance to limit electrostatic effects in accordance with Rules 232A and 232D3c.]

Maximum operating voltage phase to phase (kV)	Switching-surge factor (per unit)	Switching surge (kV)	Electrical component of clearance	
			(m)	(ft)
242	3.54 or less	700 or less	2.17 ①	7.1 ①
362	2.37 or less	700 or less	2.17 ①	7.2 ①
550	1.56 or less	700 or less	2.17 ①	7.2 ①
	1.90	853	3.1	9.9
	2.00	898	3.3	10.8
	2.20	988	3.9	12.7
	2.40	1079	4.5	14.6
	2.60	1168	5.1	16.7
800	1.60	1045	4.3	13.9
	1.80	1176	5.2	16.9
	2.00	1306	6.2	20.1
	2.10 or more	1372 or more	6.7 ②	21.9 ②

①Shall be not less than that required by Rule 232D4, including the altitude correction for lines above 1000 m (3300 ft) elevation as specified in Rule 232C1b.

②Shall be not less than that required by Rules 232A and 232B.

233. Clearances between wires, conductors, and cables carried on different supporting structures

A. General

Crossings should be made on a common supporting structure, where practical. In other cases, the clearance between any two crossing or adjacent wires, conductors, or cables carried on different supporting structures shall be not less than that required by Rules 233B and 233C at any location in the spans. The clearance shall be not less than that required by application of a clearance envelope developed under Rule 233A2 to the positions on or within conductor movement envelopes developed under Rule 233A1 at which the two wires, conductors, or cables would be closest together. For purposes of this determination, the relevant positions of the wires, conductors, or cables on or within their respective conductor movement envelopes are those that can occur when (1) both are simultaneously subjected to the same ambient air temperature and wind loading conditions, and (2) each is subjected individually to the full range of its icing conditions and applicable design electrical loading.

Figure 233-1 is a graphical illustration of the application of Rule 233A. Alternate methods that ensure compliance with these rules may be used.

Table 234-6—Clearance over roof not readily accessible ①
[See Rule 324C3d(1).]

	Cable type	Clearance over portions of roof within 6.0 ft radius of the service mast			Clearance over portions of roof outside 6.0 ft radius of the service mast		
		Voltage ②			Voltage ②		
		0 to 300 V	301 to 750 V	Over 750 V	0 to 300 V	301 to 750 V	Over 750 V
Mast not more than 4.0 ft from nearest roof edge	230C3 230C2	1.5	1.5	NA	3.0	3.0	NA
	230C1	1.5	1.5	1.5	3.0	3.0	3.0
	230D	1.5	10.0	NA	3.0	10.0	NA
Mast more than 4.0 ft from nearest roof edge	230C3 230C2	3.0	3.0	NA	3.0	3.0	NA
	230C1	3.0	3.0	3.0	3.0	3.0	3.0
	230D	3.0	10.0	NA	3.0	10.0	NA

① If the roof is readily accessible, a clearance of not less than 10 ft vertical clearance for all service drop conductors including the drip loop shall be maintained above all portions of the roof.
② All voltages are between the conductors involved.

235. Clearance for wires, conductors, or cables carried on the same supporting structure

A. Application of rule

1. Multiconductor wires or cables

   Cables, and duplex, triple, or paired conductors supported on insulators or messengers meeting Rule 230C or 230D, whether single or grouped, for the purposes of this rule are considered single conductors even though they may contain individual conductors not of the same phase or polarity.

2. Conductors supported by messengers or span wires

   Clearances between individual wires, conductors, or cables supported by the same messenger, or between any group and its supporting messenger, or between a trolley feeder, supply conductor, or communication conductor, and their respective supporting span wires, are not subject to the provisions of this rule.

3. Line conductors of different circuits

   a. Unless otherwise stated, the voltage between line conductors of different circuits shall be the greater of the following:

      (1) The phasor difference between the conductors involved

      NOTE: A phasor relationship of 180° is considered appropriate where the actual phasor relationship is unknown.

      (2) The phase-to-ground voltage of the higher-voltage circuit

   b. When the circuits have the same nominal voltage, either circuit may be considered to be the higher-voltage circuit.

B. Horizontal clearance between line conductors

1. Fixed supports

Line conductors attached to fixed supports shall have horizontal clearances from each other not less than the larger value required by either Rule 235B1a or 235B1b for the situation concerned. Voltage is between the two conductors for which the clearance is being determined except for railway feeders, which are to ground.

EXCEPTION 1: The pin spacing at buckarm construction may be reduced as specified in Rule 236F to provide climbing space.

EXCEPTION 2: Grade N need meet only the requirements of Rule 235B1a.

EXCEPTION 3: These clearances do not apply to cables meeting Rule 230C or covered conductors of the same circuit meeting Rule 230D.

EXCEPTION 4: For voltages to ground exceeding 98 kV ac or 139 kV dc, clearances less than those required by a and b below are permitted for systems with known maximum switching-surge factors. (See Rule 235B3.)

a. Horizontal clearance between line conductors of the same or different circuits

Clearances shall be not less than those given in Table 235-1.

b. Clearance according to sags

The clearance at the supports of line conductors of the same or different circuits of Grade B or C shall be not less than the values given by the following formulas, at a conductor temperature of 15 °C (60 °F), at final sag, no wind. For the purpose of this rule, the line conductor clearances are between the surfaces of the conductors only, not including armor rods, tie wires, or other fasteners. The requirements of Rule 235B1a apply if they give a greater clearance than this rule.

When using the applicable formula with a fixed conductor clearance to determine maximum allowable sag for that conductor clearance, the resultant maximum sag shall be rounded down.

EXCEPTION: No requirement is specified for clearance between conductors of the same circuit when rated above 50 kV.

In the following, S is the final sag in millimeters of the conductor having the greater sag, and the clearance is in millimeters. Voltage (kV) is the voltage between the conductors.

(1) For line conductors smaller than AWG No. 2: clearance = 7.6 mm per kV + $20.4\sqrt{S-610}$. (Table 235-2 shows selected values up to 46 kV.)

(2) For line conductors of AWG No. 2 or larger: clearance = 7.6 mm per kV + $8\sqrt{(2.12S)}$. (Table 235-3 shows selected values up to 46 kV.)

(3) For voltages exceeding 814 kV, the clearance shall be determined by the alternate method given by Rule 235B3.

(4) The clearance for voltages exceeding 50 kV specified in Rules 235B1b(1) and (2) shall be increased 3% for each 300 m in excess of 1000 m above mean sea level. All clearances for lines over 50 kV shall be based on the maximum operating voltage.

In the following, S is the final sag in inches of the conductor having the greater sag, and the clearance is in inches. Voltage (kV) is the voltage between the conductors.

(1) For line conductors smaller than AWG No. 2: clearance = 0.3 in per kV + $4.04\sqrt{S-24}$. (Table 235-2 shows selected values up to 46 kV.)

(2) For line conductors of AWG No. 2 or larger: clearance = 0.3 in per kV + $8\sqrt{S/12}$. (Table 235-3 shows selected values up to 46 kV.)

(3) For voltages exceeding 814 kV, the clearance shall be determined by the alternate method given by Rule 235B3.

(4) The clearance for voltages exceeding 50 kV specified in Rules 235B1b(1) and 235B1b(2) shall be increased 3% for each 1000 ft in excess of 3300 ft above mean sea level. All clearances for lines over 50 kV shall be based on the maximum operating voltage.

2. Suspension insulators

Where suspension insulators are used and are not restrained from movement, the clearance between conductors shall be increased so that one string of insulators may swing transversely throughout a range of insulator swing up to its maximum design swing angle without reducing the values given in Rule 235B1. The maximum design swing angle shall be based on a 290 Pa (6 lb/ft^2) wind on the conductor at final sag at 15 °C (60 °F). This may be reduced to a 190 Pa (4 lb/ft^2) wind in areas sheltered by buildings, terrains, or other obstacles. Trees are not considered to shelter a line. The displacement of the wires, conductors, and cables shall include deflection of flexible structures and fittings, where such deflection would reduce the horizontal clearance between two wires, conductors, or cables.

3. Alternate clearances for different circuits where one or both circuits exceed 98 kV ac to ground or 139 kV dc to ground

The clearances specified in Rules 235B1 and 235B2 may be reduced for circuits with known switching-surge factors but shall be not less than the clearances derived from the following computations. For these computations, communication conductors and cables, guys, messengers, neutral conductors meeting Rule 230E1, and supply cables meeting Rule 230C1 shall be considered line conductors at zero voltage.

a. Clearance

(1) The alternate clearance shall be maintained under the expected loading conditions and shall be not less than the electrical clearance between conductors of different circuits computed from the following equation. For convenience, clearances for typical system voltages are shown in Table 235-4.

$$D = 1.00\left[\frac{V_{L-L} \cdot (PU) \cdot a}{500K}\right]^{1.667} b \qquad \text{(m)}$$

$$D = 3.28\left[\frac{V_{L-L} \cdot (PU) \cdot a}{500K}\right]^{1.667} b \qquad \text{(ft)}$$

where

V_{L-L} = maximum ac crest operating voltage in kilovolts between phases of different circuits or maximum dc operating voltage between poles of different circuits. If the phases are of the same phase and voltage magnitude, one phase conductor shall be considered grounded

PU = maximum switching-surge factor expressed in per-unit peak operating voltage between phases of different circuits and defined as a switching-surge level between phases for circuit breakers corresponding to 98% probability that the maximum switching surge generated per breaker operation does not exceed this surge level, or the maximum anticipated switching-surge level generated by other means, whichever is greater

a = 1.15, the allowance for three standard deviations

b = 1.03, the allowance for nonstandard atmospheric conditions

K = 1.4, the configuration factor for a conductor-to-conductor gap

(2) The value of D shall be increased 3% for each 300 m (1000 ft) in excess of 450 m (1500 ft) above mean sea level.

b. Limit

The clearance derived from Rule 235B3a shall not be less than the basic clearances given in Table 235-1 computed for 169 kV ac.

C. Vertical clearance at the support for line conductors and service drops

All line wires, conductors, cables, and service drops located at different levels on the same supporting structure shall have vertical clearances not less than the following:

1. Basic clearance for line wires, conductors, ~~and~~ cables, and service drops of same or different circuits

   a. Between supply lines of the same or different circuits

   The clearance requirements given in Table 235-5 shall apply to supply wires, conductors, or cables of 0 to 50 kV attached to supports. No value is specified for clearances between conductors of the same circuit exceeding 50 kV or between ungrounded open supply conductors 0 to 50 kV of the same phase and circuit of the same utility.

   b. Between supply lines and communication lines

   The clearance requirements given in Table 235-5 shall apply.

   c. Between communication lines located in the communication space

   The clearance and spacing requirements of Rule 235H shall apply to communication lines located in the communication space.

   d. Between communication lines located in the supply space

   The clearance requirements of Table 235-5 shall apply to communication lines located in the supply space.

EXCEPTION 1: Line wires, conductors, or cables on vertical racks or separate brackets placed vertically and meeting the requirements of Rule 235G may have spacings as specified in that rule.

EXCEPTION 2: Where communication service drops cross under supply conductors on a common crossing structure, the clearance between the communication conductor and an effectively grounded supply conductor may be reduced to 100 mm (4 in) provided the clearance between the communication conductor and supply conductors not effectively grounded meets the requirements of Rule 235C as appropriate.

EXCEPTION 3: Supply service drops of 0 to 750 V running above and parallel to communication service drops may have a clearance of not less than 300 mm (12 in) at any point in the span including the point of their attachment to the building or structure being served provided that the nongrounded conductors are insulated and that the clearance as otherwise required by this rule is maintained between the two service drops at the pole.

EXCEPTION 4: This rule does not apply to conductors of the same circuit meeting Rule 230D.

2. Additional clearances

Greater clearances than those required (by Rule 235C1) and given in Table 235-5 shall be provided under the following conditions. The increases are cumulative where more than one is applicable.

   a. Voltage related clearances

   (1) For voltages between 50 and 814 kV, the clearance between line wires, conductors, or cables of different circuits shall be increased 10 mm (0.4 in) per kilovolt in excess of 50 kV.

   EXCEPTION: For voltages to ground exceeding 98 kV ac or 139 kV dc, clearances less than those required above are permitted for systems with known switching-surge factors. (See Rule 235C3.)

   EXAMPLES: Calculations of clearances required by Rule 235C2a for a 69.7 kV maximum operating voltage phase-to-ground conductor above a 7.2 kV phase-to-ground conductor, assuming conductors are 180° out of phase.

   Rule 235C2a: Clearance required at support

(a) Same utility [basic clearance = 0.41 m (16 in)]:

SI units: {0.41 + [(50 – 8.7) × 0.01]} + [(69.7 + 7.2 – 50) × 0.01] = 1.09 m. No rounding required in this example.

Customary units: {16.0 + [(50 – 8.7) × 0.4]} + [(69.7 + 7.2 – 50) × 0.4] = 43.3 in. Round up to 44 in.

(b) Different utilities [basic clearance = 1.00 m (40 in)]:

SI units: {1.00 + [(50 – 8.7) × 0.01]} + [(69.7 + 7.2 – 50) × 0.01] = 1.68 m. No rounding required in this example.

Customary units: {40.0 + [(50 – 8.7) × 0.4]} + [(69.7 + 7.2 – 50) × 0.4] = 67.3 in. Round up to 68 in.

(2) The increase in clearance for voltages in excess of 50 kV specified in Rule 235C2a(1) shall be increased 3% for each 300 m (1000 ft) in excess of 1000 m (3300 ft) above mean sea level.

(3) All clearances for lines over 50 kV shall be based on the maximum operating voltage.

(4) No value is specified for clearances between conductors of the same circuit.

b. Sag-related clearances

(1) Line wires, conductors, and cables supported at different levels on the same structures shall have vertical clearances at the supporting structures so adjusted that the clearance at any point in the span shall be not less than any of the following:

(a) For voltages less than 50 kV between conductors, 75% of that required at the supports by Table 235-5.

(b) For voltages more than 50 kV between conductors, use the value as calculated by the following appropriate formula:

If the basic value is 0.41 m (16 in): 0.62 m (24.4 in) plus 10 mm (0.4 in) per kV in excess of 50 kV.

If the basic value is 1.0 m (40 in):1.08 m (42.4 in) plus 10 mm (0.4 in) per kV in excess of 50 kV.

The increase in clearance for voltages in excess of 50 kV specified in Rule 235C2b(1)(b) shall be increased 3% for each 300 m (1000 ft) in excess of 1000 m (3300 ft) above mean sea level.

All clearances for lines over 50 kV shall be based on the maximum operating voltage.

EXAMPLES: Calculations of clearances required by Rule 235C2b(1)(b) for a 69.7 kV maximum operating voltage phase-to-ground conductor above a 7.2 kV phase-to-ground conductor, assuming conductors are 180 degrees out of phase.

Rule 235C2b(1)(b): Clearance required at any point in the span

(i) Same utility [basic clearance = 0.41m (16 in)]:

SI units: {0.41 + [(50 – 8.7) × 0.01]} × 0.75 + [(69.7 + 7.2 – 50) × 0.01] = 0.89 m. No rounding required in this example.

Customary units: {16.0 + [(50 – 8.7) × 0.4]} × 0.75 + [(69.7 + 7.2 – 50) × 0.4] = 35.2 in. Round up to 36 in.

(ii) Different utilities [basic clearance = 1.00 m (40 in)]:

SI units: {1.00 + [(50 – 8.7) × 0.01]} × 0.75 + [(69.7 + 7.2 – 50) × 0.01] = 1.33 m. No rounding required in this example.

Customary units: {40.0 + [(50 – 8.7) × 0.4]} × 0.75 + [(69.7 + 7.2 – 50) × 0.4] = 53.2 in. Round up to 54 in.

EXCEPTION 1: For Rules 235C2b(1)(a) and 235C2b(1)(b), the following conductors/cables may have a clearance of not less than 300 mm (12 in) at any point in the span from communication cables located in the communication space provided (a) the supply neutral meeting Rule 230E1 or messenger is bonded to the communication messenger at intervals specified in Rule 092C1, and (b) a clearance of not less than 0.75 m (30 in) is maintained at the supporting structures between the supply conductors and cables located in the supply space and communication cables located in the communication space:

(1) Neutral conductors meeting Rule 230E1,

(2) Fiber-optic supply cables meeting Rule 230F1a or 230F1b,

(3) Insulated communication cables located in the supply space and supported by an effectively grounded messenger, and

(4) Supply cables meeting Rule 230C1 (including their support brackets) in the supply space running above and parallel to communication cables in the communications space.

Bonding is not required for entirely dielectric cables meeting Rule 230F1b.

EXCEPTION 2: For Rules 235C2b(1)(a) and 235C2b(1)(b), when all parties involved are in agreement, for supply conductors of different utilities, vertical clearance at any point in the span need not exceed 75% of the values required at the support for the same utility by Table 235-5.

(c) For purposes of this determination the vertical clearances required in Rules 235C2b(1)(a) and 235C2b(1)(b) apply to the following conductor temperature and loading conditions specified below in i or ii, whichever produces the greater vertical clearance at the structure.

i. The upper conductor is at final sag at 50 °C (120 °F) or the maximum operating temperature for which the line is designed to operate. The lower conductor is at final sag without electrical loading at the same ambient conditions that are used to determine the operating temperature of the upper conductor

EXCEPTION: Rule 235C2b(1)(c)i does not apply to conductors of the same utility when the upper and lower conductors are of the same circuit, the same size and type, installed at the same sag and tension, and will be without electrical loading simultaneously.

ii. The upper conductor is at final sag at 0 °C (32 °F) with the radial thickness of ice, if any, specified in Table 230-1 for the zone concerned. The lower conductor is at final sag without electrical loading and without ice loading at the same ambient conditions as the upper conductor.

EXCEPTION: Rule 235C2b(1)(c)ii does not apply where experience in an area has shown that different ice conditions do not occur between the upper and lower conductors.

NOTE: The ambient temperature may be less than the 0 °C (32 °F) used for the upper conductor due to the electrical loading that produced the 0 °C (32 °F) used for the upper conductor temperature.

If both *EXCEPTIONS* in Rule 235C2b(1)(c) can be used, then Rule 235C2b does not apply. See Rule 012C.

(2) Sags should be readjusted when necessary to accomplish the foregoing, but not reduced sufficiently to conflict with the requirements of Rule 261H1. In cases where conductors of different sizes are strung to the same sag for the sake of appearance or to maintain unreduced clearance throughout storms, the chosen sag should be such as will keep the smallest conductor involved in compliance with the sag requirements of Rule 261H1.

(3) For span lengths in excess of 45 m (150 ft), vertical clearance at the structure between open supply conductors and communication cables or conductors shall be adjusted so that under conditions of conductor temperature of 15 °C (60 °F), no wind displacement and final sag, no open supply conductor of over 750 V but less than 50 kV shall be lower in the span than a straight line joining the points of support of the highest communication cable or conductor.

EXCEPTION: Effectively grounded supply conductors associated with systems of 50 kV or less need meet only the provisions of Rule 235C2b(1).

3. Alternate clearances for different circuits where one or both exceed 98 kV ac, or 139 kV dc to ground

The clearances specified in Rules 235C1 and 235C2 may be reduced for circuits with known switching-surge factors, but shall not be less than the crossing clearances required by Rule 233C3.

4. Communication worker safety zone

The clearances specified in Rules 235C and 238 create a *communication worker safety zone* between the facilities located in the supply space and facilities located in the communication space, both at the structure and in the span between structures. Except as allowed by Rules 238C, 238D, and 239, no supply or communication facility shall be located in the communication worker safety zone.

D. Diagonal clearance between line wires, conductors, and cables located at different levels on the same supporting structure

No wire, conductor, or cable may be closer to any other wire, conductor, or cable than defined by the dashed line in Table 235-1, where V and H are determined in accordance with other parts of Rule 235.

E. Clearances in any direction at or near a support from line conductors to supports, and to vertical or lateral conductors, service drops, and span or guy wires, attached to the same support

1. Fixed supports

Clearances shall be not less than those given in Table 235-6.

EXCEPTION: For voltages exceeding 98 kV ac to ground or 139 kV dc to ground, clearances less than those required by Table 235-6 are permitted for systems with known switching-surge factor. (See Rule 235E3.)

NOTE 1: For clearances in any direction from supply line conductors to communication antennas in the supply space attached to the same supporting structure, see Rule 235I.

NOTE 2: For antennas in the communication space, see Rule 236D1 and Rule 238.

2. Suspension insulators

Where suspension insulators are used and are not restrained from movement, the clearance shall be increased so that the string of insulators may swing transversely throughout a range of insulator swing up to its maximum design swing angle without reducing the values given in Rule 235E1. The maximum design swing angle shall be based on a 290 Pa (6 lb/ft^2) wind on the conductor at final sag at 15 °C (60 °F). This may be reduced to a 190 Pa (4 lb/ft^2) wind in areas sheltered by buildings, terrain, or other obstacles. Trees are not considered to shelter a line. The displacement of the wires, conductors, and cables shall include deflection of flexible structures and fittings, where such deflection would reduce the clearance.

3. Alternate clearances for voltages exceeding 98 kV ac to ground or 139 kV dc to ground

The clearances specified in Rules 235E1 and 235E2 may be reduced for circuits with known switching-surge factors but shall not be less than the following:

a. Alternate clearances to anchor guys, surge-protection wires, and vertical or lateral conductors

The alternate clearances shall be not less than the crossing clearances required by Rule 233B3 and Rules 233C3a and 233C3b for the conductor voltages concerned. For the purpose of this rule, anchor guys and surge-protection wires shall be assumed to be at ground potential. The limits of Rule 235E3b(2) shall apply to the clearance derived from Rules 233C3a and 233C3b.

b. Alternate clearance to surface of support arms and structures

(1) Alternate clearance

(a) Basic computation

The alternate clearances shall be maintained under the expected loading conditions and shall be not less than the electrical clearances computed from the following equation. For convenience, clearances for typical system voltages are shown in Table 235-7.

$$D = 1.00\left[\frac{V \cdot (PU) \cdot a}{500K}\right]^{1.667} b \qquad \text{(m)}$$

$$D = 39.37\left[\frac{V \cdot (PU) \cdot a}{500K}\right]^{1.667} b \qquad \text{(in)}$$

where

V = maximum ac crest operating voltage to ground or maximum dc operating voltage to ground in kilovolts

PU = maximum switching-surge factor expressed in per-unit peak voltage to ground and defined as a switching-surge level for circuit breakers corresponding to 98% probability that the maximum switching surge generated per breaker operation does not exceed this surge level, or the maximum anticipated switching-surge level generated by other means, whichever is greater

a = 1.15, the allowance for three standard deviations with fixed insulator supports
= 1.05, the allowance for one standard deviation with free-swinging insulators

b = 1.03, the allowance for nonstandard atmospheric conditions

K = 1.2, the configuration factor for conductor-to-tower window

(b) Atmospheric correction

The value of D shall be increased 3% for each 300 m (1000 ft) in excess of 450 m (1500 ft) above mean sea level.

(2) Limits

The alternate clearance shall not be less than the clearance of Table 235-6 for 169 kV ac. The alternate clearance shall be checked for adequacy of clearance to workers and increased, if necessary, where work is to be done on the structure while the circuit is energized. (Also see Part 4.)

F. Clearances between circuits located in the supply space on the same support arm

Different circuits may be maintained in the supply space on the same support arm only under one or more of the five following conditions. For purposes of these determinations, a neutral conductor shall be considered as having the same voltage classification as the circuit with which it is associated:

1. If they occupy positions on opposite sides of the structure.
2. If in bridge-arm or sidearm construction, the clearance is not less than the climbing space required for the higher voltage concerned and provided for in Rule 236.

3. If the higher-voltage conductors occupy the outer positions and the lower-voltage conductors occupy the inner positions.
4. If series lighting or similar supply circuits are ordinarily dead during periods of work on or above the support arm concerned.
5. If the two circuits concerned are communication circuits (located in the supply space in accordance with Rule 224A), or one circuit is such a communication circuit and the other is a supply circuit, provided they are installed as specified in Rule 235F1 or 235F2.

G. Conductor spacing: vertical racks or separate brackets

Conductors or cables may be carried on vertical racks or separate brackets other than wood placed vertically on one side of the structure and securely attached thereto with less clearance between the wires, conductors, or cables than specified in Rule 235C if all the following conditions are met:

1. All wires, conductors, and cables are owned and maintained by the same utility, unless by agreement between all parties involved.
2. The voltage shall be not more than 750 V, except supply cables and conductors meeting Rule 230C1 or 230C2, which may carry any voltage.
3. Conductors shall be arranged so that the vertical spacing shall be not less than that specified in Table 235-8 under the conditions specified in Rule 235C2b(1)(c).

EXCEPTION 1: A supporting neutral conductor of a supply cable meeting Rule 230C3 or an effectively grounded messenger of a supply cable meeting Rule 230C1 or 230C2 may attach to the same insulator or bracket as a neutral conductor meeting Rule 230E1, so long as the clearances of Table 235-8 are maintained in mid-span and insulated energized conductors are positioned away from the open supply neutral at the attachment.

EXCEPTION 2: No mid-span clearance is required where supply cables meeting Rule 230C3 or service drops meeting Rule 234C3a are attached to the neutral conductor meeting Rule 230E1 anywhere in the span.

H. Clearance and spacing between communication conductors, cables, and equipment

1. The spacing between messengers supporting communication cables should be not less than 300 mm (12 in) except by agreement between the parties involved including the pole owner(s).
2. The clearances between the conductors, cables, and equipment of one communication utility to those of another, anywhere in the span, shall be not less than 100 mm (4 in), except by agreement between the parties involved including the pole owner(s).

I. Communication antenna clearances in any direction from supply and communication lines attached to the same supporting structure

1. General

These clearances apply to communication antennas operated at a radio frequency of 3 kHz to 300 GHz, including any associated conductive mounting hardware. Communication antennas located in the supply space shall be installed and maintained only by personnel authorized and qualified to work in the supply space in accordance with the applicable work rules. Antennas function as rigid (vertical or lateral) open wire communication conductors for the purpose of determining clearances under this rule. See also Rule 224A.

2. Communication antenna clearances

a. Communication antennas located in the supply space shall have clearances in any direction from supply lines not less than the value given in Table 235-6, row 1c, and a vertical clearance of not less than 1.00 m (40 in) from communication lines in the communication space.

NOTE: Clearances shown in Table 235-6 are not intended to apply to personnel working in the vicinity of communication antennas. See Rule 420Q.

b. Communication antennas located in the communication space shall have clearances in any direction from communication lines in the communication space not less than the value in

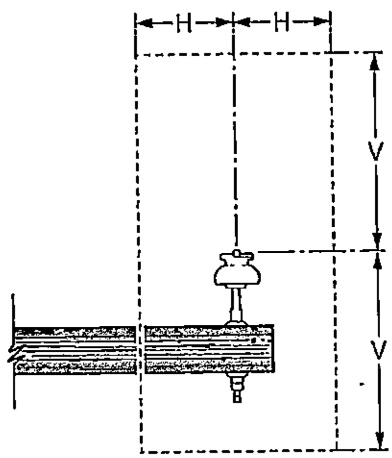
Table 235-6, row 1c, and a vertical clearance from supply conductors located in the supply space not less than the value given in Table 235-5, row 1a.

3. Equipment case that supports or is adjacent to a communication antenna

   The clearance between an equipment case that supports or is adjacent to a communication antenna and a supply line conductor shall be not less than the value given in Table 235-6, row 4a.

4. Vertical or lateral communication conductors and cables attached to a communication antenna

   The clearance between a supply line conductor and the vertical or lateral communication conductor and cable attached to a communication antenna shall be not less than the value given in Rule 239F2.



V = Vertical clearance
H = Horizontal clearance

Figure 235-1—Clearance diagram for energized conductor

Table 235-1—Horizontal clearance between wires, conductors, or cables at supports
(All voltages are between conductors involved except for railway feeders, which are to ground.
See also Rules 235A, 235B1a, and 235B3b.)

Class of circuit	Clearance (mm)	Clearance (in)	Notes
Open communication conductors	150	6	Does not apply at conductor transposition points.
	75	3	Permitted where pin spacings less than 150 mm (6 in) have been in regular use. Does not apply at conductor transposition points.
Railway feeders: 0 to 750 V, AWG No. 4/0 or larger 0 to 750 V, smaller than AWG No. 4/0 Over 750 V to 8.7 kV	 150 300 300	 6 12 12	Where 250 mm to 300 mm (10 in to 12 in) clearance has already been established by practice, it may be continued, subject to the provisions of Rule 235B1b, for conductors having final sags not over 900 mm (3 ft) and for voltages not exceeding 8.7 kV.
Supply conductors of the same circuit: 0 to 8.7 kV Over 8.7 kV to 50 kV Above 50 kV	 300 300 plus 10 per kV in excess of 8.7 kV No value specified	 12 12 plus 0.4 per kV in excess of 8.7 kV No value specified	
Supply conductors of different circuits: 0 to 8.7 kV Over 8.7 kV to 50 kV Over 50 kV to 814 kV	 300 300 plus 10 per kV in excess of 8.7 kV 715 plus 10 per kV in excess of 50 kV	 12 12 plus 0.4 per kV in excess of 8.7 kV 29 plus 0.4 per kV in excess of 50 kV	For all voltages above 50 kV, the additional clearance shall be increased 3% for each 300 m (1000 ft) in excess of 1000 m (3300 ft) above mean sea level. All clearances for voltages above 50 kV shall be based on the maximum operating voltage.

T-235-2(m)

m

Table 235-2—Horizontal clearances between line conductors smaller than AWG No. 2 at supports, based on sags

(See also Rules 235A and 235B1b.)

Voltage between conductors (kV)	Sag (mm)							
	915	1220	1830	2440	3050	4570	6095	But not less than ①
	Horizontal clearance (mm)							
2.4	375	525	735	895	1030	1305	1530	300
4.16	390	540	745	905	1040	1320	1545	300
12.47	455	600	810	970	1105	1380	1610	340
13.2	460	605	815	975	1100	1385	1615	345
13.8	465	610	820	980	1115	1390	1620	355
14.4	470	615	825	985	1120	1395	1625	360
24.94	550	695	905	1065	1200	1475	1705	465
34.5	620	770	975	1135	1270	1550	1775	560
46	710	855	1065	1225	1360	1635	1865	675

①Clearance determined by Table 235-1, Rule 235B1a.

NOTE: Clearance = 7.6 per kV + 20.4 $\sqrt{S-610}$, where S is the sag in millimeters.

in

Table 235-2—Horizontal clearances between line conductors smaller than AWG No. 2 at supports, based on sags

(See also Rules 235A and 235B1b.)

Voltage between conductors (kV)	Sag (in)							
	36	48	72	96	120	180	240	But not less than ①
	Horizontal clearance (in)							
2.4	15	21	29	36	41	52	61	12
4.16	16	22	30	36	41	52	61	12
12.47	18	24	32	39	44	55	64	14
13.2	18	24	32	39	44	55	64	14
13.8	19	24	33	39	44	55	64	15
14.4	19	25	33	39	44	55	64	15
24.94	22	28	36	42	48	58	67	19
34.5	25	31	39	45	50	61	70	23
46	28	34	42	49	54	65	74	27

①Clearance determined by Table 235-1, Rule 235B1a.

NOTE: Clearance = 0.3 per kV + 4.04 $\sqrt{S-24}$, where S is the sag in inches.

m

Table 235-3—Horizontal clearances between line conductors AWG No. 2 or larger at supports, based on sags
(See also Rules 235A and 235B1b.)

Voltage between conductors (kV)	Sag (mm)							
	915	1220	1830	2440	3050	4570	6095	But not less than ①
	Horizontal clearance (mm)							
2.4	375	430	520	595	665	810	930	300
4.16	385	440	530	610	675	820	945	300
12.47	450	505	595	675	740	885	1005	340
13.2	455	510	600	680	745	890	1010	345
13.8	460	515	605	685	750	895	1015	355
14.4	465	520	610	685	755	900	1020	360
24.94	545	600	690	765	835	980	1100	465
34.5	615	670	765	840	910	1050	1175	560
46	705	760	850	925	995	1140	1260	675

① Clearance determined by Table 235-1, Rule 235B1a.

NOTE: Clearance = 7.6 per kV + $8\sqrt{2.12S}$, where S is the sag in millimeters.

in

Table 235-3—Horizontal clearances between line conductors AWG No. 2 or larger at supports, based on sags

(See also Rules 235A and 235B1b.)

Voltage between conductors (kV)	Sag (in)							
	36	48	72	96	120	180	240	But not less than ①
	Horizontal clearance (in)							
2.4	15	17	21	24	27	32	37	12
4.16	16	18	21	24	27	33	38	12
12.47	18	20	24	27	30	35	40	14
13.2	18	20	24	27	30	35	40	14
13.8	18	21	24	27	30	36	40	15
14.4	19	21	24	27	30	36	41	15
24.94	22	24	28	31	33	39	44	19
34.5	25	27	30	33	36	42	47	23
46	28	30	34	37	40	45	50	27

①Clearance determined by Table 235-1, Rule 235B1a.

NOTE: Clearance = 0.3 per kV + 8 $\sqrt{S/12}$, where S is the sag in inches.

Table 235-4—Electrical clearances in Rule 235B3a(1)
[This clearance shall be increased 3% for each 300 m (1000 ft) in excess of 450 m (1500 ft) above mean sea level.]

Maximum operating voltage phase to phase (kV)	Switching surge factor (per unit)	Switching surge (kV)	Electrical component of clearance	
			(m)	(ft)
242	2.6 or less	890 or less	1.94	6.4
	2.8	958	2.20	7.2
	3.0	1027	2.47	8.1
	3.2 or more	1095 or more	2.65 ②	8.8 ②
362	1.8	893 or less	2.06	6.8
	2.0	1024	2.46	8.1
	2.2	1126	2.88	9.5
	2.4	1228	3.4	10.9
	2.6	1330	3.8	12.5
	2.7 or more	1382 or more	3.9 ②	12.8 ②
550	1.6	1245	3.4	11.2
	1.8	1399	4.2	13.6
	2.0	1555	5.0	16.2
	2.2	1711	5.8 ②	19.0 ②
	2.3	1789 or more	5.8 ②	19.1 ②
800	1.6	1810	6.4	20.8
	1.8	2037	7.8	25.3
	1.9 or more	2149 or more	8.3 ②	27.4 ②

①Not used in this edition.
②Need not be greater than specified in Rules 235B1 and 235B2.

m

Table 235-5— Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235A, 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels [12]	Conductors and cables usually at upper levels [12]			
	Supply cables meeting Rule 230C1, 230C2, or 230C3; neutral conductors meeting Rule 230E1; communications cables meeting Rule 224A2 (m)	Open supply conductors		
		0 to 8.7 kV [11] (m)	Over 8.7 kV to 50 kV	
			Same utility [7] (m)	Different utilities [7] (m)
1. Communication conductors and cables				
a. Located in the communication space	1.00 [1] [5]	1.00	1.00	1.00 plus 0.01 per kV [6] in excess of 8.7 kV
b. Located in the supply space	0.41 [9] [10]	0.41 [10]	1.00 [10]	1.00 plus 0.01 per kV [6] in excess of 8.7 kV
2. Supply conductors and cables				
a. Open conductors 0 to 750 V [11]; supply cables meeting Rule 230C1, 230C2, or 230C3; neutral conductors meeting Rule 230E1	0.41 [8] [9]	0.41 [2]	0.41 plus 0.01 per kV [6] in excess of 8.7 kV	1.00 plus 0.01 per kV [6] in excess of 8.7 kV
b. Open conductors over 750 V to 8.7 kV		0.41 [2]	0.41 plus 0.01 per kV [4] [6] in excess of 8.7 kV	1.00 plus 0.01 per kV A [6] in excess of 8.7 kV
c. Open conductors over 8.7 to 22 kV				
(1) If worked on energized with live-line tools and adjacent circuits are neither de-energized nor covered with shields or protectors			0.41 plus 0.01 per kV [6] in excess of 8.7 kV	1.00 plus 0.01 per kV [6] in excess of 8.7 kV

m

Table 235-5— *(continued)*
Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235A, 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels⑩	Conductors and cables usually at upper levels ⑩			
	Supply cables meeting Rule 230C1, 230C2, or 230C3; neutral conductors meeting Rule 230E1; communications cables meeting Rule 224A2 (m)	Open supply conductors		
		0 to 8.7 kV⑩ (m)	Over 8.7 kV to 50 kV	
			Same utility ⑦ (m)	Different utilities ⑦ (m)
(2) If not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live-line tools not requiring line workers to go between live wires			0.41 plus 0.01 per kV ③ ⑥ in excess of 8.7 kV	0.41 plus 0.01 per kV ③ ⑥ in excess of 8.7 kV
d. Open conductors exceeding 22 kV, but not exceeding 50 kV			0.41 plus 0.01 per kV ③ ⑥ in excess of 8.7 kV	1.00 plus 0.01 per kV ③ ⑥ in excess of 8.7 kV

①Where railroad supply circuits of 600 V or less, with transmitted power of 5000 W or less, are run below communication circuits in accordance with Rule 220B2, the clearance may be reduced to 0.41 m.

②Where conductors are operated by different utilities, a vertical clearance of not less than 1.00 m is recommended.

③These values do not apply to conductors of the same circuit or circuits being carried on adjacent conductor supports.

④May be reduced to 0.41 m where conductors are not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live-line tools not requiring line workers to go between live wires.

⑤May be reduced to 0.75 m for supply neutrals meeting Rule 230E1, fiber-optic supply cables on an effectively grounded messenger meeting Rule 230F1a, entirely dielectric fiber-optic supply cables meeting Rule 230F1b, insulated communication cables located in the supply space and supported by an effectively grounded messenger, and cables meeting Rule 230C1 where the supply neutral or messenger is bonded to the communication messenger at intervals specified in Rule 092C. Bonding is not required for entirely dielectric cables meeting Rule 230F1b.

⑥The greater of phasor difference or phase-to-ground voltage; see Rule 235A3.

⑦See examples of calculations in Rules 235C2a and 235C2b.

⑧For supply cables meeting Rule 230C3 and neutral conductors meeting Rule 230E1, see Rule 235G.

⑨No clearance is specified between neutral conductors meeting Rule 230E1 and insulated communication cables located in the supply space and supported by an effectively grounded messenger. The cable messenger may be attached to the neutral at the pole or in the span, provided that the cable is positioned away from the neutral to prevent abrasion damage. If the cable messenger is not attached to the neutral in the span, midspan spacing shall be not less than that specified in Rule 235G.

⑩No clearance is specified between fiber-optic supply cables (FOSC) meeting Rule 230F1b and supply cables and conductors. The FOSC may be attached to a supply conductor or cable at the pole or in the span, provided that the FOSC is positioned away from the supply conductor or cable to prevent abrasion damage. If the FOSC is not attached to the neutral in the span, midspan spacing shall be not less than that specified in Rule 235G.

⑪Does not include neutral conductors meeting Rule 230E1.
⑫For simplicity, this table shows clearance requirements between specified facilities located in frequently used positions over or under one another. Where such facilities are located in opposite relative positions from those shown in the table, the table values for usual positions are to be used.

in

Table 235-5— Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235A, 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels ⑫	Conductors and cables usually at upper levels ⑫			
	Supply cables meeting Rule 230C1, 230C2, or 230C3; neutral conductors meeting Rule 230E1; communications cables meeting Rule 224A2 (in)	Open supply conductors		
		0 to 8.7 kV ⑪ (in)	Over 8.7 kV to 50 kV	
			Same utility ⑦ (in)	Different utilities ⑦ (in)
1. Communication conductors and cables				
a. Located in the communication space	40 ① ⑤	40	40	40 plus 0.4 per kV ⑥ in excess of 8.7 kV
b. Located in the supply space	16 ⑨ ⑩	16 ⑩	40 ⑩	40 plus 0.4 per kV ⑥ in excess of 8.7 kV
2. Supply conductors and cables				
a. Open conductors 0 to 750 V ⑪; supply cables meeting Rule 230C1, 230C2, or 230C3; neutral conductors meeting Rule 230E1	16 ⑧ ⑨	16 ②	16 plus 0.4 per kV ⑥ in excess of 8.7 kV	40 plus 0.4 per kV ⑥ in excess of 8.7 kV
b. Open conductors over 750 V to 8.7 kV		16 ②	16 plus 0.4 per kV ④ ⑥ in excess of 8.7 kV	40 plus 0.4 per kV ⑥ in excess of 8.7 kV
c. Open conductors over 8.7 kV to 22 kV				
(1) If worked on energized with live-line tools and adjacent circuits are neither de-energized nor covered with shields or protectors			16 plus 0.4 per kV ⑥ in excess of 8.7 kV	40 plus 0.4 per kV ⑥ in excess of 8.7 kV

in

Table 235-5— *(continued)*
Vertical clearance between conductors at supports

(When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. When calculating clearance values within the table, all voltages are between the conductors involved. See the definitions section for voltages of other systems. See also Rules 235A, 235C1, 235C2, and 235F.)

Conductors and cables usually at lower levels ⑩	Conductors and cables usually at upper levels ⑩			
	Supply cables meeting Rule 230C1, 230C2, or 230C3; neutral conductors meeting Rule 230E1; communications cables meeting Rule 224A2 (in)	Open supply conductors		
		0 to 8.7 kV ⑩ (in)	Over 8.7 kV to 50 kV	
			Same utility ⑦ (in)	Different utilities ⑦ (in)
(2) If not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live-line tools not requiring line workers to go between live wires			16 plus 0.4 per kV ③⑥ in excess of 8.7 kV	16 plus 0.4 per kV ③⑥ in excess of 8.7 kV
d. Open conductors exceeding 22 kV, but not exceeding 50 kV			16 plus 0.4 per kV ③⑥ in excess of 8.7 kV	40 plus 0.4 per kV ③⑥ in excess of 8.7 kV

①Where railroad supply circuits of 600 V or less, with transmitted power of 5000 W or less, are run below communication circuits in accordance with Rule 220B2, the clearance may be reduced to 16 in.

②Where conductors are operated by different utilities, a vertical clearance of not less than 40 in is recommended.

③These values do not apply to conductors of the same circuit or circuits being carried on adjacent conductor supports.

④May be reduced to 16 in where conductors are not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live line tools not requiring line workers to go between live wires.

⑤May be reduced to 30 in for supply neutrals meeting Rule 230E1, fiber-optic supply cables on an effectively grounded messenger meeting Rule 230F1a, entirely dielectric fiber-optic supply cables meeting Rule 230F1b, insulated communication cables located in the supply space and supported by an effectively grounded messenger, and cables meeting meeting Rule 230C1 where the supply neutral or messenger is bonded to the communication messenger at intervals specified in Rule 092C. Bonding is not required for entirely dielectric cables meeting Rule 230F1b.

⑥The greater of phasor difference or phase-to-ground voltage; see Rule 235A3.

⑦See examples of calculations in Rules 235C2a and 235C2b.

⑧For supply cables meeting Rule 230C3 and neutral conductors meeting Rule 230E1, see Rule 235G.

⑨No clearance is specified between neutral conductors meeting Rule 230E1 and insulated communication cables located in the supply space and supported by an effectively grounded messenger. The cable messenger may be attached to the neutral at the pole or in the span, provided that the cable is positioned away from the neutral to prevent abrasion damage. If the cable messenger is not attached to the neutral in the span, midspan spacing shall be not less than that specified in Rule 235G.

⑩No clearance is specified between fiber-optic supply cables (FOSC) meeting Rule 230F1b and supply cables and conductors. The FOSC may be attached to a supply conductor or cable at the pole or in the span, provided that the FOSC is positioned away from the supply conductor or cable to prevent abrasion damage. If the FOSC is not attached to the neutral in the span, midspan spacing shall be not less than that specified in Rule 235G.

⑪Does not include neutral conductors meeting Rule 230E1.

⑫For simplicity, this table shows clearance requirements between specified facilities located in frequently used positions over or under one another. Where such facilities are located in opposite relative positions from those shown in the table, the table values for usual positions are to be used.

mm

Table 235-6—
Clearance in any direction from line conductors at or near a support to supports, and to vertical or lateral conductors, service drops, span or guy wires, and to communication antennas attached to the same support
[See also Rules 235A, 235E1, 235E3b(2), and 235I.]

Clearance of line conductors from	Communication lines in general (mm)	Communication lines on jointly used structures (mm)	Supply lines			
			Neutral conductors meeting Rule 230E1 (mm)	Circuit phase-to-phase voltage		
				0 to 8.7 kV ⑭ (mm)	Over 8.7 kV to 50 kV (mm)	Over 50 kV to 814 kV ④ ⑨ (mm)
1. Vertical and lateral conductors—at the support⑰						
a. Of the same circuit	75	75	75	75	75 plus 6.5 per kV in excess of 8.7 kV	No value specified
b. Of other circuits ⑫	75	75	75	150 ⑤	150 plus 10 per kV in excess of 8.7 kV	580 plus 10 per kV in excess of 50 kV
c. Communication ⑬ antennas	75	75	75	150 ⑤	150 plus 10 per kV in excess of 8.7 kV	580 plus 10 per kV in excess of 50 kV
2. Span or guy wires⑪, or messengers attached to same structure—at or near the support						
a. When parallel to line	75 ⑦	150 ① ⑦	150 ① ⑦	300 ①	300 plus 10 per kV in excess of 8.7 kV	740 plus 10 per kV in excess of 50 kV
b. Anchor guys	75 ⑦	150 ① ⑦	150 ① ⑦	150 ①	150 plus 6.5 per kV in excess of 8.7 kV	410 plus 6.5 per kV in excess of 50 kV
c. All other	75 ⑦	150 ① ⑦	150 ① ⑦	150	150 plus 10 per kV in excess of 8.7 kV	580 plus 10 per kV in excess of 50 kV

mm

Table 235-6— *(continued)*

Clearance in any direction from line conductors at or near a support to supports, and to vertical or lateral conductors, service drops, span or guy wires, and to communication antennas attached to the same support

[See also Rules 235A, 235E1, 235E3b(2), and 235I.]

Clearance of line conductors from	Communication lines in general (mm)	Communication lines on jointly used structures (mm)	Supply lines			
			Neutral conductors meeting Rule 230E1 (mm)	Circuit phase-to-phase voltage		
				0 to 8.7 kV ⑧ (mm)	Over 8.7 kV to 50 kV (mm)	Over 50 kV to 814 kV ④ ⑨ (mm)
3. Surface of support arms—at the support	75 ②	75 ③	75 ⑥	75 ⑧	75 plus 5 per kV in excess of 8.7 kV ⑧ ⑩	280 plus 5 per kV in excess of 50 kV
4. Surface of structures—at the support						
a. On jointly used structures	—	125 ③	125 ⑥	125 ③ ⑧	125 plus 5 per kV in excess of 8.7 kV ⑧ ⑩	330 plus 5 per kV in excess of 50 kV
b. All other	75 ②	—	—	75 ⑧	75 plus 5 per kV in excess of 8.7 kV ⑧ ⑩	280 plus 5 per kV in excess of 50 kV
5. Service drops ⑮ —in the span:						
a. Communication	300	300	750 ⑮	750	750 plus 10 per kV in excess of 8.7 kV	1200 plus 10 per kV in excess of 50 kV
b. Supply	N/A	750	300	300	300 plus 10 per kV in excess of 8.7 kV	750 plus 10 per kV in excess of 50 kV

①For guy wires, if practical. For clearances between span wires and communication conductors, see Rule 238C.

On jointly used structures, guys that pass within 300 mm of supply conductors, and also pass within 300 mm of communication cables, shall be protected with a suitable insulating covering where the guy passes the supply conductors, unless the guy is effectively grounded or insulated with a strain insulator at a point below the lowest supply conductor and above the highest communication cable.

The clearance from an insulated or effectively grounded guy to a communication cable may be reduced to 75 mm when abrasion protection is provided on the guy or communication cable.

②Communication conductors may be attached to supports on the sides or bottom of crossarms or surfaces of poles with less clearance.

③This clearance applies only to supply conductors at the support below communication conductors, on jointly used structures.

Where supply conductors are above communication conductors, this clearance may be reduced to 75 mm.

④All clearances for line over 50 kV shall be based on the maximum operating voltage. For voltages exceeding 814 kV, the clearance shall be determined by the alternate method given by Rule 235E3.
⑤For supply circuits of 0 to 750 V, this clearance may be reduced to 75 mm.
⑥A neutral conductor meeting Rule 230E1 may be attached directly to the structure surface.
⑦Guys and messengers may be attached to the same strain plates or to the same through bolts.
⑧For open supply circuits of 0 to 750 V and supply cables of all voltages meeting Rule 230C1, 230C2, or 230C3, this clearance may be reduced to 25 mm. No clearance is specified for phase conductors of such cables where they are physically restrained by a suitable bracket from abrasion against the pole.
⑨The additional clearance for voltages in excess of 50 kV specified in Table 235-6 shall be increased 3% for each 300 m in excess of 1000 m above mean sea level.
⑩Where the circuit is effectively grounded and the neutral conductor meets Rule 230E1, phase-to-ground voltage may be used to determine the clearance from the surface of support arms and structures.
⑪These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.
⑫See Rule 235A3 to determine the voltage between the conductors involved.
⑬These clearances from supply conductors apply to communication antennas located in the supply space and operated at a radio frequency of 3 kHz to 300 GHz. Also see Rules 235I4, 238A, and 239H1, EXCEPTION 3.
⑭Does not include neutral conductors meeting Rule 230E1.
⑮These service drop values apply anywhere in the span but not at the support. For vertical clearances at the support, see Table 235-5.
NOTE: These values were derived from Table 235-5 and Rule 235C2b(1)(a).
⑯This value may be reduced to 300 mm if the supply neutral and communication messenger are electrically bonded together.
⑰For clearance requirements in any direction between vertical or lateral supply conductors located in the supply space and communication line conductors located in the communication space, use the values in Table 235-5, row 1.

in

Table 235-6—
Clearance in any direction from line conductors at or near a support to supports, and to vertical or lateral conductors, service drops, span or guy wires, and to communication antennas attached to the same support
[See also Rules 235A, 235E1, 235E3b(2), and 235I.]

Clearance of line conductors from	Communication lines in general (in)	Communication lines on jointly used structures (in)	Supply lines			
			Neutral conductors meeting Rule 230E1 (in)	Circuit phase-to-phase voltage		
				0 to 8.7 kV ⑭ (in)	Over 8.7 kV to 50 kV (in)	Over 50 kV to 814 kV ④ ⑨ (in)
1. Vertical and lateral conductors—at the support⑰						
a. Of the same circuit	3	3	3	3	3 plus 0.25 per kV in excess of 8.7 kV	No value specified
b. Of other circuits ⑫	3	3	3	6 ⑤	6 plus 0.4 per kV in excess of 8.7 kV	23 plus 0.4 per kV in excess of 50 kV
c. Communication antennas ⑬	3	3	3	6 ⑤	6 plus 0.4 per kV in excess of 8.7 kV	23 plus 0.4 per kV in excess of 50 kV
2. Span or guy wires⑪**, or messengers attached to same structure—at or near the support**						
a. When parallel to line	3 ⑦	6 ① ⑦	6 ① ⑦	12 ①	12 plus 0.4 per kV in excess of 8.7 kV	29 plus 0.4 per kV in excess of 50 kV
b. Anchor guys	3 ⑦	6 ① ⑦	6 ① ⑦	6 ①	6 plus 0.25 per kV in excess of 8.7 kV	16 plus 0.25 per kV in excess of 50 kV
c. All other	3 ⑦	6 ① ⑦	6 ① ⑦	6 ①	6 plus 0.4 per kV in excess of 8.7 kV	23 plus 0.4 per kV in excess of 50 kV
3. Surface of support arms—at the support	3 ②	3 ②	3 ⑥	3 ⑧	3 plus 0.2 per kV in excess of 8.7 kV ⑧ ⑩	11 plus 0.2 per kV in excess of 50 kV

Table 235-6— *(continued)*
Clearance in any direction from line conductors at or near a support to supports, and to vertical or lateral conductors, service drops, span or guy wires, and to communication antennas attached to the same support

[See also Rules 235A, 235E1, 235E3b(2), and 235I.]

Clearance of line conductors from	Communication lines in general (in)	Communication lines on jointly used structures (in)	Supply lines			
			Neutral conductors meeting Rule 230E1 (in)	Circuit phase-to-phase voltage		
				0 to 8.7 kV ⑭ (in)	Over 8.7 kV to 50 kV (in)	Over 50 kV to 814 kV ④ ⑨ (in)
4. Surface of structures— at the support						
a. On jointly used structures	—	5 ②	5 ⑥	5 ③ ⑧	5 plus 0.2 per kV in excess of 8.7 kV ⑧ ⑩	13 plus 0.2 per kV in excess of 50 kV
b. All other	3 ②	—	—	3 ⑧	3 plus 0.2 per kV in excess of 8.7 kV ⑧ ⑩	11 plus 0.2 per kV in excess of 50 kV
5. Service drops— in the span ⑮						
a. Communication	12	12	30 ⑮	30	30 plus 0.4 per kV in excess of 8.7 kV	47 plus 0.4 per kV in excess of 50 kV
b. Supply	N/A	30	12	12	12 plus 0.4 per kV in excess of 8.7 kV	29 plus 0.4 per kV in excess of 50 kV

①For guy wires, if practical. For clearances between span wires and communication conductors, see Rule 238C.

On jointly used structures, guys that pass within 12 in of supply conductors, and also pass within 12 in of communication cables, shall be protected with a suitable insulating covering where the guy passes the supply conductors, unless the guy is effectively grounded or insulated with a strain insulator at a point below the lowest supply conductor and above the highest communication cable.

The clearance from an insulated or effectively grounded guy to a communication cable may be reduced to 3 in when abrasion protection is provided on the guy or communication cable.

②Communication conductors may be attached to supports on the sides or bottom of crossarms or surfaces of poles with less clearance.

③This clearance applies only to supply conductors at the support below communication conductors, on jointly used structures.

Where supply conductors are above communication conductors, this clearance may be reduced to 3 in.

④All clearances for line over 50 kV shall be based on the maximum operating voltage. For voltages exceeding 814 kV, the clearance shall be determined by the alternate method given by Rule 235E3.

⑤For supply circuits of 0 to 750 V, this clearance may be reduced to 3 in.

⑥A neutral conductor meeting Rule 230E1 may be attached directly to the structure surface.

⑦Guys and messengers may be attached to the same strain plates or to the same through bolts.

⑧For open supply circuits of 0 to 750 V and supply cables of all voltages meeting Rule 230C1, 230C2 or 230C3, this clearance may be reduced to 1 in. No clearance is specified for phase conductors of such cables where they are physically restrained by a suitable bracket from abrasion against the pole.

⑨The additional clearance for voltages in excess of 50 kV specified in Table 235-6 shall be increased 3% for each 1000 ft in excess of 3300 ft above mean sea level.

⑩Where the circuit is effectively grounded and the neutral conductor meets Rule 230E1, phase-to-ground voltage may be used to determine the clearance from the surface of support arms and structures.

⑪These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.

⑫ See Rule 235A3 to determine the voltage between the conductors involved.

⑬These clearances from supply conductors apply to communication antennas located in the supply space and operated at a radio frequency of 3 kHz to 300 GHz. Also see Rules 235I4, 238A, and 239H1, EXCEPTION 3.

⑭Does not include neutral conductors meeting Rule 230E1.

⑮These service drop values apply anywhere in the span but not at the support. For vertical clearances at the support, see Table 235-5.
NOTE: These values were derived from Table 235-5 and Rule 235C2b(1)(a).

⑯This value may be reduced to 12 in if the supply neutral and communication messenger are electrically bonded together.

⑰For clearance requirements in any direction between vertical or lateral supply conductors located in the supply space and communication line conductors located in the communication space, use the values in Table 235-5, row 1.

Table 235-7— Clearance in any direction from line conductors to supports

[See also Rules 235A, 235E3b, and 235E3b(1)(a).]

Maximum operating voltage phase to phase (kV)	Switching-surge factor (per unit)	Switching surge (kV)	Computed clearance to supports			
			Fixed		Free swinging at maximum angle	
			(m)	(in)	(m)	(in)
242	2.4	474	0.88 [1]	35 [1]	0.88 [1]	35 [1]
	2.6	514	1.01	40	0.88 [1]	35 [1]
	2.8	553	1.14	45	0.98	39
	3.0	593	1.24 [2]	49 [2]	1.10	44
	3.2	632	1.24 [2]	49 [2]	1.22	49
362	1.6	473	0.88 [1]	35 [1]	0.88 [1]	35 [1]
	1.8	532	1.07	42	0.92	36
	2.0	591	1.27	50	1.09	43
	2.2	650	1.49	59	1.28	51
	2.4	709	1.72	68	1.48	59
	2.5	739	1.84	73	1.59	63
550	1.6	719	1.76	69	1.51	60
	1.8	808	2.14	84	1.84	73

Table 235-7— *(continued)*
Clearance in any direction from line conductors to supports
[See also Rules 235A, 235E3b, and 235E3b(1)(a).]

Maximum operating voltage phase to phase (kV)	Switching-surge factor (per unit)	Switching surge (kV)	Computed clearance to supports			
			Fixed		Free swinging at maximum angle	
			(m)	(in)	(m)	(in)
	2.0	898	2.55	100	2.19	87
	2.2	988	2.78 ②	111 ②	2.57	102
800	1.6	1045	3.3	129	2.82	111
	1.8	1176	4.0	157	3.5	136
	1.9	1241	4.1②	161 ②	3.8	148
	2.0	1306	4.1②	161 ②	4.1 ②	161 ②

①Shall be not less than that required by Rule 235E3b(2), including the altitude correction for lines as specified in Footnote 9 of Table 235-6.
②Need not be greater than specified in Rules 235E1 and 235E2.

Table 235-8—Vertical spacing between conductors supported on vertical racks or separate brackets

Span length		Vertical spacing between conductors	
(m)	(ft)	(mm)	(in)
0 to 45	0 to 150	100	4
Over 45 to 60	Over 150 to 200	150	6
Over 60 to 75	Over 200 to 250	200	8
Over 75 to 90	Over 250 to 300	300	12

EXCEPTION: The vertical spacing between open wire conductors may be reduced where the conductors are held apart by intermediate spacers, but may not be less than 100 mm (4 in).

Table 263-2—Sizes of service drops of 750 V or less
(Voltages of trolley-contact conductors are voltage to ground.
AWG used for aluminum and copper wires; Stl WG used for steel wire.)

	Copper wire			
Situation	Soft-drawn	Medium- or hard-drawn	Steel wire	EC aluminum wire ②
Alone	10	12	12	4
Concerned with communication conductor	10	12	12	4
Over supply conductors of				
0 to 750 V	10	12	12	4
750 V to 8.7 kV ①	8	10	12	4
Exceeding 8.7 kV ①	6	8	9	4
Over trolley-contact conductors				
0 to 750 V ac or dc	8	10	12	4
Exceeding 750 V ac or dc	6	8	9	4

①Installation of service drops of not more than 750 V above supply lines of more than 750 V should be avoided where practical.
②ACSR or high-strength aluminum alloy conductor size shall be not less than No. 6.

264. Guying and bracing

A. Where used

When the loads are greater than can be supported by the structure alone, additional strength shall be provided by the use of guys, braces, or other suitable construction. Such measures shall also be used where necessary to limit the increase of sags in adjacent spans and provide sufficient strength for those supports on which the loads are sufficiently unbalanced, for example, at corners, angles, dead ends, large differences in span lengths, and changes of grade of construction.

B. Strength

Guys shall be designed to withstand the loads in Rule 252 multiplied by the load factors in Table 253-1 without exceeding the permitted load. The permitted load shall be equal to the strength multiplied by the strength factors in Table 261-1. For guy wires conforming to ASTM standards, the nominal breaking strength value therein defined shall be the rated breaking strength required in this Code.

NOTE: For protection and marking of guys, see Rule 217C.

C. Point of attachment

The guy or brace should be attached to the structure as near as is practical to the center of the conductor load to be sustained. However, on lines exceeding 8.7 kV, the location of the guy or brace may be adjusted to minimize the reduction of the insulation offered by nonmetallic support arms and supporting structures.

D. Guy fastenings

Guys having a rated breaking strength of 9.0 kN (2000 lb) or more and that are subject to small radius bends should be stranded and should be protected by suitable guy thimbles or their equivalent. Any guy having a design loading of 44.5 kN (10 000 lb) or more wrapped around cedar or similar softwood poles should be protected by the use of suitable guy shims.

Where there is a tendency for the guy to slip off the shim, guy hooks or other suitable means of limiting the likelihood of this action should be used. Shims are not necessary in the case of supplementary guys, such as storm guys.

E. Electrolysis

Where anchors and rods are subject to electrolysis, suitable measures should be taken to minimize corrosion from this source.

F. Anchor rods

1. Anchor rods should be installed so as to be in line with the pull of the attached guy when under load.

   EXCEPTION: This is not required for anchor rods installed in rock or concrete.

2. The anchor and rod assembly shall have an ultimate strength not less than that required of the guy(s) by Rule 264B.

2. Insulating spacers used in spacer cable systems shall withstand the loads specified in Section 25 (except those of Rules 250C and 250D) without exceeding 50% of their rated ultimate strength.

279. Guy and span insulators

A. Insulators

1. Properties of guy insulators

Where guy insulators are used in accordance with Rule 215C2, the guy insulators shall meet the following requirements:

a. Material

Insulators shall be made of wet-process porcelain, wood, fiber-reinforced polymer, or other material of suitable mechanical and electrical properties.

b. Electrical strength

A guy insulator may consist of one or more units. The guy insulator design shall have a rated dry flashover voltage at least double, and a rated wet flashover voltage at least as high as, the voltage to which the insulator may be exposed with guys intact or under the conditions of Rule 215C2. Testing shall validate dry and wet flashover values using the Low-Frequency Dry and Low-Frequency Wet Flashover Voltage Tests specified in ANSI C29.1-1988 (R2012) or ANSI C29.11-2012 [B6].

Fiber-reinforced polymer guy insulators, or guy insulators of other suitable materials, that can reasonably be expected to be degraded by ultraviolet light shall be protected against UV degradation.

c. Mechanical strength

The rated ultimate strength of the guy insulator shall be at least equal to the required strength of the guy in which it is installed.

2. Galvanic corrosion and BIL insulation

a. Limitation of galvanic corrosion

An insulator in the guy strand used exclusively to limit galvanic corrosion of metal in ground rods, anchors, anchor rods, or pipe in an effectively grounded system shall not be classified as a guy insulator and shall not reduce the mechanical strength of the guy.

NOTE: See Rule 215C7.

b. BIL insulation

An insulator in the guy strand used exclusively to meet BIL requirements for the structure in an effectively grounded system shall not be classified as a guy insulator, provided mechanical strength of the insulator meets Rule 279A1c and either of the following provisions is met:

(1) The guy is otherwise insulated to meet the requirements of Rules 215C2 and 279A1.

(2) Anchor guys are effectively grounded below the BIL insulator as illustrated in Figure 279-1, and span guys are effectively grounded beyond the BIL insulator in accordance with Rules 092C2 and 215C2.

B. Properties of span-wire insulators

Where span-wire insulators are used in accordance with Rule 215C3, the span-wire insulators shall meet the following requirements:

1. Material

Insulators shall be made of wet-process porcelain, wood, fiber-reinforced polymer, or other material of suitable mechanical and electrical properties.

2. Insulation level

   The insulation level of span-wire insulators shall meet the requirements of Rule 274.

   A hanger insulator, where used to provide single insulation as permitted by Rule 279B2, shall meet the requirements of Rule 274.

3. Mechanical strength

   The rated ultimate strength of the span-wire insulator shall be at least equal to the required strength of the span wire in which it is located.

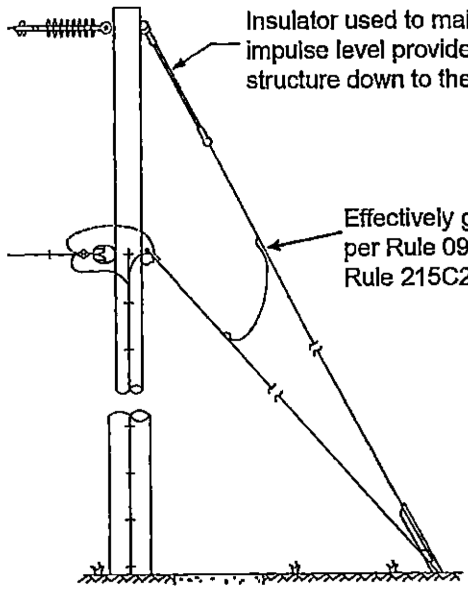


Figure 279-1—Insulator used for BIL insulation

28. Section number 28 not used in this edition.

29. Section number 29 not used in this edition.

Section 25.
Loadings for Grades B and C

250. General loading requirements and maps

A. General

1. It is necessary to assume the wind and ice loads that may occur on a line. The intent of the NESC rules is to apply wind loading in an essentially horizontal plane. Three weather loadings are specified in Rules 250B, 250C, and 250D. Where all three rules apply, the required loading shall be the one that has the greatest effect.

2. Where construction or maintenance loads exceed those imposed by Rule 250A1, the assumed loadings shall be increased accordingly. When temporary loads, such as lifting of equipment, stringing operations, or a worker on a structure or its component, are to be imposed on a structure or component, the strength of the structure or component should be taken into account or other provisions should be made to limit the likelihood of adverse effects of structure or component failure.

   NOTE: Other provisions could include cranes that can support the equipment loads, guard poles and spotters with radios, and stringing equipment capable of promptly halting stringing operations.

3. It is recognized that loadings actually experienced in certain areas in each of the loading districts may be greater, or in some cases, may be less than those specified in these rules. In the absence of a detailed loading analysis, using the same respective statistical methodologies used to develop the maps in Rule 250C or 250D, no reduction in the loadings specified therein shall be made without the approval of the administrative authority.

4. The structural capacity provided by meeting the loading and strength requirements of Sections 25 and 26 provides sufficient capability to resist earthquake ground motions.

B. Combined ice and wind district loading

Four general degrees of district loading due to weather conditions are recognized and are designated as heavy, medium, light, and warm island loadings. Figure 250-1 shows the districts where these loadings apply. Warm island loading applies to islands located from latitude 25 degrees south through 25 degrees north.

NOTE: The localities are classified in the different loading districts according to the relative simultaneous prevalence of the wind velocity and thickness of ice that accumulates on wires. Light loading is for places where little, if any, ice accumulates on wires. In the warm island loading zone, cold temperatures and ice accumulation on wires only occurs at high altitudes.

Table 250-1 shows the radial thickness of ice and the wind pressures to be used in calculating loads. Ice is assumed to weigh 913 kg/m^3 (57 lb/ft^3).

C. Extreme wind loading

If no portion of a structure or its supported facilities exceeds 18 m (60 ft) above ground or water level, the provisions of this rule are not required, except as specified in Rule 261A1c, 261A2e, or 261A3d. Where a structure or its supported facilities exceeds 18 m (60 ft) above ground or water level the structure and its supported facilities shall be designed to withstand the extreme wind load associated with the Basic Wind Speed, as specified by Figure 250-2. The wind pressures calculated shall be applied to the entire structure and supported facilities without ice. The following formula shall be used to calculate wind load.

NOTE: The commentary to ASCE 7-10 indicates that these wind speeds represent a 50-to-90 year mean recurrence interval.

Load in newtons $= 0.613 \cdot (V_{m/s})^2 \cdot k_z \cdot G_{RF} \cdot I \cdot C_f \cdot A(m^2)$

Load in pounds $= 0.00256 \cdot (V_{mi/h})^2 \cdot k_z \cdot G_{RF} \cdot I \cdot C_f \cdot A(ft^2)$

where

0.613 0.00256	Velocity-pressure numerical coefficient reflects the mass density of air for the standard atmosphere, i.e., temperature of 15 °C (59 °F) and sea level pressure of 760 mm (29.92 in) of mercury. The numerical coefficient 0.613 metric (0.00256 customary) shall be used except where sufficient climatic data are available to justify the selection of a different value of this factor for a design application.
k_z	Velocity pressure exposure coefficient, as defined in Rule 250C1, Table 250-2
V	Basic wind speed, 3 s gust wind speed in m/s at 10 m (mi/h at 33 ft) aboveground, Figure 250-2
G_{RF}	Gust response factor, as defined in Rule 250C2
I	Importance factor, 1.0 for utility structures and their supported facilities
C_f	Force coefficient (shape factor). As defined in Rules 251A2 and 252B
A	Projected wind area, m^2 (ft^2)

The wind pressure parameters (k_z, V, and G_{RF}) are based on open terrain with scattered obstructions (Exposure Category C as defined in ASCE 7-10). Exposure Category C is the basis of the NESC extreme wind criteria. Topographical features such as ridges, hills, and escarpments may increase the wind loads on site-specific structures. A Topographic Factor, K_{zt}, from ASCE 7-10, may be used to account for these special cases.

NOTE: Special wind regions—Although the wind speed map is valid for most regions of the country, special wind regions indicated on the map are known to have wind speed anomalies. Winds blowing over mountain ranges or through gorges or river valleys in these special regions can develop speeds that are substantially higher than the values indicated on the map.

1. Velocity pressure exposure coefficient, k_z

   The velocity pressure exposure coefficient, k_z, is based on the height, h, to the center-of-pressure of the wind area for the following load applications:

   a. k_z for the structure is based on 0.67 of the total height, h, of the structure aboveground line.

      NOTE: In Table 250-2, for h ≤ 75 m (250 ft), the structure k_z values are adjusted for the wind load to be determined at the center-of-pressure of the structure assumed to be at 0.67 h. The wind pressure is assumed uniformly distributed over the structure face normal to the wind.

   b. k_z for the wire is based on the height, h, of the wire at the structure.

      In special terrain conditions (i.e., mountainous terrain and canyon) where the height of the wire aboveground anywhere in the span may be substantially higher than at the structure, engineering judgment may be used in determining an appropriate value for the wire k_z.

   c. k_z for a specific height on a structure or component is based on the height, h, to the center-of-pressure of the wind area being considered.

      The formulas shown in Table 250-2 shall be used to determine all values of k_z.

      EXCEPTION: The selected values of k_z tabulated in Table 250-2 may be used instead of calculating the values.

2. Gust response factor, G_{RF}

   a. The structure gust response factor, G_{RF}, is determined using the total structure height, h. When calculating a wind load at a specific height on a structure, the structure gust response factor, G_{RF}, determined using the total structure height, h, shall be used.

   b. The wire gust response factor is determined using the height of the wire at the structure, h, and the span length, L. Wire attachment points that are 18 m (60 ft) or less above ground or water level must be considered if the total structure height is greater than 18 m (60 ft) above ground or water.

In special terrain conditions (i.e., mountainous terrain and canyon) where the height of the wire aboveground at mid-span may be substantially higher than at the attachment point, engineering judgment may be used in determining an appropriate value for the wire G_{RF}.

c. The gust response factor, G_{RF}, to be used on components, such as antennas, transformers, etc., shall be the structure gust response factor determined in Rule 250C2a.

Selected values of the structure and wire gust response factors are tabulated in Table 250-3. The structure and wire gust response factors may also be determined using the formulas in Table 250-3. For values of h > 75 m (250 ft) and L > 600 m (2000 ft), the G_{RF} shall be determined using the formulas in Table 250-3.

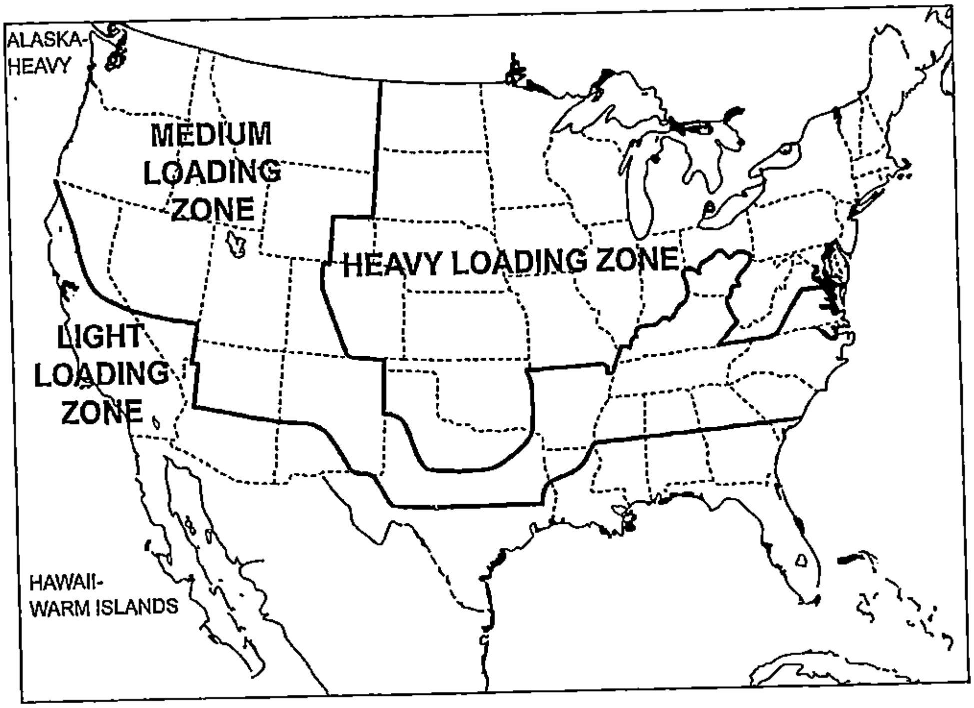
NOTE: Where structure heights are 50 m (165 ft) or less and spans are 600 m (2000 ft) or less, the combined product of k_z and G_{RF} may be conservatively taken as 1.15 if it is desired to simplify calculations.

D. Extreme ice with concurrent wind loading

If no portion of a structure or its supported facilities exceeds 18 m (60 ft) above ground or water level, the provisions of this rule are not required. Where a structure or its supported facilities exceeds 18 m (60 ft) above ground or water level, the structure and its supported facilities shall be designed to withstand loads associated with the Uniform Ice Thickness and Concurrent Wind Speed, as specified by Figure 250-3. The wind pressures for the concurrent wind speed shall be as indicated in Table 250-4. The wind pressures calculated shall be applied without ice to the entire structure and to all supported facilities without ice other than wires, conductors, cables, and messengers and to the iced diameters of wires, conductors, cables, and messengers determined in accordance with Rule 251. Vertical loads due to radial ice shall be computed on wires, conductors, cables, and messengers but need not be computed on the structure and other supported facilities. No loading is specified in this rule for extreme ice with concurrent wind loading for warm islands located from 25 degrees latitude south through 25 degrees latitude north.

Ice is assumed to weigh 913 kg/m^3 (57 lb/ft^3).

1. For Grade B, the radial thickness of ice from Figure 250-3 shall be multiplied by a factor of 1.00.
2. For Grade C, the radial thickness of ice from Figure 250-3 shall be multiplied by a factor of 0.80.
3. The concurrent wind shall be applied to the projected area resulting from Rules 250D1 and 250D2 multiplied by a factor of 1.00.



The Warm Island Loading District includes American Samoa, Guam, Hawaii, Puerto Rico, Virgin Islands, and other islands located from 0 to 25 degrees latitude, north or south.

Figure 250-1—General loading map of United States with respect to loading of overhead lines

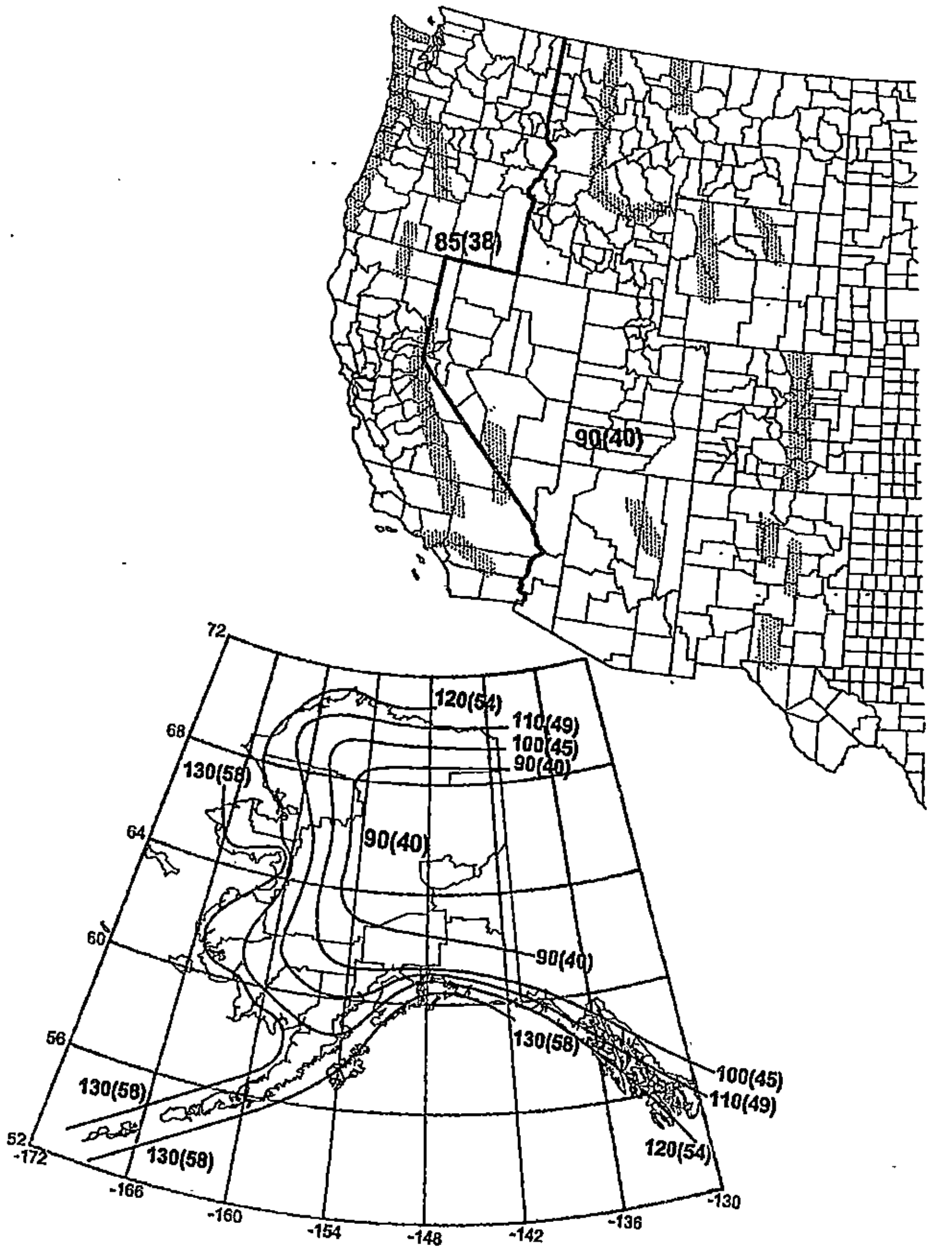


Figure 250-2(a)—Basic wind speeds

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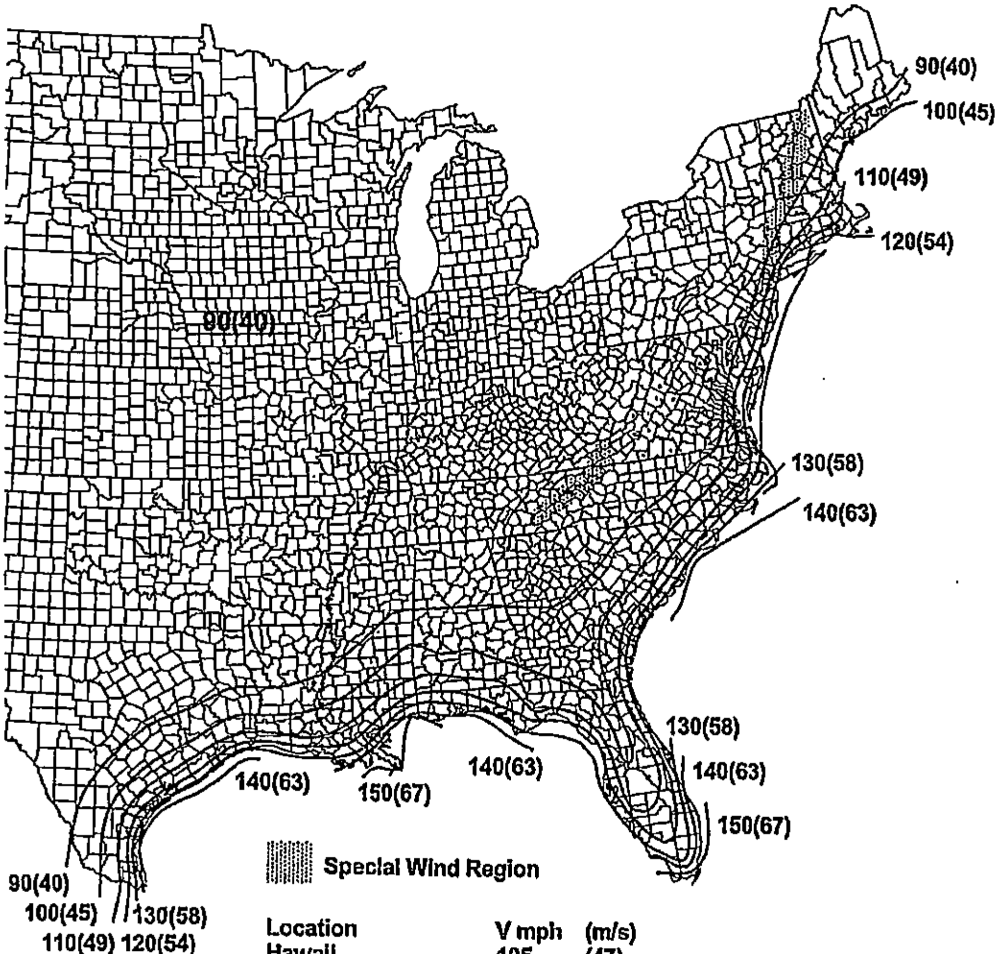

Location	V mph	(m/s)
Hawaii	105	(47)
Puerto Rico	145	(65)
Guam	170	(76)
Virgin Islands	145	(65)
American Samoa	125	(56)

Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

Figure 250-2(b)—Basic wind speeds

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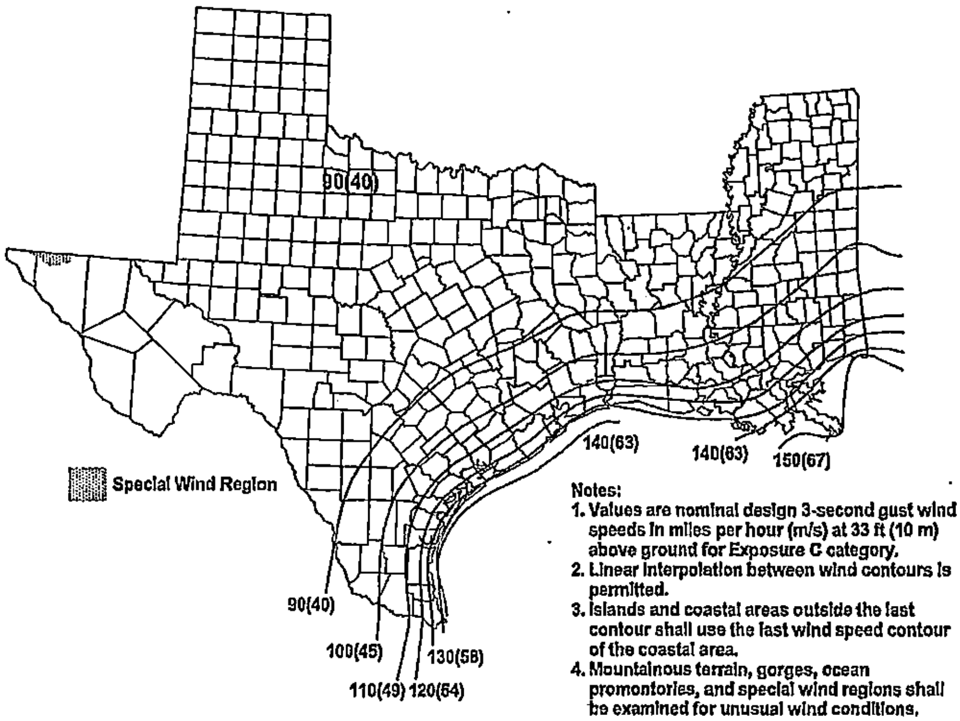

Figure 250-2(c)—Western Gulf of Mexico hurricane coastline

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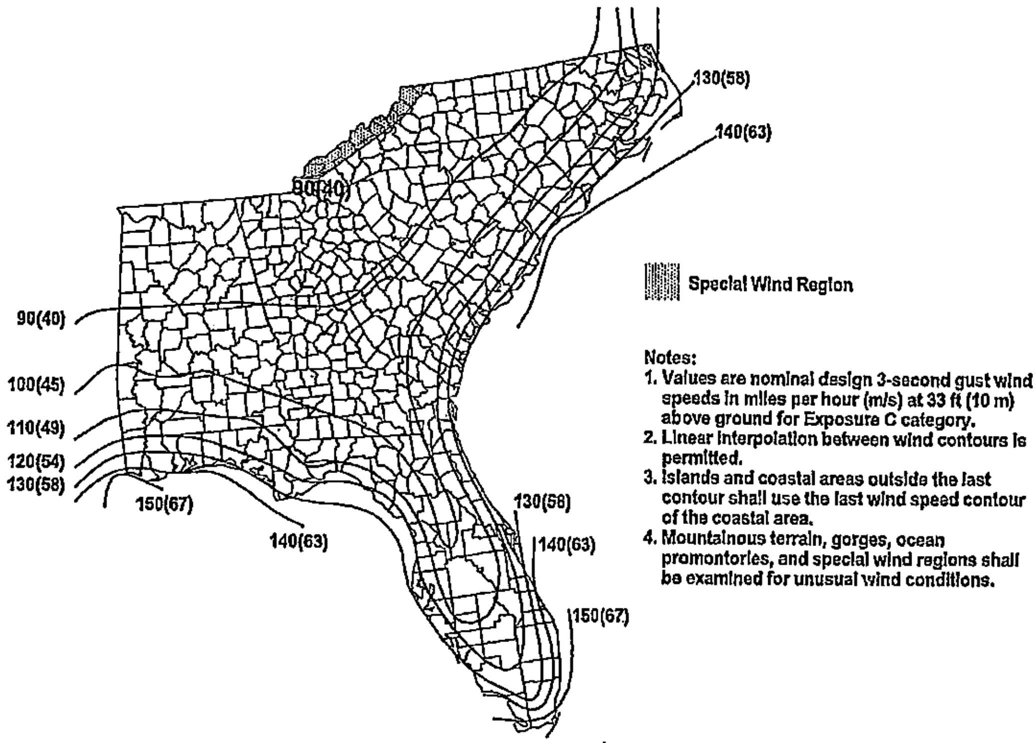

Figure 250-2(d)—Eastern Gulf of Mexico and southeastern U.S. hurricane coastline

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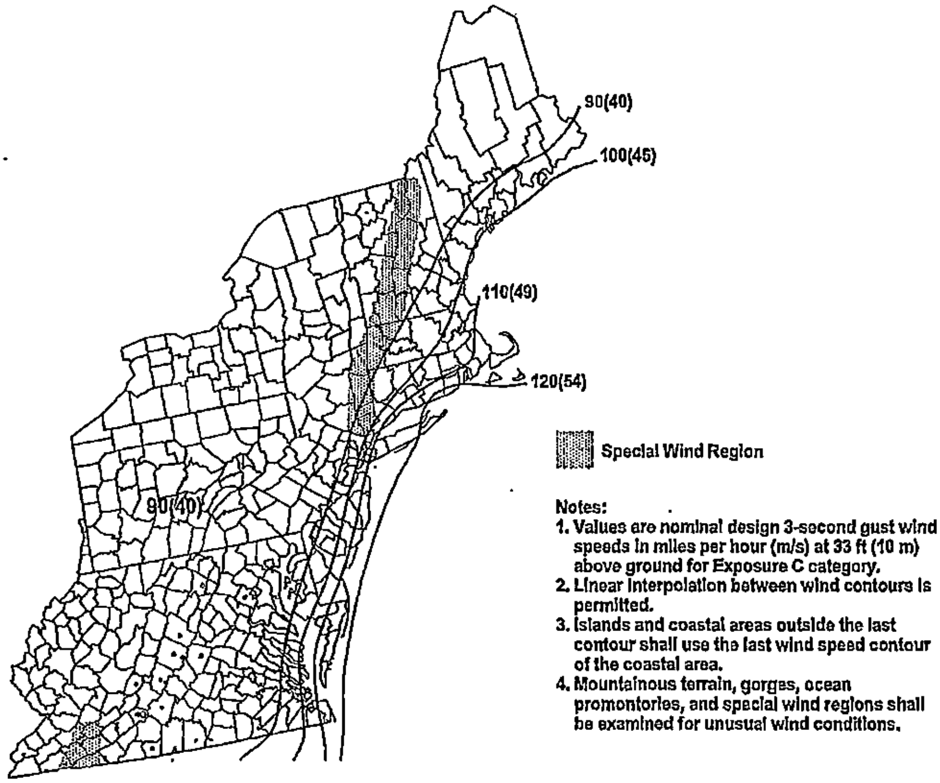

Figure 250-2(e)—Mid and northern Atlantic hurricane coastline

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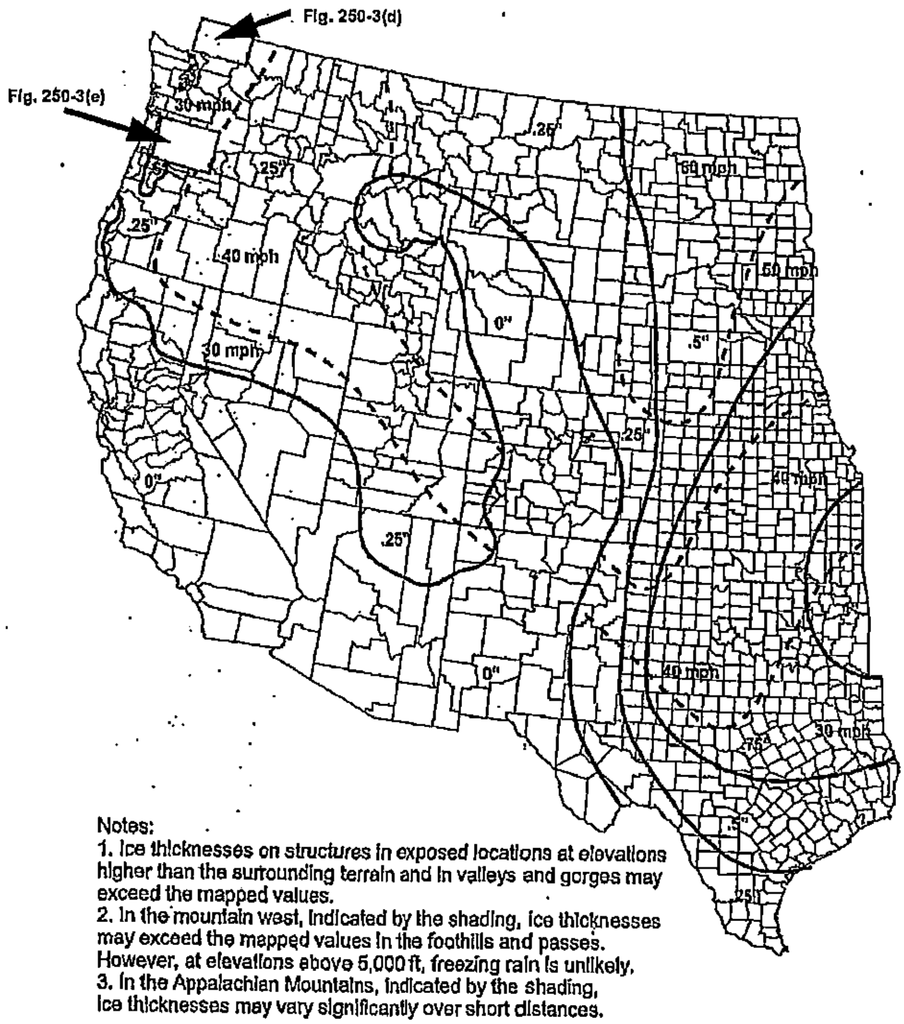

50-YEAR MEAN RECURRENCE INTERVAL UNIFORM ICE THICKNESSES DUE TO FREEZING RAIN WITH CONCURRENT 3-SECOND GUST SPEEDS: CONTIGUOUS 48 STATES.

Figure 250-3(a)—Uniform ice thickness with concurrent wind

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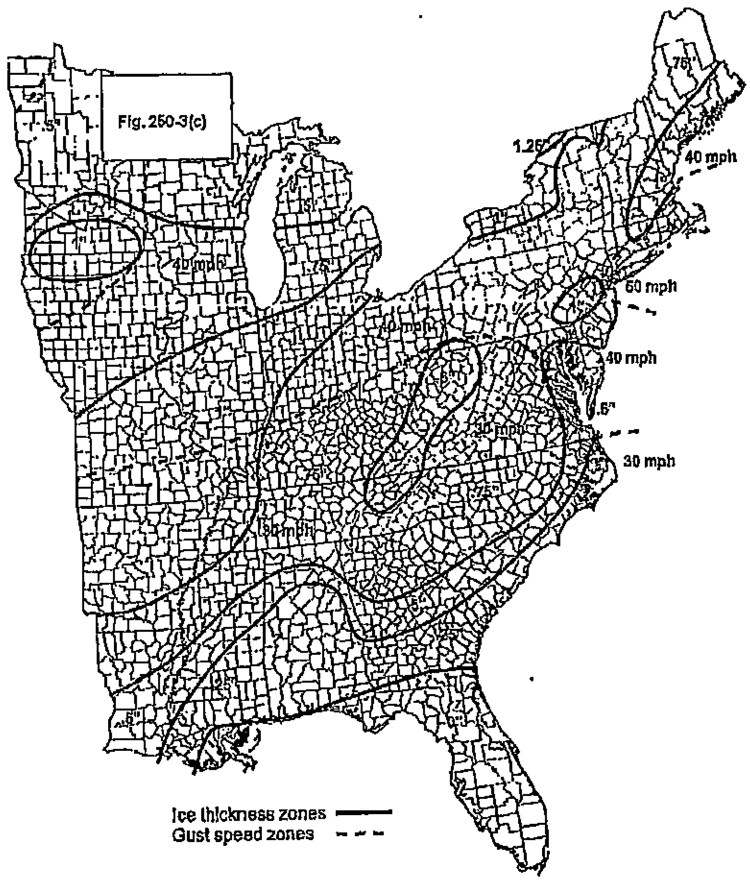

50-YEAR MEAN RECURRENCE INTERVAL UNIFORM ICE THICKNESSES DUE TO FREEZING RAIN WITH CONCURRENT 3-SECOND GUST SPEEDS: CONTIGUOUS 48 STATES.

Figure 250-3(b)—Uniform ice thickness with concurrent wind

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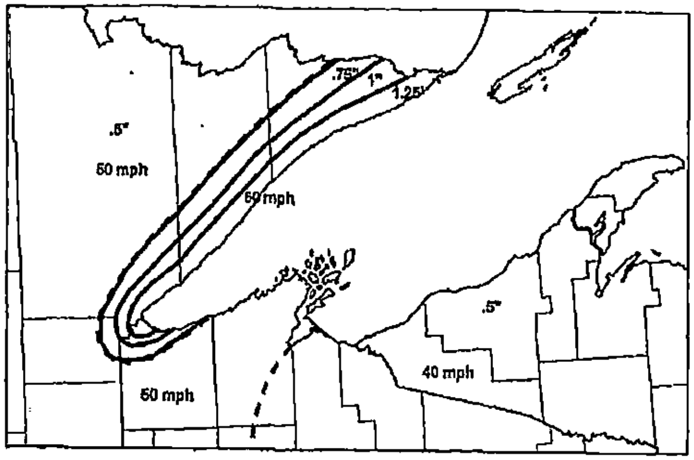

LAKE SUPERIOR DETAIL

Figure 250-3(c)—Uniform ice thickness with concurrent wind

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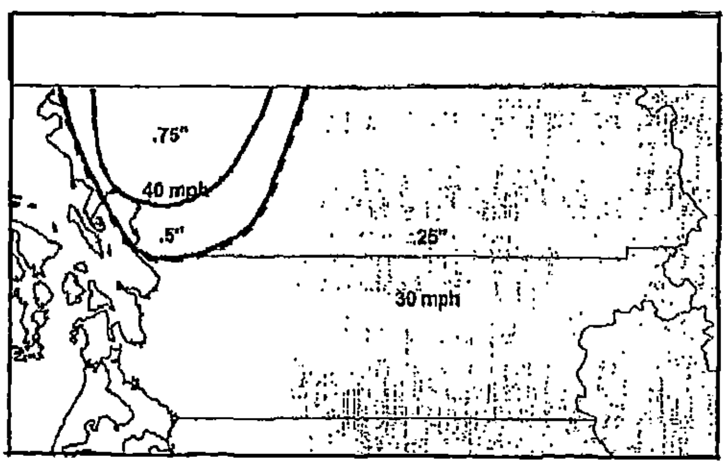

FRASER VALLEY, WASHINGTON DETAIL

Figure 250-3(d)—Uniform ice thickness with concurrent wind

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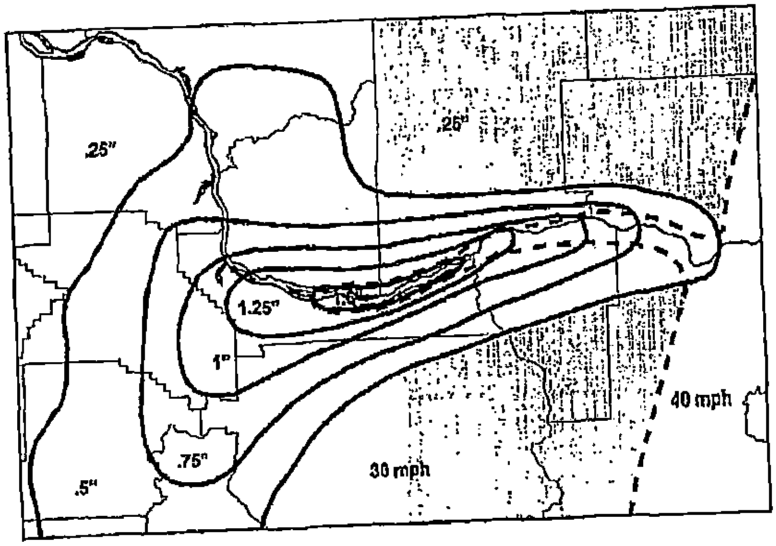

COLUMBIA RIVER GORGE, WASHINGTON DETAIL

Figure 250-3(e)—Uniform ice thickness with concurrent wind

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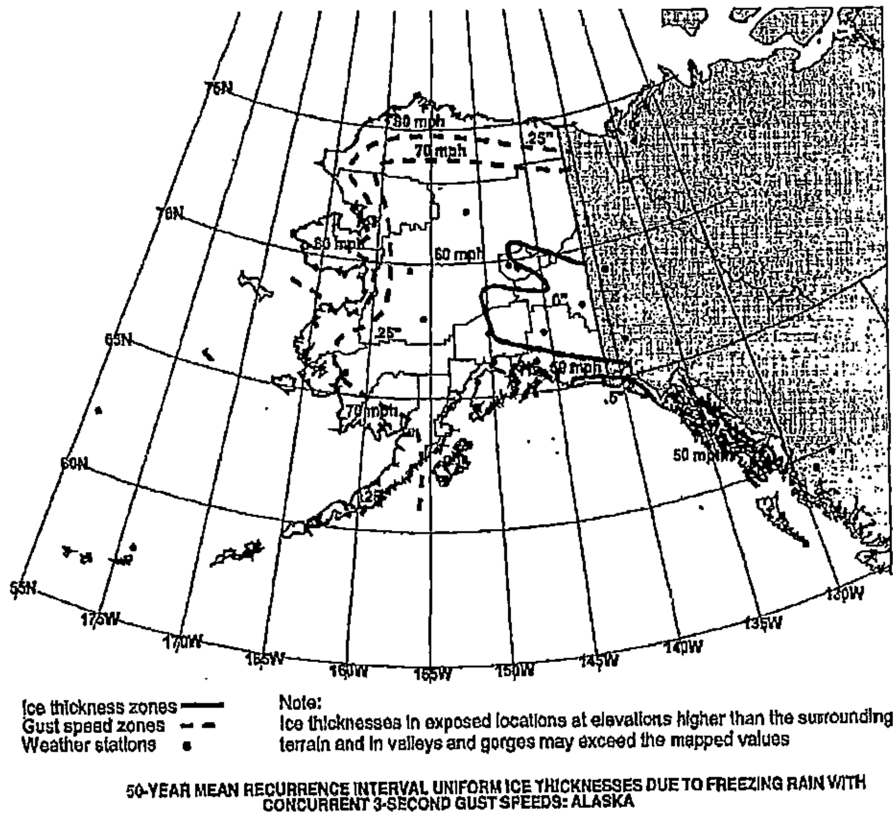

Figure 250-3(f)—Uniform ice thickness with concurrent wind

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Table 250-1—Ice, wind pressures, and temperatures

	Loading districts (for use with Rule 250B)					Extreme wind loading (for use with Rule 250C)	Extreme ice loading with concurrent wind (for use with Rule 250D)
	Heavy see Figure 250-1	Medium see Figure 250-1	Light see Figure 250-1	Warm islands ①			
				Altitudes sea level to 2743 m (9000 ft)	Altitudes above 2743 m (9000 ft)		
Radial thickness of ice							
(mm)	12.5	6.5	0	0	6.5	0	See Figure 250-3
(in)	0.50	0.25	0	0	0.25	0	See Figure 250-3
Horizontal wind pressure							
(Pa)	190	190	430	430	190	See Figure 250-2	See Figure 250-3
(lb/ft2)	4	4	9	9	4	See Figure 250-2	See Figure 250-3
Temperature							
(°C)	–20	–10	–1	+10	–10	+15	–10
(°F)	0	+15	+30	+50	+15	+60	+15

①Warm islands located from latitude 25 degrees south through 25 degrees north include American Samoa (14°S), Guam (13°N), Hawaii (22°N), Puerto Rico (18°N), and Virgin Islands (18°N).

Table 250-2—Velocity pressure exposure coefficient k_z

Height, h (m)	Height, h (ft)	k_z (structure)	k_z (wire, specified height on the structure, and component)
≤ 10	≤ 33	0.9	1.0
> 10 to 15	> 33 to 50	1.0	1.1
> 15 to 25	> 50 to 80	1.1	1.2
> 25 to 35	> 80 to 115	1.2	1.3
> 35 to 50	> 115 to 165	1.3	1.4
> 50 to 75	> 165 to 250	1.4	1.5
> 75	> 250	Use formulas	Use formulas

Formulas (metric):

Structure	$k_z = 2.01 \cdot (0.67 \cdot h/275)^{(2/9.5)}$	$h \leq 275$ m
	$k_z = 1.85$	$h > 275$ m
Wire, specified height on the structure, and component	$k_z = 2.01 \cdot (h/275)^{(2/9.5)}$	$h \leq 275$ m
	$k_z = 2.01$	$h > 275$ m

Formulas (customary):

Structure	$k_z = 2.01 \cdot (0.67 \cdot h/900)^{(2/9.5)}$	$h \leq 900$ ft
	$k_z = 1.85$	$h > 900$ ft
Wire, specified height on the structure, and component	$k_z = 2.01 \cdot (h/900)^{(2/9.5)}$	$h \leq 900$ ft
	$k_z = 2.01$	$h > 900$ ft

h = Structure, specified height on the structure, and component and wire height as defined in Rule 250C1

Minimum $k_z = 0.85$

Formulas are for Exposure Category C, ASCE 7-10.

NOTE: Calculations in this table are based on the maximum values in the stated ranges.

m

Table 250-3—Structure and wire gust response factors, G_{RF}

Height	Structure	Wire G_{RF}, span length, L (m)						
h (m)	G_{RF}	≤75	75<L≤150	150<L≤225	225<L ≤300	300<L ≤450	450<L ≤600	L >600
≤ 10	1.00	0.91	0.86	0.79	0.75	0.72	0.69	①
> 10 to 15	0.96	0.87	0.82	0.76	0.73	0.70	0.67	①
> 15 to 25	0.93	0.85	0.80	0.75	0.71	0.69	0.66	①
> 25 to 35	0.89	0.82	0.78	0.73	0.70	0.68	0.65	①
> 35 to 50	0.86	0.81	0.77	0.72	0.69	0.67	0.64	①
> 50 to 75	0.83	0.79	0.75	0.71	0.68	0.66	0.63	①
> 75	①	①	①	①	①	①	①	①

Formulas:

Structure $G_{RF} = [1 + (2.7 \cdot E_s \cdot B_s^{0.5})]/k_v^2$

Wire $G_{RF} = [1 + (2.7 \cdot E_w \cdot B_w^{0.5})]/k_v^2$

$E_s = 0.346 \cdot [10/(0.67 \cdot h)]^{1/7}$

$E_w = 0.346 \cdot (10/h)^{1/7}$

$B_s = 1/(1 + 0.56 \cdot (0.67 \cdot h)/67)$

$B_w = 1/(1 + 0.8 \cdot L/67)$

Where:

E_w = Wire exposure factor

E_s = Structure exposure factor

B_w = Dimensionless response term corresponding to the quasi-static background wind loads on the wire

B_s = Dimensionless response term corresponding to the quasi-static background wind loads on the structure

$k_v = 1.43$

h = Structure or wire height, as defined in Rule 250C2, in meters

L = Design wind span, in meters

Formulas are for Exposure Category C, ASCE 7-10.

①For heights greater than 75 m and/or spans greater than 600 m, the formulas shall be used.

ft

Table 250-3—Structure and wire gust response factors, G_{RF}

Height	Structure	Wire G_{RF}, span length, L (ft)						
h (ft)	G_{RF}	≤250	250<L ≤500	500<L ≤750	750<L ≤1000	1000<L ≤1500	1500<L ≤2000	L> 2000①
≤ 33	1.02	0.93	0.86	0.79	0.75	0.73	0.69	①
> 33 to 50	0.97	0.88	0.82	0.76	0.72	0.70	0.67	①
> 50 to 80	0.93	0.86	0.80	0.75	0.71	0.69	0.66	①
> 80 to 115	0.89	0.83	0.78	0.73	0.70	0.68	0.65	①
> 115 to 165	0.86	0.82	0.77	0.72	0.69	0.67	0.64	①
> 165 to 250	0.83	0.80	0.75	0.71	0.68	0.66	0.63	①
> 250	①	①	①	①	①	①	①	①

Formulas:

Structure $G_{RF} = [1 + (2.7 \cdot E_s \cdot B_s^{0.5})]/k_v^2$

Wire $G_{RF} = [1 + (2.7 \cdot E_w \cdot B_w^{0.5})]/k_v^2$

$E_s = 0.346 \cdot [33/(0.67 \cdot h)]^{1/7}$

$E_w = 0.346 \cdot (33/h)^{1/7}$

$B_s = 1/(1 + 0.56 \cdot (0.67 \cdot h)/220)$

$B_w = 1/(1 + 0.8 \cdot L/220)$

Where:

E_w = Wire exposure factor

E_s = Structure exposure factor

B_w = Dimensionless response term corresponding to the quasi-static background wind loads on the wire

B_s = Dimensionless response term corresponding to the quasi-static background wind loads on the structure

$k_v = 1.43$

h = Structure or wire height, as defined in Rule 250C2, in feet

L = Design wind span, in feet

Formulas are for Exposure Category C, ASCE 7-10.

①For heights greater than 250 ft and/or spans greater than 2000 ft, the formulas shall be used.

Table 250-4—Wind speed conversions to pressure

To be used only with the extreme ice with concurrent wind loading of Rule 250D and Figure 250-3.

Wind speed (mph)	Horizontal wind pressure	
	Pascals	lb/ft^2
30	110	2.3
40	190	4.0
50	310	6.4
60	440	9.2
70	600	12.5
80	780	16.4

251. Conductor loading

A. General

Ice and wind loads are specified in Rule 250.

1. Where a cable is attached to a messenger, the specified loads shall be applied to both cable and messenger.
2. In determining wind loads on a conductor or cable without ice covering, the assumed projected area shall be that of a smooth cylinder whose outside diameter is the same as that of the conductor or cable. The force coefficient (shape factor) for cylindrical surfaces is assumed to be 1.0.

   EXCEPTION: The force coefficient (shape factor) of 1.0 may be reduced for the bare conductor (without radial ice) if wind tunnel tests or a qualified engineering study justifies a reduction.

   NOTE: Experience has shown that as the size of multiconductor cable decreases, the actual projected area decreases, but the roughness factor increases and offsets the reduction in projected area.
3. An appropriate mathematical model shall be used to determine the wind and weight loads on ice-coated conductors and cables. In the absence of a model developed in accordance with Rule 251A4, the following mathematical model shall be used:
   a. On a conductor, lashed cable, or multiple-conductor cable, the coating of ice shall be considered to be a hollow cylinder touching the outer strands of the conductor or the outer circumference of the lashed cable or multiple-conductor cable.
   b. On bundled conductors, the coating of ice shall be considered as individual hollow cylinders around each subconductor.
4. It is recognized that the effects of conductor stranding or of non-circular cross section may result in wind and ice loadings more or less than those calculated according to assumptions stated in Rules 251A2 and 251A3. No reduction in these loadings is permitted unless testing or a qualified engineering study justifies a reduction.

B. Load components

The load components shall be determined as follows:

1. Vertical load component

   The vertical load on a wire, conductor, or messenger shall be its own weight plus the weight of conductors, spacers, or equipment that it supports, ice covered where required by Rule 250.

2. Horizontal load component

The horizontal load shall be the horizontal wind pressure of determined under Rule 250 applied at right angles to the direction of the line using the projected area of the conductor or messenger and conductors spacers, or equipment that it supports, ice covered where required by Rule 250.

NOTE: The projected area of the conductor or messenger is equal to the diameter of the conductor or messenger, plus ice if appropriate, multiplied by the span length (see Rule 252B4). See Rule 251A2 for force coefficient values of different surface shapes.

3. Total load

The total load on each wire, conductor, or messenger shall be the resultant of components 1 and 2 above, calculated at the applicable temperature in Table 251-1, plus the corresponding additive constant in Table 251-1. In all cases the conductor or messenger tension shall be computed from this total load.

Table 251-1—Temperatures and constants

	Loading districts (for use with 250B)					Extreme wind loading (for use with Rule 250C)	Extreme ice loading with concurrent wind (for use with Rule 250D)
	Heavy (see Figure 250-1)	Medium (see Figure 250-1)	Light (see Figure 250-1)	Warm islands ① Altitudes sea level to 2743 m (9000 ft)	Warm islands ① Altitudes above 2743 m (9000 ft)		
Temperature							
(°C)	–20	–10	–1	+10	–10	+15	–10
(°F)	0	+15	+30	+50	+15	+60	+15
Constant to be added to the resultant (all conductors) ②							
(N/m)	4.40	2.90	0.73	0.73	2.90	0.0	0.0
(lb/ft)	0.30	0.20	0.05	0.05	0.20	0.0	0.0

① Warm islands located from latitude 25 degrees south through 25 degrees north include American Samoa (14°S), Guam (13°N), Hawaii (22°N), Puerto Rico (18°N), and Virgin Islands (18°N).

② For cable arrangements supported by a messenger using spacers or rings and where each conductor or cable is separately loaded with ice and wind as described in Rule 251A3b (as opposed to being analyzed with the ice and wind applied to a hollow cylinder touching the outer strands of the conductors as described in Rule 251A3a), the constant specified here shall be added to the resultant load of each component conductor and the messenger.

252. Loads on line supports

A. Assumed vertical loads

The vertical loads on poles, towers, foundations, crossarms, pins, insulators, and conductor fastenings shall be their own weight plus the weight that they support, including all wires and cables, in accordance with Rules 251A and 251B1, together with the effect of any difference in elevation of supports. Loads due to radial ice shall be computed on wires, cables, and messengers, but need not be computed on supports.

B. Assumed transverse loads

The total transverse loads on poles, towers, foundations, crossarms, pins, insulators, and conductor fastenings shall include the following:

1. Transverse loads from conductors and messengers

The transverse loads from conductors and messengers shall be the horizontal load determined by Rule 251.

EXCEPTION: In medium- and heavy-loading districts, where supporting structures carry ten or more conductors on the same crossarm, not including cables supported by messengers, and where the horizontal pin spacing does not exceed 380 mm (15 in), the transverse wind load may be calculated on two-thirds of the total number of such conductors if at least ten conductors are used in the calculations.

2. Wind loads on structures

The transverse load on structures and equipment shall be computed by applying, at right angles to the direction of the line, the appropriate horizontal wind pressure determined under Rule 250. This load shall be calculated using the projected surfaces of the structures and equipment supported thereon, without ice covering. The following force coefficient (shape factors) shall be used.

a. Cylindrical structures and components

Wind loads on straight or tapered cylindrical structures or structures composed of numerous narrow relatively flat panels that combine to form a total cross section that is circular or elliptical in shape shall be computed using a force coefficient (shape factor) of 1.0.

b. Flat surfaced (not latticed) structures and components

Wind loads on structures or components, having solid or enclosed flat sided cross sections that are square or rectangular, with rounded corners, shall be computed using a force coefficient (shape factor) of 1.6.

c. Latticed structures

Wind loads on square or rectangular latticed structures or components shall be computed using a force coefficient (shape factor) of 3.2 on the sum of the projected areas of the members of the front face if structural members are flat surfaced or 2.0 if structural surfaces are cylindrical. The total, however, need not exceed the load that would occur on a solid structure of the same outside dimension.

EXCEPTION: The force coefficient (shape factor) listed under Rules 252B2a, 252B2b, and 252B2c may be reduced if wind tunnel tests or a qualified engineering study justifies a reduction.

3. At angles

Where a change in direction of wires occurs, the loads on the structure, including guys, shall be the vector sum of the transverse wind load and the wire tension load. In calculating these loads, a wind direction shall be assumed that will give the maximum resultant load. Proper reduction may be made to the loads to account for the reduced wind pressure on the wires resulting from the angularity of the application of the wind on the wire.

4. Wind span

The calculated transverse load shall be based on the wind span, the average of the two spans adjacent to the structure concerned.

NOTE: For structures with wire terminations or with large line angles, engineering judgment may be used in determining the appropriate wind span.

C. Assumed longitudinal loading

1. Change in grade of construction

The longitudinal loads on supporting structures, including poles, towers, and guys at the ends of sections required to be of Grade B construction, when located in lines of lower than Grade B construction, shall be taken as an unbalanced tension in the direction of the higher grade section equal to the larger of the following values:

a. Conductors with rated breaking strength of 13.3 kN (3000 lb) or less

The unbalanced tension shall be the tension of two-thirds, but not fewer than two, of the conductors having a rated breaking strength of 13.3 kN (3000 lb) or less. The conductors selected shall produce the maximum stress in the support.

EXCEPTION: Where there are one or two conductors having rated breaking strength of 13.3 kN (3000 lb) or less, the load shall be that of one conductor.

b. Conductors with rated breaking strength of more than 13.3 kN (3000 lb)

The unbalanced tension shall be the tension resulting from one conductor when there are eight or fewer conductors (including overhead ground wires) having rated breaking strength of more than 13.3 kN (3000 lb), and the tension of two conductors when there are more than eight conductors. The conductors selected shall produce the maximum stress in the support.

2. Jointly used poles at crossings over railroads, communication lines, or limited access highways

Where a joint line crosses a railroad, a communication line, or a limited access highway, and Grade B is required for the crossing span, the tension in the communication conductors of the joint line shall be considered as limited to one-half their rated breaking strength, provided they are smaller than Stl WG No. 8 if of steel, or AWG No. 6 if of copper.

3. Deadends

The longitudinal load on a supporting structure at a deadend shall be an unbalanced pull equal to the tensions of all conductors and messengers (including overhead ground wires); except that with spans in each direction from the dead-end structure, the unbalanced pull shall be the difference in tensions.

4. Unequal spans and unequal vertical loads

The structure should be capable of supporting the unbalanced longitudinal load created by the difference in tensions in the wires in adjacent spans caused by unequal vertical loads or unequal spans.

5. Stringing loads

Consideration should be given to longitudinal loads that may occur on the structure during wire stringing operations.

6. Communication conductors on unguyed supports at railroad and limited access highway crossings

The longitudinal load shall be assumed equal to an unbalanced pull in the direction of the crossing of all open-wire conductors supported, where the tension of each conductor is assumed to be 50% of its rated breaking strength in the heavy-loading district, 33-1/3% in the medium-loading district, and 22-1/4% in the light-loading district.

RECOMMENDATION: Structures having a longitudinal strength capability should be provided at reasonable intervals along the line.

D. Simultaneous application of loads

Where a combination of vertical, transverse, or longitudinal loads may occur simultaneously, the structure shall be designed to withstand the simultaneous application of these loads.

NOTE: Under the extreme wind conditions of Rule 250C, an oblique wind may require greater structural strength than that computed by Rules 252B and 252C.

253. Load factors for structures, crossarms, support hardware, guys, foundations, and anchors

Loads due to the district loads in Rule 250B, the extreme wind loading condition in Rule 250C, and the extreme ice with concurrent wind condition in Rule 250D shall be multiplied by the load factors in Table 253-1.

Table 253-1—Load factors for structures①, crossarms, support hardware ⑧, guys, foundations, and anchors to be used with the strength factors of Table 261-1

Load Factors			
	Grade B	Grade C	
		At crossings ⑥	Elsewhere
Rule 250B loads (Combined ice and wind district loading) Vertical loads ③	1.50	1.90 ⑤	1.90 ⑤
Transverse loads Wind Wire tension	2.50 ② 1.65 ②	2.20 ④ 1.30 ④	1.75 ④ 1.30 ④
Longitudinal loads In general At deadends	1.10 ② 1.65 ②	No requirement 1.30 ④	No requirement 1.30 ④
Rule 250C loads (Extreme wind) Wind loads All other loads	1.00 1.00	0.87 ⑦ 1.00	0.87 ⑦ 1.00
Rule 250D loads (Extreme ice with concurrent wind)	1.00	1.00	1.00

①Includes pole.
②For guys and anchors associated with structures supporting communication conductors and cables only, this factor may be reduced to 1.33.
③Where vertical loads significantly reduce the stress in a structure member, a vertical load factor of 1.0 should be used for the design of such member. Such member shall be designed for the worst case loading.
④For metal or prestressed concrete, portions of structures, crossarms, guys, foundations, and anchors, use a value of 1.10.
⑤For metal, prestressed concrete, or fiber-reinforced polymer portions of structures and crossarms, guys, foundations, and anchors, use a value of 1.50.
⑥This applies only where a line crosses another supply or communication line (see Rule 241C and Table 242-1).
⑦For wind velocities above 100 mph (except Alaska), a factor of 0.75 may be used.
⑧Support hardware does not include insulators. See Section 27 for insulator strength and loading requirements.

Section 26. Strength requirements

260. General (see also Section 20)

A. Preliminary assumptions

1. It is recognized that deformation, deflections, or displacement of parts of the structure may change the effects of the loads assumed. In the calculation of stresses, allowance may be made for such deformation, deflection, or displacement of supporting structures including poles, towers, guys, crossarms, pins, conductor fastenings, and insulators when the effects can be evaluated. Such deformation, deflection, or displacement should be calculated using Rule 250 loads prior to application of the load factors in Rule 253. For crossings or conflicts, the calculations shall be subject to mutual agreement.

   NOTE: Depending upon the characteristics of the structural material, significant sustained (everyday) stress (such as stresses produced by gravity or tension loads) can decrease the strength during the expected life of the material and may require guying or bracing to be able to meet the required strength capability.

2. It is recognized that new materials may become available. While these materials are in the process of development, they must be tested and evaluated. Trial installations are permitted where the requirements of Rule 13A2 are met.

B. Application of strength factors

1. Supporting structures and structural components shall be designed to withstand the appropriate loads multiplied by the load factors in Section 25 without exceeding their strength multiplied by the strength factors in Table 261-1.

   EXCEPTION: For insulators, see Section 27 for strength and loading requirements.

   NOTE 1: The latest edition of the following document may be used for providing information for determining the 5% lower exclusion limit strength of a FRP structure or component for use with an appropriate strength factor (Table 261-1) and the specified NESC loads and load factors (Table 253-1): ASCE-111, Reliability-Based Design of Utility Pole Structures [B18].

   NOTE 2: The latest edition (unless a specific edition is referenced) of the following documents are among those available for determining structure design capacity with the specified NESC loads, load factors, and strength factors:

   ANSI/ASCE-10, Design of Latticed Steel Transmission Structures [B12]
   ASCE-91, Design of Guyed Electrical Transmission Structure [B16]
   ASCE-123, Prestressed Concrete Transmission Pole Structures Recommended Practice for Design and Installation [B20]
   ASCE-48, Design of Steel Transmission Pole Structures [B15]
   ASCE-104, Recommended Practice For Fiber-Reinforced Polymer Products For Overhead Utility Line Structures [B17]
   PCI Design Handbook: Precast and Prestressed Concrete [B71]
   ASCE-113, Substation Structure Design Guide [B19]
   ACI-318, Building Code Requirements for Structural Concrete (for reinforced concrete designs) [B3]
   ACI-318, 1983, Building Code Requirements for Structural Concrete (for anchor bolt bond strength and design) [B4]
   IEEE Std 751™-1991, IEEE Trial-Use Design Guide for Wood Transmission Structures [B38]
   AISI S100, Specification for the Design of Cold-Formed Steel Structural Members [B5]
   The Aluminum Association, Aluminum Design Manual [B72]
   U.S. Dept. of Agriculture Rural Utilities Service Utility Electric Program Bulletin 1724E-200 Design Manual for High Voltage Transmission Lines.

2. Where strength factors are not defined in Rule 261, a strength factor of 0.80 shall be used for the extreme wind loading conditions specified in Rule 250C and for the extreme ice with concurrent wind specified in Rule 250D for all supported facilities.

261. Grades B and C construction

A. Supporting structures

The strength requirements for supporting structures may be met by the structures alone or with the aid of guys or braces or both.

1. Metal, prestressed-, and reinforced-concrete structures

   a. These structures shall be designed to withstand the loads in Rule 252 multiplied by the appropriate load factors in Table 253-1 without exceeding the permitted stress.

   NOTE: When determining required strength for axial loads, buckling needs to be considered.

   b. The permitted stress shall be the strength multiplied by the strength factors in Table 261-1 (where guys are used, see Rule 261C).

   c. All structures including those below 18 m (60 ft) shall be designed to withstand, without conductors, the extreme wind load in Rule 250C applied in any direction on the structure and any supported facilities and equipment that may be in place prior to installation of conductors.

   d. Spliced and reinforced structures

   Reinforcements or permanent splices to a supporting structure are permitted provided they develop the required strength of the structure.

2. Wood structures

   Wood structures shall be of material and dimensions to meet the following requirements:

   a. Wood structures shall be designed to withstand the loads in Rule 252 multiplied by the appropriate load factors in Table 253-1 without exceeding the permitted stress level at the point of maximum stress.

   EXCEPTION 1: When installed, unguyed naturally grown wood poles 16.8 m (55 ft) or less in total length, acting as single-based structures or unbraced multiple-pole structures, shall meet the requirements of Rule 261A2a without exceeding the permitted stress level at the ground line. However, all guyed poles, regardless of length, shall meet the requirements of Rule 261A2a without exceeding the permitted stress level at points of attachment for guys and guy struts.

   EXCEPTION 2: At a Grade B crossing, in a straight section of line, wood structures complying with the transverse strength requirements of Rule 261A2a, without the use of transverse guys, shall be considered as having the required longitudinal strength, providing the longitudinal strength is comparable to the transverse strength of the structure. This *EXCEPTION* does not modify the requirements of this rule for deadends.

   EXCEPTION 3: At a Grade B crossing of a supply line over a highway or a communication line where there is an angle in the supply line, wood structures shall be considered as having the required longitudinal strength if all of the following conditions are met:

   (a) The angle is not over 20 degrees.

   (b) The angle structure is guyed in the plane of the resultant of the conductor tensions. The tension in this guy under the loading in Rule 252 multiplied by a load factor of 2.0 shall not exceed the rated breaking strength multiplied by the strength factor in Table 261-1.

   (c) The angle structure has sufficient strength to withstand, without guys, the transverse loading of Rule 252 multiplied by the appropriate load factors in Table 253-1 or 253-2, which would exist if there were no angle at that structure without exceeding the permitted stress level.

   NOTE: When determining required strength for axial loads, buckling needs to be considered.

   b. Permitted stress level

   (1) Natural wood pole
   The permitted stress level of natural wood poles of various species meeting the requirements of ANSI O5.1-2015 shall be determined by multiplying the designated fiber strength set forth in that standard by the appropriate strength factors in Table 261-1.

(2) Sawn or laminated wood structural members, crossarms, and braces

The permitted stress level of sawn or laminated wood structural members, crossarms, and braces meeting the requirements of ANSI O5.2-2012 or ANSI O5.3-2015 shall be determined by multiplying the appropriate designated fiber strength set forth in the respective standard, by the appropriate strength factors in Table 261-1.

c. Strength of guyed poles

Guyed poles shall be designed as columns, resisting the vertical component of the tension in the guy plus any other vertical loads.

d. Spliced and reinforced poles

Reinforcements or permanent splices at any section along the pole are permitted provided they develop the required strength of the pole.

e. All structures including those below 18 m (60 ft) shall be designed to withstand, without conductors, the extreme wind load in Rule 250C applied in any direction on the structure and any supported facilities and equipment which may be in place prior to installation of conductors.

3. Fiber-reinforced polymer structures

a. These structures shall be designed to withstand the loads in Rule 252 multiplied by the appropriate load factors in Table 253-1 without exceeding the permitted load.

NOTE: When determining required strength for axial loads, buckling needs to be considered.

b. The permitted load shall be the 5th percentile strength (i.e., "5% lower exclusion limit") or less, multiplied by the strength factors in Table 261-1 (where guys are used, see Rule 261C).

c. Spliced and reinforced poles

Reinforcements or permanent splices to a supporting pole are permitted provided they develop the required strength of the pole.

d. All structures including those below 18 m (60 ft) shall be designed to withstand, without conductors, the extreme wind load in Rule 250C applied in any direction on the structure and any supported facilities and equipment which may be in place prior to installation of conductors.

4. Transverse strength requirements for structures where side guying is required, but can be installed only at a distance

Grade B: If the transverse strength requirements of this section cannot be met except by the use of side guys or special structures, and where it is physically impractical to employ side guys, the transverse strength requirements may be met by side-guying the line at each side of, and as near as practical to, the crossing, or other transversely weak structure, and with a distance between such side-guyed structures of not over 250 m (800 ft), provided that:

a. The side-guyed structures for each such section of 250 m (800 ft) or less shall be designed to withstand the calculated transverse load due to wind on the supports and ice-covered conductors, on the entire section between side-guyed structures.

b. The line between such side-guyed structures shall be substantially in a straight line and the average span between the side-guyed structures shall not exceed 45 m (150 ft).

c. The entire section between the structures with the required transverse strength shall comply with the highest grade of construction concerned in the given section, except as to the transverse strength of the intermediate poles or towers.

Grade C: The above provisions do not apply to Grade C.

5. Longitudinal strength requirements for sections of higher grade in lines of a lower grade construction

a. Methods of providing longitudinal strength

Grade B: The longitudinal strength requirements for sections of line of higher grade in lines of a lower grade (for assumed longitudinal loading, see Rule 252) may be met by placing a structure of the required longitudinal strength at each end of the higher grade section.

Where this is impractical, the structures of the required longitudinal strength may be located away from the section of higher grade, within 150 m (500 ft) on each side and with not more than 250 m (800 ft) between the structures of the required longitudinal strength. This is permitted provided the following conditions are met:

(1) The structures and the line between them meet the requirements for transverse strength and stringing of conductors of the highest grade occurring in the section, and

(2) The line between the structures of the required longitudinal strength is approximately straight or suitably guyed.

The longitudinal strength requirement of the structures may be met by using guys.

Grade C: The above provisions do not apply to Grade C.

b. Flexible supports

Grade B: When supports of the section of higher grade are capable of considerable deflection in the direction of the line, it may be necessary to increase the clearances required in Section 23 or to provide line guys or special reinforcements to reduce the deflection.

Grade C: The above provision does not apply to Grade C.

B. Strength of foundations, settings, and guy anchors

Foundations, settings, and guy anchors shall be designed or be determined by experience to withstand the loads in Rule 252 multiplied by the load factors in Table 253-1 without exceeding the permitted load. The permitted load shall be equal to the strength multiplied by the strength factors in Table 261-1.

NOTE 1: Excessive movement of foundations, settings, and guy anchors or errors in settings can reduce clearances or structure capacity.

NOTE 2: Soil saturation can have an adverse effect on the strengths of foundations, settings, and guy anchors.

C. Strength of guys and guy insulators

The strength requirements for guys and guy insulators are covered under Rules 264 and 279A1c, respectively.

1. Metal and prestressed-concrete structures

Guys shall be considered as an integral part of the structure.

2. Wood and reinforced-concrete structures

When guys are used to meet the strength requirements, they shall be considered as taking the entire load in the direction in which they act, the structure acting as a strut only, except for those structures considered to possess sufficient rigidity so that the guy can be considered an integral part of the structure.

NOTE: Excessive movement of guys can reduce clearances or structure capacity.

3. Fiber-reinforced polymer structures

When guys are used to meet the strength requirements, the guys shall be considered as taking the entire load in the direction in which they act, as if the structure is acting as a strut only, except for those structures considered to possess sufficient rigidity so that the guys can be considered an integral part of the structure.

NOTE: Excessive movement of guys can reduce clearances or structure capacity.

D. Crossarms and braces

1. Concrete and metal crossarms and braces

Crossarms and braces shall be designed to withstand the loads in Rule 252 multiplied by the load factors in Table 253-1 without exceeding the permitted load. The permitted load shall be equal to the strength multiplied by the strength factors in Table 261-1.

2. Wood crossarms and braces

a. Strength

(1) Crossarms and braces shall be designed to withstand the loads in Rule 252 multiplied by the load factors in Table 253-1 without exceeding their permitted stress.

(2) The permitted stress level of solid sawn or laminated wood crossarms and braces shall be determined by multiplying their ultimate fiber strength by the strength factors in Table 261-1.

b. Material and size

Wood crossarms and braces of select Southern pine or Douglas fir shall have a cross section of not less than those in Table 261-2. Crossarms of other species may be used provided they have equal strength.

3. Fiber-reinforced polymer crossarms and braces

Crossarms and braces shall be designed to withstand the loads in Rule 252 multiplied by the load factors in Table 253-1 without exceeding the permitted load. The permitted load shall be the 5th percentile strength (i.e., "5% lower exclusion limit") or less, multiplied by the strength factors in Table 261-1.

4. Crossarms and braces of other materials

Crossarms and braces should meet the strength requirements of Rule 261D2.

5. Additional requirements

a. Longitudinal strength

(1) General

(a) Crossarms shall be designed to withstand a load of 3.1 kN (700 lb) applied at the outer conductor attachment point without exceeding the permitted stress level for wood crossarms or the permitted load for crossarms of other materials, as applicable.

(b) At each end of a transversely weak section, as described in Rule 261A4, the longitudinal load shall be applied in the direction of the weak section.

(2) Methods of meeting Rule 261D2a(1)

Grade B: Where conductor tensions are limited to a maximum of 9.0 kN (2000 lb) per conductor, double wood crossarms having cross sections in Table 261-2 and properly assembled will comply with the longitudinal strength requirements in Rule 261D2a(1).

Grade C: This requirement is not applicable.

(3) Location

At crossings, crossarms should be mounted on the face of a pole away from the crossing, unless special bracing or double crossarms are used.

b. Bracing

Crossarms shall be supported by bracing, if necessary, to support expected loads, including line personnel working on them. Crossarm braces used only to sustain unbalanced vertical loads need only to be designed for these unbalanced vertical loads.

c. Double crossarms, brackets, or equivalent support assembly

Grade B: Where pin-type construction is used, double wood crossarms, each crossarm having the strength required by Rule 261D2a, or a support assembly equivalent in strength to double wood crossarms shall be used at each crossing structure, at ends of joint-use or conflict sections, at deadends, and at corners where the angle of departure from a straight line exceeds 20 degrees. Under similar conditions, where a bracket supports a conductor operated at more than 750 V to ground and there is no crossarm below, double brackets or a support assembly equivalent in strength to double wood crossarms shall be used.

EXCEPTION: The above does not apply where communication cables or conductors cross below supply conductors and either are attached to the same pole, or where supply conductors are continuous and of uniform tension in the crossing span and each adjacent span. This *EXCEPTION* does not apply to railroad crossings and limited access highways except by mutual agreement.

Grade C: The above requirement is not applicable.

E. Insulators

The strength requirements for insulators are covered under Rules 277 and 279.

F. Strength of pin-type or similar construction and conductor fastenings

1. Longitudinal strength

a. General

Pin-type or similar construction and ties or other conductor fastenings shall be designed to withstand the applicable longitudinal loads in Rule 252, multiplied by the load factors for longitudinal loads in Table 253-1, or 3.1 kN (700 lb) applied at the pin, whichever is greater.

b. Method of meeting Rule 261F1a

Grade B: Where conductor tensions are limited to 9.0 kN (2000 lb) and such conductors are supported on pin insulators, double wood pins and ties or their equivalent will be considered to meet the requirements of Rule 261F1a.

Grade C: No requirement.

c. At deadends and at ends of higher grade construction in line of lower grade

Grade B: Pins and ties or other conductor fastenings connected to the structure at a deadend or at each end of the higher grade section shall be designed to withstand an unbalanced pull due to the conductor load in Rule 251 multiplied by the load factors in Rule 253-1.

Grade C: This requirement is not applicable except for deadends.

d. At ends of transverse sections described in Rule 261A4

Grade B: Pins and ties or other conductor fastenings connected to the structure at ends of the transverse section as described in Rule 261A4 shall be designed to withstand the unbalanced pull in the direction of that transverse section under the load in Rule 252 multiplied by the load factors in Rule 253-1.

Grade C: No requirement.

2. Double pins and conductor fastenings

Grade B: Double pins and conductor fastenings shall be used where double crossarms or brackets are required by Rule 261D5c.

EXCEPTION: The above does not apply where communication cables or conductors cross below supply conductors and either are attached to the same pole, or where supply conductors are continuous and of uniform tension in a crossing span and each adjacent span. This *EXCEPTION* does not apply in the case of railroad crossings and limited access highway crossings except by mutual agreement.

Grade C: No requirement.

3. Single supports used in lieu of double wood pins

A single conductor support and its conductor fastening, when used in lieu of double wood pins, shall develop strength equivalent to double wood pins and their conductor fastenings as specified in Rule 261F1a.

G. Armless construction

1. General

Open conductor armless construction is a type of open conductor supply line construction in which conductors are individually supported at the structure without the use of crossarms.

2. Insulating material

   Strength of insulating material shall meet the requirements of Section 27.

3. Other components

   Strengths of other components shall meet the requirements of Rules 260 and 261.

H. Open supply conductors and overhead shield wires

1. Tensions

   a. Design tensions shall be not more than

      (1) 60% of their rated breaking strength for the load of Rule 250B as applied in Rule 251, multiplied by a load factor of 1.0.

      (2) 80% of their rated breaking strength under the loads of Rules 250C and 250D as applied in Rule 251, multiplied by a load factor of 1.0, where applicable.

   b. The potential for Aeolian vibration damage to conductors and related hardware shall be considered. Aeolian vibration mitigation shall be based on a qualified engineering study, manufacturer's recommendations, or experience from comparable installations. Consideration shall include but is not limited to: conductor material, stranding, type, size, tension, conductor attachment hardware, span length, wind exposure, and expected atmospheric loadings.

      If from these considerations, mitigation actions are considered necessary, recognized vibration mitigation methods include, but are not limited to, the appropriate use of one or more of the following:

      (1) vibration control devices
      (2) stress-reduction devices
      (3) self-damping conductors and (or) vibration resistant conductors
      (4) reducing design tension limits for cold weather condition

   c. If limiting tension in Rule 261H1b(4) is the only method applied to mitigate any potential Aeolian vibration damage, the tension at the applicable temperature listed in Table 251-1 shall not exceed the following percentages of the conductor's rated breaking strength:

      35% at initial tension without external loading

      25% at final tension without external loading

      NOTE 1: Initial tension in this application is a conductor condition that exists immediately after installation. This condition exists before inelastic elongation, creep or stress relaxation occurs and before the conductor is subjected to external loads.

      NOTE 2: Final tension in this application is intended to be the tension that exists after long term creep and prior to ice or wind loading.

      NOTE 3: The above percentage limits may not protect the conductor or facilities from damage due to Aeolian vibration.

2. Splices, taps, dead-end fittings, and associated attachment hardware

   a. Splices should be avoided in crossings and adjacent spans. If it is impractical to avoid such splices, they shall have sufficient strength to withstand the maximum tension resulting from the loads of Rule 250B in Rule 251 multiplied by a load factor of 1.65. If Rules 250C and 250D are applicable, splices shall not be stressed beyond 80% of their rated breaking strength under the loads of Rules 250C and 250D in Rule 251 multiplied by a load factor of 1.0.

   b. Taps should be avoided in crossing spans but, if required, shall be of a type that will not impair the strength of the conductors to which they are attached.

c. Dead-end fittings, including the associated attachment hardware, shall have sufficient strength to withstand the maximum tension resulting from the loads of Rule 250B in Rule 251 multiplied by a load factor of 1.65. If Rules 250C and 250D are applicable, deadend fittings shall not be stressed beyond 80% of their rated breaking strength under the loads of Rules 250C and 250D in Rule 251 multiplied by a load factor of 1.0.

3. Trolley-contact conductors

In order to provide for wear, no trolley-contact conductor shall be installed of less size than AWG No. 0, if of copper, or AWG No. 4, if of silicon bronze.

I. Supply cable messengers

Messengers shall be stranded and shall not be stressed beyond 60% of their rated breaking strength under the loads of Rule 250B in Rule 251 multiplied by a load factor of 1.0. If Rules 250C and 250D are applicable, messengers shall not be stressed beyond 80% of their rated breaking strength under the loads of Rules 250C and 250D in Rule 251 multiplied by a load factor of 1.0.

NOTE: There are no strength requirements for cables supported by messengers.

J. Open-wire communication conductors

Open-wire communication conductors in Grade B or C construction shall have the tensions in Rule 261H1 for supply conductors of the same grade.

EXCEPTION: Where supply conductors are trolley-contact conductors of 0 to 750 V to ground, WG No. 12 Stl may be used for communication conductors for spans of 0 to 30 m (0 to 100 ft), and Stl WG No. 9 may be used for spans of 38 to 45 m (125 to 150 ft).

K. Communication cables and messengers

1. Communication cables

a. There are no strength requirements for communication cables supported by messengers. See Rule 261K2 for the strength requirements for messengers supporting communication cables.

b. Self-supporting cables shall not be stressed beyond the limits stated in Rule 261K2.

c. For paired metallic communication conductors, see Rule 261L.

2. Messenger

The messenger shall not be stressed beyond 60% of its rated breaking strength under the loads of Rule 250B in Rule 251 multiplied by a load factor of 1.0. If Rules 250C and 250D are applicable, messengers shall not be stressed beyond 80% of their rated breaking strength under the loads of Rules 250C and 250D in Rule 251 multiplied by a load factor of 1.0.

NOTE: The above tension limitations might exceed the maximum allowable design tensions of some self-supporting fiber-optic cables for operational reliability. Depending on the type of fiber-optic cable, the maximum allowable design tensions may be referred to as Maximum Rated Design Tension (MRDT), Maximum Rated Cable Load (MRCL), or Maximum Allowed Tension (MAT).

L. Paired metallic communication conductors

1. Paired conductors supported on messenger

a. Use of messenger

A messenger may be used for supporting paired conductors in any location, but is required for paired conductors crossing over trolley-contact conductors of more than 7.5 kV to ground.

b. Tension of messenger

Messenger used for supporting paired conductors required to meet Grade B construction because of crossing over trolley-contact conductors shall meet the tension requirements for Grade B.

c. Size and sag of conductors

There are no requirements for paired conductors when supported on messenger.

2. Paired conductors not supported on messenger

   a. Above supply lines

      Grade B: Tensions shall not exceed those in Rule 261H1 for supply conductors of similar grade.

      Grade C: Sizes and tensions

      Spans 0 to 30 m (0 to 100 ft)—No requirements.

      Each conductor shall have a rated breaking strength of not less than 0.75 kN (170 lb).

      Spans 30 m to 45 m (100 ft to 150 ft)— Tensions shall not exceed those required for Grade B communication conductors.

      Spans exceeding 45 m (150 ft)—Tensions shall not exceed those required for Grade C supply conductors. (See Rule 261H1.)

   b. Above trolley-contact conductors

      Grade B: Sizes and tensions

      Spans 0 to 30 m (0 to 100 ft)—No size requirements. Tensions shall not exceed those of Rule 261H1.

      Spans exceeding 30 m (100 ft)—Each conductor shall have a rated breaking strength of not less than 0.75 kN (170 lb). Tensions shall not exceed those of Rule 261H1.

      Grade C: Sizes and tensions

      Spans 0 to 30 m (0 to 100 ft)—No requirements.

      Spans exceeding 30 m (100 ft)—No tension requirements.

      Each conductor shall have a rated breaking strength of not less than 0.75 kN (170 lb).

M. Support and attachment hardware

The strength required for all support and attachment hardware not covered by Rule 261F or 261H2 shall be not less than the load times the appropriate load factor given in Section 25 and the load factor shall not be less than 1.0. For appropriate strength factors, see Rule 260B.

N. Climbing and working steps and their attachments to the structure

The strength required for all climbing devices (includes steps, ladders, platforms and their attachments) shall be capable of supporting 2.0 times the maximum intended load. Unless otherwise quantified by the owner, the maximum intended load shall be assumed to be 136 kg (300 lb), which includes the weight of the lineman, harness, tools, and equipment being supported by the lineman.

NOTE: See IEEE Std 1307™-2004 [B53].

Table 261-1—Strength factors for structures①, crossarms, braces, support hardware, guys, foundations, and anchors

[It is recognized that structures will experience some level of deterioration after installation, depending upon materials, maintenance, and service conditions. The table values specify strengths required at installation. Footnotes specify deterioration allowed, if any. When new or changed facilities add loads to existing structures (a) the strength of the structure when new shall have been great enough to support the additional loads and (b) the strength of the deteriorated structure shall exceed the strength required at replacement. If either (a) or (b) cannot be met, the structure must be replaced, augmented, or rehabilitated.]

	Grade B	Grade C
Strength factors for use with loads of Rule 250B (combined ice and wind district loading)		
Metal and prestressed-concrete structures, crossarms, and braces ⑥	1.0	1.0
Wood and reinforced-concrete structures, crossarms, and braces ② ④	0.65	0.85
Fiber-reinforced polymer structures, crossarms, and braces ⑥	1.0	1.0
Support hardware	1.0	1.0
Guy wire ⑤ ⑥	0.9	0.9
Guy anchor and foundation ⑥	1.0	1.0
Strength factors for use with loads of Rules 250C (extreme wind) and 250D (extreme ice with concurrent wind loadings)		
Metal and prestressed-concrete structures, crossarms, and braces ⑥	1.0	1.0
Wood and reinforced-concrete structures, crossarms, and braces ③ ④	0.75	0.75
Fiber-reinforced polymer structures, crossarms, and braces ⑥	1.0	1.0
Support hardware	0.8	0.8
Guy wire ⑤ ⑥	0.9	0.9
Guy anchor and foundation ⑥	1.0	1.0

①Includes poles.

②Wood and reinforced structures shall be replaced or rehabilitated when deterioration reduces the structure strength to 2/3 of that required when installed. When new or changed facilities modify loads on existing structures, the required strength shall be based on the revised loadings. If a structure or component is replaced, it shall meet the strength required by Table 261-1. If a structure or component is rehabilitated, the rehabilitated portions of the structures shall have strength greater than 2/3 of that required when installed.

③Wood and reinforced structures shall be replaced or rehabilitated when deterioration reduces the structure strength to 3/4 of that required when installed. When new or changed facilities modify loads on existing structures, the required strength shall be based on the revised loadings. If a structure or component is replaced, it shall meet the strength required by Table 261-1. If a structure or component is rehabilitated, the rehabilitated portions of the structures shall have strength greater than 3/4 of that required when installed.

④Where a wood or reinforced concrete structure is built for temporary service, the structure strength may be reduced to values as low as those permitted by Footnotes 2 and 3 provided the structure strength does not decrease below the minimum required during the planned life of the structure.

⑤For guy insulator requirements, see Rule 279.

⑥Deterioration during service shall not reduce strength capability below the required strength.

Table 261-2—Dimensions of crossarm cross section of select Southern Pine and Douglas Fir

Crossarm length		Grades of construction	
		Grade B	Grade C
1.20 m or less	mm:	75 × 100	70 × 95
4 ft or less	in:	3 × 4	2-3/4 × 3-3/4
2.45 m	mm:	82 × 108	75 × 100
8 ft	in:	3-1/4 × 4-1/4	3 × 4
3.0 m	mm:	82 × 108	75 × 100
10 ft	in:	3-1/4 × 4-1/4	3 × 4

262. Number 262 not used in this edition.

263. Grade N construction

The strength of Grade N construction need not be equal to or greater than Grade C.

A. Poles

Poles used for lines for which neither Grade B nor C is required shall be of initial size or guyed or braced to withstand expected loads, including line personnel working on them.

B. Guys

The general requirements for guys are covered in Rules 264 and 279A.

C. Crossarm strength

Crossarms shall be securely supported by bracing, if necessary, to withstand expected loads, including line personnel working on them.

NOTE: Double crossarms are generally used at crossings, unbalanced corners, and dead ends, in order to permit conductor fastenings at two insulators to limit the opportunity for slipping, although single crossarms might provide sufficient strength. To secure extra strength, double crossarms are frequently used, and crossarm guys are sometimes used.

D. Supply line conductors

1. Size

Supply-line conductors shall be not smaller than the sizes listed in Table 263-1.

RECOMMENDATION: It is recommended that these sizes for copper and steel not be used in spans longer than 45 m (150 ft) for the heavy-loading district, and 53 m (175 ft) for the medium- and light-loading districts.

E. Service drops

1. Size of open-wire service drops

a. Not over 750 V.

Service drops shall be as required by (1) or (2):

(1) Spans not exceeding 45 m (150 ft)

Sizes shall be not smaller than those in Table 263-2.

(2) Spans exceeding 45 m (150 ft)

Sizes shall be not smaller than 8 AWG.

b. Exceeding 750 V

Sizes of service drops of more than 750 V shall be not less than required for supply line conductors of the same voltage.

2. Tension of open-wire service drops

The tension of the service drop conductors shall not exceed the strength of the conductor attachment or its support under the expected loads.

3. Cabled service drops

Service conductors may be grouped together in a cable, provided the following requirements are met:

a. Size

The size of each conductor shall be not less than required for drops of separate conductors (Rule 263E1).

b. Tension of cabled service drops

The tension of the service drop conductors shall not exceed the strength of the conductor attachment or its support under the expected loads.

F. Trolley-contact conductors

In order to provide for wear, trolley-contact conductors shall be not smaller than size AWG No. 0, if of copper, or AWG No. 4, if of silicon bronze.

G. Communication conductors

There are no specific requirements for Grade N communication line conductors or service drops.

H. Street and area lighting equipment

The lowering rope or chain for luminaires arranged to be lowered for examination or maintenance shall be of a material and strength designed to withstand climatic conditions and to sustain the luminaire safely.

I. Insulators

The strength requirements for insulators are covered under Rules 277 and 279.

Table 263-1—Sizes for Grade N supply line conductors

	Required AWG ① or Stl WG ②
Soft copper	6
Medium- or hard-drawn copper	8
Steel	9
Stranded aluminum:	
EC	2
ACSR	4
ALLOY	4
ACAR	2

①Copper or aluminum
②Steel

Table 263-2—Sizes of service drops of 750 V or less
(Voltages of trolley-contact conductors are voltage to ground.
AWG used for aluminum and copper wires; Stl WG used for steel wire.)

	Copper wire			
Situation	**Soft-drawn**	**Medium- or hard-drawn**	**Steel wire**	**EC aluminum wire** ②
Alone	10	12	12	4
Concerned with communication conductor	10	12	12	4
Over supply conductors of				
0 to 750 V	10	12	12	4
750 V to 8.7 kV ①	8	10	12	4
Exceeding 8.7 kV ①	6	8	9	4
Over trolley-contact conductors				
0 to 750 V ac or dc	8	10	12	4
Exceeding 750 V ac or dc	6	8	9	4

①Installation of service drops of not more than 750 V above supply lines of more than 750 V should be avoided where practical.
②ACSR or high-strength aluminum alloy conductor size shall be not less than No. 6.

264. Guying and bracing

A. Where used

When the loads are greater than can be supported by the structure alone, additional strength shall be provided by the use of guys, braces, or other suitable construction. Such measures shall also be used where necessary to limit the increase of sags in adjacent spans and provide sufficient strength for those supports on which the loads are sufficiently unbalanced, for example, at corners, angles, dead ends, large differences in span lengths, and changes of grade of construction.

B. Strength

Guys shall be designed to withstand the loads in Rule 252 multiplied by the load factors in Table 253-1 without exceeding the permitted load. The permitted load shall be equal to the strength multiplied by the strength factors in Table 261-1. For guy wires conforming to ASTM standards, the nominal breaking strength value therein defined shall be the rated breaking strength required in this Code.

NOTE: For protection and marking of guys, see Rule 217C.

C. Point of attachment

The guy or brace should be attached to the structure as near as is practical to the center of the conductor load to be sustained. However, on lines exceeding 8.7 kV, the location of the guy or brace may be adjusted to minimize the reduction of the insulation offered by nonmetallic support arms and supporting structures.

D. Guy fastenings

Guys having a rated breaking strength of 9.0 kN (2000 lb) or more and that are subject to small radius bends should be stranded and should be protected by suitable guy thimbles or their equivalent. Any guy having a design loading of 44.5 kN (10 000 lb) or more wrapped around cedar or similar softwood poles should be protected by the use of suitable guy shims.

Where there is a tendency for the guy to slip off the shim, guy hooks or other suitable means of limiting the likelihood of this action should be used. Shims are not necessary in the case of supplementary guys, such as storm guys.

E. Electrolysis

Where anchors and rods are subject to electrolysis, suitable measures should be taken to minimize corrosion from this source.

F. Anchor rods

1. Anchor rods should be installed so as to be in line with the pull of the attached guy when under load.

   EXCEPTION: This is not required for anchor rods installed in rock or concrete.

2. The anchor and rod assembly shall have an ultimate strength not less than that required of the guy(s) by Rule 264B.

I/A

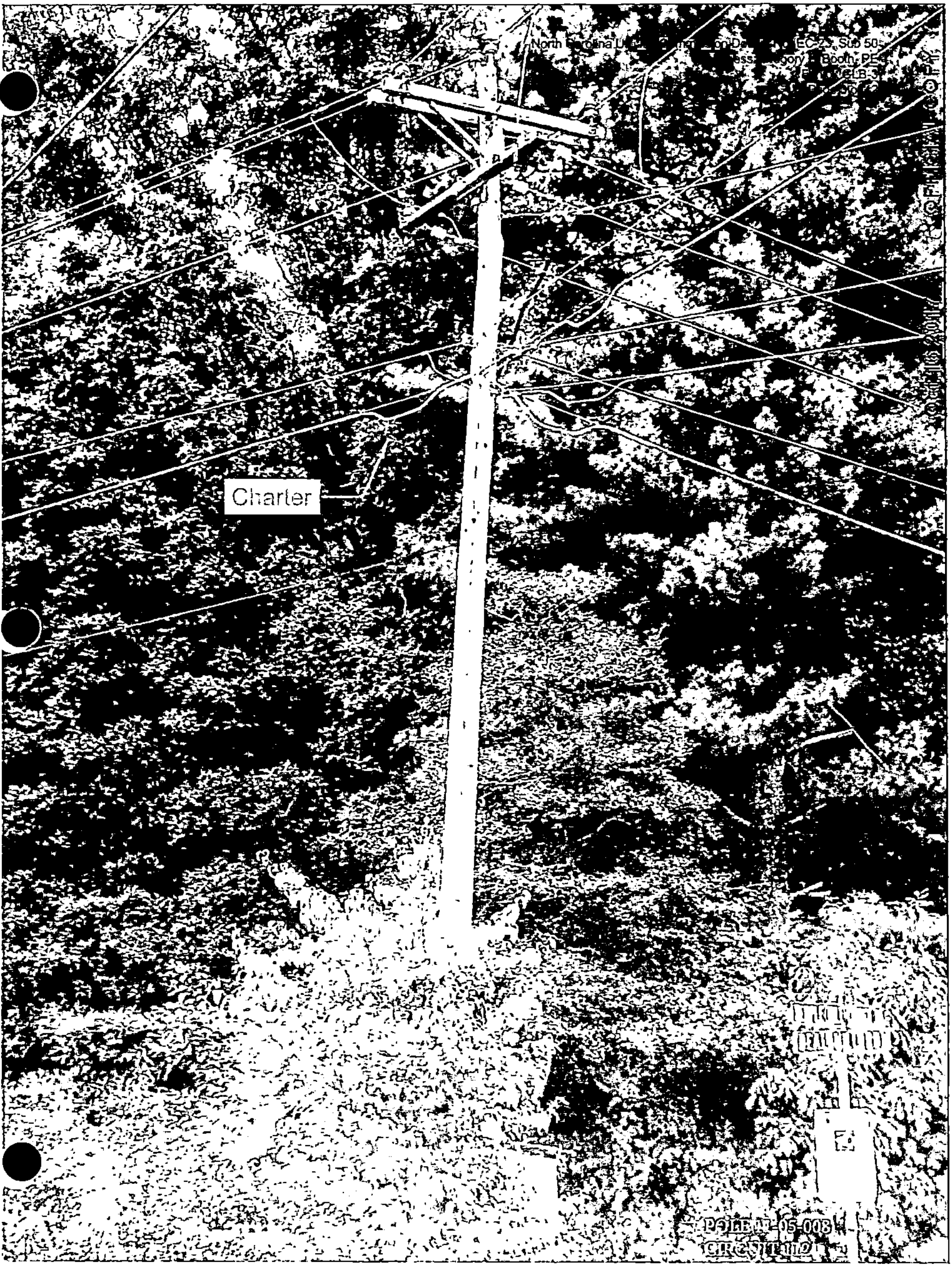
EXHIBIT GLB-3

Exhibit GLB-3

Glossary of True Size Pole Image Terms (Included in Table Format on top of some images):

Term	Explanation
ImageFilename	Filename assigned by IKE to pole photograph
GpsFix	Global Positioning System signal reception value
Pdop	Position dilution of precision (confidence level of positional measurements—closer to zero is optimal, range of 1-6 is normal)
Distance	Distance from IKE instrument to pole
TrueBearing	Bearing from IKE instrument to pole
TargetLatitude	Latitude of pole location
TargetLongitude	Longitude of pole location
TargetAltitude	Mean Sea Level elevation of the aiming point on the pole where the IKE instrument records the bearing and distance to the pole and generates the positional data of the pole. This aiming point elevation is dependent upon the operator's discretion based on field conditions, such as intermediate objects that may obscure a good laser ranging to the pole. The operator typically aims the IKE instrument at eye level or higher on the pole to avoid picking up intermediate objects instead of target.

SECTION A: Failure To Observe Forty-Inch Clearance


Charter

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Year	2017
Month	08
Day	22
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Hour	11
Minute	26
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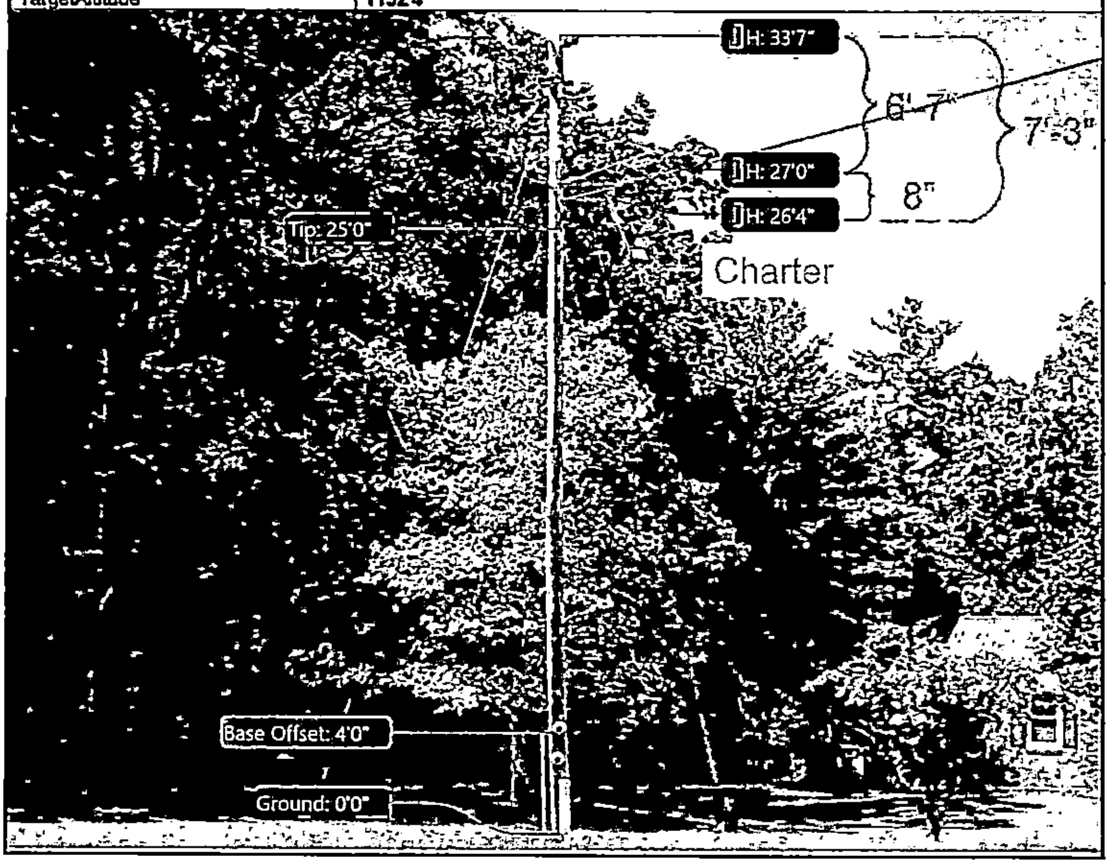

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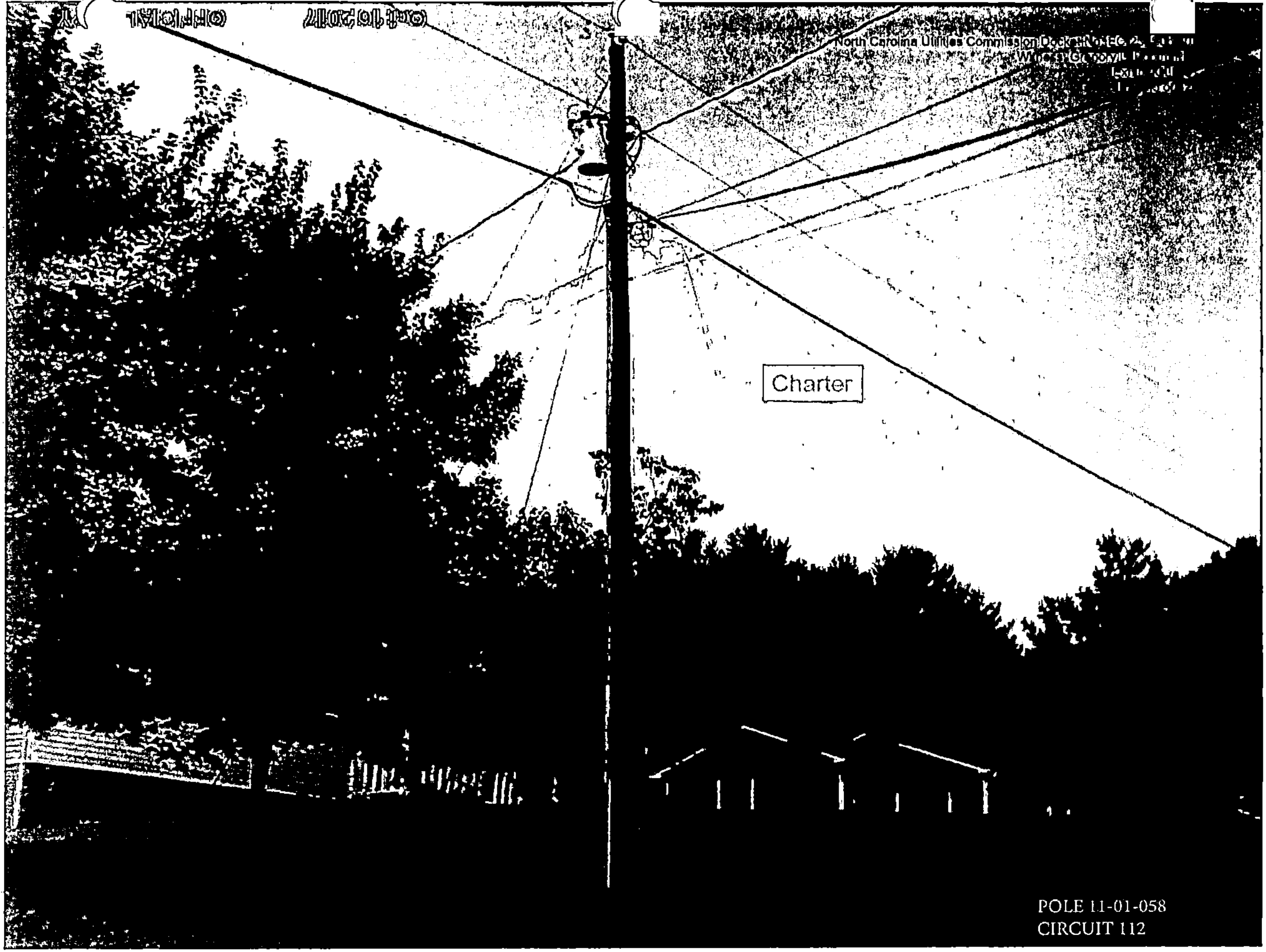
North Carolina Utilities Commission Docket
Charter
POLE 11-01-058
CIRCUIT 112

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Month	08
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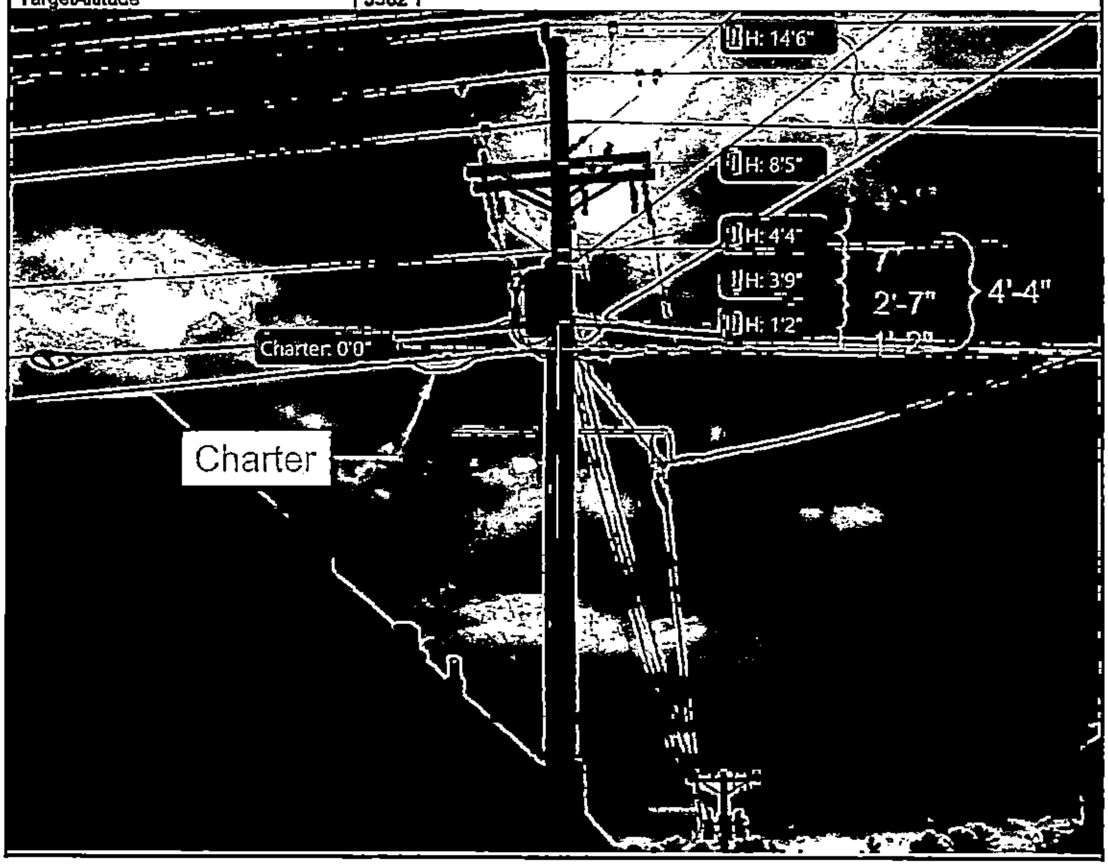

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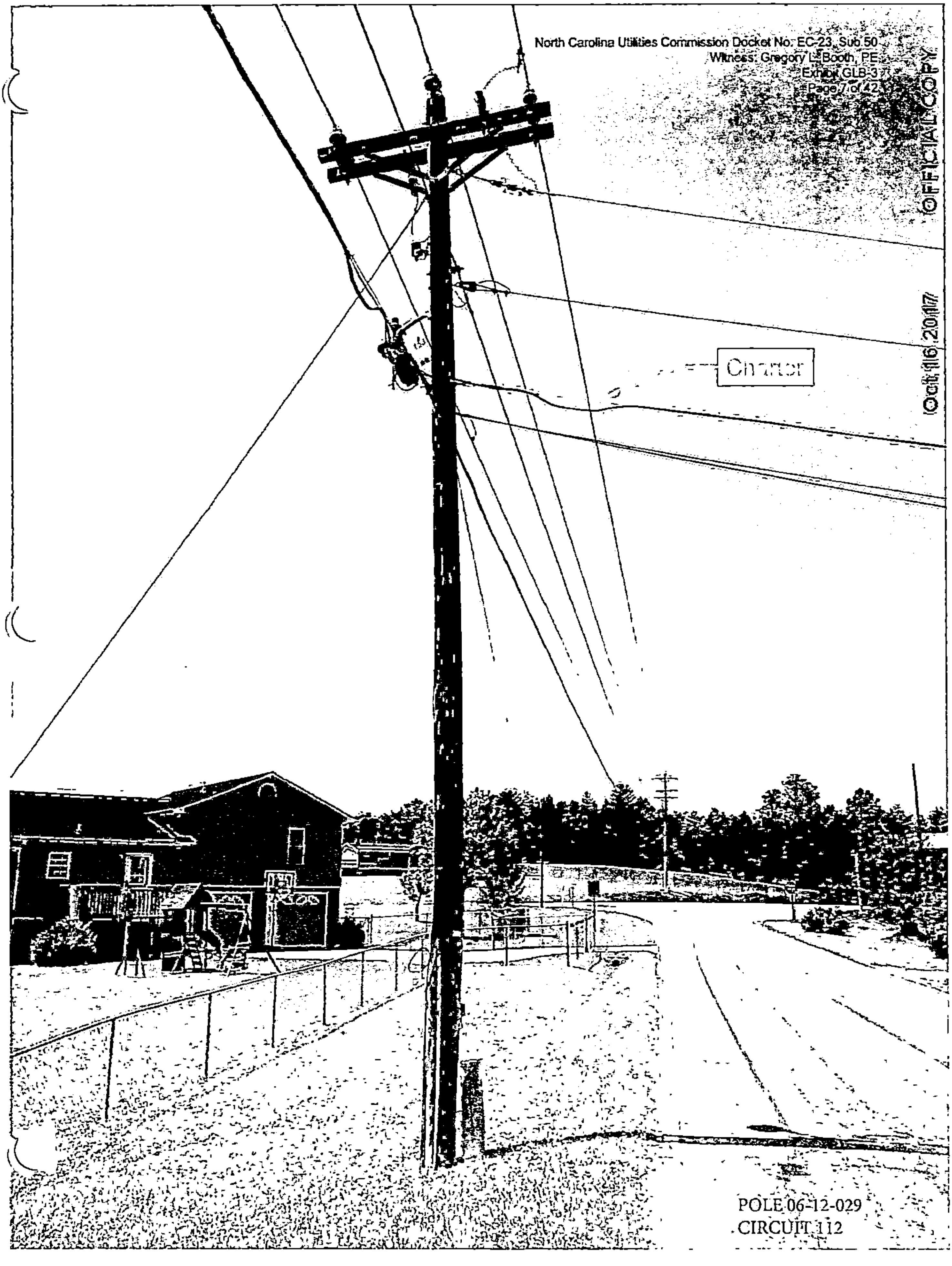
Charter
POLE 06-12-029
CIRCUIT 112


Charter
POLE 10-04-134
CIRCUIT 112

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Month	08
Day	24
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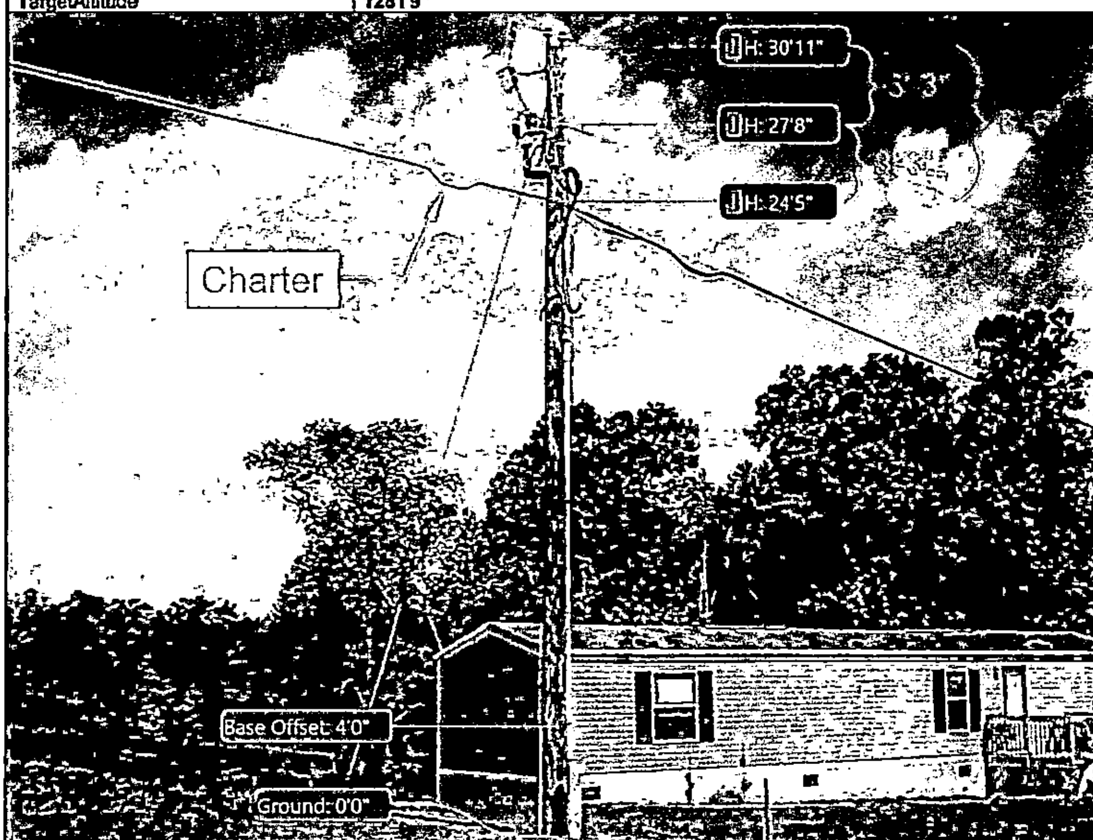
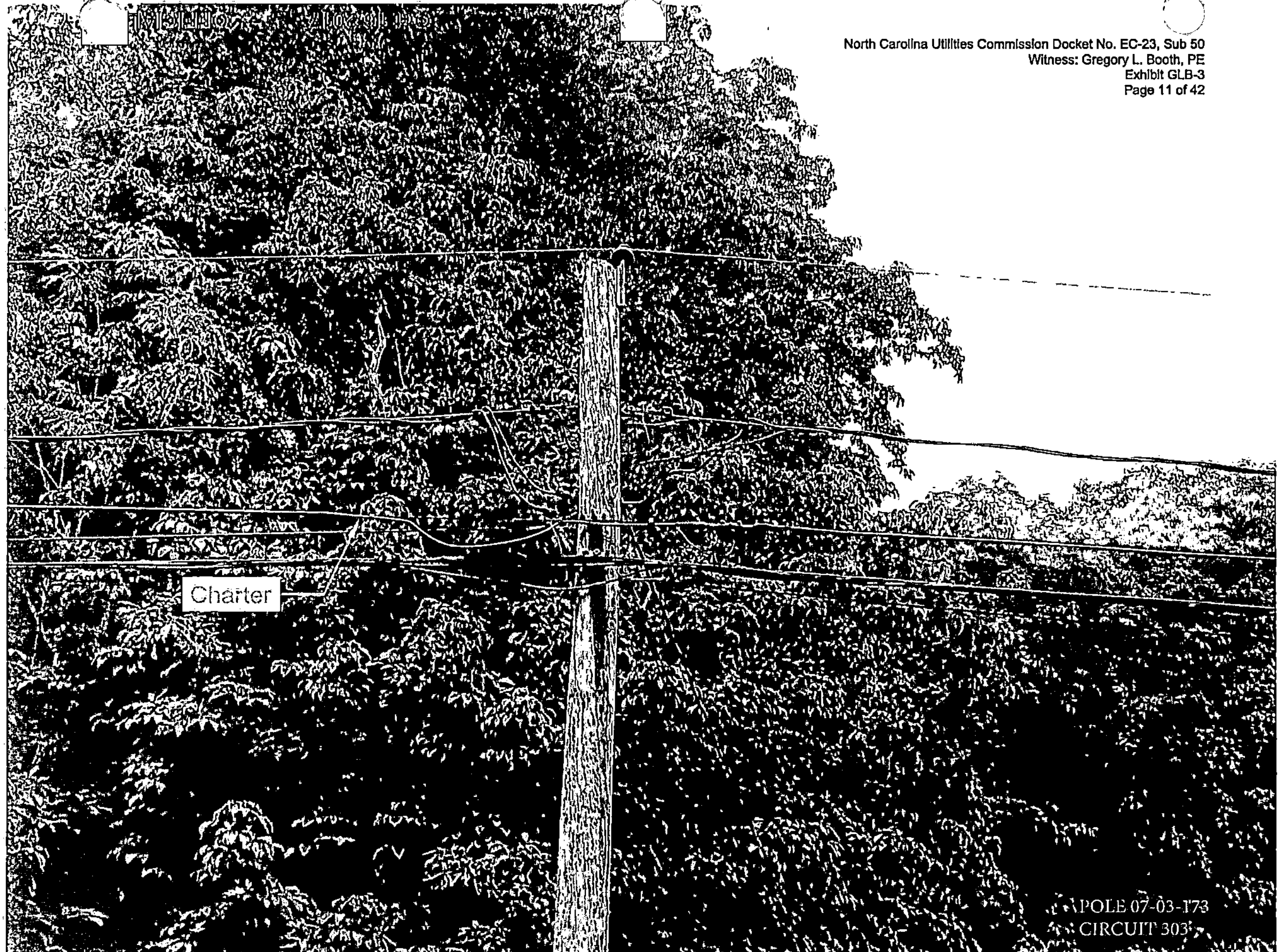
TargetAltitude	1281'9"



POLE 11-02-031
CIRCUIT 112


Charter
SPEED LIMIT 15


Charter
POLE 07-03-173
CIRCUIT 303

SECTION B: Encroachment into Electrical Supply Space

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Month	08
Day	22
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Minute	59
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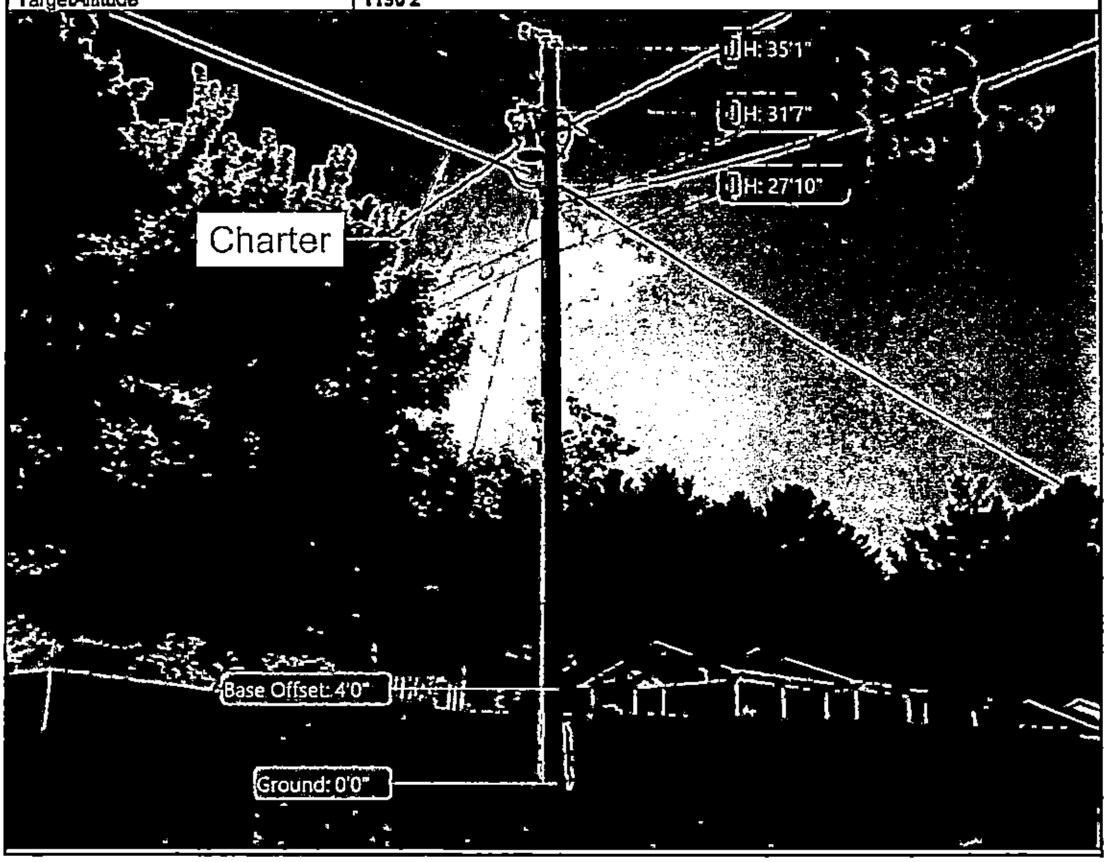
TargetAltitude	1190'2"



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Month	08
Day	22
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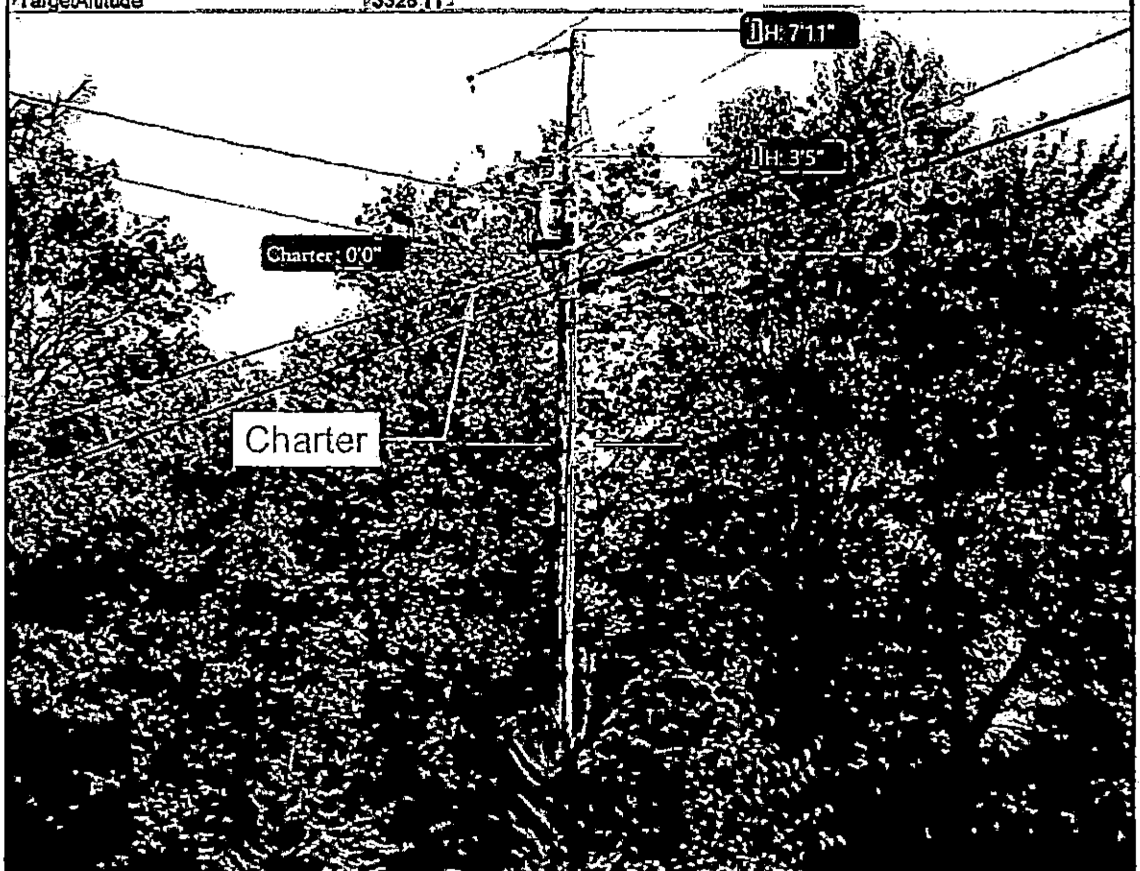
TargetAltitude	3326'11"



Text	pole 17 01 291: Charter is attached within 8.5 feet of top of pole and too too close to transformer.

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Day	23
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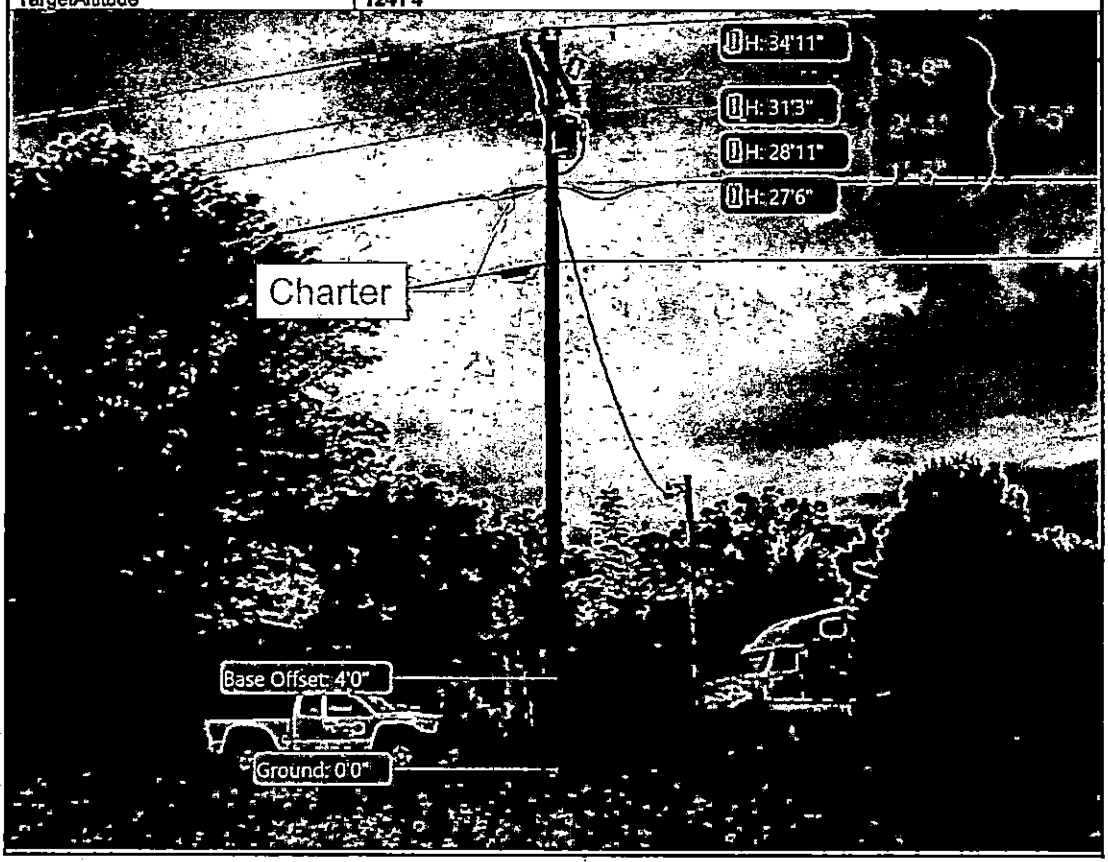

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Day	25
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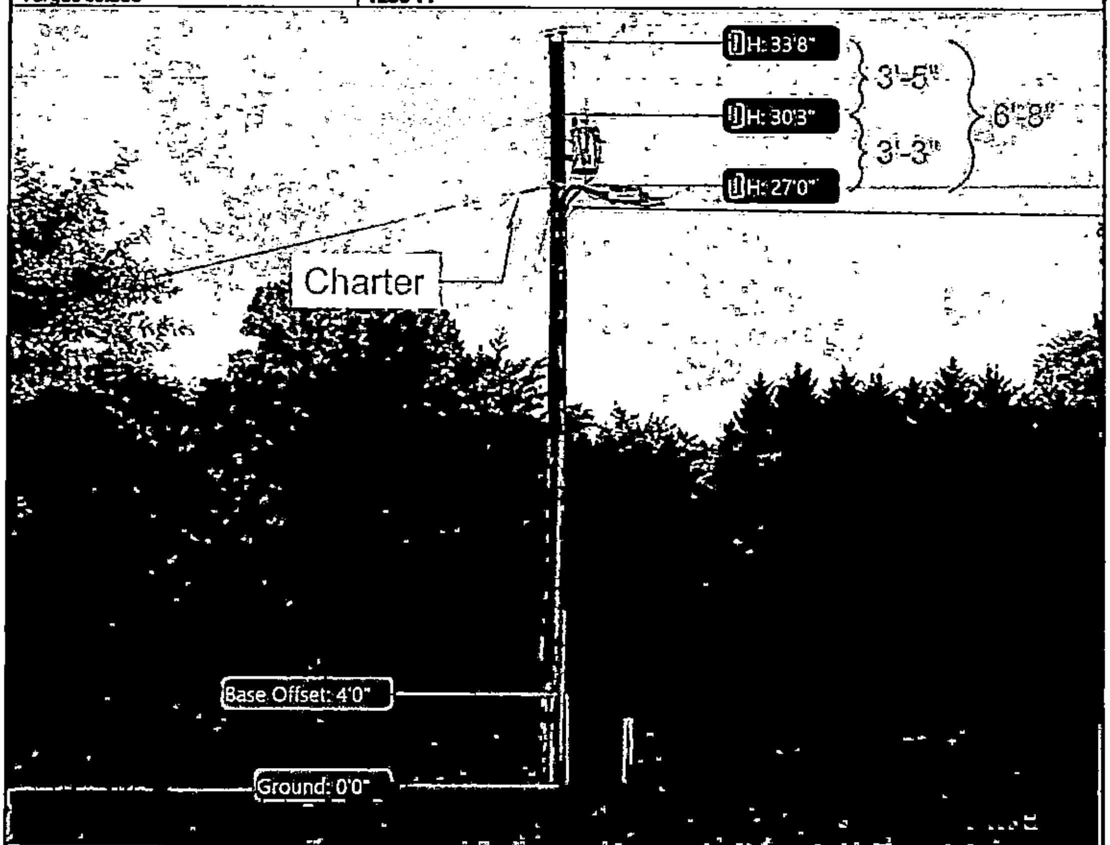
TargetAltitude	1258'11"



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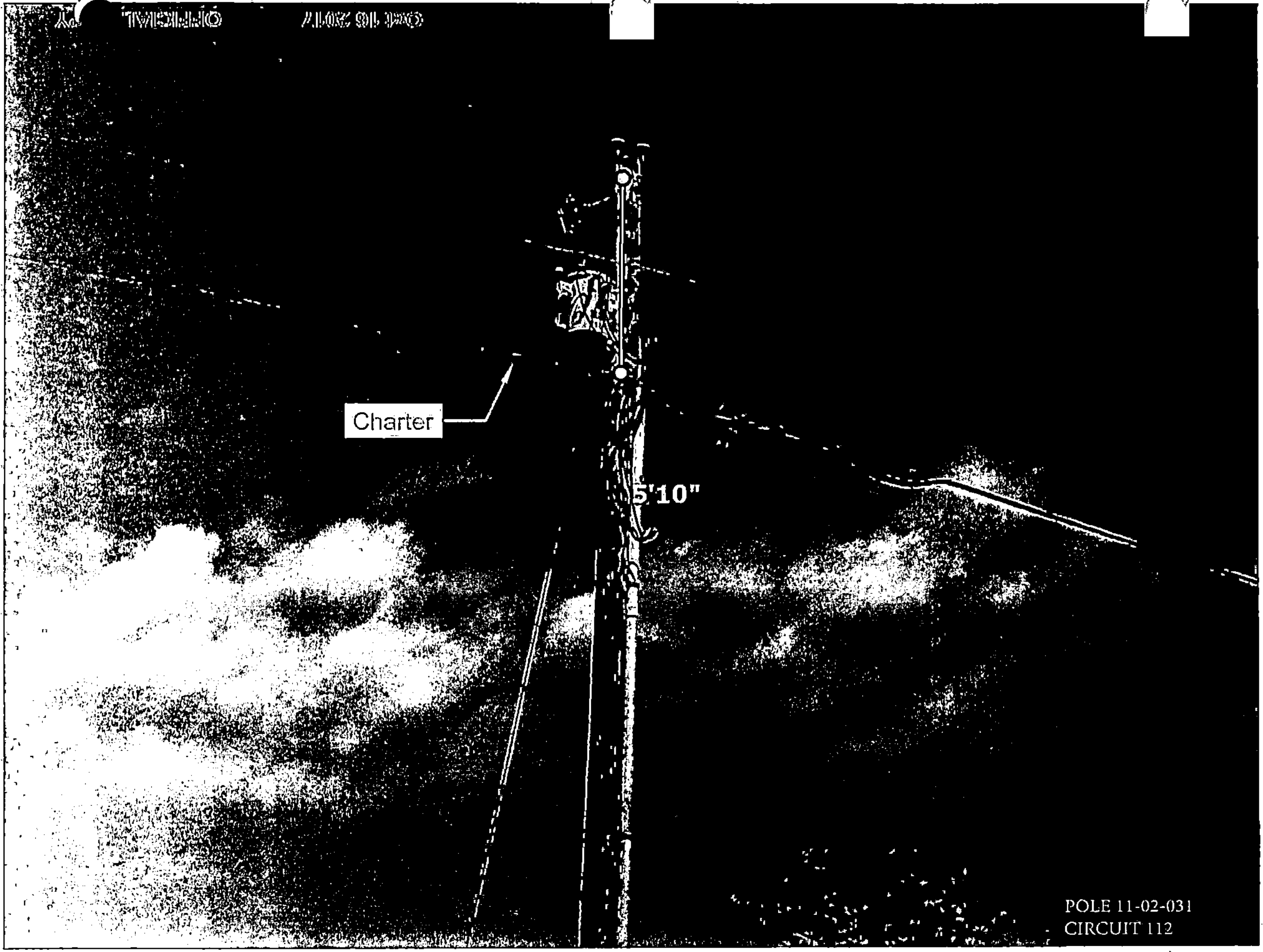
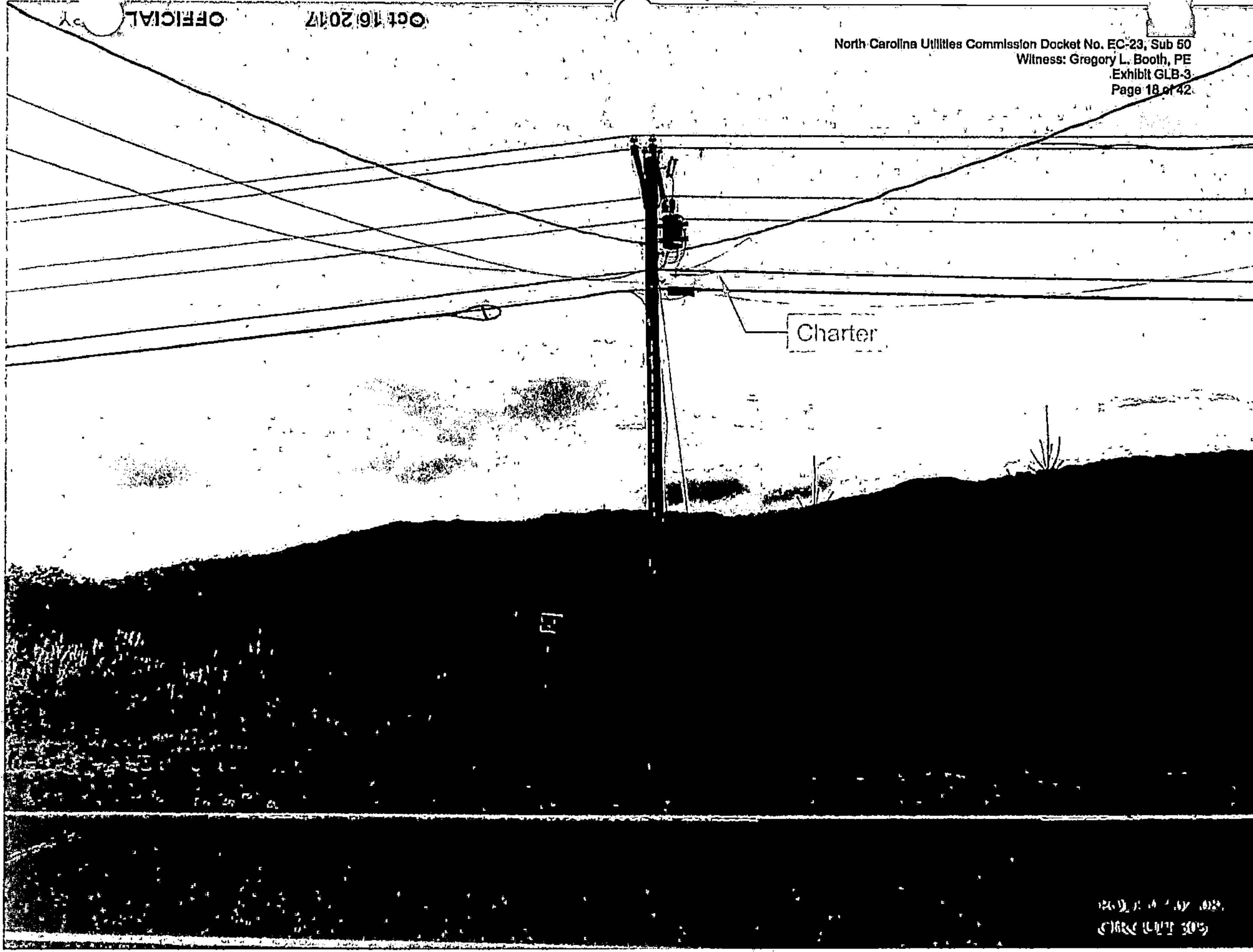
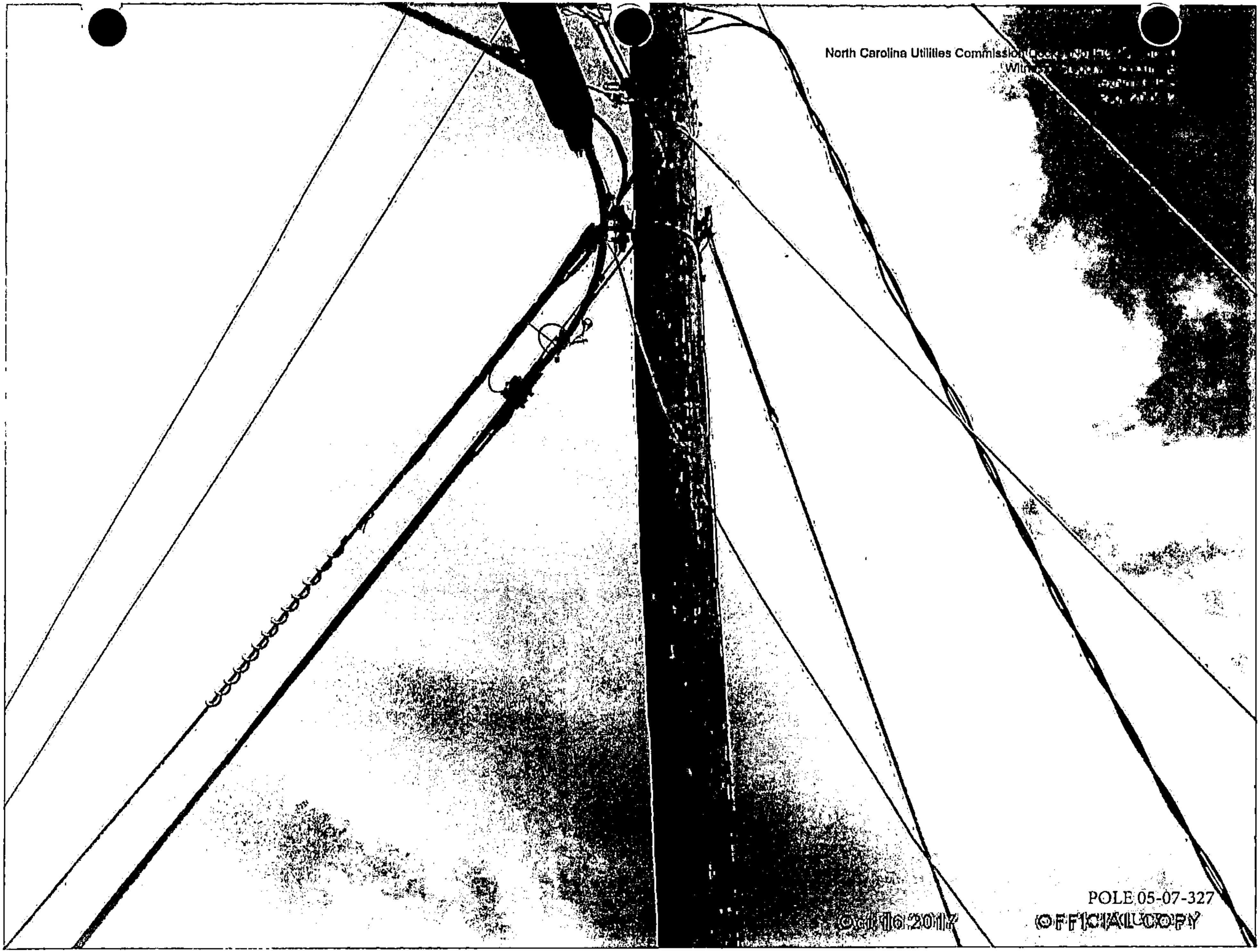

Charter
5'10"
POLE 11-02-031
CIRCUIT 112

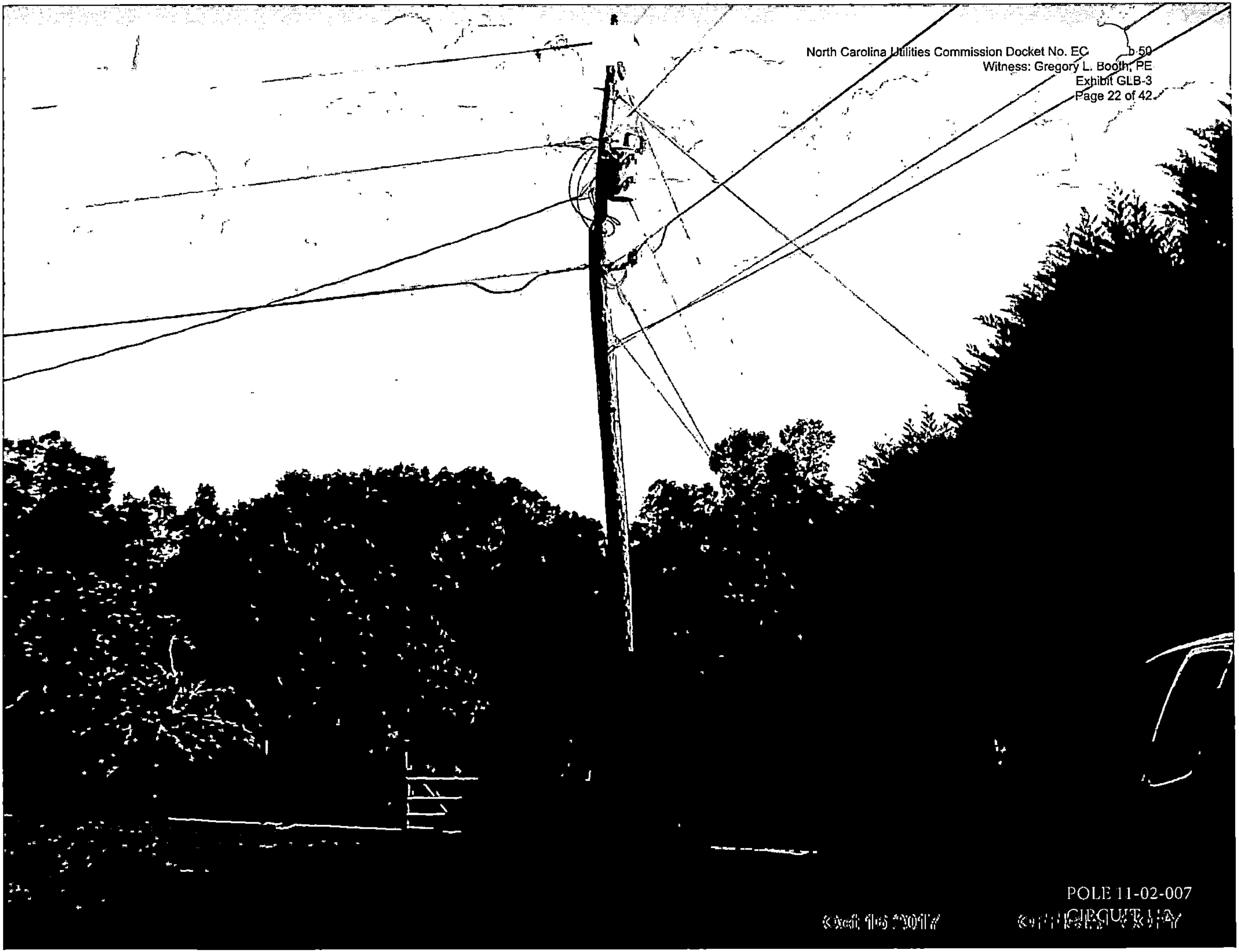

Charter

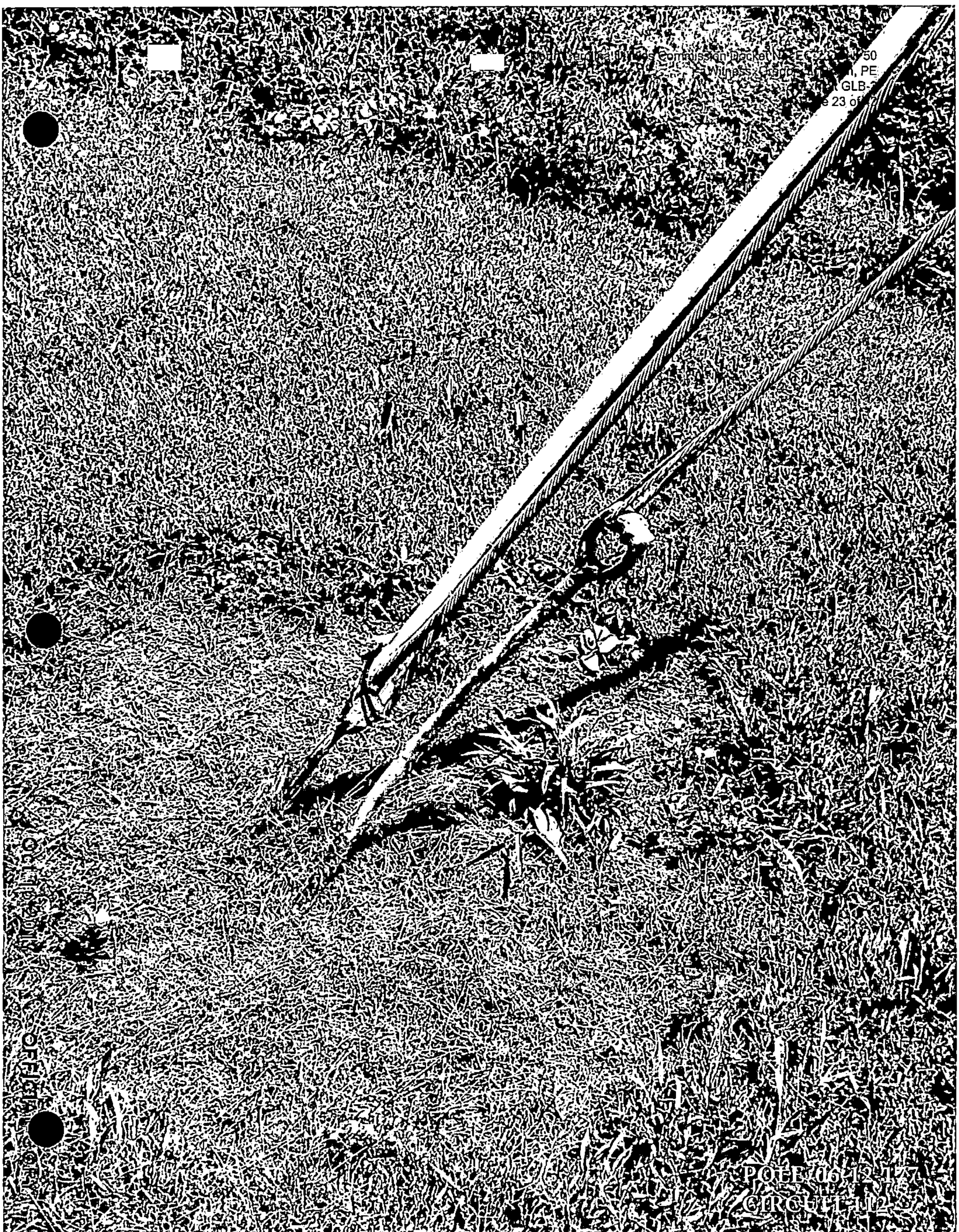
SECTION C: GUY AND ANCHOR VIOLATIONS

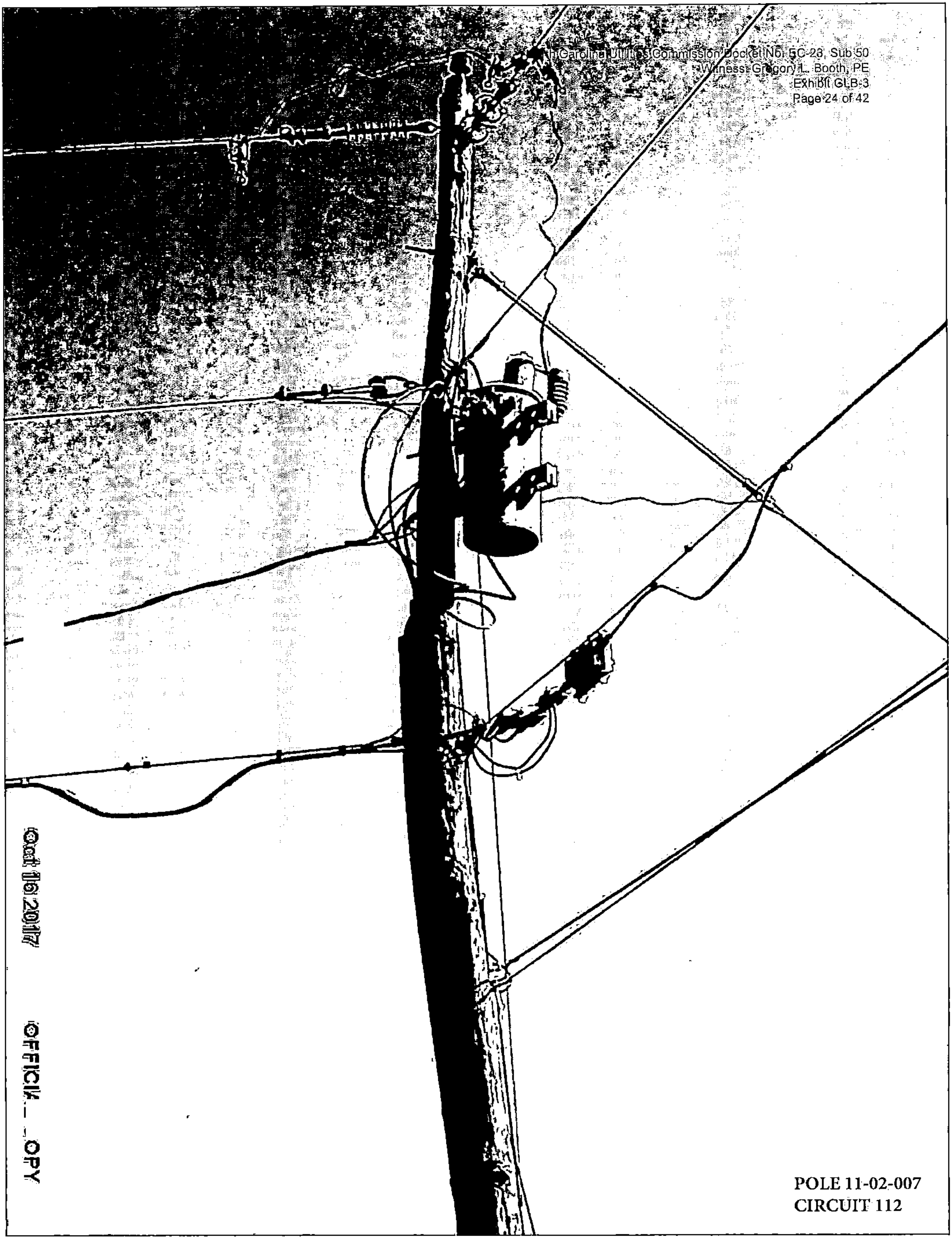

North Carolina Utilities Commission
POLE 05-07-327


Oct-16-2017

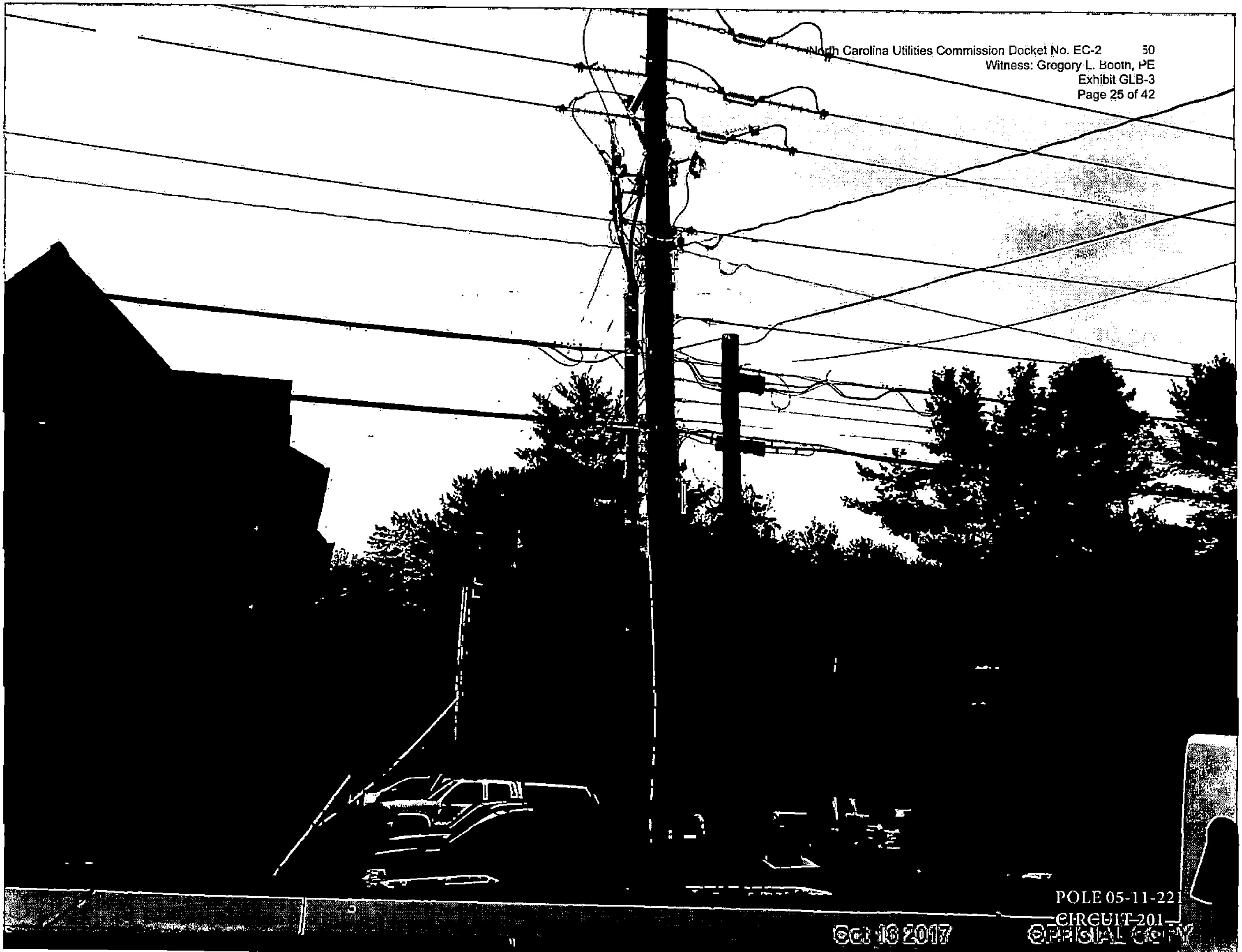

POLE 05-07-291
CIRCUIT 291
Oct 16 2017


POLE 11-02-007

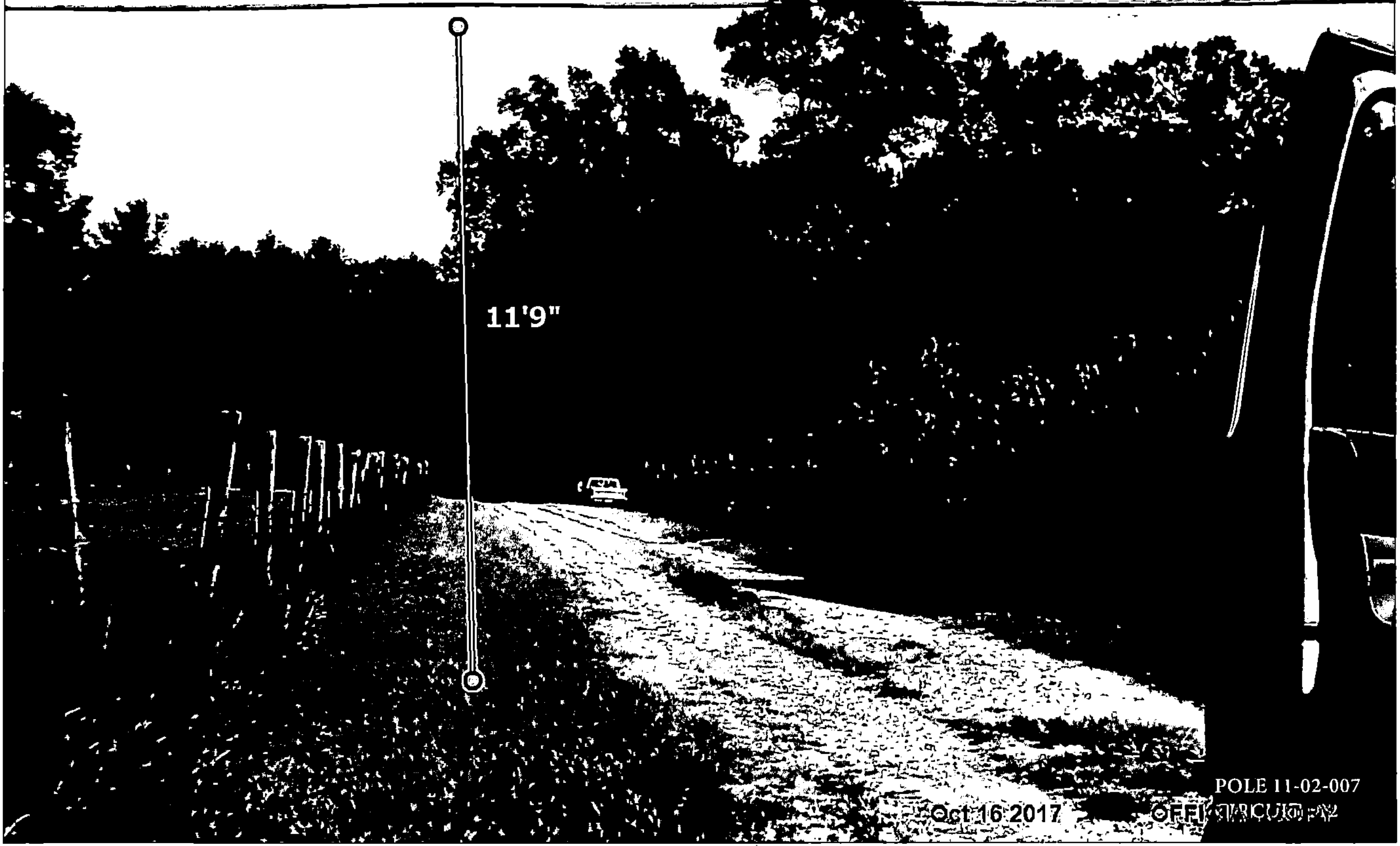

POLE 06-12-17
CIRCUIT 112



POLE 11-02-007
CIRCUIT 112


POLE 05-11-221
CIRCUIT 201
Oct 16 2017
OFFICIAL COPY

SECTION D: Vertical Clearance Violations


11'9"
POLE 11-02-007
Oct 16 2017

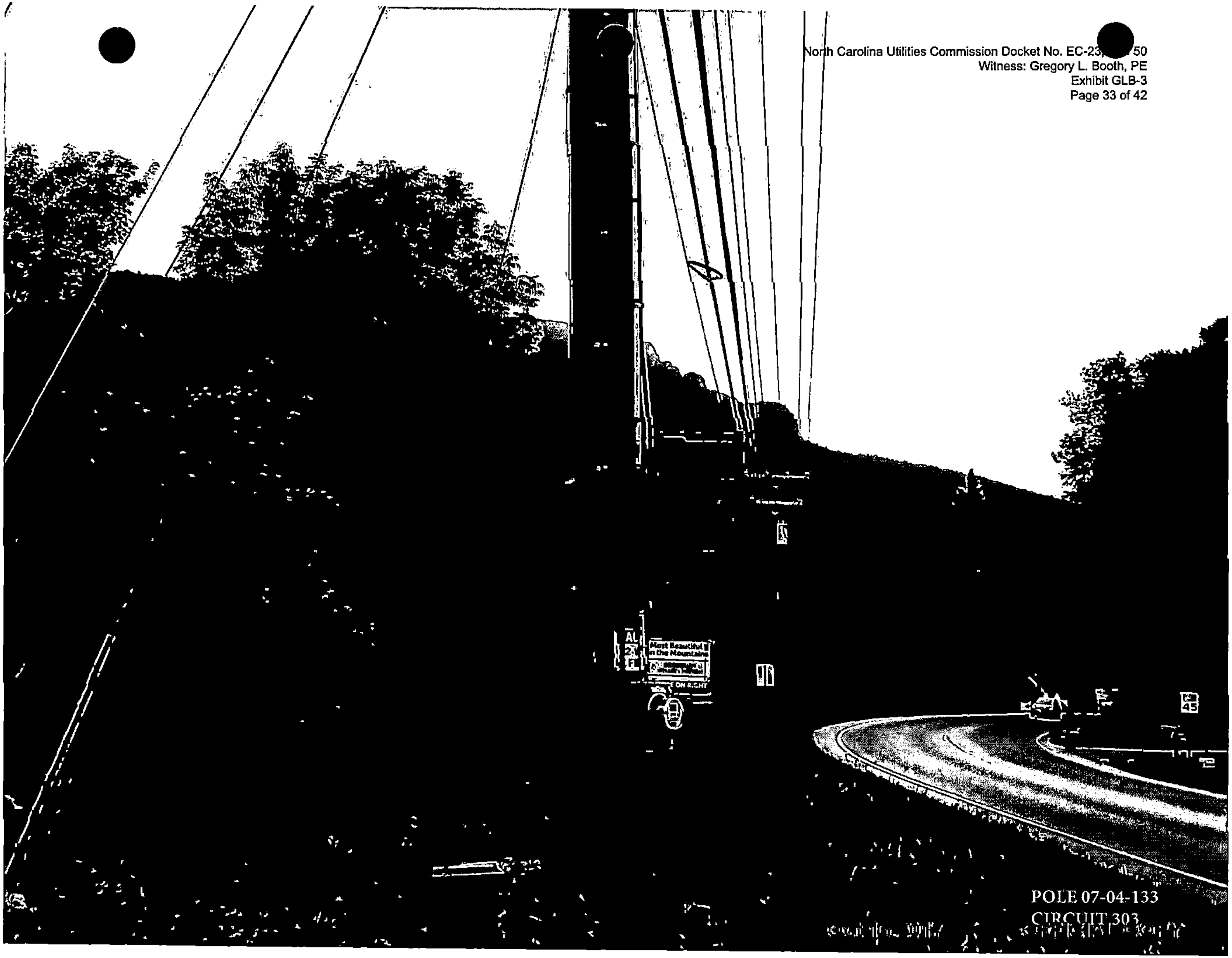

TPOST
Firearms
&
Reloader
Supplies
13'0"
POLE 22-09-003
Oct 16 2017
OFFICIAL COPY


POLE 06-12-030
CIRCUIT 112


POLE 16-04-032
Oct 16 2017


9'4"
POLE 16-04-032
CIRCUIT 293

SECTION E: Climbing Impediments


Most Beautiful in the Mountains
ON RIGHT
45
POLE 07-04-133
CIRCUIT 303

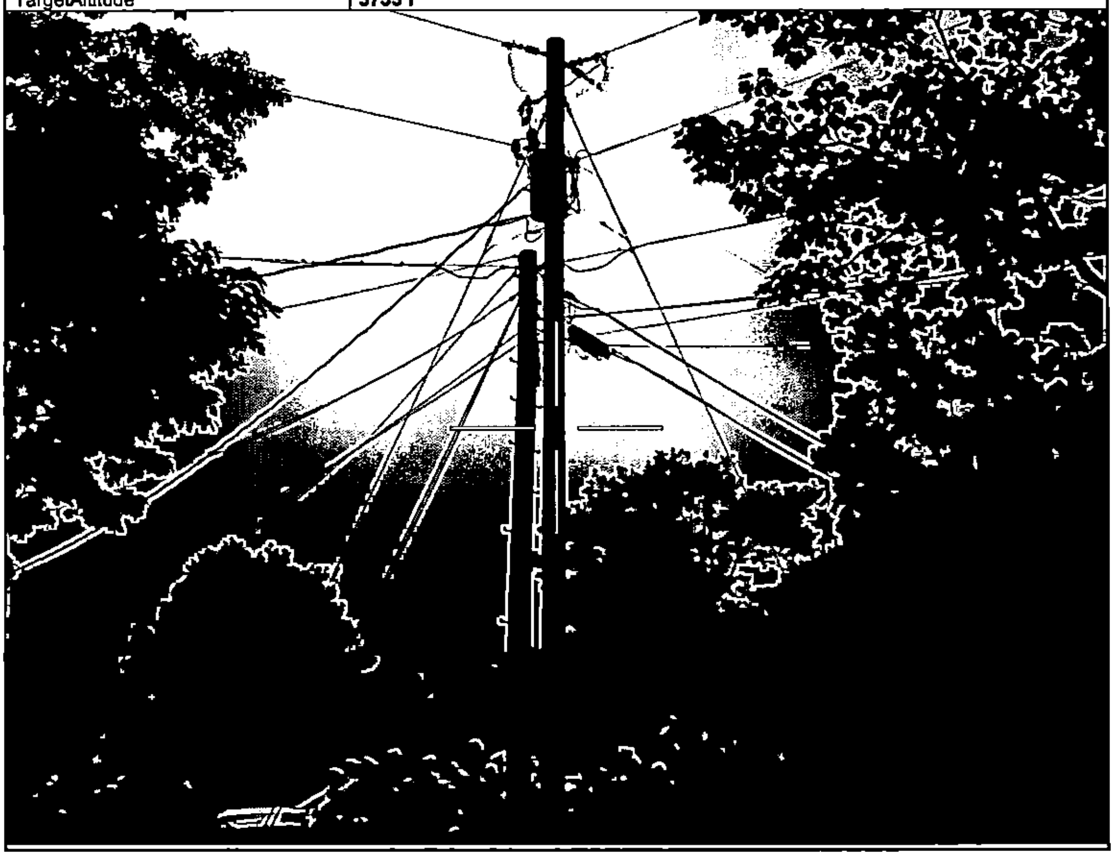

alpha
POLE 05-07-283
CIRCUIT 201
Oct 16 2017

POLE 05-07-261
CIRCUIT 201

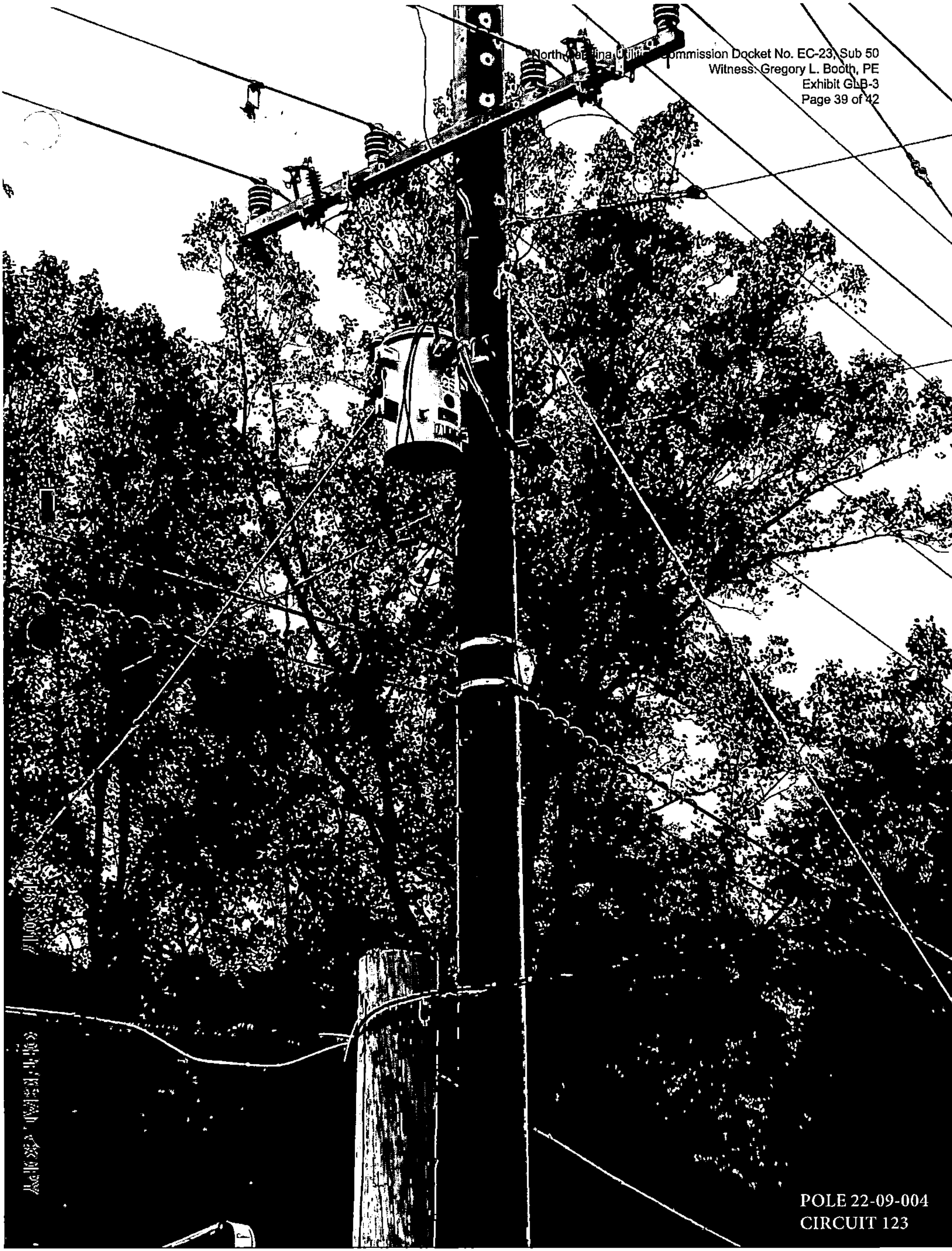

POLE 05-07-120
CIRCUIT 201

SECTION F: Failure To Transfer Pole Attachments

True Size Pole	
Date	2017-08-23
Year	2017
Month	08
Day	23
Time	09:21:24
Hour	09
Minute	21
ImageFilename	True Size Pole_G100849_20170823_092124.jpg
GpsFix	SBAS+
Pdop	1.9
Distance	57'3"
TrueBearing	301.8°
TargetLatitude	36.121264913°
TargetLongitude	-81.668955290°
TargetAltitude	3733'7"



Text	Pole 05 07 166. Charter attached to old pole. Guy anchors are too close together.


POLE 22-09-004
CIRCUIT 123


Oct 16 2017

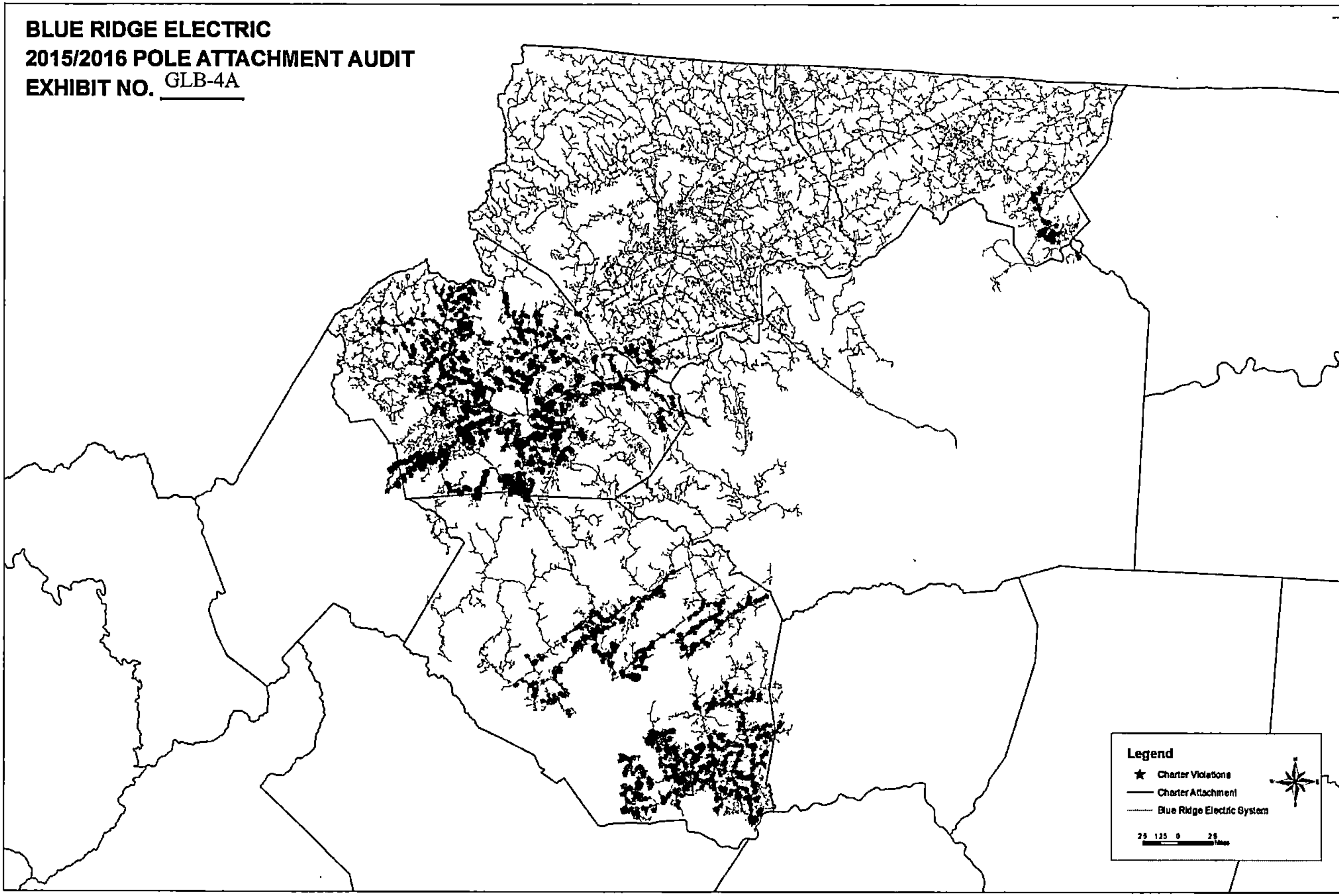

POLE 07-09-029
CIRCUIT 112


POLE 11-01-041
CIRCUIT 112

I/A

EXHIBIT GLB-4A

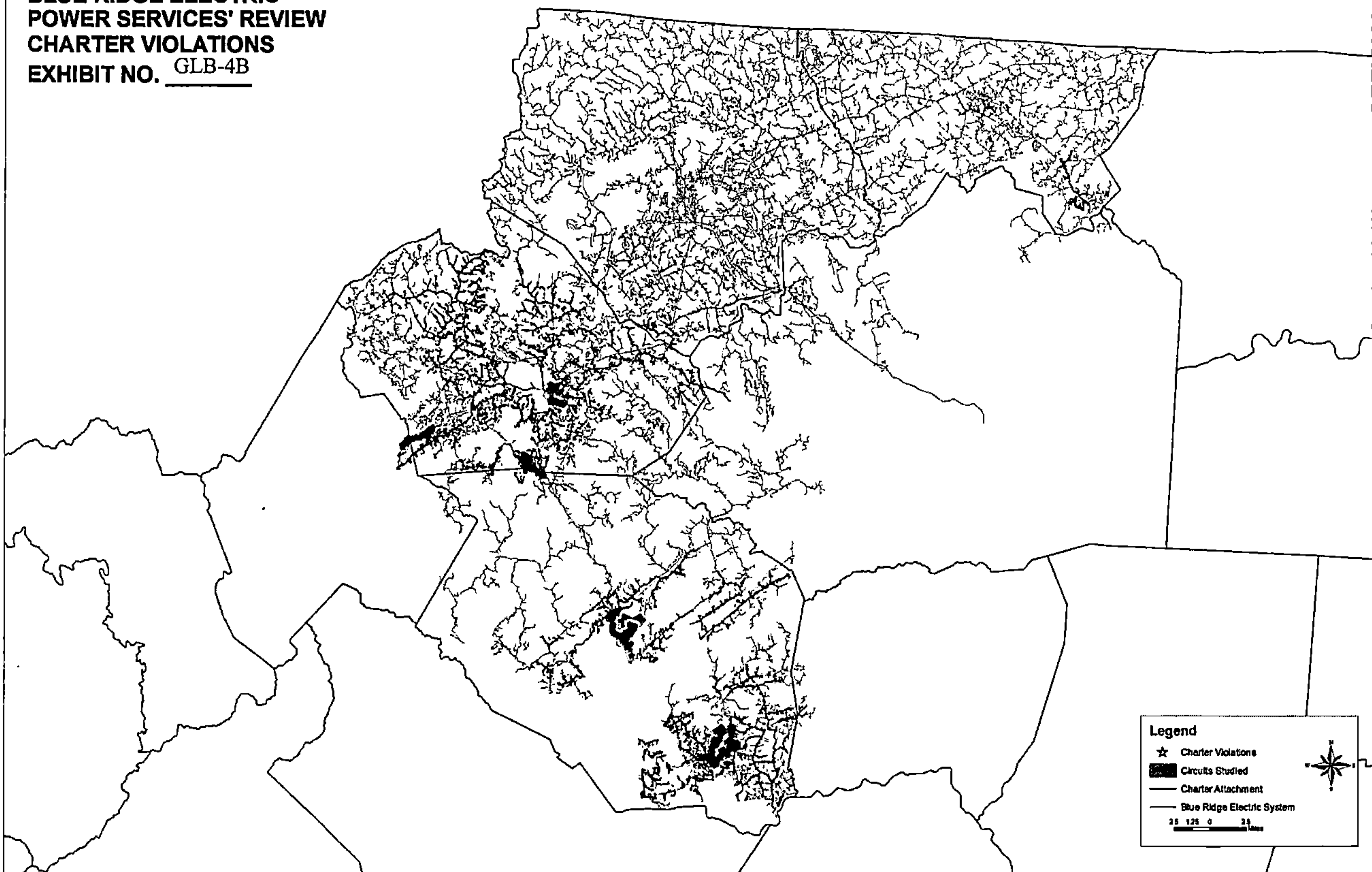
BLUE RIDGE ELECTRIC
2015/2016 POLE ATTACHMENT AUDIT
EXHIBIT NO. GLB-4A



I/A

EXHIBIT GLB-4B

BLUE RIDGE ELECTRIC
POWER SERVICES' REVIEW
CHARTER VIOLATIONS
EXHIBIT NO. GLB-4B



I/A

EXHIBIT GLB-5

Blue Ridge EMC
Pole Inventory Summary
10/11/2017

File Photo ID		Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day	1	1,2,3	112	Pole 06-11-178	x		x			
Day	1	5,6	112	Pole 06-11-378	x		x			
Day	1	7,8	112	Pole 06-11-182	x					
Day	1	9	112	Pole 06-11-183	x					
Day	1	10, 11, 12	112	Pole 06-11-184	x					
Day	1	13	112	Pole 06-11-185	x					
Day	1	14, 15, 16	112	Pole 06-12-029	x					
Day	1	17, 18, 19	112	Pole 06-12-083	x		x			
Day	1	20,21,22,23,24	112	Pole 06-11-188	x		x			
Day	1	25,26	112	Pole 06-12-022	x					
Day	1		112	Pole 06-12-023	x					
Day	1	27,28,29	112	Pole 06-12-252						x
Day	1	30,31,32	112	Pole 06-12-020	x					
Day	1	33,34	112	Pole 06-12-024		x				
Day	1	35,36	112	Pole 06-12-025		x				
Day	1	37,38,39	112	Pole 06-12-190	x					
Day	1	40,41,42	112	Pole 06-12-026		x				
Day	1		112	Pole 06-12-027	x					
Day	1	43,44,45	112	Pole 06-12-189	x					
Day	1	46,47,48	112	Pole 06-12-206	x					
Day	1	49,50,51	112	Pole 06-12-032	x					
Day	1	52,53	112	Pole 06-12-031						x
Day	1	54,55,56	112	Pole 06-12-204	x					
Day	1	57,80	112	Pole 06-12-030					x	
Day	1	58,59,60,61	112	Pole 06-12-033		x				
Day	1	62,63	112	Pole 06-12-053	x					
Day	1	81,82	112	Pole 06-12-052	x	x				
Day	1	64,65,66	112	Pole 06-12-034	x		x			
Day	1	67,68,69	112	Pole 06-12-035	x					
Day	1	70,71,72,73	112	Pole 06-12-044	x					
Day	1		112	Pole 06-12-045		x				
Day	1	74,75,76	112	Pole 06-12-253	x					
Day	1	77,78,79	112	Pole 06-12-046	x		x			
Day	2	1,2,3	112	Pole 06-12-058	x	x				
Day	2	4,5,6	112	Pole 06-12-102	x					
Day	2	7,8,9	112	Pole 06-12-059	x	x				
Day	2	10,11,12	112	Pole 06-12-092	x	x				
Day	2	13,14,15	112	Pole 06-12-086	x	x				
Day	2	16,17,18	112	Pole 06-12-060	x	x				
Day	2	19,20	112	Pole 06-12-061		x				
Day	2	21,22,23	112	Pole 06-12-087	x	x				
Day	2	24,25,26	112	Pole 06-12-244	x	x				
Day	2	27,28,29,30	112	Pole 06-12-093	x		x			
Day	2	31,32,33	112	Pole 06-12-245	x	x				
Day	2	34,35,36	112	Pole 06-12-181	x	x				
Day	2	37,38,39	112	Pole 06-12-182	x	x				
Day	2	40,41	112	Pole 06-12-184		x				
Day	2	42,43,44	112	Pole 06-12-237	x					
Day	2	45,46,47	112	Pole 06-12-236	x					
Day	2	48,49,50,51	112	Pole 07-09-181			x			
Day	2	52,53,54	112	Pole 06-12-063	x					
Day	2	55,56,57	112	Pole 06-12-146	x					
Day	2	58,59,60	112	Pole 06-12-147	x					
Day	2	61,62,108,109	112	Pole 06-12-174	x	x				
Day	2	63,64,65,66	112	Pole 06-12-202	x					
Day	2	67,68	112	Pole 06-12-175						x
Day	2	69,70,71	112	Pole 06-12-176	x	x	x			
Day	2	72,73,74,75,76	112	Pole 06-12-177	x	x	x			
Day	2	77,78,79	112	Pole 06-12-203	x					
Day	2	80,81,82,83	112	Pole 06-12-104	x	x				
Day	2	84,85,86	112	Pole 10-04-104		x				
Day	2	87,88,89	112	Pole 10-04-101	x	x				
Day	2	90,91,92	112	Pole 10-04-134	x	x				
Day	2	93,94,95	112	Pole 10-04-173	x	x				
Day	8	1,2,3,4,5	112	Pole 10-04-114	x		x			
Day	2	99,100,101,102	112	Pole 10-04-090	x	x	x			
Day	2	103,104	112	Pole 10-04-167	x	x				
Day	2	105,106,107	112	Pole 10-04-168	x					
Day	2	108,109,110	112	Pole 10-04-092		x				
Day	2	111,112,113	112	Pole 10-04-094	x	x				
Day	2	114,115	112	Pole 11-01-133	x	x				
Day	8	6,7,8,9	112	Pole 10-04-095	x	x	x			
Day	2	118,119,120	112	Pole 11-01-100	x	x				

File Photo ID	Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day 2	121,122,123	112	Pole 11-01-101	x	x				
Day 2	124,125,126	112	Pole 11-01-054	x	x				
Day 2	127,128,129,130	112	Pole 11-01-035	x		x			
Day 2	131,132,133,134	112	Pole 11-01-102	x		x			
Day 2	135,136	112	Pole 11-01-020		x				
Day 2	137,138	112	Pole 11-01-024	x	x				
Day 2	139,140,141	112	Pole 10-04-098	x	x				
Day 2		112	Pole 10-04-097	x					
Day 2	142,143,144,145	112	Pole 11-01-016	x	x				
Day 2	146,147,148,149	112	Pole 11-01-050	x	x	x			
Day 2	150,151,152,153	112	Pole 11-01-051	x					
Day 2	154,155,156,157	112	Pole 11-01-056	x	x	x			
Day 2	158,159,160	112	Pole 11-01-057	x	x				
Day 2		112	Pole 11-01-058	x					
Day 2	161,162	112	Pole 11-01-060	x	x				
Day 2		112	Pole 11-01-069	x	x				
Day 2	163,164,165	112	Pole 11-01-070	x	x				
Day 2	166,167,168	112	Pole 11-01-095	x	x				
Day 2	169,170	112	Pole 11-01-071	x	x				
Day 2	171,172,173	112	Pole 11-01-072	x	x				
Day 2	174,175,176	112	Pole 10-04-136	x	x				
Day 2	177,178,179	112	Pole 10-04-137	x	x				
Day 8	10,11,12,13	112	Pole-10-04-139	x	x				
Day 2	183,184,185	112	Pole 10-04-140	x	x				
Day 2	186,187,188	112	Pole 10-04-138	x	x				
Day 2-Camera	1,2,3,4	112	Pole 06-12-197	x	x				
Day 2-Camera	5,6,7	112	Pole 06-12-198	x	x				
Day 2-Camera	8,9,10	112	Pole 06-12-149	x					
Day 2-Camera	11,12,13	112	Pole 06-12-150	x					
Day 2-Camera	14,15,16,17	112	Pole 07-09-052	x	x				
Day 2-Camera	18,19,20	112	Pole 07-09-168	x	x				
Day 2-Camera	21,22,23,24	112	Pole 07-09-046	x	x	x			
Day 2-Camera	25,26,27,28	112	Pole 07-09-045	x	x				
Day 2-Camera	29,30,31	112	Pole 07-09-190	x	x				
Day 2-Camera	32,33,34	112	Pole 07-09-144	x	x				
Day 2-Camera	35,36,37	112	Pole 07-09-067	x	x				
Day 2-Camera	38,39,40,41	112	Pole 07-09-079	x	x				
Day 2-Camera	42,43,44	112	Pole 07-09-041	x		x			
Day 2-Camera		112	Pole 07-09-080	x	x				
Day 2-Camera	45,46	112	Pole 07-09-040		x				
Day 2-Camera	47,48,49	112	Pole 07-09-059		x				
Day 2-Camera	50,51,52	112	Pole 07-09-042	x	x				
Day 2-Camera	53,54,55	112	Pole 07-09-073		x				
Day 2-Camera	56,57,58	112	Pole 07-09-084	x					
Day 2-Camera	59,60,61	112	Pole 07-09-043	x					
Day 2-Camera	62,63,64	112	Pole 07-09-071	x	x				
Day 2-Camera	65,66,67	112	Pole 07-09-072	x	x				
Day 2-Camera	68,69,70	112	Pole 07-09-075	x	x				
Day 2-Camera	71,72,73	112	Pole 07-09-081	x	x				
Day 2-Camera	74,75,76	112	Pole 07-09-083	x		x			
Day 2-Camera	77,78,79,80	112	Pole 07-09-090	x	x				
Day 2-Camera	81,82,83	112	Pole 07-09-091	x	x				
Day 2-Camera	84,85,86	112	Pole 07-09-092	x	x				
Day 2-Camera	87,88	112	Pole 07-09-093	x	x				
Day 2-Camera	89,90	112	Pole 07-09-094	x	x				
Day 2-Camera	91,92	112	Pole 06-12-199		x				
Day 2-Camera	94,95,96	112	Pole 06-12-142	x					
Day 2-Camera	97,98,99,100	112	Pole 06-12-163	x	x	x			
Day 2-Camera	101,102,103,104	112	Pole 06-12-164		x	x			
Day 2-Camera	105,106,107	112	Pole 06-12-170		x				
Day 3	1,2,3,4	112	Pole 11-01-015	x	x				
Day 8	14,15,16,17	112	Pole 11-01-066	x	x				
Day 3	10,11,12	112	Pole 11-01-052	x	x				
Day 3	13,14,15	112	Pole 11-01-053	x					
Day 3	16,17,18	112	Pole 11-01-084	x	x				
Day 3	19,20,21,22	112	Pole 11-01-085	x	x				
Day 3	23,24,25,26	112	Pole 11-01-086	x	x				
Day 3	27,28,29,30	112	Pole 11-01-087	x	x				
Day 3	31,32,33	112	Pole 11-01-088		x	x			
Day 8	18,19,20	112	Pole 11-01-089	x					
Day 8	21,22,23,24	112	Pole 11-01-098	x	x				
Day 3	40,41,42	112	Pole 11-01-090	x					
Day 3	43,44,45	112	Pole 11-01-091	x	x				
Day 3		112	Pole 11-01-093	x					
Day 3	46,47,48,49	112	Pole 10-04-127	x	x				
Day 3	50,51,52	112	Pole 10-04-128		x				
Day 3	53,54,55	112	Pole 11-01-131	x					
Day 3	56,57,58	112	Pole 10-04-131	x					
Day 3	59,60,61	112	Pole 11-01-014	x					

File Photo ID		Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day	3	62,63,64	112	Pole 11-01-013	x					
Day	3	65,66,67	112	Pole 11-01-094	x					
Day	3	68,69,70,71	112	Pole 11-01-097	x					
Day	3	72,73,74	112	Pole 11-01-103	x					
Day	3	75,76,77	112	Pole 11-01-004	x					
Day	3	78,79,80	112	Pole 11-01-003	x	x				
Day	3	81,82,83	112	Pole 11-01-002		x				
Day	3		112	Pole 11-05-120	x					
Day	3	84,85	112	Pole 11-05-012		x				
Day	3	86,87	112	Pole 11-05-011		x				
Day	3		112	Pole 11-05-010	x					
Day	3	88,89,90,91	112	Pole 11-05-064	x	x	x			
Day	3	92,93,94,95	112	Pole 11-05-043	x		x			
Day	3	96,97,98	112	Pole 11-05-060		x				
Day	3	99,100,101,102	112	Pole 11-05-061	x	x	x			
Day	3	103,104,105,106	112	Pole 11-05-063	x	x	x			
Day	3		112	Pole 11-05-009	x					
Day	8	25,26,27,28	112	Pole 11-05-008	x					
Day	3	110,111,112	112	Pole 11-05-062	x	x	x			
Day	3	113,114,115	112	Pole 11-05-056	x					
Day	3	116,117,118	112	Pole 11-05-077	x	x				
Day	3	119,120,121	112	Pole 11-05-076	x	x				
Day	3	122,123,124	112	Pole 11-05-079	x	x				
Day	8	29,30,31,32	112	Pole 11-05-080	x	x				
Day	3	126,127,128	112	Pole 11-05-078	x	x				
Day	3	129,130,131	112	Pole 11-05-037	x					
Day	3		112	Pole 11-05-013	x					
Day	3	132,133,134,135	112	Pole 11-05-081	x	x	x			
Day	3	136,137,138,139	112	Pole 11-05-083	x	x	x			
Day	3	140,141,142,143	112	Pole 11-05-085	x					
Day	3	144,145	112	Pole 11-05-091	x	x				
Day	3	146,147,148	112	Pole 11-05-015	x	x				
Day	3	149,150	112	Pole 11-05-100	x	x				
Day	3	151,152,153	112	Pole 11-05-016	x					
Day	3	154,155,156	112	Pole 11-05-017	x	x				
Day	3	157,158,159	112	Pole 11-05-093	x					
Day	3	160,161,162	112	Pole 11-05-018	x					
Day	3	163,164,165,166	112	Pole 11-05-019	x		x			
Day	3	167,168,169	112	Pole 11-05-052	x					
Day	3	170,171,172,173	112	Pole 11-05-088	x		x			
Day	8	33,34,35,36	112	Pole 11-05-089	x					
Day	3	177,178	112	Pole 11-05-117	x					
Day	8	37,38,39,40,41	112	Pole 11-05-020	x	x	x			
Day	3	184,185,186,187	112	Pole 11-05-057	x	x	x			
Day	3	188,189,190	112	Pole 11-05-097	x					x
Day	3	191,192,193,194	112	Pole 11-05-058	x	x	x			
Day	3	195,196,197	112	Pole 11-05-033	x	x				
Day	8	42,43,44,45	112	Pole 11-05-034	x	x				
Day	3	201,202,203	112	Pole 11-05-111		x				
Day	3	204,205,206	112	Pole 11-05-086		x				
Day	3	207,208	112	Pole 11-05-059	x					
Day	3	209,210	112	Pole 11-05-096	x	x				
Day	3	211,212,213,214	112	Pole 11-05-095	x	x	x			
Day	3	215,216,217	112	Pole 11-05-006	x					
Day	3	218,219,220	112	Pole 11-05-104	x	x				
Day	3	221,222,223	112	Pole 11-05-001	x					
Day	3	224,225,226,227	112	Pole 11-06-140	x	x				
Day	3	228,229,230,231	112	Pole 11-06-028	x					
Day	3	232,233	112	Pole 11-06-039	x	x				
Day	3	234,235,236	112	Pole 11-06-061	x		x			
Day	3	237,238,239,240	112	Pole 11-06-137	x	x				
Day	3	241,242,243	112	Pole 11-06-038	x					
Day	3		112	Pole 11-06-141	x		x			
Day	3	244,245,246,247	112	Pole 11-06-078	x					
Day	3	248,249,250	112	Pole 11-06-077	x		x			
Day	3	251,252,253	112	Pole 11-06-011	x					
Day	3	254,255,256,257	112	Pole 11-06-079	x		x			
Day	3	258,259,260	112	Pole 11-06-012	x		x			
Day	8	46,47,48,49	112	Pole 11-06-055	x					
Day	3	264,265	112	Pole 11-06-145	x					
Day	3	266,267	112	Pole 11-06-146	x	x				
Day	3	268,269,270	112	Pole 11-06-147	x	x	x			
Day	3	271,272,273,274	112	Pole 11-06-148	x	x	x			
Day	3	275,276,277,278	112	Pole 11-06-013	x	x				
Day	4	1,2,3	112	Pole 11-06-034	x	x	x			
Day	4	4,5,6,7,8	112	Pole 11-06-111	x	x				
Day	4	9,10	112	Pole 11-06-035	x	x				
Day	4	11	112	Pole 11-06-036	x	x				
Day	4	12,13	112	Pole 11-06-010						x
Day	4	14,15,16	112	Pole 11-06-082	x	x				
Day	4	17,18,19	112	Pole 11-06-083	x	x	x			
Day	4	20,21,22	112	Pole 11-06-008	x	x				
Day	4	23,24,25	112	Pole 11-06-007		x				
Day	4	29,30,31	112	Pole 11-06-005	x		x			

File Photo ID		Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day	4	32,33,34	112	Pole 11-06-045	X					
Day	4	35,36,37	112	Pole 11-06-100	X	X	X			
Day	4	38,39,40	112	Pole 11-06-101	X					
Day	4	41,42,43	112	Pole 11-06-070		X				
Day	4	44,45,46,47	112	Pole 11-06-071	X					
Day	4	48,49,50	112	Pole 11-06-104		X				
Day	4	51,52,53	112	Pole 11-06-105	X	X				
Day	4	54,55,56	112	Pole 11-06-073	X		X			
Day	4	57,58,59,60	112	Pole 11-02-027	X		X			
Day	4	61,62	112	Pole 11-02-007	X	X	X		X	
Day	4	63,64,65	112	Pole 11-02-153	X	X				
Day	4	66,67,68,69	112	Pole 11-02-174	X		X			
Day	4	70,71,72,73	112	Pole 11-01-081		X	X			
Day	4	74,75,76,77	112	Pole 11-02-008	X		X			
Day	4	78,79,80,81	112	Pole 11-02-069		X				
Day	4	84,85,86	112	Pole 11-02-009	X	X				
Day	4	82,83	112	Pole 11-02-010	X	X				
Day	4	281,282,283	112	Pole 11-02-084	X	X				
Day	4	87,88,89	112	Pole 11-02-017	X	X				
Day	4	90,91,92,93	112	Pole 11-02-138	X		X			
Day	4	94,95	112	Pole 11-01-080	X					
Day	4	96,97,98	112	Pole 11-01-108	X	X				
Day	4	99,100,101,102	112	Pole 11-01-030	X		X			
Day	4	103,104,105,106,107	112	Pole 11-02-137	X	X	X			
Day	4	108,109,110	112	Pole 11-02-136	X	X				
Day	4	111,112,113	112	Pole 11-02-016	X					
Day	4	114,115,116,117	112	Pole 11-02-102	X					
Day	4	127,128	112	Pole 11-02-020		X				
Day	4	118,119,120	112	Pole 11-02-103	X		X			
Day	4	121,122	112	Pole 11-02-104	X					
Day	4	123,124,125,126	112	Pole 11-02-119	X		X			
Day	4	129,130	112	Pole 11-02-021		X				
Day	4	131,132,133	112	Pole 11-02-022	X					
Day	4	134,135,136	112	Pole 11-02-023	X					
Day	4	137,138,139	112	Pole 11-02-089		X				
Day	4	144,145,146,147	112	Pole 11-02-024	X	X				
Day	4	148,149,150,151	112	Pole 11-02-148	X					
Day	4	152,153,154,155	112	Pole 11-02-029	X		X			
Day	4	156,157,158,159	112	Pole 11-02-030	X	X				
Day	4		112	Pole 11-02-031	X	X				
Day	4	160,161,162,163	112	Pole 11-02-032	X					
Day	4	164,165	112	Pole 11-02-091	X	X				
Day	4	166,167	112	Pole 11-02-092	X	X				
Day	4	168,169	112	Pole 11-02-074	X	X				
Day	4	170,171,172	112	Pole 11-02-033	X	X				
Day	4	173,174,175	112	Pole 11-02-038	X	X				
Day	4	176,177,178	112	Pole 11-02-140	X	X				
Day	4	179,180,181,182	112	Pole 11-02-141	X					
Day	8	50,51,52,53	112	Pole 11-01-129	X	X				
Day	4	186,187,188	112	Pole 11-01-041						X
Day	4	189,190	112	Pole 11-01-105		X				
Day	4	191,192,193,194	112	Pole 11-01-040						X
Day	4	195,196,197	112	Pole 11-01-126	X	X				
Day	4	198,199,200	112	Pole 11-01-138						X
Day	4	201,202	112	Pole 11-01-062	X	X				
Day	4	203,204,205,206	112	Pole 11-01-036						X
Day	4	207,208	112	Pole 11-01-037		X				
Day	4	209,210,211	112	Pole 11-01-127		X				
Day	4	212,213,214,215	112	Pole 07-09-106	X		X			
Day	4	216,217,218	112	Pole 11-01-128	X	X				
Day	4	219,220,221,222	112	Pole 07-09-136	X	X	X			
Day	4	223,224,225	112	Pole 07-09-137	X	X				
Day	4	226,227,228	112	Pole 07-09-095	X	X				
Day	4	229,230,231,232,233	112	Pole 07-09-025	X	X	X			
Day	4	234,235,236,237	112	Pole 11-02-037						X
Day	4		112	Pole 11-02-107	X	X				
Day	4	238,239	112	Pole 11-02-129	X	X				
Day	4	240,241	112	Pole 11-02-039	X	X				
Day	4	242,243	112	Pole 11-02-130	X	X				
Day	4	244,245,246	112	Pole 11-02-131	X	X				
Day	4	247,248,249	112	Pole 11-02-132	X	X				
Day	4	250,251,252	112	Pole 11-02-133	X					
Day	4	253,254,255,256	112	Pole 11-02-171	X	X				
Day	4	257,258,259,260	112	Pole 11-02-172	X	X				
Day	4	261,262,263,264,265	112	Pole 11-01-027	X	X				
Day	4	266,267,268,269,270	112	Pole 11-01-028	X	X				
Day	4	271,272,273	112	Pole 11-02-178	X	X				
Day	4	274,275,276,277	112	Pole 11-02-042						X
Day	4	278,279,280	112	Pole 11-02-070	X	X				
Day	5	1,2,3	112	Pole 07-09-189	X	X				
Day	5	4,5,6	112	Pole 07-09-188	X					
Day	5	7,8,9,10	112	Pole 07-09-142	X	X				
Day	5	11,12,13,14,15	112	Pole 07-09-118	X					
Day	5	16,17,18,19	112	Pole 07-09-139		X				

File Photo ID		Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day	5	20,21,22,23	112	Pole 07-09-152	x	x				
Day	5	24,25,26,27	112	Pole 07-09-121	x	x				
Day	5	28,29,30,31	112	Pole 07-09-125	x					
Day	5	32,33,34,35	112	Pole 07-09-122	x	x				
Day	5	36,37,38	112	Pole 07-09-028	x	x				
Day	5	39,40,41	112	Pole 07-09-145	x					
Day	5	42,43	112	Pole 07-09-060	x	x				
Day	5	44,45,46	112	Pole 07-09-029						x
Day	5	47,48,49,50	112	Pole 07-09-031	x	x				
Day	5	51,52	112	Pole 07-09-032	x	x				
Day	5	53,54,55,56	112	Pole 07-09-033	x	x	x			
Day	5	57,58,59,60	112	Pole 07-09-133	x	x				
Day	5	61,62,63	112	Pole 07-09-087	x	x				
Day	5	64,65,66	112	Pole 07-09-034	x	x				
Day	5	67,68,69,70,71	112	Pole 07-09-035	x		x			
Day	5	72,73,74	112	Pole 11-02-047	x					
Day	5	75,76,77,78	112	Pole 11-02-122	x					
Day	5	79,80	112	Pole 11-02-121	x	x				
Day	5	81,82,83	112	Pole 11-02-071		x				
Day	5	84,85,86	112	Pole 11-02-127	x					
Day	5	87,88,89	112	Pole 11-02-072	x	x				
Day	5	90,91,92,93	112	Pole 11-02-128	x	x				
Day	5	94,95,96	112	Pole 11-02-075	x	x				
Day	5	97,98	112	Pole 11-02-076	x	x				
Day	5	99,100	112	Pole 11-02-077		x	x			
Day	5	101,102,103,104	112	Pole 11-02-173	x	x	x			
Day	5	105,106,107	112	Pole 11-02-045	x	x				
Day	5	108,109	112	Pole 11-02-162	x	x				
Day	5	110,111	112	Pole 11-02-044						x
Day	5	112,113,114	112	Pole 11-02-043	x	x				
Day	5	115,116,117,118	123	Pole 22-06-115	x					
Day	5	119,120,121	123	Pole 22-07-030						x
Day	5	122,123,124	123	Pole 22-03-055	x	x				
Day	5	125,126,127	123	Pole 22-03-066		x				
Day	5	128,129,130,131	123	Pole 22-03-054		x				
Day	5	132,133,134,135,136	123	Pole 22-06-001	x	x				
Day	5	141,142,143,144	123	Pole 22-06-138	x					
Day	5	145,146,147	123	Pole 22-06-002	x	x				
Day	5	148,149,150	123	Pole 22-07-031	x	x				
Day	5	151,152,153,154,155	123	Pole 22-07-032			x			
Day	5	156,157,158,159	123	Pole 22-07-033	x	x				
Day	5	160,161,162,163	123	Pole 22-07-034						x
Day	5	164,165,166,167	123	Pole 22-07-035	x					
Day	5	168,169	123	Pole 22-07-036						x
Day	5	170,171,172,173	123	Pole 22-07-038	x	x				
Day	5	174,175,176	123	Pole 22-07-012	x	x				
Day	5	177,178,179	123	Pole 22-07-017	x					
Day	5	180,181,182,183	123	Pole 22-07-013	x	x				
Day	5	184,185,186	123	Pole 22-06-091	x					
Day	5	187,188	123	Pole 22-06-012						x
Day	6	1,2,3,4	123	Pole 22-06-017	x					
Day	6	5,6,7	123	Pole 22-06-018	x					
Day	6	8,9,10,11	123	Pole 22-06-023	x					
Day	6	12,13,14,15,16	123	Pole 22-06-126	x	x				
Day	6	17,18,19	123	Pole 22-06-127	x	x				
Day	6	20,21,22,23	123	Pole 22-06-019	x					
Day	6	24,25,26,27	123	Pole 22-06-020	x					
Day	6	28,29,30	123	Pole 22-06-128	x	x				
Day	6	31,32	123	Pole 22-06-110	x					
Day	6	33,34	123	Pole 22-06-033	x					
Day	6	35,36,37	123	Pole 22-06-129	x	x				
Day	6	38,39,40	123	Pole 22-06-065	x					
Day	6	41,42,43	123	Pole 22-06-090	x	x				
Day	6	44,45,46	123	Pole 22-06-035		x				
Day	6	47,48,49,50	123	Pole 22-06-122	x					
Day	6	51,52,53	123	Pole 22-10-069	x	x				
Day	6	54,55,56	123	Pole 22-10-070	x	x				
Day	6	57,58,59,60	123	Pole 22-10-023	x					
Day	6	61,62,63	123	Pole 22-10-045		x				
Day	6	64,65	123	Pole 22-06-031	x	x				
Day	6	66,67	123	Pole 22-06-032	x					
Day	6	68,69,70	123	Pole 22-10-053		x				
Day	6	71,72	123	Pole 22-10-055	x	x				
Day	6	73,74,75	123	Pole 22-10-054	x					
Day	6	76,77,78	123	Pole 22-10-056	x					
Day	6	79,80,81,82	123	Pole 22-10-049	x	x				
Day	6	83,84,85	123	Pole 22-10-050	x	x				
Day	6	86,87,88	123	Pole 22-10-051	x	x				
Day	6	89,90,91,125,126	123	Pole 22-10-001	x	x				
Day	6	92,93	123	Pole 22-06-130	x	x				
Day	6	94,95,96	123	Pole 22-06-131	x	x				
Day	6	97,98,99,100	123	Pole 22-06-025	x					
Day	6	101,102	123	Pole 22-06-024		x				
Day	6	103,104,105,106	123	Pole 22-06-106	x					

File Photo ID	Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day 6	107,108,109	123	Pole 22-11-042	x	x				
Day 6	110,111,112	123	Pole 22-11-044		x				
Day 6	113,114	123	Pole 22-11-046	x	x				
Day 6	115,116	123	Pole 22-10-012		x				
Day 6	117,118,119	123	Pole 22-10-011		x				
Day 6	120,121	123	Pole 22-10-003	x	x				
Day 6	122,123,124	123	Pole 22-10-002	x	x				
Day 6	127,128,129	123	Pole 22-11-045	x	x				
Day 6	130,131,132,133	123	Pole 22-11-093	x					
Day 6	134,135	123	Pole 22-11-049	x					
Day 6	136,137,138	123	Pole 22-11-001		x				
Day 6	139,140,141	123	Pole 22-11-036	x					
Day 6	142,143	123	Pole 22-11-050	x					
Day 6	144,145	123	Pole 22-11-037	x	x				
Day 6	146,147	123	Pole 22-11-038	x	x				
Day 6	148,149,150	123	Pole 22-11-039	x	x				
Day 6	151,152,153	123	Pole 22-11-040						x
Day 6	154,155,156	123	Pole 22-11-034	x	x				
Day 6	157,158,159	123	Pole 22-11-051	x	x				
Day 6	160,161,162,163	123	Pole 22-11-053	x	x				
Day 6	164,165,166,167	123	Pole 22-11-054	x					
Day 6	168,169	123	Pole 22-11-055	x	x				
Day 6	170,171,172	123	Pole 22-11-041	x	x				
Day 6	173,174,175,176	123	Pole 22-11-064	x	x				
Day 6	177,178	123	Pole 22-11-065	x	x				
Day 6	179,180,181	123	Pole 22-11-066	x	x				
Day 6	182,183,184	123	Pole 22-11-067	x	x				
Day 6	185,186,187	123	Pole 22-11-058	x	x				
Day 6	188,189,190	123	Pole 22-11-060	x	x				
Day 6	191,192,193	123	Pole 22-11-061	x	x				
Day 6	194,195,196,197	123	Pole 22-11-082	x	x				
Day 6	198,199,200	123	Pole 22-11-002	x	x				
Day 6	201,202,203	123	Pole 22-11-004	x					
Day 6	204,205	123	Pole 22-11-072	x	x				
Day 6	206,207,208,209	123	Pole 22-11-005	x	x				
Day 6	210,211,212	123	Pole 22-11-080	x	x				
Day 6	213,214	123	Pole 22-11-007	x					
Day 6	215,216,217	123	Pole 22-11-008		x				
Day 6	218,219,220	123	Pole 22-11-006	x					
Day 6	221,222,223,224	123	Pole 22-11-079		x				
Day 6	225,226,227	123	Pole 22-11-009	x	x				
Day 6	228,229,230	123	Pole 22-11-029		x				
Day 6	231,232,233,234	123	Pole 22-11-010	x	x	x			
Day 6	235,236,237	123	Pole 22-11-011		x				
Day 6	238,239,240	123	Pole 22-11-033	x	x				
Day 6	241,242,243	123	Pole 22-11-017	x	x				
Day 6	244,245	123	Pole 22-11-019	x					
Day 6	246,247,248	123	Pole 22-11-030	x	x				
Day 6	249,250,251,252	123	Pole 22-11-018		x				
Day 6	253,254,255,256	123	Pole 22-11-020	x	x				
Day 6	257,258,259,260	123	Pole 22-06-013					x	
Day 6	261,262,263	123	Pole 22-06-056	x					
Day 6	264,265,266	123	Pole 22-06-042	x					
Day 6	267,268,269	123	Pole 22-06-040	x					
Day 6	270,271,272	123	Pole 22-06-016	x					
Day 6	273,274,275,276	123	Pole 22-06-014	x					
Day 6	277,278	123	Pole 22-06-015		x				
Day 6	279,280,281	123	Pole 22-06-112	x	x				
Day 6	282,283,284	123	Pole 22-06-111		x				
Day 7	1,2,3	123	Pole 22-06-041	x					
Day 7	4,5,6,7,8	123	Pole 22-06-081	x	x	x			
Day 7	9,10,11	123	Pole 22-06-021	x	x				
Day 7	12,13,14	123	Pole 22-06-022	x	x				
Day 7	15,16,17,18	123	Pole 22-06-062	x	x				
Day 7	19,20,21	123	Pole 22-06-114	x	x				
Day 7	22,23,24	123	Pole 22-10-067	x	x				
Day 7	25,26,27	123	Pole 22-06-069	x					
Day 7	28,29,30,31	123	Pole 22-10-019	x	x				
Day 7	32,33,34	123	Pole 22-06-082	x	x				
Day 7	35,36,37	123	Pole 22-06-121	x	x				
Day 7	38,39,40	123	Pole 22-06-086	x	x				
Day 7	41,42,43	123	Pole 22-06-089	x	x				
Day 7	49,50,51	123	Pole 22-06-097		x				
Day 7	52,53,54	123	Pole 22-10-042	x	x				
Day 7	55,56,57	123	Pole 22-10-039	x	x				
Day 7	58,59,60	123	Pole 22-10-037	x	x				
Day 7	61,62,63	123	Pole 22-09-001	x					
Day 7	64,65,66	123	Pole 22-09-059	x					
Day 7	67,68,69	123	Pole 22-09-060		x	x			
Day 7	70,71,72	123	Pole 22-10-033	x					
Day 7	73,74,75	123	Pole 22-10-034	x					
Day 7	76,77,78	123	Pole 22-10-035	x					
Day 7		123	Pole 22-10-038	x					
Day 7	79,80,81	123	Pole 22-10-041	x					

File Photo ID	Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day 7	82,83,84,85	123	Pole 22-10-043	X					
Day 7	86,87,88	123	Pole 22-10-036	X					
Day 7	89,90,91	123	Pole 22-06-134	X					
Day 7	92,93	123	Pole 22-06-059	X					
Day 7	94,95,96	123	Pole 22-06-096						X
Day 7		123	Pole 22-09-003					X	
Day 7	97,98,99	123	Pole 22-09-004						X
Day 7	100,101,102	123	Pole 22-09-005						X
Day 7	103,104,105	123	Pole 22-09-006	X					
Day 7	106,107,108,109	123	Pole 22-09-007	X					
Day 7	110,111,112,113	123	Pole 22-09-010	X					
7	117,118,119	123	Pole 22-01-011	X					
Day 7	114,115,116	123	Pole 22-09-075	X	X				
Day 7	120,121,122	123	Pole 22-09-011	X					
Day 7	123,124,125,126,127	123	Pole 22-09-008	X					
Day 7	128,129,130	123	Pole 22-09-012	X					
Day 7	131,133	123	Pole 29-01-152	X	X				
Day 7	134,135,136	123	Pole 29-01-149	X					
Day 7	137,138,139	123	Pole 22-09-035	X	X				
Day 7	140,141,142	123	Pole 22-09-034	X					
Day 7	143,144,145	123	Pole 22-09-062		X				
Day 7		123	Pole 22-09-038	X				X	
Day 7	146,147,148	123	Pole 29-01-168	X	X				
Day 7	149,150,151	123	Pole 29-01-017		X				
Day 7	152,153,154,155	123	Pole 29-01-155	X					
Day 7	156,157,158	123	Pole 29-01-154	X	X				
Day 7	159,160,161	123	Pole 29-01-156	X					
Day 7	162,163,164	123	Pole 29-01-157	X					
Day 7	165,166	123	Pole 29-01-102	X					
Day 7	167,168,169,170	123	Pole 29-01-020	X					
Day 7	171,172,173	123	Pole 29-01-021	X					
Day 7	174,175,176	123	Pole 29-01-106	X	X				
Day 7	177,178,179,180	123	Pole 29-01-103	X	X	X			
Day 7	181,182,183,184	123	Pole 29-01-019	X					
Day 7	185,186,187,188,189	123	Pole 29-01-026	X					
Day 8	54,55,56,57	123	Pole 29-01-022	X					
Day 8	58,59,60	123	Pole 29-01-018	X					
Day 8	61,62,63,64	123	Pole 29-01-220	X	X				
Day 8	65,66,67	123	Pole 29-02-075	X	X				
Day 8	68,69,70,71	123	Pole 29-01-222	X					
Day 8	72,73,74,75	123	Pole 29-01-221	X					
Day 8	76,77,78	123	Pole 29-02-066	X	X				
Day 8	79,80,81	123	Pole 29-02-070						X
Day 8	82,83,84,85	123	Pole 29-02-069	X	X				
Day 8	86,87,88,89	123	Pole 29-02-068	X	X				
Day 8	90,91,92,93,94	123	Pole 29-02-065	X	X				
Day 8	95,96,97	123	Pole 29-02-102	X	X				
Day 8	98,99,100	123	Pole 29-02-076	X	X				
Day 8	101,102,103,104,105	123	Pole 29-02-099	X	X	X			
Day 8	106,107,108	123	Pole 29-02-084	X	X				
Day 8	109,110,111,112	123	Pole 29-02-085	X	X				
Day 8	113,114,115	123	Pole 29-02-086		X				
Day 8	116,117,118,119	123	Pole 29-01-091	X	X	X			
Day 8	120,121,122	123	Pole 29-01-031						X
Day 8	123,124,125	123	Pole 29-01-034	X	X				
Day 8	126,127,128	123	Pole 29-01-032	X	X				
Day 8	129,130,131,152,153	123	Pole 29-01-023	X	X				
Day 8	132,133,134	123	Pole 29-01-125	X	X	X			
Day 8		123	Pole 29-01-126	X					
Day 8	135,136,137	123	Pole 29-01-025	X	X				
Day 8	138,139,140	123	Pole 29-01-100	X	X				
Day 8	141,142,143,144	123	Pole 29-01-101	X	X	X			
Day 8	145,146,147	123	Pole 29-01-227	X	X	X			
Day 8	148,149,150,151	123	Pole 29-01-024	X	X	X			
Day 8	154,156,157	123	Pole 29-01-114	X	X	X			
Day 2	1232, 1233, 1234, 1235, 1236, 1237, 1238	201	Pole 05-07-412	X	X				
Day 3	1300, 1301	201	Pole 05-07-186		X				
Day 3	1425, 1426, 1427, 1428	201	Pole 05-07-130	X	X				
Day 2	1269, 1270, 1271, 1272, 1273	201	Pole 05-07-290		X	X			
Day 3	1395, 1396, 1397	201	Pole 05-07-345			X			
Day 2	1265, 1266, 1267, 1268	201	Pole 05-07-286		X				
Day 3	1412, 1413, 1414, 1415	201	Pole 05-03-016		X	X			
Day 3	1436, 1437, 1438, 1439, 1440	201	Pole 05-07-132	X	X	X			
Day 4	1614, 1615, 1616	201	Pole 05-06-036		X				
Day 5	1639, 1640, 1641, 1642	201	Pole 05-10-180				X		
Day 3	1384, 1385, 1386, 1387, 1388	201	Pole 05-07-192		X	X			
Day 4	1617, 1618, 1619, 1620, 1621	201	Pole 05-06-037	X	X				
Day 3	1389, 1390, 1391	201	Pole 05-07-178		X	X			
Day 2	1249, 1250, 1251, 1252, 1253, 1254, 1255	201	Pole 05-07-283		X		X		X
Day 5	1669, 1670, 1671, 1672	201	Pole 05-06-021	X	X				
Day 3	1364, 1365, 1366, 1367	201	Pole 05-07-200						
Day 3	1504, 1505, 1506	201	Pole 05-07-110		X	X			
Day 2	1217, 1218, 1219, 1220, 1221	201	Pole 05-07-257		X				
Day 3	1401, 1402	201	Pole 05-07-153		X				
Day 3	1490, 1491, 1492	201	Pole 05-07-120	X			X		
Day 3	1392, 1393, 1394	201	Pole 05-07-216			X			
Day 3	1368, 1369, 1370, 1371	201	Pole 05-07-193	X	X				
Day 2	1226, 1227, 1228	201	Pole 05-07-223	X	X				

File Photo ID	Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day 3	1479, 1480, 1481, 1482	201	Pole 05-04-046	x	x	x			
Day 3	1514, 1515, 1516	201	Pole 05-07-114		x				
Day 5	1636, 1637, 1638	201	Pole 05-10-199	x	x				
Day 3	1499, 1500	201	Pole 05-07-108			x			
Day 4	1519, 1520, 1521	201	Pole 05-06-029				x		
Day 4	1568, 1569, 1570, 1571, 1572, 1573, 1574	201	Pole 05-07-126	x	x	x	x		
Day 3	1475, 1476, 1477, 1478	201	Pole 05-04-043	x	x	x			
Day 5	1627, 1628, 1629, 1630	201	Pole 05-10-196			x			
Day 3	1398, 1399, 1400	201	Pole 05-07-300			x			
Day 4	1517, 1518	201	Pole 05-10-189	x	x				
Day 3	1357, 1358, 1359, 1360	201	Pole 05-07-172			x			
Day 3	1493, 1494, 1495, 1496, 1497, 1498	201	Pole 05-07-119		x				
Day 3	1324, 1325, 1326, 1327, 1328	201	Pole 05-07-168	x	x	x			
Day 4	1550, 1551, 1552, 1553	201	Pole 05-07-278		x				
Day 2	1202, 1203, 1204	201	Pole 05-11-388	x	x				
Day 4	1604, 1605, 1606, 1607	201	Pole 05-06-203		x				
Day 3	1483, 1484, 1485, 1486, 1487	201	Pole 05-04-048	x	x	x			
Day 2	1205, 1206, 1207, 1208, 1209	201	Pole 05-11-227	x		x			
Day 2	1289, 1290, 1291	201	Pole 05-10-355	x	x				
Day 2	1194, 1195, 1196, 1197	201	Pole 05-11-224		x				
Day 2	1286, 1287, 1288	201	Pole 05-11-394	x	x				
Day 2	1229, 1230, 1231	201	Pole 05-07-222						x
Day 3	1457, 1458, 1459, 1460	201	Pole 05-04-042	x	x				
Day	1582, 1583, 1584, 1585	201	Pole 05-06-117			x			
Day 3	1469, 1470, 1471	201	Pole 05-04-051	x	x	x			
Day 3	1488, 1489	201	Pole 05-07-121		x				
Day 3	1464, 1465, 1466, 1467, 1468	201	Pole 05-04-050	x	x	x			
Day 3	1329, 1330, 1331, 1332	201	Pole 05-07-169			x			
Day 2	1274, 1275, 1276, 1277, 1279	201	Pole 05-07-291	x	x	x			
Day 2	1292, 1293, 1294, 1295	201	Pole 05-10-356	x	x				
Day 3	1380, 1381, 1382, 1383	201	Pole 05-07-208						
Day 2	1243, 1244, 1245, 1246, 1247, 1248	201	Pole 05-07-327	x	x	x			
Day 5	1676, 1677, 1678, 1679, 1680	201	Pole 05-06-024	x	x				
Day 2	1239, 1240, 1241, 1242	201	Pole 05-07-326						
Day 4	1578, 1579, 1580, 1581	201	Pole 05-06-128	x	x	x			
Day 3	1472, 1473, 1474	201	Pole 05-04-052	x	x				
Day 4	1554, 1555, 1556	201	Pole 05-07-277						x
Day 2	1280, 1281, 1282, 1283, 1284	201	Pole 05-11-228	x	x				
Day 3	1306, 1307, 1308, 1309, 1310, 1311	201	Pole 05-07-261	x	x		x		
Day 2	1261, 1262, 1263, 1264	201	Pole 05-07-285			x			
Day 3	1376, 1377, 1378, 1379	201	Pole 05-07-207		x				
Day 5	1673, 1674, 1675	201	Pole 05-06-022						x
Day 5	1655, 1656, 1657, 1658, 1659, 1660	201	Pole 05-06-027	x	x	x			
Day 3	1312, 1313, 1314, 1315, 1316, 1317, 1318	201	Pole 05-07-166	x	x	x			
Day 4	1608, 1609, 1610	201	Pole 05-06-075			x			
Day 3	1342, 1343, 1344, 1345	201	Pole 05-07-174			x			
Day 3	1346, 1347, 1348, 1349, 1350, 1351	201	Pole 05-07-175			x			
Day 4	1611, 1612, 1613	201	Pole 05-06-077			x			
Day 3	1416, 1417, 1418, 1419	201	Pole 05-03-017		x	x			
Day 3	1441, 1442, 1443, 1444	201	Pole 05-03-020						x
Day 5	1661, 1662, 1663	201	Pole 05-07-294		x	x			
Day 3	1429, 1430, 1431, 1432, 1433, 1434	201	Pole 05-07-131	x	x	x			
Day 5	1651, 1652, 1653, 1654	201	Pole 05-06-008	x	x				
Day 2	1210, 1211, 1212, 1213, 1214, 1215	201	Pole 05-11-366	x	x	x			
Day 2	1222, 1223, 1224, 1225	201	Pole 05-07-259		x				
Day 3	1361, 1362, 1363	201	Pole 05-07-198			x			
Day 4	1526, 1527, 1528	201	Pole 05-06-055			x			
Day 4	1522, 1523, 1524, 1525	201	Pole 05-06-049			x			
Day 4	1532, 1533, 1534	201	Pole 05-06-059				x		
Day 4	1599, 1600, 1601, 1602, 1603	201	Pole 05-06-096	x		x			
Day 4	1594, 1595, 1596, 1597, 1598	201	Pole 05-06-089	x	x				
Day 3	1372, 1373, 1374, 1375	201	Pole 05-07-204			x			
Day 4	1546, 1547, 1548, 1549	201	Pole 05-06-279	x	x				
Day 2	1198, 1199, 1200, 1201	201	Pole 05-11-225	x	x				
Day 3	1333, 1334, 1335, 1336, 1337	201	Pole 05-07-170	x	x				x
Day 5	1647, 1648, 1649, 1650	201	Pole 05-10-176	x					
Day 3	1319, 1320, 1321, 1322, 1323	201	Pole 05-07-165	x		x			
Day 4	1591, 1592, 1593	201	Pole 05-06-061						x
Day 4	1622, 1623, 1624, 1625, 1626	201	Pole 05-06-230	x	x				
Day 2	1256, 1257, 1258, 1259, 1260	201	Pole 05-07-284	x	x				x
Day 3	1404, 1405, 1406, 1407, 1408	201	Pole 05-07-358	x	x				
Day 3	1409, 1410, 1411	201	Pole 05-07-359	x	x				
Day 3	1501, 1502, 1503	201	Pole 05-07-104						x
Day 4	1529, 1530, 1531	201	Pole 05-06-056			x			
Day 4	1541, 1542, 1543, 1544, 1545	201	Pole 05-06-124				x		x
Day 3	1420, 1421, 1422, 1423, 1424	201	Pole 05-07-129	x		x			
Day 4	1586, 1587, 1588, 1589, 1590	201	Pole 05-06-122		x	x			x
Day 3	1453, 1454, 1455, 1456	201	Pole 05-03-003	x	x	x			
Day 3	1461, 1462, 1463	201	Pole 05-04-049	x	x	x			
Day 4	1565, 1566, 1567	201	Pole 05-07-263	x	x				
Day 4	1557, 1558, 1559	201	Pole 05-07-276		x	x			
Day 3	1338, 1339, 1340, 1341	201	Pole 05-07-173			x			x
Day 3	1296, 1297, 1298, 1299	201	Pole 05-07-210	x	x		x		
Day 4	1560, 1561, 1562	201	Pole 05-07-274		x	x			
Day 5	1664, 1665, 1666, 1667, 1668	201	Pole 05-06-020	x	x	x			

File Photo ID	Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day 4	1535, 1536, 1537, 1538	201	Pole 05-06-060		X				
Day 3	1511, 1512, 1513	201	Pole 05-07-112		X				
Day 3	1507, 1508, 1509, 1510	201	Pole 05-07-111	X	X				
Day 2	1188, 1189, 1190, 1191, 1192, 1193	201	Pole 05-11-221	X		X			X
Day 3	1303, 1304, 1305	201	Pole 05-07-179	X			X		X
Day 3	1352, 1353, 1354, 1355, 1356	201	Pole 05-07-171			X			X
Day 3	1445, 1446, 1447, 1448, 1449, 1450, 1451, 1452	201	Pole 05-03-004	X	X	X			X
Day 4	1575, 1576, 1577	201	Pole 05-06-131	X	X	X			
Day 5	1643, 1644, 1645, 1646	201	Pole 05-10-179	X	X				
Day 1	0855, 0856, 0857, 0858	293	Pole 16-04-014	X	X		X		
Day 1	0801, 0802, 0803	293	Pole 17-05-259	X	X				
Day 2	1080, 1081, 1082, 1083, 1084	293	Pole 09-12-122		X	X			
Day 1	0772, 0773, 0774	293	Pole 17-01-257		X				
Day 2	1085, 1087, 1088, 1089	293	Pole 09-12-174	X	X				
Day 2	1176, 1177, 1178, 1179	293	Pole 10-09-125	X	X	X			
Day 2	1050, 1051, 1052	293	Pole 16-04-038		X	X			
Day 1	0816, 0817, 0818	293	Pole 16-04-090		X	X			
Day 2	0981, 0982, 0983, 0984, 0985, 0986, 0988, 0989	293	Pole 16-04-066	X	X	X			
Day 1	0903, 0904	293	Pole 16-08-080		X				
Day 2	1022, 1023, 1024, 1025	293	Pole 16-04-075	X	X	X			
Day 2	1066, 1067, 1068	293	Pole 16-04-097				X		
Day 1	0868, 0869, 0870, 0871	293	Pole 16-04-055			X			
Day 1	0917, 0918, 0919, 0920	293	Pole 16-08-039	X	X				
Day 1	0754, 0755, 0756, 0757	293	Pole 17-01-066	X	X				
Day 2	0973, 0974, 0975, 0976, 0977, 0978, 0979, 0980	293	Pole 16-04-056	X	X	X			
Day 2	0966, 0967, 0968, 0969	293	Pole 16-04-071	X	X				
Day 2	1090, 1091, 1092, 1093	293	Pole 17-01-067	X	X	X			
Day 1	0812, 0813, 0814, 0815	293	Pole 17-01-163						
Day 1	921	293	Pole 16-08-038	X	X				
Day 2	1038, 1039, 1040, 1041	293	Pole 09-12-171		X	X			
Day 1	0797, 0798, 0799, 0800	293	Pole 16-08-063	X	X				
Day 2	1152, 1153, 1154, 1155	293	Pole 10-09-162	X	X	X			
Day 2	1158, 1159	293	Pole 10-09-159	X	X				
Day 2	1109, 1110	293	Pole 10-09-101		X				
Day 1	0819, 0820, 0821	293	Pole 16-04-091	X	X				
Day 2	1119, 1120, 1121, 1122	293	Pole 10-09-104		X	X			
Day 1	0808, 0809, 0810, 0811	293	Pole 17-05-260	X	X				
Day 2	0957, 0958, 0959, 0960, 0961, 0962	293	Pole 16-04-050	X	X	X			
Day 2	1160, 1161, 1162, 1163	293	Pole 10-09-160	X	X				
Day 2	1097, 1098, 1099, 1100	293	Pole 17-01-291	X	X				
Day 2	1123, 1124, 1125, 1126	293	Pole 10-09-105	X	X	X			
Day 2	1056, 1057, 1058	293	Pole 16-04-105	X	X	X			
Day 1	0770, 0771	293	Pole 17-01-008		X				
Day 2	1062, 1063	293	Pole 09-12-125		X				
Day 2	1008, 1009, 1010, 1011	293	Pole 09-12-128		X	X			
Day 1	0863, 0864, 0865, 0866, 0867	293	Pole 16-04-032	X	X			X	
Day 2	1076, 1077, 1078, 1079	293	Pole 09-12-123	X	X				
Day 2	1012, 1013, 1014, 1015, 1016, 1017	293	Pole 09-12-127	X	X	X			
Day 1	0891, 0892	293	Pole 16-08-030		X				
Day 1	0789, 0790, 0791	293	Pole 17-05-003		X				
Day 2	1094, 1095, 1096	293	Pole 17-01-130	X	X				
Day 2	1101, 1102, 1103, 1104, 1105	293	Pole 10-09-085	X	X	X			
Day 2	0990, 0992, 0992	293	Pole 16-04-067	X	X				
Day 1	0746, 0747, 0748, 0749, 0750	293	Pole 17-01-172	X	X	X			
Day 1	0852, 0853, 0854	293	Pole 16-04-054	X	X				
Day 1	0933, 0934, 0935, 0936, 0937	293	Pole 16-08-032	X	X	X			
Day 1	0792, 0793, 0794, 0795	293	Pole 17-05-002	X	X				
Day 1	0758, 0759, 0760	293	Pole 17-01-065	X	X	X			
Day 2	1064, 1065	293	Pole 16-04-096		X				
Day 2	1106, 1107, 1108	293	Pole 10-09-086		X	X			
Day 1	0929, 0930, 0931, 0932	293	Pole 16-08-033	X	X	X			
Day 2	0993, 0994, 0995, 0996	293	Pole 16-04-068		X	X			
Day 2	1117, 1118	293	Pole 10-09-103		X				
Day 1	0886, 0887	293	Pole 16-04-142						
Day 2	1043, 1044, 1045	293	Pole 09-12-172	X	X				
Day 2	1018, 1019, 1020, 1021	293	Pole 09-12-126	X		X			
Day 2	1111, 1112, 1113, 1114, 1115, 1116	293	Pole 10-09-102	X	X	X			
Day 1	0751, 0752, 0753	293	Pole 17-01-007	X	X	X			
Day 1	0785, 0786, 0787, 0788	293	Pole 17-05-004	X	X				
Day 2	1130, 1131, 1132	293	Pole 10-09-211		X				
Day 1	0764, 0765, 0766, 0767	293	Pole 17-01-093	X	X				
Day 1	0822, 0823, 0824, 0825	293	Pole 16-08-065	X	X				
Day 1	0888, 0889, 0890	293	Pole 16-08-029	X	X				
Day 1	0922, 0923, 0924, 0925	293	Pole 16-08-035	X		X			
Day 2	1127, 1128, 1129	293	Pole 10-09-106	X	X				
Day 2	1173, 1174, 1175	293	Pole 10-09-124		X		X		
Day 1	0804, 0805, 0806, 0807	293	Pole 17-05-001						
Day 2	1183, 1184, 1185, 1186, 1187	293	Pole 10-09-127	X	X	X			
Day 2	1168, 1169, 1170, 1171	293	Pole 10-09-123	X	X				
Day 2	0997, 0998, 0999, 1000, 1001, 1002	293	Pole 09-12-130		X	X			
Day 2	1059, 1060, 1061	293	Pole 09-12-124			X			
Day 2	1180, 1181, 1182	293	Pole 10-09-126		X	X			
Day 1	0901, 0902	293	Pole 16-08-031		X				
Day 1	0761, 0762	293	Pole 17-01-092	X	X				
Day 2	1032, 1034, 1035, 1036, 1037	293	Pole 09-12-175			X			
Day 1	0878, 0879, 0880, 0881	293	Pole 16-04-069	X	X				
Day 1	0915, 0916	293	Pole 16-08-040	X	X				
Day 2	1053, 1054, 1055	293	Pole 16-04-040						
Day 2	1069, 1070	293	Pole 16-04-100		X				
Day 1	0829, 2830, 0831	293	Pole 16-08-067			X			
Day 2	0953, 0954, 0955, 0956	293	Pole 16-04-028	X		X			
Day 2	0970, 0971, 0972	293	Pole 16-04-033			X			
Day 2	1046, 1047, 1048, 1049	293	Pole 16-04-049	X	X				X

File Photo ID		Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day	2	1142, 1143, 1144, 1145, 1146	293	Pole 10-09-210		x				
Day	1	0844, 0845, 0846	293	Pole 16-04-017						
Day	2	1156, 1157	293	Pole 10-09-158		x	x			
Day	1	0836, 0837, 0838, 0839	293	Pole 16-04-093	x	x				
Day	1	0832, 0833, 0834, 0835	293	Pole 16-08-068	x	x	x			
Day	2	1148, 1149, 1150, 1151	293	Pole 10-09-121		x	x			
Day	1	0826, 0827 0828	293	Pole 16-08-066						
Day	1	0893, 0894, 0895, 0896, 0897, 0898, 0899, 0900	293	Pole 16-08-075	x	x	x			
Day	2	0950, 0951, 0952	293	Pole 16-04-082	x	x				
Day	1	0847, 0848, 0849	293	Pole 16-04-016	x					x
Day	2	1135, 1136	293	Pole 17-01-168			x			
Day	1	0882, 0883, 0884, 0885	293	Pole 16-04-076						
Day	1	0850, 0851	293	Pole 16-04-013						x
Day	2	0963, 0964, 0965	293	Pole 16-04-034		x				
Day	2	1137, 1138, 1139, 1140, 1141	293	Pole 10-09-120				x		
Day	2	1026, 1027, 1028	293	Pole 16-04-131			x			
Day	2	1003, 1004, 1005, 1006, 1007	293	Pole 09-12-129A	x	x				
Day	2	1164, 1165, 1166, 1167	293	Pole 10-09-161		x	x			
Day	1	0938, 0939, 0940, 0941, 0942	293	Pole 16-08-110	x	x	x			
Day	1	0859, 0860, 0861, 0862	293	Pole 16-04-015	x	x	x			
Day	2	0947, 0948, 0949	293	Pole 16-04-021				x		
Day	2	1029, 1030, 1031	293	Pole 16-04-048	x	x				
Day	2	1133, 1134	293	Pole 10-09-254	x	x				
Day	1	0926, 0927, 0928	293	Pole 16-08-034	x	x				
Day	2	1071, 1072, 1073, 1074, 1075	293	Pole 09-12-121		x	x			
Day	1	0777, 0778, 0779, 0780, 0781, 0782, 0783	293	Pole 16-04-041			x			
Day	1	0775, 0776	293	Pole 16-04-143						
Day	1	0875, 0876, 0877	293	Pole 16-04-009						
Day	1	0872, 0873, 0874	293	Pole 16-04-011	x	x				
Day	1	0768, 0769	293	Pole 17-01-075	x	x				
Day	1	0943, 0944, 0945, 0946	293	Pole 16-04-019	x	x	x			
Day	1	0905, 0906, 0907, 0908	293	Pole 16-08-081		x	x			
Day	1	0909, 0910, 0911, 0912, 0913	293	Pole 16-08-041						
Day	1	1685, 1686, 1687, 1688	303	Pole 07-04-010				x		
Day	2	1838, 1839, 1840	303	Pole 07-04-065	x	x				
Day	2	1897, 1898, 1899	303	Pole 07-02-081				x		
Day	2	1914, 1915, 1916	303	Pole 07-02-101	x	x				
Day	2	1927, 1928, 1929	303	Pole 07-02-060			x			
Day	2	1833, 1834, 1835	303	Pole 07-03-121	x	x				
Day	1	1754, 1755, 1756	303	Pole 07-08-013	x	x				
Day	2	1812, 1813, 1814, 1815	303	Pole 07-03-113			x			
Day	2	1865, 1866, 1867, 1868	303	Pole 07-03-069	x	x		x		
Day	3	1942, 1943, 1944, 1945	303	Pole 07-02-029	x		x			
Day	3	1973, 1974, 1975	303	Pole 03-10-017	x					
Day	2	1807, 1808, 1809, 1810, 1811	303	Pole 07-03-110	x	x	x			
Day	2	1771, 1772, 1773	303	Pole 07-04-067	x	x				
Day	3	1982, 1983, 1984	303	Pole 03-10-019	x					
Day	2	1905, 1906, 1907	303	Pole 07-02-108	x	x				
Day	1	1707, 1708	303	Pole 07-04-093	x	x				
Day	3	1794, 1795, 1796	303	Pole 07-03-103			x			
Day	3	2010, 2011, 2012, 2013	303	Pole 07-02-001	x	x	x			
Day	2	1829, 1830, 1831, 1832	303	Pole 07-03-119				x		
Day	2	1878, 1879, 1880, 1881	303	Pole 07-03-089	x	x				
Day	2	1882, 1883, 1884	303	Pole 07-02-086	x	x				
Day	2	1820, 1821, 1822, 1823, 1824	303	Pole 07-03-125	x	x				
Day	3	1976, 1977, 1978, 1979, 1980, 1981	303	Pole 03-10-018	x		x			
Day	1	1699, 1700, 1701, 1702	303	Pole 07-04-096	x	x				
Day	2	1917, 1918, 1919	303	Pole 07-02-102	x	x				
Day	1	1681, 1682, 1683, 1684	303	Pole 07-04-133				x		
Day	2	1841, 1842, 1843, 1844	303	Pole 07-03-134		x		x		
Day	2	1816, 1817, 1818, 1819	303	Pole 07-03-050	x	x	x			
Day	2	1908, 1909	303	Pole 07-02-073		x				
Day	1	1696, 1697, 1698	303	Pole 07-04-097	x	x				
Day		2007, 2008, 2009	303	Pole 07-02-079	x					
Day	2	1902, 1903, 1904	303	Pole 07-02-107	x	x				
Day	2	1803, 1804, 1805, 1806	303	Pole 07-03-145	x	x				
Day	2	1849, 1850, 1851, 1852, 1853	303	Pole 07-03-136	x	x	x			
Day	1	1731, 1732, 1733	303	Pole 07-04-006				x		
Day	1	1718, 1719, 1720	303	Pole 07-04-254		x				
Day	2	1825, 1826, 1827, 1828	303	Pole 07-03-144	x	x				
Day	2	1860, 1861, 1862, 1863, 1864	303	Pole 07-03-068		x	x			
Day	2	1836, 1837	303	Pole 07-03-124			x			
Day	2	1930, 1931, 1932	303	Pole 07-02-061	x	x				
Day	3	2014, 2015, 2016	303	Pole 07-02-002	x					
Day	3	1964, 1965, 1966	303	Pole 03-10-090	x	x				
Day	2	1874, 1875, 1876, 1877	303	Pole 07-02-126			x			
Day	2	1890, 1891, 1892, 1893, 1894	303	Pole 07-02-084	x	x	x			
Day	2	1857, 1858, 1859	303	Pole 07-03-011	x	x	x			
Day	3	1967, 1968, 1969	303	Pole 03-10-083	x					
Day	1	1739, 1740, 1741, 1742	303	Pole 07-04-258	x	x				
Day	2	1774, 1775, 1776	303	Pole 07-04-068	x	x				

File Photo ID	Photo Numbers	Circuit Number	Pole Number	40" Separation	8.5' Encumbrance	Guy & Anchor	Pole Equipment & Pedestal	Low Span	Transfer Needed
Day 1	1757, 1758, 1759	303	Pole 07-08-016	X	X				
Day 1	1715, 1716, 1717	303	Pole 07-04-005			X			
Day 1	1728, 1729, 1730	303	Pole 07-04-043			X			
Day 3	1970, 1971, 1972	303	Pole 03-10-016	X	X				
Day 2	1785, 1786, 1787, 1788, 1789	303	Pole 07-03-101	X	X				
Day 3	1950, 1951, 1952	303	Pole 07-02-032						
Day 1	1760, 1761, 1762, 1763	303	Pole 07-08-017						X
Day 1	1721, 1722, 1723, 1724	303	Pole 07-04-040	X	X	X			X
Day 1	1725, 1726, 1727	303	Pole 07-04-042						X
Day 2	1777, 1778, 1779, 1780, 1781	303	Pole 07-08-067	X	X	X			
Day 2	1845, 1846, 1847, 1848	303	Pole 07-03-135	X	X	X			
Day 1	1751, 1752, 1753	303	Pole 07-08-189	X	X				
Day 1	1703, 1704, 1705, 1706	303	Pole 07-04-094			X			
Day 1	1712, 1713, 1714	303	Pole 07-04-003	X	X				
Day 2	1924, 1925, 1926	303	Pole 07-02-058	X	X				
Day 2	1854, 1855, 1856	303	Pole 07-03-010	X	X				
Day 3	1953, 1954, 1955,1956	303	Pole 07-02-033	X	X	X			
Day 3	1988, 1989, 1990, 1991	303	Pole 03-10-085						X
Day 2	1797, 1798, 1799	303	Pole 07-03-105	X	X				
Day 2	1910, 1911, 1912, 1913	303	Pole 07-02-074	X	X				
Day 2	1900, 1901	303	Pole 07-02-116		X				
Day 3	1992, 1993, 1994	303	Pole 03-10-095	X					
Day 3	1939, 1940, 1941	303	Pole 07-02-025	X					
Day 2	1871, 1872, 1873	303	Pole 07-03-097	X	X				
Day 3	2021, 2022, 2023	303	Pole 07-02-005	X					
Day 1	1747, 1748, 1749, 1750	303	Pole 07-08-179	X	X				
Day 2	1790, 1791, 1792, 1793	303	Pole 07-03-173		X	X			
Day 1	1691, 1692, 1693, 1694	303	Pole 07-04-100	X	X				
Day 3	1957, 1958, 1959, 1960	303	Pole 07-02-035	X			X		
Day 1	1743, 1744, 1745, 1746	303	Pole 07-08-078	X	X				
Day 2	1782, 1783, 1784	303	Pole 07-04-069	X	X				
Day 2	1885, 1886, 1887, 1888, 1889	303	Pole 07-02-085	X	X	X			
Day	2017, 2018, 2019, 2020	303	Pole 07-02-004	X		X			
Day 3	2000, 2001, 2002, 2003	303	Pole 03-10-094	X	X	X			
Day 2	1768, 1769, 1770	303	Pole 07-04-064						
Day 3	1985, 1986, 1987	303	Pole 03-10-089	X	X				
Day 2	1895, 1896	303	Pole 07-02-082		X				
Day 3	2004, 2005, 2006	303	Pole 03-10-093	X	X				
Day 3	1946, 1947,1948,1949	303	Pole 07-02-030	X					
Day 2	1920, 1921, 1922, 1923	303	Pole 07-02-055	X	X	X			
Day 1	1734, 1735, 1736, 1737, 1738	303	Pole 07-04-009	X	X		X		
Day 1	1764, 1765, 1766	303	Pole 07-08-250			X			
Day 2	1800, 1801, 1802	303	Pole 07-03-106		X				
Day 3	1961, 1962, 1963	303	Pole 07-02-076	X		X			
Day 1	1689, 1690	303	Pole 07-04-102	X	X				
Day 2	1869, 1870	303	N		X				

E/A

EXHIBIT GLB-6

GENERAL STATUTES OF NORTH CAROLINA
CHAPTER 89C.
ENGINEERING AND LAND SURVEYING

(Through 2015 Session Laws)

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89C-26	[Repealed.]
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§ 89C-1. Short title.

This Chapter shall be known and may be cited as "The North Carolina Engineering and Land Surveying Act." (1951, c. 1084, s. 1; 1975, c. 681, s. 1.)

§ 89C-2. Declarations; prohibitions.

In order to safeguard life, health, and property, and to promote the public welfare, the practice of engineering and the practice of land surveying in this State are hereby declared to be subject to regulation in the public interest. It shall be unlawful for any person to practice or to offer to practice engineering or land surveying in this State, as defined in the provisions of this Chapter, or to use in connection with the person's name or otherwise assume or advertise any title or description tending to convey the impression that the person is either a professional engineer or a professional land surveyor, unless the person has been duly licensed. The right to engage in the practice of engineering or land surveying is a personal right, based on the qualifications of the person as evidenced by the person's certificate of licensure, which shall not be transferable. (1921, c. 1, s. 1; C.S., s. 6055(b); 1951, c. 1084, s. 1; 1975, c. 681, s. 1; 1998-118, s. 1.)

§ 89C-3. Definitions.

The following definitions apply in this Chapter:

(1) Board. - The North Carolina State Board of Examiners for Engineers and Surveyors provided for by this Chapter.

(1a) Business firm. - A partnership, firm, association, or another organization or group that is not a corporation and is acting as a unit.

(2) Engineer. - A person who, by reason of special knowledge and use of the mathematical, physical and engineering sciences and the principles and methods of engineering analysis and design, acquired by engineering education and engineering experience, is qualified to practice engineering.

(3) Engineer intern. - A person who complies with the requirements for education, experience and character, and has passed an examination on the fundamentals of engineering as provided in this Chapter.

(3a) Inactive licensee. - A licensee who is not engaged in the practice of engineering or land surveying in this State, but renews his or her license as "inactive" as provided in this Chapter.

(4) Land surveyor intern. - A person who complies with the requirements for education, experience, and character and has passed an examination on the fundamentals of land surveying as provided in this Chapter.

(5) Person. - Any natural person, firm, partnership, corporation or other legal entity.

(6) Practice of engineering. -

a. Any service or creative work, the adequate performance of which requires engineering education, training, and experience, in the application of special knowledge of the mathematical, physical, and engineering sciences to such services or creative work as consultation, investigation, evaluation, planning, and design of engineering works and systems, planning the use of land and water, engineering surveys, and the observation of construction for the purposes of assuring compliance with drawings and specifications, including the consultation, investigation, evaluation, planning, and design for either private or public use, in connection with any utilities, structures, buildings, machines, equipment, processes, work systems, projects, and industrial or consumer products or equipment of a mechanical, electrical, hydraulic, pneumatic or thermal nature, insofar as they involve safeguarding life, health or property, and including such other professional services as may be necessary to the planning, progress and completion of any engineering services.

A person shall be construed to practice or offer to practice engineering, within the meaning and intent of this Chapter, who practices any branch of the profession of engineering; or who, by verbal claim, sign, advertisement, letterhead, card, or in any other way represents the person to be a professional engineer, or through the use of some other title implies that the person is a professional engineer or that the person is licensed under this Chapter; or who holds the person out as able to perform, or who does perform any engineering service or work not exempted by this Chapter, or any other service designated by the practitioner which is recognized as engineering.

b. The term "practice of engineering" shall not be construed to permit the location, description, establishment or reestablishment of property lines or descriptions of land boundaries for conveyance. The term does not include the assessment of an underground storage tank required by applicable rules at closure or change in service unless there has been a discharge or release of the product from the tank.

(7) Practice of land surveying. -

a. Providing professional services such as consultation, investigation, testimony, evaluation, planning, mapping, assembling, and interpreting reliable scientific measurements and information relative to the location, size, shape, or physical features of the earth, improvements on the earth, the space above the earth, or any part of the earth, whether the gathering of information for the providing of these services is accomplished by conventional ground measurements, by aerial photography, by global positioning via satellites, or by a combination of any of these methods, and the utilization and development of these facts and interpretations into an orderly survey map, plan, report, description, or project. The practice of land surveying includes the following:

1. Locating, relocating, establishing, laying out, or retracing any property line, easement, or boundary of any tract of land;
2. Locating, relocating, establishing, or laying out the alignment or elevation of any of the fixed works embraced within the practice of professional engineering;
3. Making any survey for the subdivision of any tract of land, including the topography, alignment and grades of streets and incidental drainage within the subdivision, and the preparation and perpetuation of maps, record plats, field note records, and property descriptions that represent these surveys;
4. Determining, by the use of the principles of land surveying, the position for any survey monument or reference point, or setting, resetting, or replacing any survey monument or reference point;
5. Determining the configuration or contour of the earth's surface or the position of fixed objects on the earth's surface by measuring lines and angles and applying the principles of mathematics or photogrammetry;
6. Providing geodetic surveying which includes surveying for determination of the size and shape of the earth both horizontally and vertically and the precise positioning of points on the earth utilizing angular and linear measurements through spatially oriented spherical geometry; and
7. Creating, preparing, or modifying electronic or computerized data, including land information systems and geographic information systems relative to the performance of the practice of land surveying.

b. The term "practice of land surveying" shall not be construed to permit the design or preparation of specifications for (i) major highways; (ii) wastewater systems; (iii) wastewater or industrial waste treatment works; (iv) pumping or lift stations; (v) water supply, treatment, or distribution systems; (vi) streets or storm sewer systems except as incidental to a subdivision.

(8) Professional engineer. - A person who has been duly licensed as a professional engineer by the Board established by this Chapter.

(8a) Professional engineer, retired. - A person who has been duly licensed as a professional engineer by the Board and who chooses to relinquish or not to renew a license and who applies to and is approved by the Board after review of record, including any disciplinary action, to be granted the use of the honorific title "Professional Engineer, Retired".

(9) Professional land surveyor. - A person who, by reason of special knowledge of mathematics, surveying principles and methods, and legal requirements which are acquired by education and/or practical experience, is qualified to

engage in the practice of land surveying, as attested by the person's licensure as a professional land surveyor by the Board.

(9a) Professional land surveyor, retired. - A person who has been duly licensed as a professional land surveyor by the Board and who chooses to relinquish or not to renew a license and who applies to and is approved by the Board after review of record, including any disciplinary action, to be granted the use of the honorific title "Professional Land Surveyor, Retired".

(10) Responsible charge. - Direct control and personal supervision, either of engineering work or of land surveying, as the case may be. (1951, c. 1084, s. 1; 1953, c. 999, s. 1; 1973, c. 449; 1975, c. 681, s. 1; 1993 (Reg. Sess., 1994), c. 671, s. 1; 1996, 2nd Ex. Sess., c. 18, s. 7.10(i); 1998-118, s. 2; 2011-304, s. 1; 2013-98, s. 1.)

§ 89C-4. State Board of Examiners for Engineers and Surveyors; appointment; terms.

A State Board of Examiners for Engineers and Surveyors, whose duty it is to administer the provisions of this Chapter, is created. The Board shall consist of four licensed professional engineers, three licensed professional land surveyors and two public members, who are neither professional engineers nor professional land surveyors. Of the land surveyor members, one and only one may hold dual licenses as a professional land surveyor and professional engineer. All of the members shall be appointed by the Governor. Appointments of the engineer and land surveyor members shall preferably, but not necessarily, be made from a list of nominees submitted by the professional societies for engineers and land surveyors in this State. Each member of the Board shall receive a certificate of appointment from the Governor and shall file with the Secretary of State a written oath or affirmation for the faithful discharge of the duties.

Members of the Board serve for staggered five-year terms, and no member may be appointed for more than two full terms. Members serve until the expiration of their respective terms and until their respective successors are appointed. If a vacancy occurs during a term, the Governor shall appoint a successor from the same classification as the person causing the vacancy to serve for the remainder of the unexpired term. If the vacancy is not filled within 90 days after it occurs, the Board may appoint a provisional member to serve until the appointment by the Governor becomes effective. The provisional member during his tenure has all the powers and duties of a regular member. (1921, c. 1, ss. 3-6; C.S., ss. 6055(d)-6055(g); 1951, c. 1084, s. 1; 1957, c. 1060, s. 1; 1963, c. 843; 1965, c. 940; 1975, c. 681, s. 1; 1979, c. 819, s. 1; 1998-118, s. 3.)

§ 89C-5. Board members; qualifications.

Each engineer member of the Board shall be a resident of North Carolina and shall be a licensed professional engineer engaged in the lawful practice of engineering in North Carolina for at least six years.

Each land surveyor member of the Board shall be a resident of North Carolina and shall be a licensed professional land surveyor engaged in the lawful practice of land surveying in North Carolina for at least six years.

Each public member of the Board shall be a resident of North Carolina. (1921, c. 1, ss. 3-6; C.S., ss. 6055(d)-6055(g); 1951, c. 1084, s. 1; 1957, c. 1060, s. 1; 1963, c. 843; 1965, c. 940; 1975, c. 681, s. 1; 1979, c. 819, s. 2; 1989, c. 108; 1998-118, s. 4.)

§ 89C-6. Compensation and expenses of Board members.

Each member of the Board, when attending to the work of the Board or any of its committees, shall receive as compensation for services the per diem and, in addition, shall be reimbursed for travel expenses and incidentals not exceeding the maximum set forth by law. In addition to per diem allowances, travel and incidentals, the secretary of the Board may, with the approval of the Board, receive such reasonable additional compensation as is compatible with the actual hours of work required by the duties of the office. (1921, c. 1, ss. 3-6; C.S., ss. 6055(d)-6055(g); 1951, c. 1084, s. 1; 1957, c. 1060, s. 1; 1963, c. 843; 1965, c. 940; 1975, c. 681, s. 1; 1998-118, s. 5.)

§ 89C-7. Vacancies; removal of member.

The Governor may remove any member of the Board for misconduct, incompetency, neglect of duty, or any sufficient cause, in the manner prescribed by law for removal of State officials. Vacancies in the membership of the Board shall be filled for the unexpired term by appointment by the Governor as provided in G.S. 89C-4. (1921, c. 1, ss. 3-6; C.S., ss. 6055(d)-6055(g); 1951, c. 1084, s. 1; 1957, c. 1060, s. 1; 1963, c. 843; 1965, c. 940; 1975, c. 681, s. 1.)

§ 89C-8. Organization of the Board; meetings; election of officers.

The Board shall hold at least two regular meetings each year. Special meetings may be held at such times and upon such notice as the rules and regulations of the Board may provide. The Board shall elect annually from its members a chair, a vice-chair, and a secretary. A quorum of the Board shall consist of not less than five members. The Board shall operate under its rules and regulations supplemented by Robert's Rules of Order. (1921, c. 1, ss. 3-6; C.S., ss. 6055(d)-6055(g); 1951, c. 1084, s. 1; 1957, c. 1060, s. 1; 1963, c. 843; 1965, c. 940; 1975, c. 681, s. 1; 1998-118, s. 6.)

§ 89C-9. Executive director; duties and liabilities.

The Board shall employ an executive director who is not a member of the Board. The executive director shall be a full-time employee of the Board and perform the duties assigned to the director by the secretary subject to the approval of the Board. The executive director shall receive a salary and compensation fixed by the Board. The executive director shall give a surety bond satisfactory to the Board conditioned upon the faithful performance of the director's duties assigned. The premium on the bond shall be a necessary and proper expense of the Board. (1921, c. 1, ss. 3-6; C.S., ss. 6055(d)-6055(g); 1951, c. 1084, s. 1; 1957, c. 1060, s. 1; 1963, c. 843; 1965, c. 940; 1975, c. 681, s. 1; 1998-118, s. 7.)

§ 89C-10. Board powers.

(a) The Board may adopt and amend all rules and rules of procedure as may be reasonably necessary for the proper performance of its duties, the regulation of its procedures, meetings, records, the administration of examinations, and the authority to enforce the rules of professional conduct as may be adopted by the Board pursuant to G.S. 89C-20.

The action by the Board in carrying out any of the powers specified in this section shall be binding upon all persons licensed under this Chapter, including corporations and business firms holding certificates of authorization.

(b) The Board shall adopt and have an official seal, which shall be affixed to each certificate issued.

(c) The Board may in the name of the State apply for relief, by injunction, in the established manner provided in cases of civil procedure, without bond, to enforce the provisions of this Chapter, or to restrain any violation of the provisions of this Chapter. In proceedings for injunctive relief, it shall not be necessary to allege or prove either that an adequate remedy at law does not exist, or that substantial or irreparable damage would result from the continued violation of the provisions of this Chapter. The members of the Board shall not be personally liable under this proceeding.

(d) The Board may subject an applicant for licensure to any examination necessary to determine the applicant's qualifications.

(e) The Board may issue an appropriate certificate of licensure to any applicant who, in the opinion of the Board, has met the requirements of this Chapter.

(f) It shall be the responsibility and duty of the Board to conduct a regular program of investigation concerning all matters within its jurisdiction under the provisions of this Chapter. The investigation of a licensee is confidential until the Board issues a citation to the licensee. The Board may expend its funds for salaries, fees, and per diem expenses, in connection with its investigations, provided that no funds other than per diem expenses shall be paid to any member of the Board in connection with its investigations, nor may any member of the Board give testimony and later sit in deciding on any matter which may directly involve punitive action for the testimony.

(g) The Board may use its funds to establish and conduct instructional programs for persons who are currently licensed to practice engineering or land surveying, as well as refresher courses for persons interested in obtaining adequate instruction or programs of study to qualify them for licensure to practice engineering or land surveying. The Board may expend its funds for these purposes and may not only conduct, sponsor, and arrange for instructional programs, but also may carry out instructional programs through extension courses or other media. The Board may enter into plans or agreements with community colleges, public or private institutions of higher learning, State and county boards of education, or with the governing authority of any industrial education center for the purpose of planning, scheduling or arranging courses, instruction, extension courses, or in assisting in obtaining courses of study or programs in the field of engineering and land surveying. The Board shall encourage the educational institutions in this State to offer courses necessary to complete the educational requirements of this Chapter. For the purpose of carrying out these objectives, the Board may adopt rules as may be necessary for the educational programs, instruction, extension services, or for entering into plans or contracts with persons or educational and industrial institutions.

(h) The Board may license sponsors of continuing professional competency activities who agree to conduct programs in accordance with standards adopted by the Board. Sponsors shall pay a license fee established by the Board, not to exceed two hundred fifty dollars ($250.00) for licensure under this subsection. The license fee shall accompany the application. Sponsors shall renew their licenses annually on a form provided by the Board.

(i) The Board shall have the power to acquire, hold, rent, encumber, alienate, and otherwise deal with real property in the same manner as a private person or corporation, subject only to approval of the Governor and the Council of State. Collateral pledged by the Board for an encumbrance is limited to the assets, income, and revenues of the Board. (1921, c. 1, ss. 3-6; C.S., ss. 6055(d)-6055(g); 1951, c. 1084, s. 1; 1957, c. 1060, s. 1; 1963, c. 843; 1965, c. 940; 1975, c. 681, s. 1; 1985 (Reg. Sess., 1986), c. 977, s. 16; 1993 (Reg. Sess., 1994), c. 671, s. 8; 1998-118, s. 8; 2003-347, s. 1.)

§ 89C-11. Secretary; duties and liabilities; expenditures.

The secretary of the Board shall receive and account for all moneys derived from the operation of the Board as provided in this Chapter, and shall deposit them in one or more special funds in banks or other financial institutions carrying deposit insurance and authorized to do business in North Carolina. The fund or funds shall be designated as "Fund of the Board of Examiners for Engineers and Surveyors" and shall be drawn against only for the purpose of implementing provisions of this Chapter as herein provided. All expenses certified by the Board as properly and necessarily incurred in the discharge of its duties, including authorized compensation, shall be paid out of this fund on the warrant signed by the secretary of the Board. At no time shall the total of warrants issued exceed the total amount of funds accumulated under this Chapter. The secretary of the Board shall give a surety bond satisfactory to the State Board of Examiners for Engineers and Surveyors, conditioned upon the faithful performance of the duties assigned. The premium on the bond is a proper and necessary expense of the Board. The secretary of the Board may delegate to the executive director certain routine duties, such as receipt and disbursement of funds in stated amounts by a written authorization, which has the majority approval of the Board. (1921, c. 1, s. 7; C.S., s. 6055(h); 1951, c. 1084, s. 1; 1959, c. 617; 1975, c. 681, s. 1; 1998-118, s. 9; 2011-304, s. 2.)

§ 89C-12. Records and reports of Board; evidence.

The Board shall keep a record of its proceedings and a register of all applicants for licensure, showing for each the date of application, name, age, education, and other qualifications, place of business and place of residence, whether the applicant was rejected or a certificate of licensure granted, and the date licensure was rejected or granted. The books and register of the Board shall be prima facie evidence of all matters recorded by the Board, and a copy duly certified by the secretary of the Board under seal shall be admissible in evidence as if the original were produced. A roster showing the names and places of business and of residence of all licensed professional engineers and all licensed professional land surveyors shall be prepared by the secretary of the Board current to the month of January of each year. On or before the first day of May of each year, the Board shall submit to the Governor a report on its transactions for the preceding year, and shall file with the Secretary of State a copy of the report, together with a complete statement of the receipts and expenditures of the Board attested by the chair and the secretary and a copy of the roster of licensed professional engineers and professional land surveyors. (1921, c. 1, s. 8; C.S., s. 6055(i); 1951, c. 1084, s. 1; 1975, c. 681, s. 1; 1998-118, s. 10; 2000-140, s. 18; 2011-304, s. 3.)

§ 89C-13. General requirements for licensure.

(a) Engineer Applicant. - The following shall be considered as minimum evidence satisfactory to the Board that the applicant is qualified for licensure as a professional engineer:

(1) To be certified as an engineer intern, an applicant shall (i) pass the fundamentals of engineering examination and make application to the Board, (ii) be of good character and reputation, (iii) submit three character references to the Board, one of whom is a professional engineer, (iv) comply with the requirements of this Chapter, and (v) meet one of the following requirements:

a. Education. - Be a graduate of an engineering curriculum or related science curriculum of four years or more, approved by the Board as being of satisfactory standing.

b. Education and experience. - Be a graduate of an engineering curriculum or related science curriculum of four years or more, other than curriculums approved by the Board as being of satisfactory standing, or possess equivalent education and engineering experience satisfactory to the Board with a specific record of four or more years of progressive experience on engineering projects of a grade and character satisfactory to the Board.

(1a) To be licensed as a professional engineer, an applicant shall (i) be of good character and reputation, (ii) submit five character references to the Board, three of whom are professional engineers or individuals acceptable to the Board with personal knowledge of the applicant's engineering experience, (iii) comply with the requirements of this Chapter, and (iv) meet one of the following requirements:

a. Licensure by Comity or Endorsement. - A person holding a certificate of licensure to engage in the practice of engineering, on the basis of comparable qualifications, issued to the person by a proper authority of a state, territory, or possession of the United

States, the District of Columbia, or of any foreign country possessing credentials that, based on verifiable evidence, in the opinion of the Board, of a standard not lower than that in effect in this State at the time the certificate was issued, may upon application, be licensed without further examination, except as required to examine the applicant's knowledge of laws, rules, and requirements unique to North Carolina.

b. E.I. Certificate, Experience, and Examination. - A holder of a certificate of engineer intern and with a specific record of an additional four years or more of progressive experience on engineering projects of a grade and character which indicates to the Board that the applicant may be competent to practice engineering, shall be admitted to the principles and practice of engineering examination. Upon passing the examination, the applicant shall be granted a certificate of licensure to practice professional engineering in this State, provided the applicant is otherwise qualified.

c. Graduation, Experience, and Examination. - A graduate of an engineering curriculum of four years or more approved by the Board as being of satisfactory standing, shall be admitted to the fundamentals of engineering examination, and with a specific record of an additional four years or more of progressive experience on engineering projects of a grade and character that indicates to the Board that the applicant may be competent to practice engineering, the principles and practice of engineering examination. Upon passing the examinations, the applicant shall be granted a certificate of licensure to practice professional engineering in this State, provided the applicant is otherwise qualified.

d. Graduation, Experience, and Examination. - A graduate of an engineering or related science curriculum of four years or more, other than the ones approved by the Board as being of satisfactory standing or with an equivalent education and engineering experience satisfactory to the Board shall be admitted to the fundamentals of engineering examination and with a specific record of an additional eight years or more of progressive experience on engineering projects of a grade and character that indicates to the Board that the applicant may be competent to practice engineering, the principles and practice of engineering examination. Upon passing the examinations, the applicant shall be granted a certificate of licensure to practice professional engineering in this State, provided the applicant is otherwise qualified.

e. Long-Established Practice. - A person with a specific record of 20 years or more of progressive experience on engineering projects of a grade and character which indicates to the Board that the applicant may be competent to practice engineering shall be admitted to the principles and practice of engineering examination. Upon passing the examination, the applicant shall be granted a certificate of licensure to practice professional engineering in this State, provided the applicant is otherwise qualified.

f. Full-time faculty. - Full-time engineering faculty members who teach in an approved engineering program offering a four-year or more degree approved by the Board, may request and be granted waiver of the fundamentals of engineering examination. The faculty applicant shall document that the degree meets the Board's requirement. The faculty applicant shall then be admitted to the principles and practice of engineering examination.

g. Doctoral degree. - A person possessing an earned doctoral degree in engineering from an institution in which the same discipline undergraduate engineering program has been accredited by ABET (EAC) may request and be granted waiver of the fundamentals of engineering examination. The doctoral degree applicant shall document that the degree meets the Board's requirement. The doctoral degree applicant shall then be admitted to the principles and practice of engineering examination.

At its discretion the Board may require an applicant to submit exhibits, drawings, designs, or other tangible evidence of engineering work which the applicant personally accomplished or supervised.

(2) Repealed by Session Laws 2013-98, s. 2, effective June 12, 2013.

(b) Land Surveyor Applicant. - The evaluation of a land surveyor applicant's qualifications shall involve a consideration of the applicant's education, technical, and land surveying experience, exhibits of land surveying projects with which the applicant has been associated, and recommendations by references. The land surveyor applicant's qualifications may be reviewed at an interview if the Board determines it necessary. Educational credit for institute courses, correspondence courses, or other courses shall be determined by the Board.

The following shall be considered as minimum evidence satisfactory to the Board that the applicant is qualified for licensure as a professional land surveyor:

(1) To be certified as a land surveyor intern, an applicant shall (i) pass the fundamentals of land surveying examination and make application to the Board, (ii) be of good character and reputation, (iii) submit three character references to the Board, one of whom is a professional land surveyor, (iv) comply with the requirements of this Chapter, and (v) satisfy one of the following requirements related to education and experience:

a. Be a graduate of a surveying curriculum of four years or more or other equivalent curriculum in surveying approved by the Board.

b. Have rightful possession of an associate degree in surveying technology approved by the Board, a record satisfactory to the Board of four years of progressive practical experience, two years of which shall have been under a practicing professional land surveyor, and have satisfactorily passed a written and oral examination as required by the Board.

c. Have graduated from high school or completed a high school equivalency certificate with a record satisfactory to the Board of 10 years of progressive, practical experience, six years of which shall have been under a practicing licensed land surveyor, and have satisfactorily passed any oral and written examinations required by the Board.

(1a) To be licensed as a professional land surveyor, an applicant shall (i) be of good character and reputation, (ii) submit five character references to the Board, three of whom are professional land surveyors or individuals acceptable to the Board, with personal knowledge of the applicant's land surveying experience, (iii) comply with the requirements of this Chapter, and (iv) meet one of the following requirements:

a. Rightful possession of a bachelor of science degree in surveying or other equivalent curricula, all approved by the Board and a record satisfactory to the Board of two years or more of progressive practical experience, one year of which shall have been under a practicing professional land surveyor if the applicant has successfully passed the first examination (Fundamentals of Surveying) on or before January 1, 2013, or if the applicant has not successfully passed the first examination on or before January 1, 2013, two years of which shall have been under a practicing professional land surveyor, and satisfactorily passing any oral and written examination required by the Board, all of which shall determine and indicate that the applicant is competent to practice land surveying. Upon passing the first examination and successful completion of the experience required by this subdivision, the applicant may apply to take the second examination (Principles and Practice of Land Surveying). An applicant who passes both examinations and completes the educational and experience requirements of this subdivision shall be granted licensure as a professional land surveyor.

b. Rightful possession of an associate degree in surveying technology approved by the Board and a record satisfactory to the Board of four years of progressive practical experience, three years of which shall have been under a practicing licensed land surveyor if the applicant has successfully passed the first examination (Fundamentals of Surveying) on or before January 1, 2013, or if the applicant has not successfully passed the first examination on or before January 1, 2013, eight years of progressive practical experience, four years of which shall have been under a practicing professional land surveyor, and satisfactorily passing any written and oral examination required by the Board, all of which shall determine and indicate that the applicant is competent to practice land surveying. If the applicant has not successfully completed the first examination on or before January 1, 2013, the applicant may apply to the Board to take the first examination after obtaining the associate degree and completing four years of practical experience, two years of which shall have been under a practicing professional land surveyor at the first regularly scheduled examination thereafter. Upon passing the first examination and successfully completing the practical experience required under this subdivision, the applicant may apply to the Board to take the second examination (Principles and Practice of Land Surveying). An applicant who passes both examinations and successfully completes the educational and experience requirements of this subdivision shall be granted licensure as a professional land surveyor.

c. Repealed by Session Laws 1998-118, s. 11.

d. Graduation from a high school or the completion of a high school equivalency certificate and a record satisfactory to the Board of seven years of progressive practical experience, six years of which shall have been under a practicing licensed land surveyor if the applicant has successfully passed the first examination (Fundamentals of Surveying) on or before January 1, 2013, or if the applicant has not successfully passed the first examination on or before January 1, 2013, 16 years of progressive practical experience, nine years of which shall have been under a practicing professional land surveyor, and satisfactorily passing any oral and written examinations required by the Board, all of which shall determine and indicate that the candidate is competent to practice land surveying. If the applicant has not successfully passed the first examination on or before January 1, 2013, the applicant may be qualified by the Board to take the first examination upon graduation from high school or the completion of a high school equivalency certificate and successfully completing 10 years of progressive practice experience, six of which shall have been under a practicing licensed land surveyor.

e. Repealed by Session Laws 1985 (Regular Session, 1986), c. 977, s. 7.

f. Licensure by Comity or Endorsement. - A person holding a certificate of licensure to engage in the practice of land surveying issued on comparable qualifications from a state, territory, or possession of the United States or the District of Columbia, possessing credentials that, based on verifiable evidence, in the opinion of the Board, of a standard not lower than that in effect in this State at the time the certificate was issued, may upon application, be licensed without further examination, except to take any examinations as the Board requires to determine the applicant's qualifications, but in any event, the applicant shall be required to pass an examination which shall include questions on laws, procedures, and practices pertaining to the practice of land surveying in North Carolina.

g. A licensed professional engineer who can satisfactorily demonstrate to the Board that the professional engineer's formal academic training in acquiring a degree and field experience in engineering includes land surveying, to the extent necessary to reasonably qualify the applicant in the practice of land surveying, may apply for and may be granted permission to take the principles and practice of land surveying examination and the fundamentals of land surveying examination. Upon satisfactorily passing the examinations, the applicant shall be granted a license to practice land surveying in the State of North Carolina.

h. Professional Engineers in Land Surveying. - Any person presently licensed to practice professional engineering under this Chapter shall upon application be licensed to practice land surveying, providing a written application is filed with the Board within one year next after June 19, 1975.

i. Photogrammetrists. - Any person presently practicing photogrammetry with at least seven years of experience in the profession, two or more of which shall have been in responsible charge of photogrammetric mapping projects meeting National Map Accuracy Standards shall, upon application, be licensed to practice land surveying, provided:

1. The applicant submit certified proof of graduation from high school, high school equivalency, or higher degree;
2. The applicant submit proof of employment in responsible charge as a photogrammetrist practicing within the State of North Carolina to include itemized reports detailing methods,

procedures, amount of applicant's personal involvement and the name, address, and telephone numbers of the client for five projects completed by the applicant with the State. A final map for one of the five projects shall also be submitted;

3. Five references to the applicant's character and quality of work, three of which shall be from professional land surveyors, are submitted to the Board; and

4. The application is submitted to the Board by July 1, 1999. After July 1, 1999, no photogrammetrist shall be licensed without meeting the same requirements as to education, length of experience, and testing required of all land surveying applicants.

j. Any person performing activities described in G.S. 89C-3(7)a.2. and 7. with at least seven years of experience in performing mapping science surveys, two or more of which have been in responsible charge of mapping science projects that meet the requirements of 21 NCAC 56.1608, shall, upon application, be licensed to practice surveying in their area of competence (mapping science) provided all of the following requirements are met:

1. The applicant submits certified proof of graduation from high school, high school equivalency, or higher degree.
2. The applicant submits proof of employment in responsible charge of mapping science projects within the State of North Carolina, including itemized reports detailing methods, procedures, amount of applicant's personal involvement, and the name, address, and telephone numbers of the client for five projects completed by the applicant within the State. The applicant shall also submit a final map, report, or digital product for one of the five projects.
3. Five references as to the applicant's character and quality of work, three of which shall be from professional land surveyors, are submitted to the Board.
4. The application is submitted to the Board by July 1, 2014. After July 1, 2014, no individual performing surveys described in 21 NCAC 56.1608 shall be licensed without meeting the same requirements as to education, length of experience, and testing required of all land surveying applications.

(2) Repealed by Session Laws 2013-98, s. 2 effective June 12, 2013.

The Board shall require an applicant to submit exhibits, drawings, plats, or other tangible evidence of land surveying work executed by the applicant under proper supervision and which the applicant has personally accomplished or supervised.

Land surveying encompasses a number of disciplines including geodetic surveying, hydrographic surveying, cadastral surveying, engineering surveying, route surveying, photogrammetric (aerial) surveying, and topographic surveying. A professional land surveyor shall practice only within the surveyor's area of expertise.

The Board shall require an applicant to submit exhibits, drawings, plats, or other tangible evidence of land surveying work executed by the applicant under proper supervision and which the applicant has personally accomplished or supervised. (1921, c. 1, s. 9; C.S., s. 6055(j); 1951, c. 1084, s. 1; 1953, c. 999, s. 2; 1957, c. 1060, ss. 2, 3; 1975, c. 681, s. 1; 1985 (Reg.

Sess., 1986), c. 977, ss. 1-15; 1993 (Reg. Sess., 1994), c. 671, s. 2; 1995, c. 509, s. 36.1; 1998-118, s. 11; 1998-217, s. 41; 2005-296, s. 1; 2011-304, s. 4; 2013-98, s. 2.)

§ 89C-14. Application for licensure; license fees.

(a) Application for licensure as a professional engineer or professional land surveyor shall be on a form prescribed and furnished by the Board. It shall contain statements made under oath, showing the applicant's education and a detailed summary of the applicant's technical and engineering or land surveying experience, and shall include the names and complete mailing addresses of the references, none of whom may be immediate members of the applicant's family or members of the Board.

The Board may accept the certified information on the copy of a current formal certificate of qualifications issued by the National Council of Examiners for Engineering and Surveying in lieu of the same information that is required for the form prescribed and furnished by the Board.

(b) An applicant for licensure who is required to take the written examination shall pay to the Board an application fee not to exceed one hundred dollars ($100.00). The Board may charge any fee necessary to defray the cost of any required examinations. The fee shall accompany the application. The fee for comity licensure of engineers and land surveyors who hold unexpired certificates in another state or a territory of the United States or in Canada shall be the total current fee as fixed by the Board.

(c) The certification fee for a corporation is the amount set by the Board but shall not exceed one hundred dollars ($100.00). The fee shall accompany the application. The certification fee for a business firm is the same as the fee for a corporation. The fee for renewal of a certificate of licensure of a corporation is the amount set by the Board but shall not exceed seventy-five dollars ($75.00). The fee for renewal of a certificate of licensure for a business firm is the same as the renewal fee for a corporation.

(d) Should the Board deny the issuance of a certificate of licensure to any applicant, the unobligated portion of fees paid shall be returned by the Board to the applicant.

(e) A candidate failing an examination may apply, and be considered by the Board, for reexamination at the end of six months. The Board shall make such reexamination charge as is necessary to defray the cost of the examination.

A candidate with a combination of three failures or unexcused absences on an examination shall only be eligible after submitting a new application with appropriate application fee and documented evidence of actions taken by the candidate to enhance the candidate's prospects for passing the exam. A candidate with a combination of three failures or unexcused absences may only be considered by the Board for reexamination at the end of 12 months following the third failure or unexcused absence. After the end of the 12-month period, the applicant may take the examination no more than once every calendar year. (1921, c. 1, s. 9; C.S., s. 6055(j); 1951, c. 1084, s. 1; 1953, c. 999, s. 2; 1957, c. 1060, ss. 2, 3; 1975, c. 681, s. 1; 1981, c. 230; 1983, c. 183, ss. 1, 2; 1993 (Reg. Sess., 1994), c. 671, s. 5; 1996, 2nd Ex. Sess., c. 18, s. 7.10(k); 1998-118, s. 12; 2000-115, s. 1.)

§ 89C-15. Examinations.

(a) The examinations will be held at the times and places as the Board directs. The Board shall determine the passing grade on examinations. All examinations shall be approved by the entire Board.

(b) Examinations will be given as follows:

(1) Fundamentals of Engineering. - Consists of an examination on the fundamentals of engineering. Passing this examination qualifies the applicant for an engineer intern certificate, provided the applicant has met all other requirements for licensure required by this Chapter.

(2) Principles and Practice of Engineering. - Consists of an examination on applied engineering. Passing this examination qualifies the applicant for licensure as a professional engineer, provided the applicant has met the other requirements for licensure required by this Chapter.

(3) Fundamentals of Land Surveying. - Consists of an examination on the fundamentals of land surveying. Passing this examination qualifies the applicant for a land surveyor intern certificate provided the applicant has met all other requirements for certification required by this Chapter.

(4) Principles and Practice of Land Surveying. - Consists of an examination on the applied disciplines of land surveying and an examination on requirements specific to the practice of land surveying in North Carolina. Passing each of these examinations qualifies the applicant for a professional land surveyor certificate provided the applicant has met all other requirements for certification required by this Chapter. (1975, c. 681, s. 1; 1998-118, s. 13; 2013-98, s. 3.)

§ 89C-16. Certificates of licensure; effect; seals.

(a) The Board shall issue to any applicant, who, in the opinion of the Board, has met the requirements of this Chapter, a certificate of licensure giving the licensee proper authority to practice the profession in this State. The certificate of licensure for a professional engineer shall carry the designation "professional engineer," and for a land surveyor, "professional land surveyor," shall give the full name of the licensee with the Board designated licensure number and shall be signed by the chair and the secretary under the seal of the Board.

(b) This certificate shall be prima facie evidence that the person named on the certificate is entitled to all rights, privileges and responsibilities of a professional engineer or a professional land surveyor, while the certificate of licensure remains unrevoked or unexpired.

(c) Each licensee shall upon licensure obtain a seal of a design authorized by the Board bearing the licensee's name, license number, and the legend, "professional engineer," or "professional land surveyor." Final drawings, specifications, plans and reports prepared by a licensee shall, when issued, be certified and stamped with the seal or facsimile of the seal unless the licensee is exempt under the provisions of G.S. 89C-25(7). It shall be unlawful for a licensee to affix, or permit the licensee's seal and signature or facsimile of the seal and signature to be affixed to any drawings, specifications, plans or reports after the expiration of a certificate or for the purpose of aiding or abetting any other person to evade or attempt to evade any provision of this Chapter. A professional engineer practicing land surveying shall use the licensee's land surveyor seal. (1921, c. 1, s. 11; C.S., s. 6055(m); 1951, c. 1084, s. 1; 1957, c. 1060, s. 6; 1975, c. 681, s. 1; 1998-118, s. 14.)

§ 89C-17. Expirations and renewals of certificates.

Certificates for licensure of corporations and business firms that engage in the practice of engineering or land surveying shall expire on the last day of the month of June following their issuance or renewal and shall become invalid on that date unless renewed. All other certificates for licensure shall expire on the last day of the month of December next following their issuance or renewal, and shall become invalid on that date unless renewed. When necessary to protect the public health, safety, or welfare, the Board shall require any evidence necessary to establish the continuing competency of engineers and land surveyors as a condition of renewal of licenses. When the Board is satisfied as to the continuing competency of an applicant, it shall issue a renewal of the certificate upon payment by the applicant of a fee fixed by the Board but not to exceed seventy-five dollars ($75.00). The secretary of the Board shall notify by mail every person licensed under this Chapter of the date of expiration of the certificate, the amount of the fee required for its renewal for one year, and any requirement as to evidence of continued competency. The notice shall be mailed at least one month in advance of the expiration date of the certificate. Renewal shall be effected at any time during the month immediately following the month of expiration, by payment to the secretary of the Board of a renewal fee, as determined by the Board, which shall not exceed seventy-five dollars ($75.00). Failure on the part of any licensee to renew the certificate annually in the month immediately following the month of expiration, as required above, shall deprive the licensee of the right to practice until reinstatement of the license. The license may be reinstated at anytime during the first 12 months immediately following the date the license became invalid by payment of a reinstatement fee of one hundred dollars ($100.00) in addition to the established renewal fee. Failure of a licensee to reinstate the license during the first 12 months immediately following the date the license became invalid shall require the individual, prior to resuming practice in North Carolina, to submit an application on the prescribed form, and to meet all other requirements for licensure as set forth in Chapter 89C. The secretary of the Board is instructed to remove from the official roster of engineers and land surveyors the names of all licensees who have not effected their renewal by the first day of the month immediately following the renewal period. The Board may adopt rules to provide for renewals in distress or hardship cases due to military service, prolonged illness, or prolonged absence from the State, where the applicant for renewal demonstrates to the Board that the applicant has maintained active knowledge and professional status as an engineer or land surveyor, as the case may be. It shall be the responsibility of each licensee to inform the Board promptly concerning change in address. A licensee may request and be granted inactive status. No inactive licensee may practice in this State unless otherwise exempted in this Chapter. A licensee granted inactive status shall pay annual renewal fees but shall not be subject to annual continuing professional competency requirements. A licensee granted inactive status may return to active status by meeting all requirements of the Board, including demonstration of continuing professional competency as a condition of reinstatement. (1921, c. 1, s. 9; C.S., s. 6055(k); 1951, c. 1084, s. 1; 1953, c. 1041, s. 9; 1957, c. 1060, s. 4; 1973, c. 1321; c. 1331, s. 3; 1975, c. 681, s. 1; 1979, c. 819, ss. 3, 4; 1985, c. 373; 1998-118, s. 15; 2000-115, s. 2; 2003-347, s. 3.)

§ 89C-18. Duplicate certificates.

The Board may issue a duplicate certificate of licensure or certificate of authorization to replace any certificate that has been lost, destroyed, or mutilated and may charge a fee of up to twenty-five dollars ($25.00) for issuing the certificate. (1921, c. 1, s. 10; C.S., s. 6055(l); 1939, c. 218, s. 2; 1951, c. 1084, s. 1; 1953, c. 1041, s. 10; 1957, c. 1060, s. 5; 1973, c. 1331, s. 3; 1975, c. 681, s. 1; 1993 (Reg. Sess., 1994), c. 671, s. 3; 1998-118, s. 16.)

§ 89C-18.1. Licensing of nonresidents.

(a) Definitions. - The following definitions apply in this section:
   (1) Delinquent income tax debt. - The amount of income tax due as stated in a final notice of assessment issued to a taxpayer by the Secretary of Revenue when the taxpayer no longer has the right to contest the amount.
   (2) Foreign corporation. - Defined in G.S. 55-1-40.
   (3) Foreign entity. - A foreign corporation, a foreign limited liability company, or a foreign partnership.
   (4) Foreign limited liability company. - Has the same meaning as the term "foreign LLC" in G.S. 57D-1-03.
   (5) Foreign partnership. - Either of the following that does not have a permanent place of business in this State:
      a. A foreign limited partnership as defined in G.S. 59-102.
      b. A general partnership formed under the laws of a jurisdiction other than this State.

(b) Licensing. - The Board shall not renew a certificate of licensure for a foreign corporation unless the corporation has obtained a certificate of authority from the Secretary of State pursuant to Article 15 of Chapter 55 of the General Statutes. The Board shall not renew a certificate of licensure for a foreign limited liability company unless the company has obtained a certificate of authority from the Secretary of State pursuant to Article 7 of Chapter 57D of the General Statutes.

(c) Information. - Upon request, the Board shall provide the Secretary of Revenue on an annual basis the name, address, and tax identification number of every nonresident individual and foreign entity licensed by the Board. The information shall be provided in the format required by the Secretary of Revenue.

(d) Delinquents. - If the Secretary of Revenue determines that any nonresident individual or foreign corporation licensed by the Board, a member of any foreign limited liability company licensed by the Board, or a partner in any foreign partnership licensed by the Board, owes a delinquent income tax debt, the Secretary of Revenue may notify the Board of these nonresident individuals and foreign entities and instruct the Board not to renew their certificates of licensure. The Board shall not renew the certificate of licensure of such a nonresident individual or foreign entity identified by the Secretary of Revenue unless the Board receives a written statement from the Secretary that the debt either has been paid or is being paid pursuant to an installment agreement. (1998-162, ss. 7, 13; 2013-157, s. 23.)

§ 89C-19. Public works; requirements where public safety involved.

This State and its political subdivisions such as counties, cities, towns, or other political entities or legally constituted boards, commissions, public utility companies, or authorities, or officials, or employees of these entities shall not engage in the practice of engineering or land surveying involving either public or private property where the safety of the public is directly involved without the project being under the direct supervision of a professional engineer for engineering projects, or a professional land surveyor for land surveying projects, as provided for the practice of the respective professions by this Chapter.

An official or employee of the State or any political subdivision specified in this section, holding the positions set out in this section as of June 19, 1975, shall be exempt from the provisions of this section so long as such official or employee is engaged in substantially the same type of work as is involved in the present position.

Nothing in this section shall be construed to prohibit inspection, maintenance and service work done by employees of the State of North Carolina, any political subdivision of the State, or any municipality including construction, installation, servicing, and maintenance by regular full-time employees of, secondary roads and drawings incidental to work on secondary roads, streets, street lighting, traffic-control signals, police and fire alarm systems, waterworks, steam, electric and sewage treatment and disposal plants, the services of superintendents, inspectors or foremen regularly employed by the State of North Carolina or any political subdivision of the State, or municipal corporation.

The provisions in this section shall not be construed to alter or modify the requirements of Article 1 of Chapter 133 of the General Statutes. (1975, c. 681, s. 1; 1998-118, s. 17; 2014-120, s. 11(b).)

§ 89C-19.1. Engineer who volunteers during an emergency or disaster; qualified immunity.

(a) A professional engineer who voluntarily, without compensation, provides structural, electrical, mechanical, or other engineering services at the scene of a declared disaster or emergency, declared under federal law or in accordance with the provisions of Article 1A of Chapter 166A of the General Statutes, at the request of a public official, law enforcement official, public safety official, or building inspection official, acting in an official capacity, shall not be liable for any personal injury, wrongful death, property damage, or other loss caused by the professional engineer's acts or omissions in the performance of the engineering services.

(b) The immunity provided in subsection (a) of this section applies only to an engineering service:

(1) For any structure, building, piping, or other engineered system, either publicly or privately owned.

(2) That occurs within 45 days after the declaration of the emergency or disaster, unless the 45-day immunity period is extended by an executive order issued by the Governor under the Governor's emergency executive powers.

(c) The immunity provided in subsection (a) of this section does not apply if it is determined that the personal injury, wrongful death, property damage, or other loss was caused by the gross negligence, wanton conduct, or intentional wrongdoing of the professional engineer, or arose out of the operation of a motor vehicle.

(d) As used in this section:

(1) "Building inspection official" means any appointed or elected federal, State, or local official with overall executive responsibility to coordinate building inspection in the jurisdiction in which the emergency or disaster is declared.

(2) "Law enforcement official" means any appointed or elected federal, State, or local official with overall executive responsibility to coordinate law enforcement in the jurisdiction in which the emergency or disaster is declared.

(3) "Public official" means any federal, State, or locally elected official with overall executive responsibility in the jurisdiction in which the emergency or disaster is declared.

(4) "Public safety official" means any appointed or elected federal, State, or local official with overall executive responsibility to coordinate public safety in the jurisdiction in which the emergency or disaster is declared. (1995, c. 416, s. 1; 2012-12, s. 2(q).)

§ 89C-20. Rules of professional conduct.

In the interest of protecting the safety, health, and welfare of the public, the Board shall adopt rules of professional conduct applicable to the practice of engineering and land surveying. These rules, when adopted, shall be construed to be a reasonable exercise of the police power vested in the Board of Examiners for Engineers and Land Surveyors. Every person licensed by the Board shall subscribe to and observe the adopted rules as the standard of professional conduct for the practice of engineering and land surveying and shall cooperate fully with the Board in the course of any investigation. In the case of violation of the rules of professional conduct, the Board shall proceed in accordance with G.S. 89C-22. (1975, c. 681, s. 1; 1987, c. 827, s. 73; 1998-118, s. 18.)

§ 89C-21. Disciplinary action - Reexamination, revocation, suspension, reprimand, or civil penalty.

(a) The Board may reprimand the licensee, suspend, refuse to renew, refuse to reinstate, or revoke the certificate of licensure, require additional education or, as appropriate, require reexamination, for any engineer or land surveyor, who is found guilty of any of the following:

(1) Fraud or deceit in obtaining or renewing a certificate of licensure or certificate of authorization.

(2) Gross negligence, incompetence, or misconduct in the practice of the profession.

(3) Conviction of, or entry of a plea of guilty or nolo contendere to, any crime that is a felony, whether or not related to the practice of engineering or surveying; conviction of, or entry of a plea of guilty or nolo contendere to, any crime, whether a felony, misdemeanor, or otherwise, where an essential element of the crime is dishonesty or when the crime is directly related to the practice of engineering or surveying; or conviction of, or entry of a plea of guilty or nolo contendere, of any crime involving moral turpitude.

(4) Violation of any provisions of this Chapter, the Rules of Professional Conduct, or any rules as adopted by the Board.

(5) Being declared insane or incompetent by a court of competent jurisdiction and having not later been lawfully declared sane or competent.

(6) Professional incompetence. In the event the Board finds that a certificate holder is incompetent the Board may, in its discretion, require oral or written examinations, or other indication of the certificate holder's fitness to practice engineering or land surveying and suspend the license during any such period.

(b) The Board may (i) revoke a certificate of authorization, or (ii) to suspend a certificate of authorization for a period of time not exceeding two years, of any corporation or business firm where one or more of its officers or directors have committed any act or have been guilty of any conduct which would authorize a revocation or suspension of their certificates of licensure under the provision of this section.

(c) The Board may levy a civil penalty not in excess of five thousand dollars ($5,000) for any engineer or not in excess of two thousand dollars ($2,000) for any land surveyor who violates any of the provisions of subdivisions (1) through (4) of subsection (a) of this section. The clear proceeds of all civil penalties collected by the Board, including civil penalties collected pursuant to G.S. 89C-22(c), shall be remitted to the Civil Penalty and Forfeiture Fund in accordance with G.S. 115C-457.2.

(d) Before imposing and assessing a civil penalty and fixing the amount, the Board shall, as a part of its deliberation, take into consideration the following factors:

(1) The nature, gravity, and persistence of the particular violations;

(2) The appropriateness of the imposition of a civil penalty when considered alone or in combination with other punishment;

(3) Whether the violation(s) were done willfully and maliciously; and

(4) Any other factors which would tend to either mitigate or aggravate the violation(s) found to exist. (1921, c. 1, s. 10; C.S., s. 6055(l); 1939, c. 218, s. 2; 1951, c. 1084, s. 1; 1953, c. 1041, s. 10; 1957, c. 1060, s. 5; 1973, c. 1331, s. 3; 1975, c. 681, s. 1; 1989, c. 669, s. 1; 1993 (Reg. Sess., 1994), c. 671, s. 6; 1998-118, s. 19; 1998-215, s. 134; 2003-347, s. 2; 2011-304, s. 5.)

§ 89C-22. Disciplinary action - Charges; procedure.

(a) Any person may prefer charges of fraud, deceit, gross negligence, incompetence, misconduct, or violations of this Chapter, the rules of professional conduct, or any rules adopted by the Board against any Board licensee. The charges shall be in writing and shall be sworn to by the person or persons making them and shall be filed with the Board.

(b) All charges, unless dismissed by the Board as unfounded or trivial or unless settled informally, shall be heard by the Board as provided under the requirements of Chapter 150B of the General Statutes.

(c) If, after a hearing, a majority of the Board votes in favor of sustaining the charges, the Board shall reprimand, levy a civil penalty, suspend, refuse to renew, refuse to reinstate, or revoke the licensee's certificate, require additional education or, as appropriate, require reexamination.

(d) A licensee who is aggrieved by a final decision of the Board may appeal for judicial review as provided by Article 4 of Chapter 150B.

(e) The Board may, upon petition of an individual or an entity whose certificate has been revoked, for sufficient reasons as it may determine, reissue a certificate of licensure or authorization, provided that a majority of the members of the Board vote in favor of such issuance. (1921, c. 1, s. 10; C.S., s. 6055(l); 1939, c. 218, s. 2; 1951, c. 1084, s. 1; 1953, c. 1041, s. 10; 1957, c. 1060, s. 5; 1973, c. 1331, s. 3; 1975, c. 681, s. 1; 1981, c. 789; 1989, c. 669, s. 2; 1993 (Reg. Sess., 1994), c. 671, s. 7; 1998-118, s. 20; 2011-304, s. 6.)

§ 89C-23. Unlawful to practice engineering or land surveying without licensure; unlawful use of title or terms; penalties; Attorney General to be legal adviser.

Any person who shall practice, or offer to practice, engineering or land surveying in this State without first being licensed in accordance with the provisions of this Chapter, or any person, firm, partnership, organization, association, corporation, or other entity using or employing the words "engineer" or "engineering" or "professional engineer" or "professional engineering" or "land surveyor" or "land surveying," or any modification or derivative of those words in its name or form of business or activity except as licensed under this Chapter or in pursuit of activities exempted by this Chapter, or any person presenting or attempting to use the certificate of licensure or the seal of another, or any person who shall give any false or forged evidence of any kind to the Board or to any member of the Board in obtaining or attempting to obtain a certificate of licensure, or any person who shall falsely impersonate any other licensee of like or different name, or any person who shall attempt to use an expired or revoked or nonexistent certificate of licensure, or who shall practice or offer to practice when not qualified, or any person who falsely claims that the person is registered under this Chapter, or any person who shall violate any of the provisions of this Chapter, in addition to injunctive procedures set out hereinbefore, shall be guilty of a Class 2 misdemeanor. In no event shall there be representation of or holding out to the public of any engineering expertise by unlicensed persons. It shall be the duty of all duly constituted officers of the State and all political subdivisions of the State to enforce the provisions of this Chapter and to prosecute any persons violating them.

The Attorney General of the State or an assistant shall act as legal adviser to the Board and render any legal assistance necessary to carry out the provisions of this Chapter. The Board may employ counsel and necessary assistance to aid in the enforcement of this Chapter, and the compensation and expenses for the assistance shall be paid from funds of the Board. (1921, c. 1, s. 12; C.S., s. 6055(n); 1951, c. 1084, s. 1; 1975, c. 681, s. 1; 1993, c. 539, s. 612; 1994, Ex. Sess., c. 24, s. 14(c); 1998-118, s. 21.)

§ 89C-24. Licensure of corporations and business firms that engage in the practice of engineering or land surveying.

A corporation or business firm may not engage in the practice of engineering or land surveying in this State unless it is licensed by the Board and has paid an application fee established by the Board in an amount not to exceed one hundred dollars ($100.00). A corporation or business firm is subject to the same duties and responsibilities as an individual licensee. Licensure of a corporation or business firm does not affect the requirement that all engineering or land surveying work done by the corporation or business firm be performed by or under the responsible charge of individual registrants, nor does it relieve the individual registrants within a corporation or business firm of their design and supervision responsibilities. The Board may adopt rules regulating the operation of offices and places of business of corporations and business firms licensed under this section to ensure that professional engineering and land surveying services are performed under the supervision of licensed professional engineers and land surveyors.

This section applies to every corporation that is engaged in the practice of engineering or land surveying, regardless of when it was incorporated. A corporation that is not exempt from Chapter 55B of the General Statutes by application of G.S. 55B-15 must be incorporated under that Chapter. (1921, c. 1, s. 14; C.S., s. 6055(p); 1951, c. 1084, s. 1; 1969, c. 718, s. 18; 1975, c. 681, s. 1; 1993 (Reg. Sess., 1994), c. 671, s. 4; 1998-118, s. 22; 2000-115, s. 3.)

§ 89C-25. Limitations on application of Chapter.

This Chapter shall not prevent the following activities:

(1) The practice of architecture as defined in Chapter 83A of the General Statutes, landscape architecture as defined in Chapter 89A of the General Statutes, or contracting as defined in Articles 1, 2, 4 and 5 of Chapter 87 of the General Statutes.

(2) Repealed by Session Laws 2011-304, s. 7, effective June 26, 2011.

(3) Repealed by Session Laws 2011-304, s. 7, effective June 26, 2011.

(4) Engaging in engineering or land surveying as an employee or assistant under the responsible charge of a professional engineer or professional land surveyor.

(5) The practice of professional engineering or land surveying by any person not a resident of, and having no established place of business in this State, as a consulting associate of a professional engineer or professional land surveyor licensed under the provisions of this Chapter; provided, the nonresident is qualified for performing the professional service in the person's own state or country.

(6) Practice by members of the Armed Forces of the United States; employees of the government of the United States while engaged in the practice of engineering or land surveying solely for the government on government-owned works and projects; or practice by those employees of the Natural Resources Conservation Service, county employees, or employees of the Soil and Water Conservation Districts who have federal engineering job approval authority that involves the planning, designing, or implementation of best management practices on agricultural lands.

(7a) The engineering or surveying activities of a person as defined by G.S.89C-3(5) who is engaged in manufacturing, processing, producing, or transmitting and delivering a product, and which activities are reasonably necessary and connected with the primary services performed by individuals regularly employed in the ordinary course of business by the person, provided that the engineering or surveying activity is not a holding out or an offer to the public of engineering or surveying services, as prohibited by this Chapter. The engineering and surveying services may not be offered, performed, or rendered independently from the primary services rendered by the person. For purposes of this subdivision, "activities reasonably necessary and connected with the primary service" include the following:

a. Installation or servicing of the person's product by employees of the person conducted outside the premises of the person's business.

b. Design, acquisition, installation, or maintenance of machinery, equipment, or apparatus incidental to the manufacture or installation of the product performed by employees of the person upon property owned, leased, or used by the person.

c. Research and development performed in connection with the manufacturing, processing, or production of the person's product by employees of the person.

Engineering or surveying activities performed pursuant to this subdivision, where the safety of the public is directly involved, shall be under the responsible charge of a licensed professional engineer or licensed professional surveyor.

(8) The (i) preparation of fire sprinkler planning and design drawings by a fire sprinkler contractor licensed under Article 2 of Chapter 87 of the General Statutes, or (ii) the performance of internal engineering or survey work by a manufacturing or communications common carrier company, or by a research and development company, or by employees of those corporations provided that the work is in connection with, or incidental to products of, or nonengineering services rendered by those corporations or their affiliates.

(9) The routine maintenance or servicing of machinery, equipment, facilities or structures, the work of mechanics in the performance of their established functions, or the inspection or supervision of construction by a foreman, superintendent, or agent of the architect or professional engineer, or services of an operational nature performed by an employee of a laboratory, a manufacturing plant, a public service corporation, or governmental operation.

(10) The design of land application irrigation systems for an animal waste management plan, required by G.S. 143-215.10C, by a designer who exhibits, by at least three years of relevant experience, proficiency in soil science and basic hydraulics, and who is thereby listed as an Irrigation Design Technical Specialist by the North Carolina Soil and Water Conservation Commission. (1921, c. 1, s. 13; C.S., s. 6055(o); 1951, c. 1084, s. 1; 1975, c. 681, s. 1; 1995, c. 146, s. 1; 1995 (Reg. Sess., 1996), c. 742, s. 35; 1997-454, s. 1; 1998-118, s. 23; 2007-536, s. 1; 2011-183, s. 53; 2011-304, s. 7; 2014-120, s. 11(a).)

§ 89C-25.1. Supervision of unlicensed individuals by licensed person.

In all circumstances in which unlicensed individuals are permitted under this Chapter to perform engineering or land surveying work, or both, under the supervision of a licensed engineer, land surveyor, or both, the Board may by regulation establish a reasonable limit on the number of unlicensed individuals which a licensee of the Board may directly or personally supervise at one time. (1979, c. 819, s. 5; 1998-118, s. 24.)

§ 89C-25.2. Program of licensure by discipline.

The Board shall submit to the legislative committees of reference by July 1, 1981, a program of licensure by discipline and an analysis of the costs and merits thereof in order to permit the General Assembly to make a decision on the establishment of such a program. The "committees of reference" shall be the Senate and House Committees on State Government respectively or such other committees as the respective presiding officers may determine. (1979, c. 819, s. 5.)

§ 89C-26: Repealed by Session Laws 1997-309, s. 10.

§ 89C-27. Invalid sections; severability.

If any of the provisions of this Chapter, or if any rule, regulation or order thereunder, or if the application of such provision to any person or circumstance shall be held invalid, the remainder of this Chapter and the application of such provision of this Chapter or rule, regulation or order to persons or circumstances, other than those as to which it is held valid, shall not be affected thereby. (1975, c. 681, s. 1.)

§ 89C-28. Existing licensure not affected.

Nothing in this Chapter shall be construed as affecting the status of licensure of any professional engineer or land surveyor who is rightfully in possession of a certificate of licensure duly issued by the Board and valid as of July 1, 1975. (1951, c. 1084, s. 1; 1959, c. 1236, s. 2; 1975, c. 681, s. 1; 1998-118, s. 25.)

I/A

EXHIBIT GLB-7

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH
DOCKET NO. EC-23. SUB 50

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of:	:
BLUE RIDGE ELECTRIC	:
MEMBERSHIP CORPORATION,	:
	:
Petitioner,	:
	:
vs.	:
	:
CHARTER COMMUNICATIONS	:
PROPERTIES, LLC,	:
	:
Respondent.	:

\- - -

30(b)(6) DEPOSITION OF NESTOR MARTIN
(Taken by the Petitioner)
Charlotte, North Carolina
October 4, 2017

Reported by: Jackie Johnson Milam
Court Reporter
Notary Public

the witness in your speaking objections.

MR. GEORGE: That's not even remotely what I'm doing.

You're submitting this as an exhibit, and I'd like you to tell me how this exhibit connects to the topics. You've made an attempt to do that.

I'm just saying, as you ask your question, I may -- we may need clarity as to what testimony you're trying to elicit from Mr. Martin, whether it's from his personal experience or whether it's on behalf of the company. We'll take it on a question-by-question basis.

MR. TILLEY: You're free to object to form.

BY MR. TILLEY:

Q. Mr. Martin, turning your attention back to your previous hearing testimony.

Do you recall agreeing that it is reasonable to require Time Warner Cable to comply with the NESC when making attachments to cooperatives' poles?

A. Yes.

Q. Would you also agree that it is correct and reasonable to require Charter to comply with the NESC when making attachments to cooperatives' poles?

A. Yes.

Q. Do you recall testifying that it is reasonable to

Manual discussed in your previous testimony apply to Charter in this case?

MR. GEORGE: Objection to form.

THE WITNESS: It may not apply at this time.

BY MR. TILLEY:

Q. Do you know?

A. I'm not sure, but it may not apply.

Q. Since your testimony in June, have you gone back and reviewed Time Warner Cable's Safety Practices Manual?

A. I have not.

Q. Do you know if Charter has its own Safety Practices Manual?

A. No, I do not know.

Q. Have you ever reviewed a Safety Practices Manual for Charter?

A. I have not.

Q. During your testimony, I recall that you said that Time Warner Cable does not have a separate program to inspect its aerial facilities under NESC Rule 214; do you recall that?

A. Yes.

Q. And you testified that Time Warner Cable employees generally note violations, when they come across them, and fix them in the regular course of their

work; do you recall that?
A. Yes, I do.
Q. But there's no independent or no employee who is assigned responsibility to ride Time Warner's lines or facilities to inspect them for safety issues; do you recall that?
A. I do.
Q. With respect to Charter, does Charter have a separate program to inspect its lines or aerial facilities under NESC Rule 214?
MR. GEORGE: Objection.
To the extent you're asking about training, safety, engineering practices followed by Charter, we designated Mike Mullins for that topic, and I believe you've asked these set of questions to Mike Mullins.
So you can ask Nestor his personal knowledge, but he will not be testifying on behalf of the company.
MS. HARDEN: He will be testifying in his capacity with the company, correct?
MR. GEORGE: He will be testifying as an employee of the company about his personal knowledge.
BY MR. TILLEY:
Q. You are the Senior Director of Construction overseeing Charter's operations in the Carolina Region,

correct?

A. Correct.

Q. Does Charter have a separate program to inspect its lines and aerial facilities for safety violations under NESC Rule 214?

MR. GEORGE: Same objection.

THE WITNESS: Not to my knowledge.

BY MR. Tilley:

Q. Is it your understanding that Charter's practice is, generally, to have employees note violations when they come across them in the course of their regular work?

MR. GEORGE: Same objection.

THE WITNESS: Yes.

BY MR. TILLEY:

Q. But Charter does not have a safety inspection program, other than when employees happen to come across something?

MR. GEORGE: Same objection.

THE WITNESS: Correct.

BY MR. TILLEY:

Q. And there's no Charter employee that has responsibility for riding the lines in Charter's aerial facilities to inspect them for safety issues; is that correct?

MR. GEORGE: Same objection.
THE WITNESS: Correct.
BY MR. TILLEY:
Q. I remember, in your testimony in the Time Warner case, you testified that as far as conducting regular safety inspections, Time Warner Cable generally relies on pole owners to do those inspections; do you recall that?
A. I recall saying it was a shared responsibility.
Q. Well, your testimony was, I believe, and it was almost word-for-word, that as far as conducting regular separate safety inspections, Time Warner Cable generally relies on pole owners to conduct inspections; do you recall that?
MR. GEORGE: Objection to form.
THE WITNESS: Yes.
BY MR. TILLEY:
Q. Is the same true for Charter?
MR. GEORGE: Objection.
Again, this is not a topic that this witness is designated to testify about.
THE WITNESS: Yes.
BY MR. TILLEY:
Q. It is the same for Charter?
MR. GEORGE: Same objection.

I/A

EXHIBIT GLB-8

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH
DOCKET NO. EC-23-SUB 50

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of:
BLUE RIDGE ELECTRIC
MEMBERSHIP CORPORATION,

Petitioner,

vs.

CHARTER COMMUNICATIONS
PROPERTIES, LLC,

Respondent.

- - -

30(b)6) DEPOSITION OF MICHEAL MULLINS
(Taken by the Petitioner)
Charlotte, North Carolina
October 4, 2017

Reported by: Jackie Johnson Milam
Court Reporter
Notary Public

the span footages. We measure clearances, and then we notify the attacher and request permission to make those attachments.

Q. When you say we, are those Charter's employees or are those Charter's contractors?

A. Those are Charter's employees.

Q. Then if the pole owner gives permission to make the attachment, who actually does the work?

A. That is our contractor.

Q. Is there any time, at least in the extension of the main line, distribution main line attachments, that or main line construction -- excuse me -- that Charter employees do the construction work, as opposed to contractors?

MR. GEORGE: Objection. Vague.

BY MR. TILLEY:

Q. Do your employees ever do construction on extension of the main line?

A. My employees do not.

Q. So in every instance when you're doing construction on the main line, that is work done through contractors?

A. That is correct.

Q. Is there a Maintenance Group, with respect to the aerial plant, or a group that performs maintenance?

A. Yes.
Q. Is that separate from your Construction Group?
A. That is.
Q. What does that Maintenance Group do when it conducts its work?
A. They monitor signal levels. They adjust the equipment, the active equipment, to ensure that it's running at its peak levels. They monitor power supplies.
Q. Do they do anything else?
A. They do repairs to the plant.
Q. What types of repairs do they perform?
A. If there's a broken cable, if there's a cut cable, if equipment is damaged, they will replace it.
Q. Now, my understanding is, when you were talking about signal strength, that the primary focus of the Maintenance Group is to make sure that the signal is being transmitted across Charter's facilities; is that correct?
A. That is correct.
Q. Does the Maintenance Group conduct regular reviews or inspections of Charter's lines to make sure that they comply with the applicable codes and construction specs?
A. They're in the field daily, and they do monitor,

look for the plant inconsistencies.

Q. When they're in the field daily, though, that's because they're performing this work monitoring signal strength, checking power supplies, or fixing broken lines; is that correct?

A. That is correct, but they're also looking at our plant to make sure that it's secure.

Q. If they see anything along the way, they're supposed to note it and do something about it; is that right?

A. They will.

Q. But they're not independently tasked to go through and make sure that the attachments are in compliance and clearances have remained the same over time?

A. Not specifically, no.

Q. Does your Construction Group have a program to regularly inspect the lines for compliance with NESC and other construction specifications?

A. Many like the maintenance techs, my coordinators are in the field every day, and we're observing the plant as we're riding our jobs.

Q. So they'll catch it if they see it in the course of other business?

A. Yes.

Q. Are any of the employees that perform -- let me back up for just a second.

Are any of Charter's employees that perform construction or maintenance work on its aerial facilities professional engineers?

A. No, they're not.

Q. Does Charter provide its employees training on the NESC?

A. We train our employees on topics within the NESC.

Q. And just for the purposes of the Record, when I said the NESC, I mean the National Electric Safety Code.

A. Correct. Yes.

Q. You said that Charter performs training on portions of the NESC.

Are those formal trainings or is that on-the-job training?

A. That is primarily on-the-job training.

Q. To the extent Charter provides formal training, what is that formal training program?

A. There are various training topics that we cover on a weekly, monthly basis. They range anywhere from defensive driving to power supplies, handling temporary cables, office safety, proper lifting, just general safety.

Q. In those trainings, is defensive driving covered

by the NESC?
A. Not that I'm aware of.
Q. And those trainings are in-house trainings for Charter employees only; is that correct?
A. Yes.
Q. They're not for contractors?
A. That's correct.
Q. Who provides those trainings?
A. The supervisors.
Q. When Charter applies to attach to Blue Ridge's poles, does it do an engineering analysis on the proposed construction before it asks Blue Ridge for permission to attach?
MR. GEORGE: Objection to form.
BY MR. TILLEY:
Q. Charter makes attachments to Blue Ridge's poles; is that correct?
A. That is correct.
Q. And Charter determines that it's going to attach to those poles before it makes the attachment, I'm assuming, correct?
A. That is correct.
Q. When Charter decides to attach to Blue Ridge's poles, does it perform an engineering analysis of the attachments before making them?

correct?

A. That is correct.

Q. Have you ever seen a loading analysis performed on overlashing --

MR. GEORGE: Objection, form.

BY MR. TILLEY:

Q. -- or proposed overlashing?

MR. GEORGE: Same objection.

THE WITNESS: I'm sorry. Repeat the question.

BY MR. TILLEY:

Q. In your work with Charter, have you ever seen or has Charter ever performed a loading analysis before or after it overlashed facilities?

MR. GEORGE: Same objection.

THE WITNESS: The cables we overlash are lightweight. So no.

BY MR. TILLEY:

Q. Have you ever performed a wind loading analysis of either proposed or completed overlashing?

MR. GEORGE: Objection, form.

THE WITNESS: That would be the same answer.

BY MR. TILLEY:

Q. Does Charter perform an analysis of its pole attachments in its proposed construction to ensure it

would need to maintain additional clearance from.
Q. So say there's a transformer on the pole that's below the neutral, how would that change things?
A. Then we would need to maintain a minimum of 40 inches below the bottom of the transformer and still maintain our 72 inches from the neutral.
Q. Where does that 72 inch clearance requirement come from?
A. Out of the Agreement with Blue Ridge.
Q. Charter's Agreement with Blue Ridge?
A. Yes.
Q. You said that Charter uses contractors to perform construction work; is that correct?
A. That is correct.
Q. In fact, it uses contractors to perform all of its construction work; is that correct?
A. That's correct.
Q. And you said that, at least with respect to construction work, Charter employees never perform that work themselves in Blue Ridge's territory; is that correct?
A. That's correct.
Q. Has Charter always used contractors to do its construction work?
A. Yes.

A. They do, yes.
Q. How do you know that?
A. We periodically review their safety training.
Q. What do you review when you review their safety training?
A. Topics, attendees.
Q. So they provide some sort of documentation?
A. Yes.
Q. And that documentation, what does it include?
A. Just the topics, safety topics covered and the attendees.
Q. Does Charter ever provide safety training to contractors' employees?
A. No, we do not.
Q. Does Charter ever provide training to contractors' employees on compliance with the NESC?
A. No, we do not.
Q. Does Charter ever provide training to contractors' employees on the specifications or construction requirements that Blue Ridge imposes on its system?
A. Yes, we do.
Q. How do you provide that training?
A. Usually verbal, just verbal communication with the supervisors so they understand the requirements for

the different utilities that we're attaching to their poles.

Q. So there's no formal communication of Blue Ridge's construction requirements; is that right?

MR. GEORGE: Objection to form.

BY MR. TILLEY:

Q. It's just verbal?

MR. GEORGE: Objection to form.

THE WITNESS: Yes. It's a meeting.

BY MR. TILLEY:

Q. It's not written?

A. Correct.

Q. And that meeting typically occurs between whom?

A. The Construction Team and the contractors' supervisors.

Q. Let me pull out a document here. Excuse me. Before I do that.

You said that Charter's -- excuse me -- Blue Ridge's construction specifications are communicated between construction personnel verbally between Charter's construction personnel and its contractors' personnel; is that right?

A. That is correct.

Q. Is there any follow-up documentation to confirm that those specifications were communicated to the

I/A

EXHIBIT GLB-1R

2017 National Electrical Safety Code® (NESC®)

C2-2017

NESC 100TH ANNIVERSARY EDITION

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Accredited
Standards
Committee
C2-2017

National Electrical Safety Code®

Secretariat
Institute of Electrical and Electronics Engineers, Inc.

Approved 26 April 2016
American National Standards Institute

2017 Edition

Abstract: This Code covers basic provisions for safeguarding of persons from hazards arising from the installation, operation, or maintenance of (1) conductors and equipment in electric supply stations, and (2) overhead and underground electric supply and communication lines. It also includes work rules for the construction, maintenance, and operation of electric supply and communication lines and equipment. The Code is applicable to the systems and equipment operated by utilities, or similar systems and equipment, of an industrial establishment or complex under the control of qualified persons. This Code consists of the introduction, definitions, grounding rules, list of referenced and bibliographic documents, and Parts 1, 2, 3, and 4 of the 2017 Edition of the National Electrical Safety Code.

Keywords: communications industry safety; construction of communication lines; construction of electric supply lines; electrical safety; electric supply stations; electric utility stations; high-voltage safety; operation of communications systems; operation of electric supply systems; power station equipment; power station safety; public utility safety; safety work rules; underground communication line safety; underground electric line safety

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climbing. The vertical movement (ascending and descending) and horizontal movement to access or depart the worksite.

common use. Simultaneous use by two or more utilities of the same kind.

communication equipment. Equipment that produces, modifies, regulates, or controls communication signals. This equipment may also produce, modify, or safeguard a supply of electric energy for the exclusive use of communication devices as long as the equipment and communication devices being served are owned and operated by the same party. *See:* **electric supply equipment.**

communication lines. *See:* **lines.**

communication space. The space on joint-use structures where communication facilities are separated from the supply space by the communication worker safety zone. See Figure D-1.

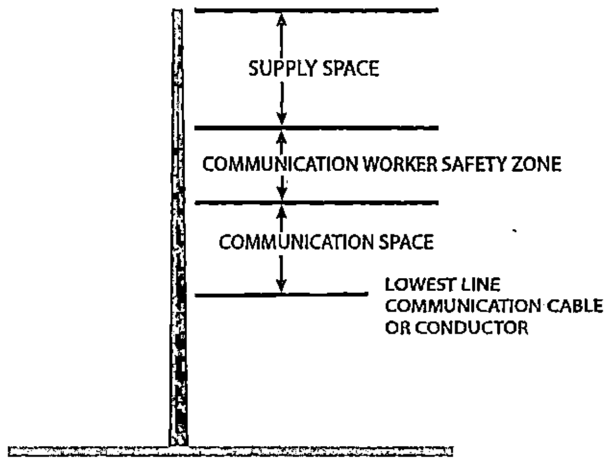

Figure D-1—Communication space

conductor.

1. A material, usually in the form of a wire, cable, or bus bar, suitable for carrying an electric current.
2. **bare conductor.** A metallic conductor without a covering.
3. **bundled conductor.** An assembly of two or more conductors used as a single conductor and employing spacers to maintain a predetermined configuration. The individual conductors of this assembly are called *subconductors*.
4. **covered conductor.** A conductor covered with a dielectric having no rated insulating strength or having a rated insulating strength less than the voltage of the circuit in which the conductor is used.
5. **fiber-optic conductor.** *See:* **fiber-optic cable—communication** or **fiber-optic cable—supply.**
6. **grounded conductor.** A conductor that is intentionally grounded, either solidly or through a noninterrupting current-limiting device.
7. **grounding conductor.** A conductor that is used to connect the equipment or the wiring system with a grounding electrode or electrodes.
8. **insulated conductor.** A conductor covered with a dielectric (other than air) having a rated insulating strength equal to or greater than the voltage of the circuit in which it is used.
9. **lateral conductor.** A wire or cable entirely supported on one structure and extending in a general horizontal, vertical, or diagonal direction to make connections to line conductors, service drops, equipment, or other facilities supported on the same structure. Lateral conductors may be attached directly to the structure or supported away from the structure.

structure conflict. A line so situated with respect to a second line that the overturning of the first line will result in contact between its supporting structures or conductors and the conductors of the second line, assuming that no conductors are broken in either line.

substation. *See:* **electric supply station.**

supervised installation. Where conditions of maintenance and supervision ensure that only qualified persons monitor and service the system.

supply equipment. *See:* **electric supply equipment.**

supply space. The space on joint-use structures where supply facilities are separated from the communication space by the communication worker safety zone. See Figure D-5.

NOTE: Communication facilities may be located in the supply space (see Rule 224A).

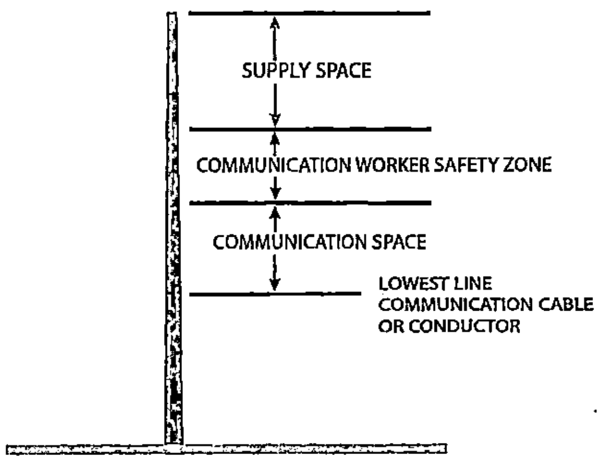

Figure D-5—Supply space

supply station. *See:* **electric supply station.**

supported facility. Any component of an overhead line system that is supported on, but is not intended to provide structural strength to, the supporting structure or mechanical support system.

NOTE: Examples of supported facilities include, but are not limited to, components such as messengers, conductors, line hardware, equipment hanger brackets, and switches.

supporting structure. The main supporting unit (usually a pole or tower) used to support supply and/or communication conductors, cables, and equipment.

NOTE: A supporting structure may consist of a single or multiple pole arrangement that supports supply and/or communication conductors, cables, and equipment at a line location.

1. **readily climbable.** A supporting structure having sufficient handholds or footholds so that the structure can be climbed easily by an average person without using a ladder, tools or devices, or extraordinary physical effort.
2. **not readily climbable.** A supporting structure not meeting the definition of a readily climbable structure, including but not limited to the following:

(3) For span lengths in excess of 45 m (150 ft), vertical clearance at the structure between open supply conductors and communication cables or conductors shall be adjusted so that under conditions of conductor temperature of 15 °C (60 °F), no wind displacement and final sag, no open supply conductor of over 750 V but less than 50 kV shall be lower in the span than a straight line joining the points of support of the highest communication cable or conductor.

EXCEPTION: Effectively grounded supply conductors associated with systems of 50 kV or less need meet only the provisions of Rule 235C2b(1).

3. Alternate clearances for different circuits where one or both exceed 98 kV ac, or 139 kV dc to ground

The clearances specified in Rules 235C1 and 235C2 may be reduced for circuits with known switching-surge factors, but shall not be less than the crossing clearances required by Rule 233C3.

4. Communication worker safety zone

The clearances specified in Rules 235C and 238 create a *communication worker safety zone* between the facilities located in the supply space and facilities located in the communication space, both at the structure and in the span between structures. Except as allowed by Rules 238C, 238D, and 239, no supply or communication facility shall be located in the communication worker safety zone.

D. Diagonal clearance between line wires, conductors, and cables located at different levels on the same supporting structure

No wire, conductor, or cable may be closer to any other wire, conductor, or cable than defined by the dashed line in Table 235-1, where V and H are determined in accordance with other parts of Rule 235.

E. Clearances in any direction at or near a support from line conductors to supports, and to vertical or lateral conductors, service drops, and span or guy wires, attached to the same support

1. Fixed supports

Clearances shall be not less than those given in Table 235-6.

EXCEPTION: For voltages exceeding 98 kV ac to ground or 139 kV dc to ground, clearances less than those required by Table 235-6 are permitted for systems with known switching-surge factor. (See Rule 235E3.)

NOTE 1: For clearances in any direction from supply line conductors to communication antennas in the supply space attached to the same supporting structure, see Rule 235I.

NOTE 2: For antennas in the communication space, see Rule 236D1 and Rule 238.

2. Suspension insulators

Where suspension insulators are used and are not restrained from movement, the clearance shall be increased so that the string of insulators may swing transversely throughout a range of insulator swing up to its maximum design swing angle without reducing the values given in Rule 235E1. The maximum design swing angle shall be based on a 290 Pa (6 lb/ft^2) wind on the conductor at final sag at 15 °C (60 °F). This may be reduced to a 190 Pa (4 lb/ft^2) wind in areas sheltered by buildings, terrain, or other obstacles. Trees are not considered to shelter a line. The displacement of the wires, conductors, and cables shall include deflection of flexible structures and fittings, where such deflection would reduce the clearance.

3. Alternate clearances for voltages exceeding 98 kV ac to ground or 139 kV dc to ground

The clearances specified in Rules 235E1 and 235E2 may be reduced for circuits with known switching-surge factors but shall not be less than the following:

a. Alternate clearances to anchor guys, surge-protection wires, and vertical or lateral conductors

The alternate clearances shall be not less than the crossing clearances required by Rule 233B3 and Rules 233C3a and 233C3b for the conductor voltages concerned. For the

E. Communication worker safety zone

The clearances specified in Rules 235C and 238 create a communication worker safety zone between the facilities located in the supply space and facilities located in the communication space, both at the structure and in the span between structures. Except as allowed by Rules 238C, 238D, and 239, no supply or communication facility shall be located in the communication worker safety zone.

Table 238-1—Vertical clearance between supply conductors and communications equipment, between communication conductors and supply equipment, and between supply and communications equipment

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems. See also Rule 238B.)

Supply voltage (kV)	Vertical clearance	
	(m)	(in)
1. Grounded conductor and messenger hardware and supports	0.75	30
2. 0 to 8.7	1.00 ①	40 ①
3. Over 8.7	1.00 plus 0.01 per kV ① in excess of 8.7 kV	40 plus 0.4 per kV ① in excess of 8.7 kV

①Where non-current-carrying parts of supply equipment are effectively grounded and the associated neutral meeting Rule 230E1 or supply cables meeting Rule 230C1 (including the support brackets) are bonded to communication messengers at intervals meeting Rule 092C through out well-defined areas and where communication is at lower levels, clearances may be reduced to 0.75 m (30 in).

Table 238-2—Vertical clearance of span wires and brackets from communication lines and equipment

(See also Rule 238C.)

	Carrying luminaires, traffic signals, or trolley conductors			
	Not effectively grounded		Effectively grounded	
	(mm)	(in)	(mm)	(in)
Above communication support arms	1000	40	500	20 ①
Below communication support arms	1000	40	600	24
Above messengers carrying communication cables	1000	40	100	4
Below messengers carrying communication cables	1000	40	100	4
From terminal box of communication cable	1000	40	100	4
From communication brackets, bridle wire rings, or drive hooks	1000	40	100	4

①This may be reduced to 300 mm (12 in) for either span wires or metal parts of brackets at points 1.0 m (40 in) or more from the structure surface.

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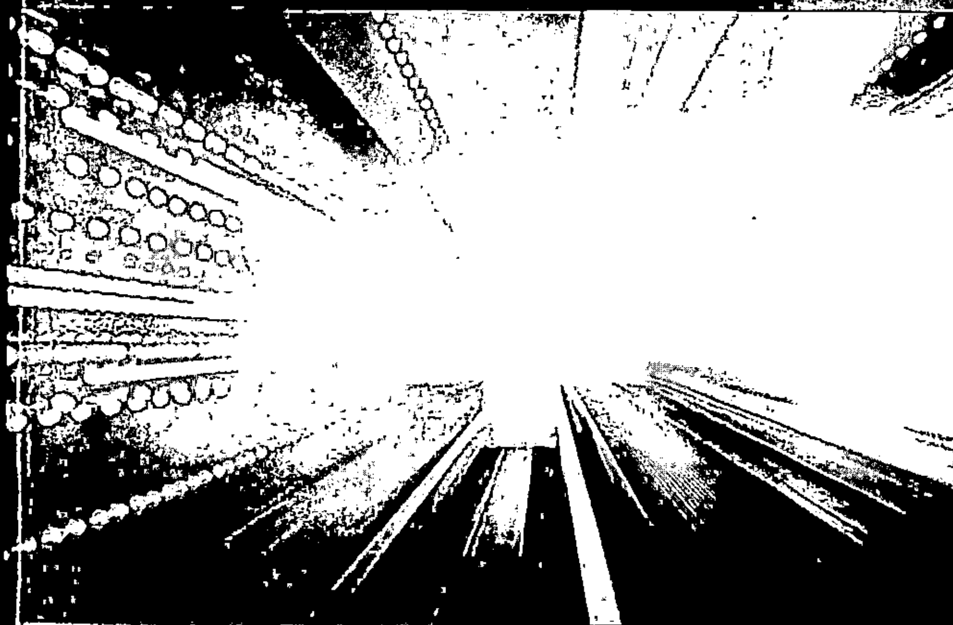
NESC® Handbook
Seventh Edition

A Discussion of the National Electrical Safety Code®

Allen L. Clapp



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On joint-use structures, a *communication worker safety zone* of 1 m (40 in) between communication and supply conductors of up to (1) 8700 V to ground for effectively grounded circuits or (2) 8700 V between conductors for other circuits is generally considered an appropriate value. The *communication worker safety zone* terminology has been in long use and was codified in the 2002 Edition. The communication worker safety zone is only needed if the communication utility chooses to use communication work rules and equipment. Experience has shown that, with span lengths of 45 m (150 ft) or less, such as are commonly found in urban joint-use construction, a 1 m (40 in) clearance at the structure will generally minimize the possibility of accidental contacts between the usual types of supply conductors and communication cables in the spans, even when the supply conductors are loaded with ice. This clearance is also generally sufficient to limit contact in situations where ice may fall or be jarred off communication cables in the lower position while the supply conductors are still under load. Such clearance also provides a clear working space between the two types of facilities so that (1) line workers working on supply wires at about waist level will have clear leg room below such wires and (2) communications workers will be provided with clear headroom while working on their facilities. Increased clearances are required with increased voltage.

Experience indicates that adequate clearance at the supports is a fundamental requirement for safety where joint-use construction is employed. While the rules provide for a minimum clearance of 1 m (40 in), greater clearances are required where spans exceed 45 m (150 ft) in length and for higher voltages. For application of Rule 235C2a, the calculation of voltage is intended to require the two circuits to be considered as being 180° out of phase, as in all similar calculations in the Code.

Where direct-current feeder circuits of voltages in excess of 750 V to ground are installed above communication conductors, particular attention should be given to the sags. Because of their size and

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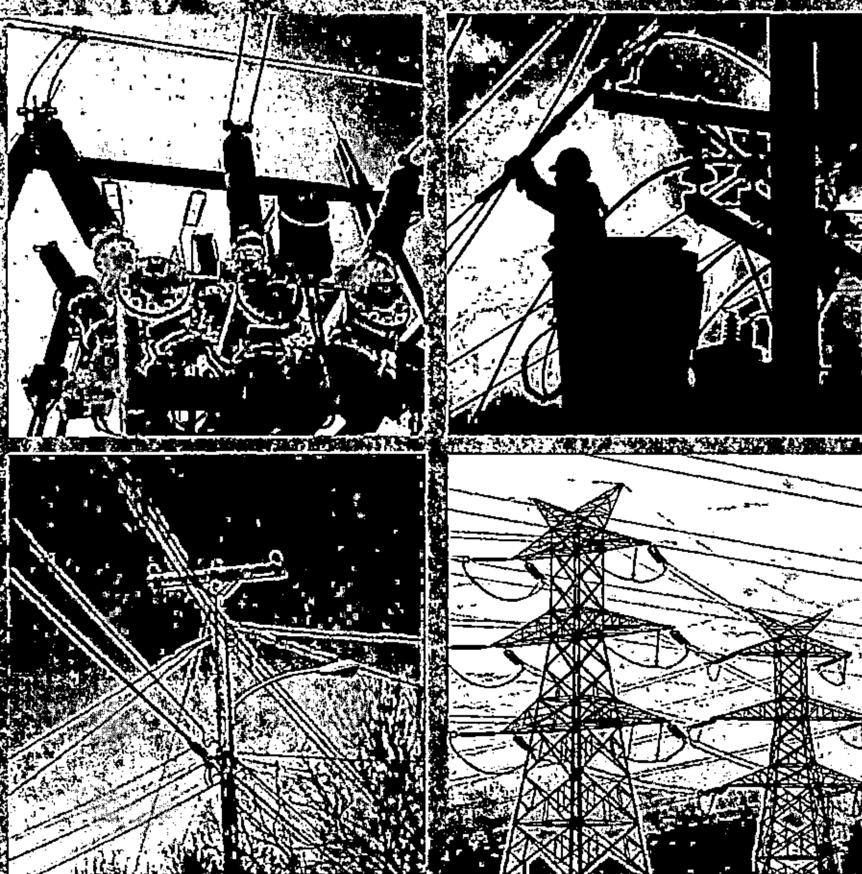

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On joint-use structures, a *communication worker safety zone* of 1 m (40 in.) between communication and supply conductors of up to (1) 8700 V to ground for effectively grounded circuits or (2) 8700 V between conductors for other circuits is generally considered an appropriate value. The *communication worker safety zone* terminology has been in long use and was codified in the 2002 Code. The communication worker safety zone is only needed if the communication utility chooses to use communication work rules and equipment (see Rule 224A). Experience has shown that, with span lengths of 45 m (150 ft) or less, such as are commonly found in urban joint-use construction, a 1 m (40 in.) clearance at the structure will generally minimize the possibility of accidental contacts between the usual types of supply conductors and communication cables in the spans, even when the supply conductors are loaded with ice. This clearance is also generally sufficient to limit contact in situations where ice may fall or be jarred off communication cables in the lower position while the supply conductors are still under load. Such clearance also provides a clear working space between the two types of facilities so that (1) line workers working on supply wires at about waist level will have clear leg room below such wires and (2) communications workers will be provided with clear headroom while working on their facilities. Increased clearances are required with increased voltage.

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Where direct-current feeder circuits of voltages in excess of 750 V to ground are installed above communication conductors, particular attention should be given to the sags. Because of their size and weight, it is somewhat difficult to deadend them under some conditions and they are often given large sags. Consequently, the vertical clearance between these trolley feeders and communication conductors at the supports should be increased over what is usually provided for supply conductors of equal voltage.

EXCEPTION 2 of Rule 235C1 was added in the 1968 Code solely to encourage the use of common crossing poles for communication service drops crossing under supply lines. *EXCEPTION 2* applies only where a communication drop from one *line* crosses under an effectively grounded supply neutral of another line and is attached to the structure of the other line. It was intended to recognize that many existing supply lines built solely for supply facilities would not have sufficient height to allow both the normal supply/communication clearances and the required ground clearances at the same time. It was concluded that, because multi-grounded neutrals do not ordinarily represent a safety hazard, and because relatively few operations on such service drops would be required by communications workers, the greater safety of a joint-crossing pole justified the reduced clearance allowed in this special instance. *EXCEPTION 2* does not apply to joint-use or colinear construction. *EXCEPTION 3* was added in the 1981 Code.

EXCEPTION 3 of Rule 235C1 was added in the 1981 Code to reflect appropriate standard practice.

The 1981 Code modified Rule 235C3 to show that it applied when one or both of the circuits exceeds 98 kV to ground.

Table 235-5 was extensively revised in the 1987 Code. Phase-to-ground voltage values are normally used in the column and row headings to enter the table. However, where a calculation is required within the table, Rule 235A3 applies and the greater of phasor difference voltage or phase-to-ground voltage is used. This recognizes that the worst case for conductors of similar voltage and phase relationships may be when one line is turned off and grounded for maintenance.

The vertical clearances of Table 235-5 are from the horizontal plane of the lowest surface of the upper conductor at its attachment point. This is a "square box" concept; vertical clearances are intended to be exactly that; they are not diagonal clearances (see Rule 235D).

A new *EXCEPTION* under Rule 235C2b(1)(a) was added in the 1987 Code that allows neutrals meeting Rule 230E1 to be attached with a clearance from communication of 750 mm (30 in.) at the structure *if* it maintains a clearance from communication of 300 mm (12 in.) or more at all points in the span. This change was coordinated with Rule 238. The requirement that the neutral be bonded with the communication messenger was added in the 1990 Code.

The 2002 Code added *EXCEPTION 2* to Rule 235C2b(1)(a) to allow different utilities to use the clearances for the same utility, if they both agreed to do so. The 2012 Code moved both *EXCEPTION*s to the end of the rule and applied them to both Rule 235C2b(1)(a) and Rule 235C2b(1)(b).

I/A

EXHIBIT GLB-2R

NORTH CAROLINA BOARD OF EXAMINERS FOR ENGINEERS AND SURVEYORS
4601 Six Forks Rd Suite 310
Raleigh, North Carolina 27609

November 2, 2017

Mr. Gregory L. Booth, PE
PowerServices, Inc.
1616 E. Millbrook Road, Suite 210
Raleigh, NC 27609

Re: Request for Guidance, "Practice of Engineering"
N.C. Gen. Stat. § 89C-3(6)

Dear Mr. Booth:

In response to your letter, dated October 31, 2017, I am providing information consistent with previous interpretations of the Board within the engineering committee and disciplinary review committees of the Board and by briefly discussing with two engineering members of the Board. While none of us can speak for the Board, this will give an insight into any possible ultimate determination by the Board. The questions that you asked about threshold determinations for when a Professional Engineer (PE) is required, as you related it to the activities under a communications contractor's scope of work in attaching cables, wires and associated facilities and equipment onto the poles of the electric utility company, must be interpreted under the licensing statute G.S. 89C-3(6) for the definition of engineering.

The range of activities that you describe falls within the definition of engineering and requires a PE. The threshold boils down to whether it requires engineering knowledge to adequately protect the public. One indicator is the calculation of loads. Please understand that the engineering committee of the Board can be requested to review and make a recommendation to the full Board for a definitive answer. Specifically, "overlashing," or physically tying additional wires or cables to those that are already attached to a utility pole thereby accommodating additional strands of fiber or coaxial cable on existing pole attachments and potentially increasing loads from deadweight and ice, snow and wind would require engineering analysis and/or calculations to assure public protection from failure and requires a PE. As you noted, overlashing increases the weight and surface area of the attachment, impacting the ice and wind loading calculations required by the National Electrical Safety Code (NESC).

Telephone	FAX	EMAIL Address	WEB Site
(919) 791-2000	(919) 791-2012	ncbels@ncbels.org	www.ncbels.org

While there is no specific threshold, if the work requires engineering knowledge (education, training or experience) to properly perform and protect the public then a PE is required. When additional loads are added to the existing systems, it will in most cases require a PE. The Board in applying G.S. 89C looks for a reasonable interpretation that will protect the public. This does not impact maintenance, repair and renovation work where loads are not increased and there are no other factors that impact the performance.

We will be glad to address any specific examples that you may encounter that you wish to submit to the Engineering Committee if you need further clarification. Let me know if I can be of additional help, by contacting me at dstuttle@ncbels.org or (919) 791- 2000 ext. 111.

Sincerely,

David S. Tuttle
Board Counsel

DST/

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EXHIBIT WA-24

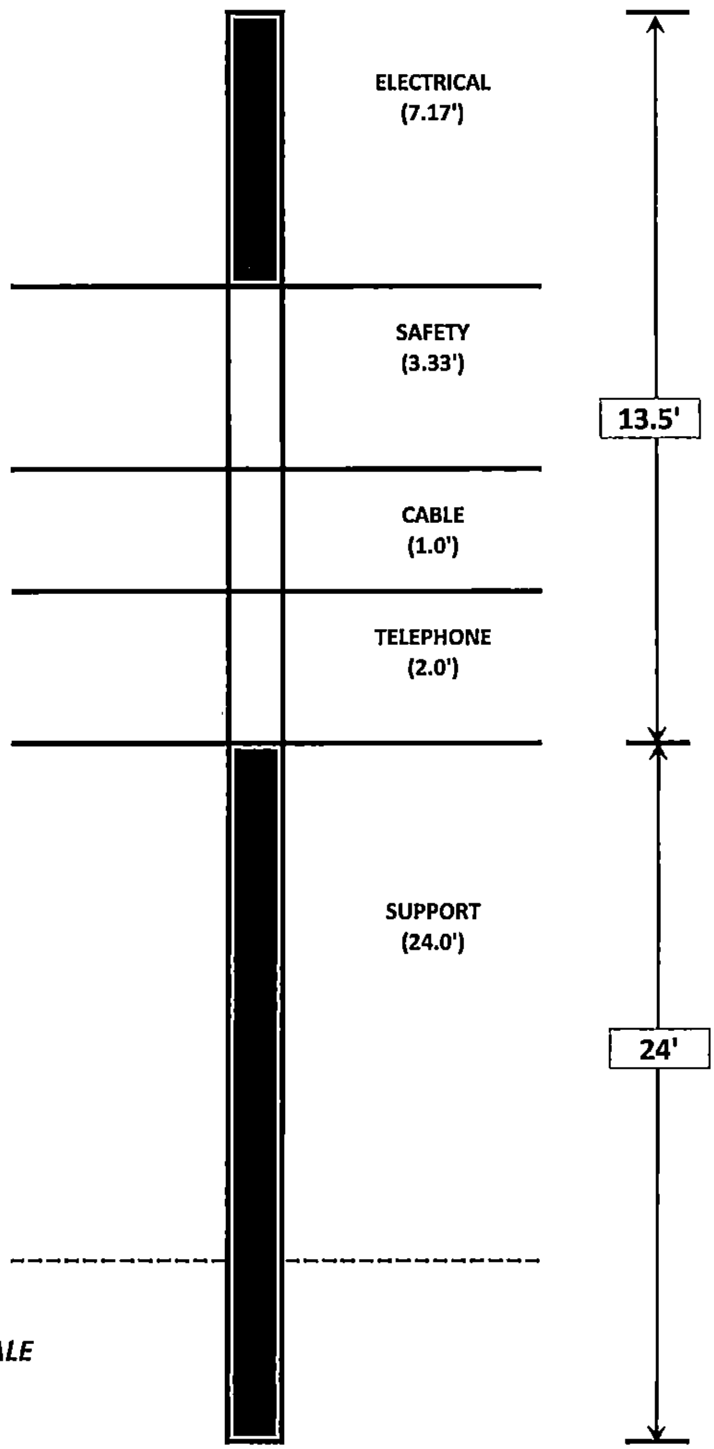
WA Exhibit No. 14
Pole Attachment
Rental Formula Comparisons

PUBLIC

POLE SPACE	RENTAL FORMULAE				
	TVA	APPA	ARKANSAS	FCC CABLE	Telecom Plus = US HR
POLE HEIGHT	37.5'	37.5'	37.5'	37.5'	37.5'
POWER	7.17' Allocated	Part of 10.17' of "Assignable" (Usable) Space	8.17' Allocated	Not Specified - Part of 13.5' of "Usable" Space	Not Specified - Part of 13.5' of "Usable" Space
COMMUNICATIONS WORKER SAFETY SPACE	Allocated Equally to 2 Communications Entities	3.33' Allocated to "Common Space"	Included in the "Un-Usable" Space	Included in the "Usable" Space	Included in the "Usable" Space
COMMUNICATIONS SPACE	Allocated to Communications Attachers	Allocated to Communications Attachers	Allocated to Communications Attachers	Allocated to Communications Attachers - Part of 13.5' of "Usable" Space	Allocated to Communications Attachers - Part of 13.5' of "Usable" Space
CATV	1' Allocated	1' Allocated	1' Allocated	1' Allocated	1' Allocated
TELCO	2' Allocated	1' Allocated	1' Allocated	N/A	1' Allocated
SUPPORT SPACE	Shared Equally By All Attachers (Including Owner)	Included in "Common" Space	Included as Part of the "Un-usable" Space	Known as "Un-usable" Space	Known as "Un-usable" Space
MINIMUM ATTACHMENT HEIGHT TO GROUND LINE	18'	18'	27.33' Which includes the Safety Space. 1/3 Allocated Fully to Owner and 2/3 Allocated Equally to All Attachers Including Owner	18'	18'
IN GROUND FOR STABILITY	6'	6'		6'	6'
PRESUMED NUMBER OF ATTACHERS (INCLUDING OWNER)	3	3	3	N/A	3
CALCULATION	$\frac{1+\frac{3.33}{2}+\frac{24}{3}}{37.5}$	$\frac{1+\frac{27.33}{3}}{37.5}$	$\frac{1+\frac{2}{3}x\frac{27.33}{3}}{37.5}$	$\frac{1}{13.5}$	$\frac{1+\frac{24}{3}}{37.5}$
% OF ANNUAL CHARGE ALLOCATED TO CATV	28.44%	26.96%	18.86%	7.41%*	24.00%
				* 1' Divided by 13.5' of "Usable" Space	

TVA

SPACE ALLOCATION ILLUSTRATION



Allocates usable space

Equal sharing of safety space among all users attaching for communication purposes

Equal sharing of support space among all users including electrical

Space allocation is 28.44% based on assumed 37.5 foot pole with 3 average users

Results in a fair allocation of costs among pole owner and pole users

NOT TO SCALE

DELAWARE FORMULA

SPACE ALLOCATION ILLUSTRATION

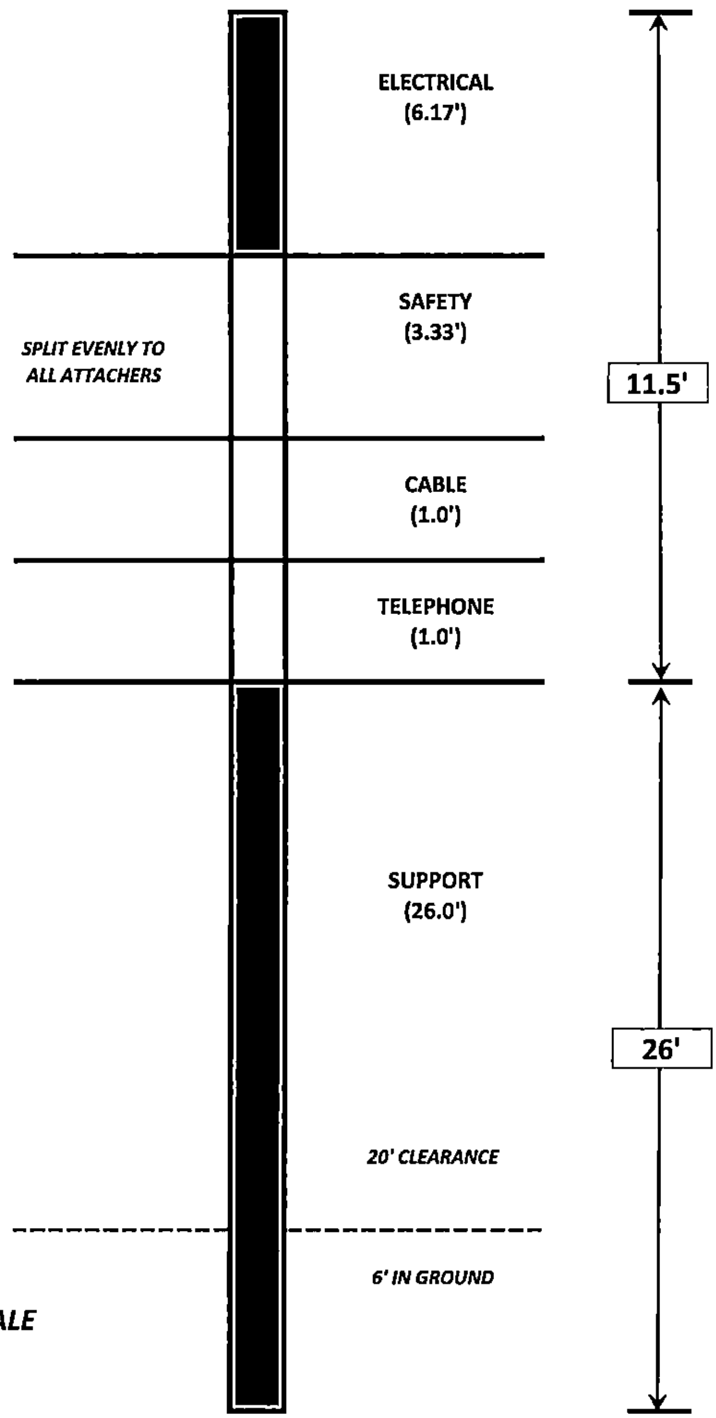
Allocates usable space

Equal sharing of safety space among all users attaching for communication purposes

Equal sharing of support space among all users including electrical

Space allocation is 28.74% based on assumed 37.5 foot pole with 3 average users

Results in a fair allocation of costs among pole owner and pole users



NOT TO SCALE

INDIANA 40' POLE - 2 Party Pole

SPACE ALLOCATION ILLUSTRATION

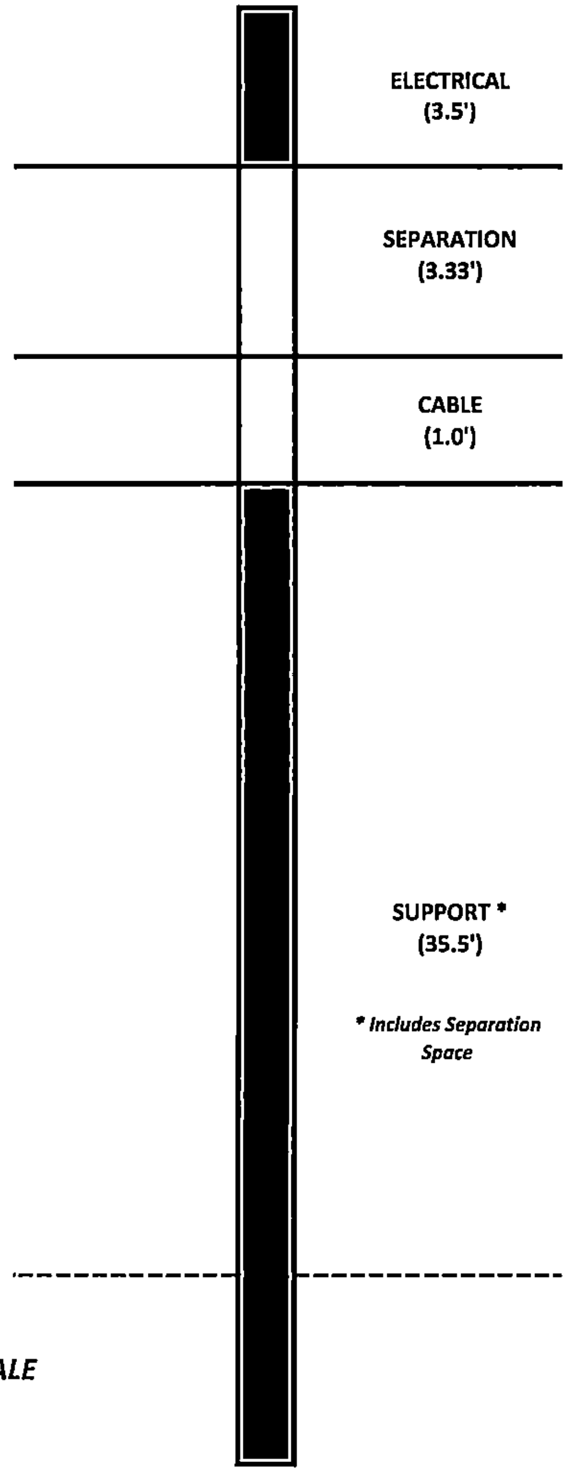
Allocates usable space

Equal sharing of safety space among all users

Equal sharing of support space among all users including electrical

Space allocation is 46.88% based on assumed 40 foot pole with 2 average users

Results in a fair allocation of costs among pole owner and pole users after proration based on the # of 2 & 3 party poles



NOT TO SCALE

INDIANA 40' POLE - 3 Party Pole

SPACE ALLOCATION ILLUSTRATION

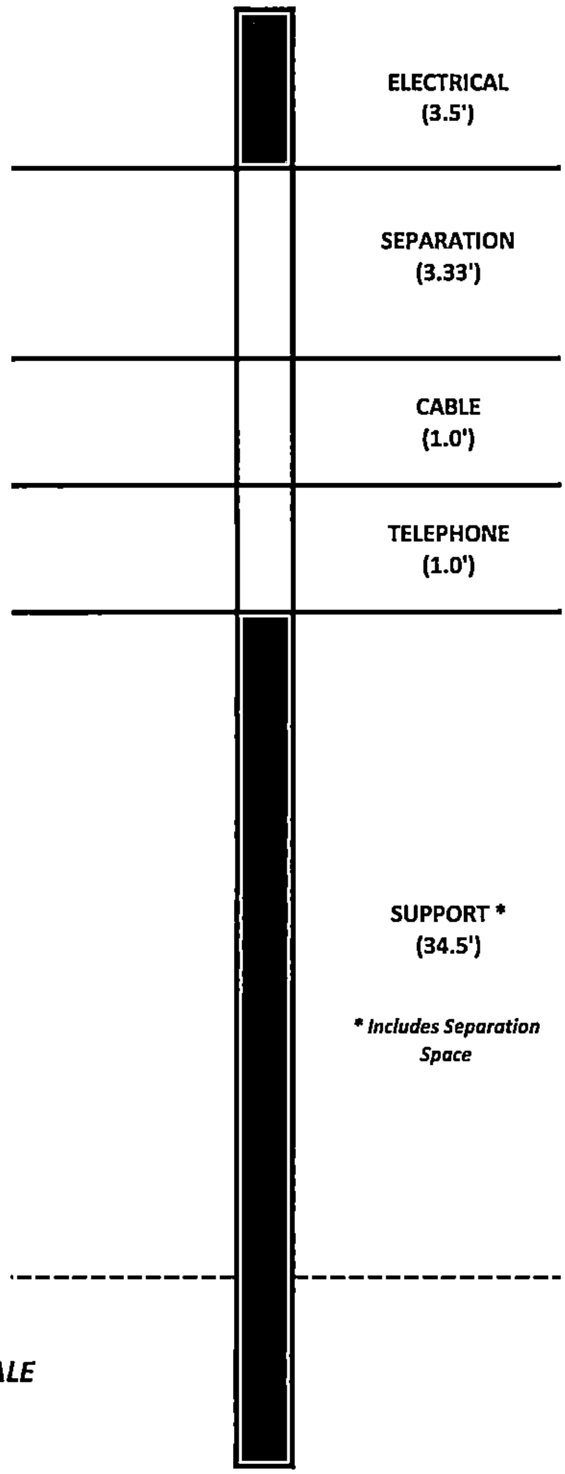
Allocates usable space

Equal sharing of safety space among all users

Equal sharing of support space among all users including electrical

Space allocation is 31.25% based on assumed 40 foot pole with 3 average users

Results in a fair allocation of costs among pole owner and pole users after proration based on the # of 2 & 3 party poles



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CITY OF SEATTLE

SPACE ALLOCATION ILLUSTRATION

STANDARD 47' POLE

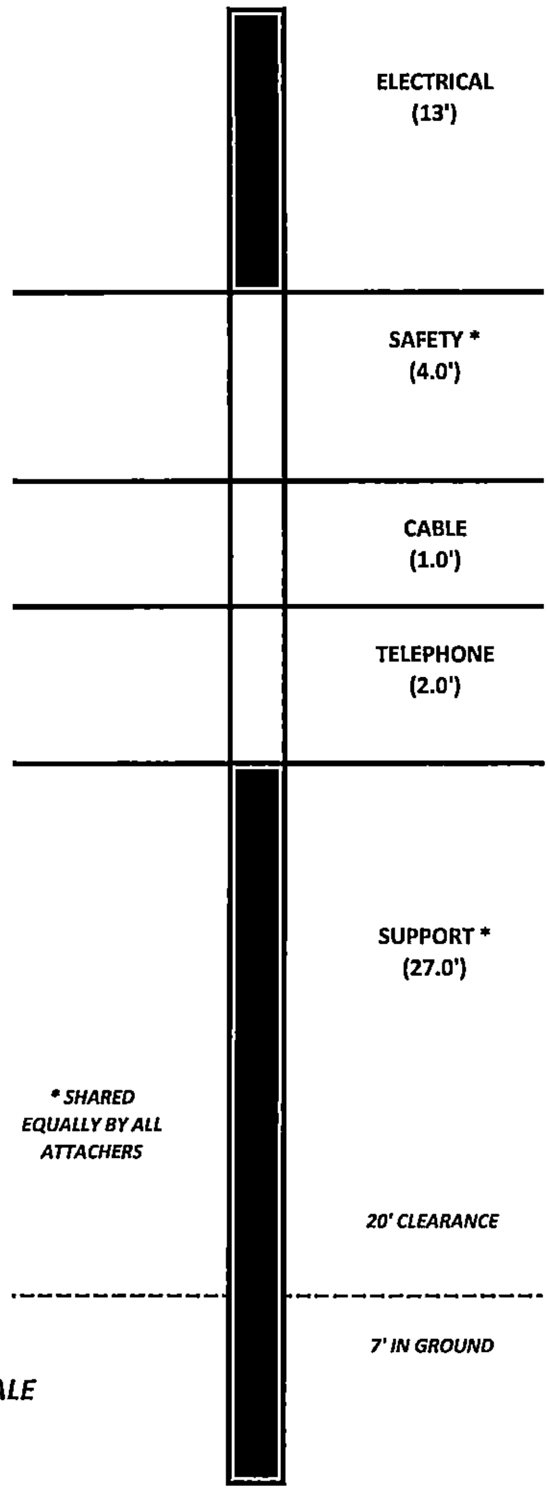
Allocates, direct a/k/a usable space

Equal sharing of safety space among all users attaching

Equal sharing of support space among all users including electrical

Space allocation is 24.11% based on assumed 47 foot pole with 3 average users & CATV using 1' of space

Results in a fair allocation of costs among pole owner and pole users



NOT TO SCALE

PUBLIC

APPA CABLE RATE

SPACE ALLOCATION ILLUSTRATION

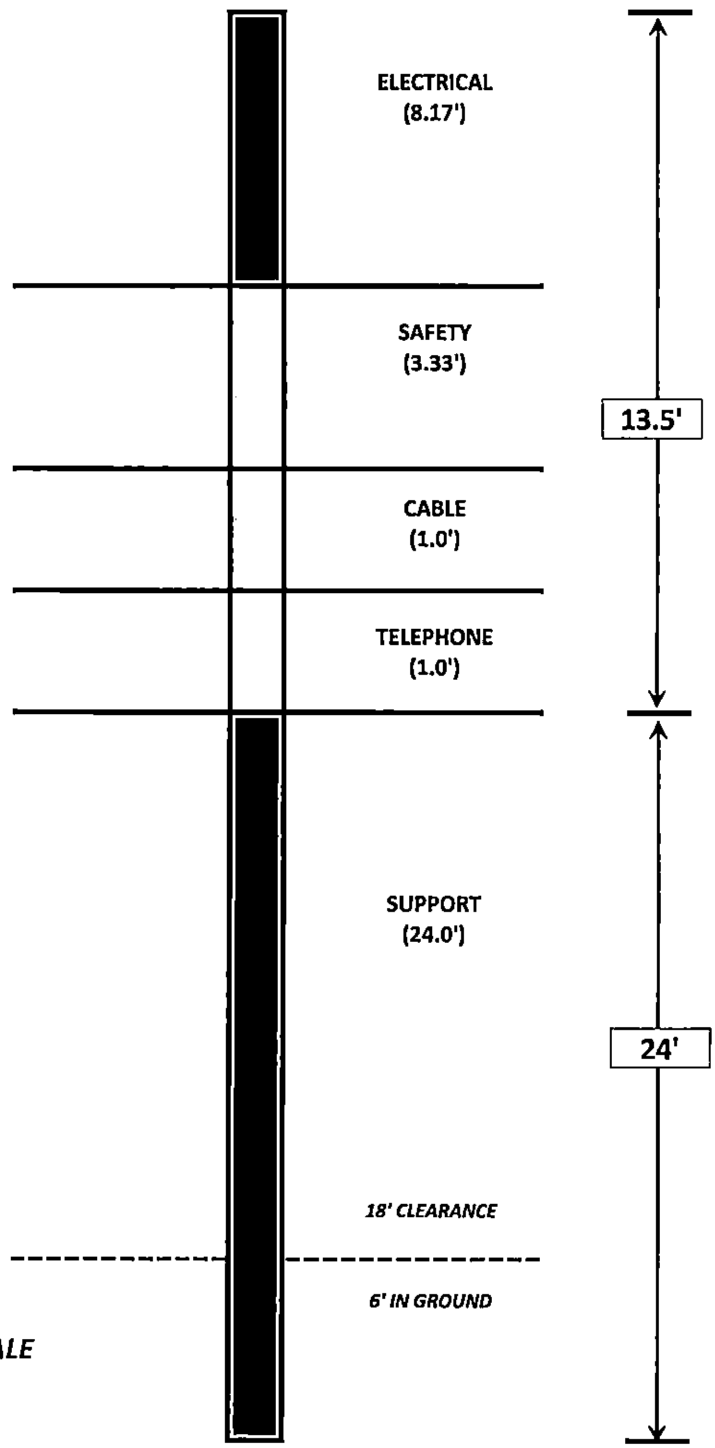
Allocates usable space only

Equal sharing of safety space among all users attaching for communication purposes

Equal sharing of support space among all users including electrical

Space allocation is 26.96% based on assumed 37.5 foot pole with 3 average users

Results in a fair allocation of costs among pole owner and pole users



NOT TO SCALE

ARKANSAS FORMULA

SPACE ALLOCATION ILLUSTRATION

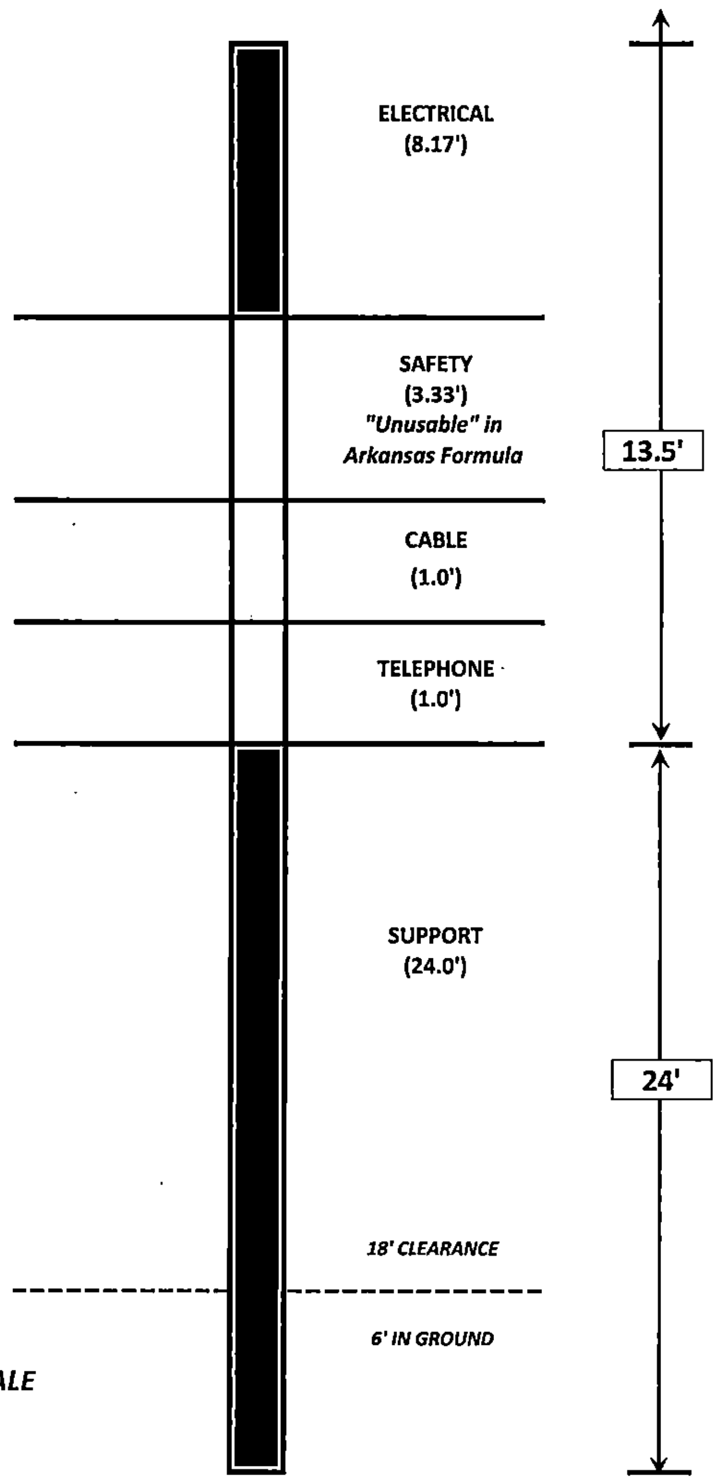
Allocates usable space

Safety space is included in the "Unusable" space.

Pole owner allocated 1/3 of unusable space. Equal sharing of 2/3 support space among all users including electrical

Space allocation is 18.86% based on assumed 37.5 foot pole with 3 average users, including the Owner

Results in a fair allocation of costs among pole owner and pole users



NOT TO SCALE

FCC CABLE RATE

SPACE ALLOCATION ILLUSTRATION

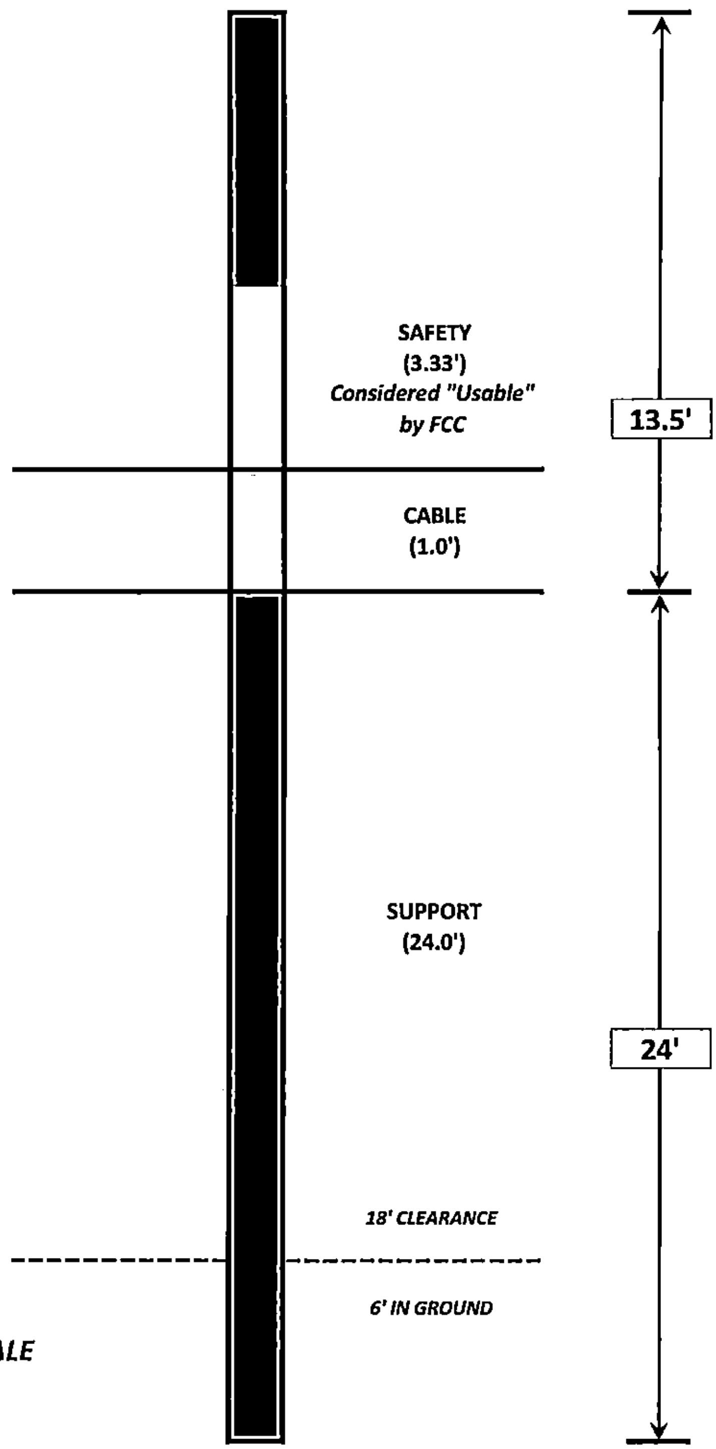
Allocates usable space only

Safety space is included in the "Unusable" space.

No sharing of support space among users

Space allocation is 7.41% based on one foot of space out of 13.5' of usable space

Results in unfair allocation of costs



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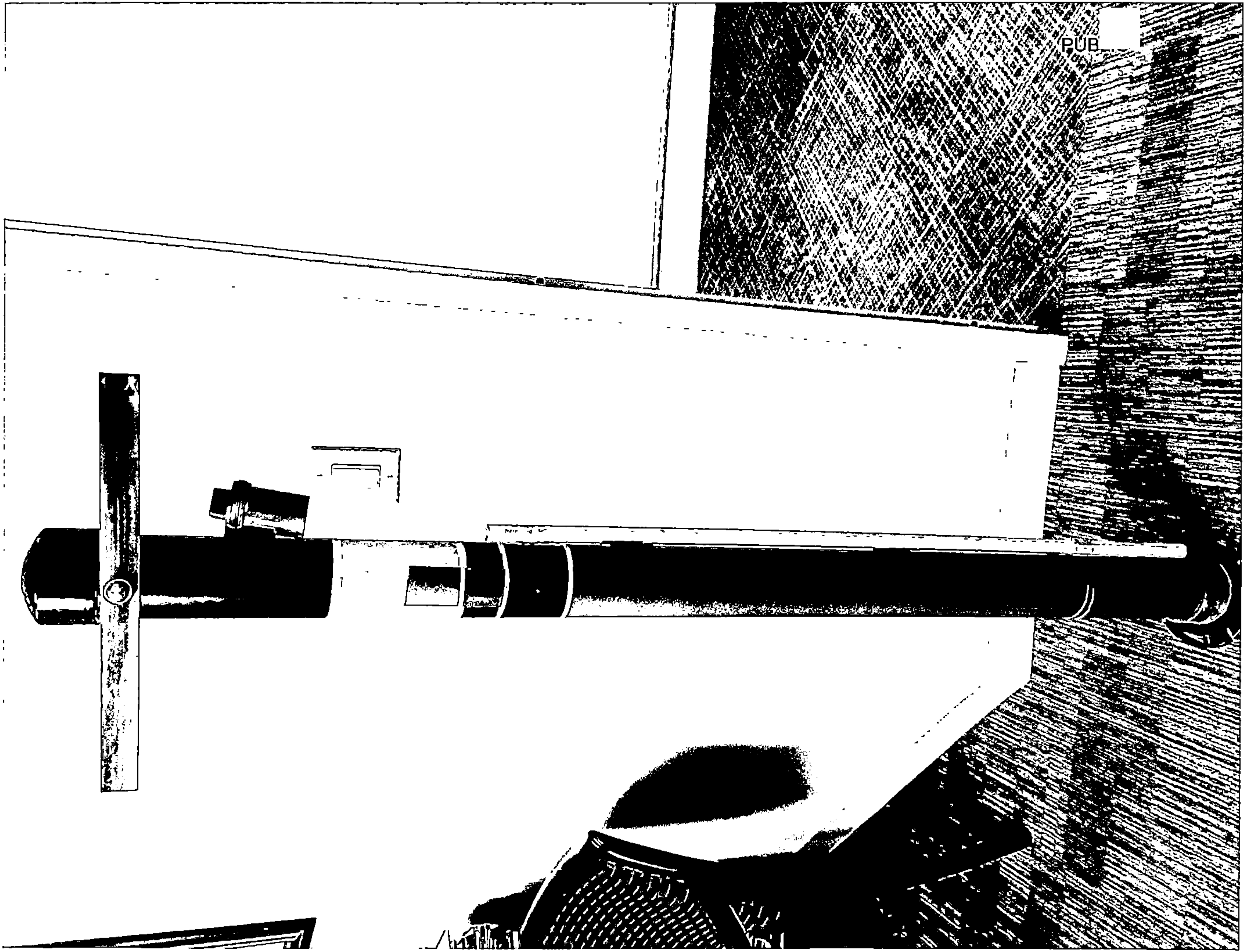

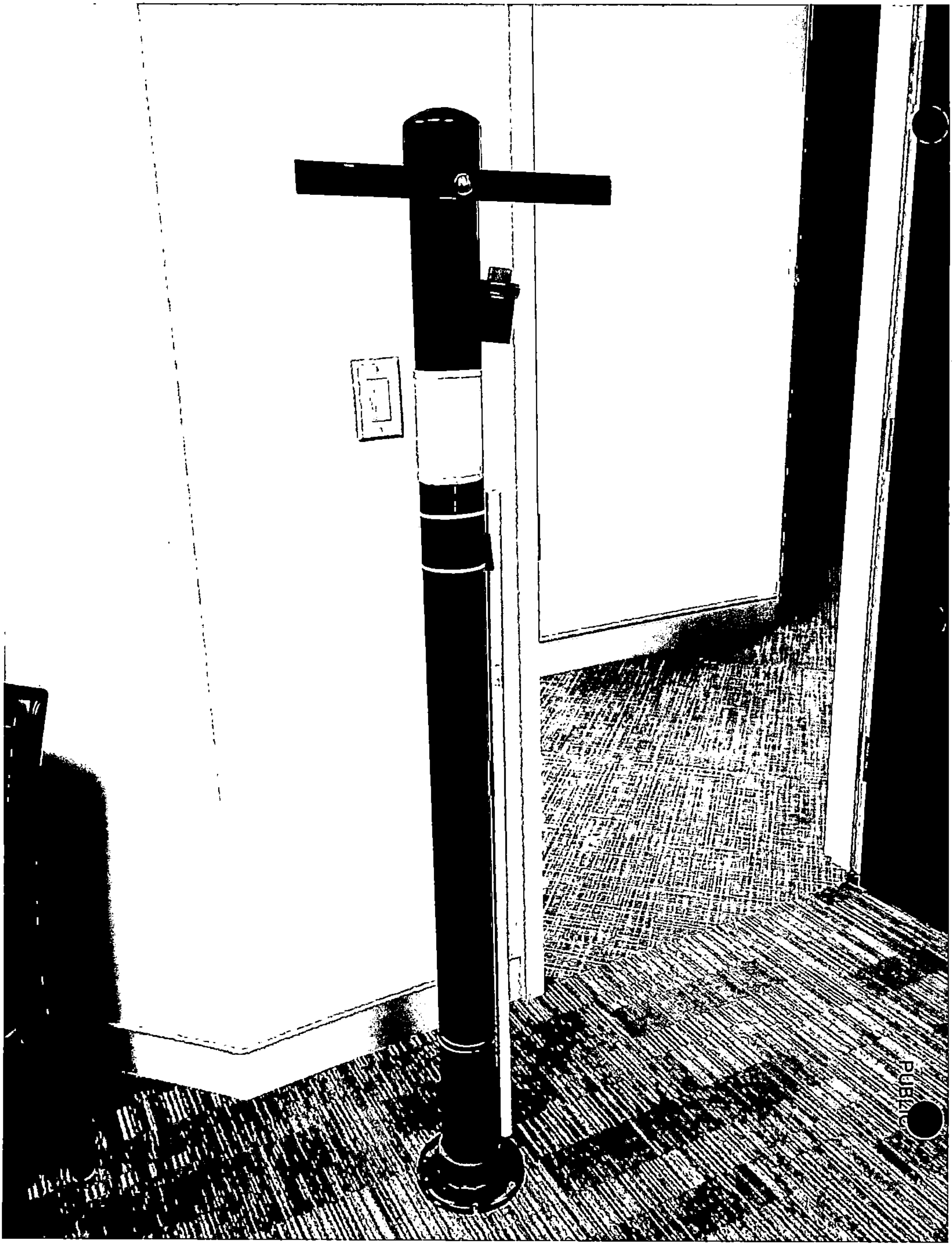

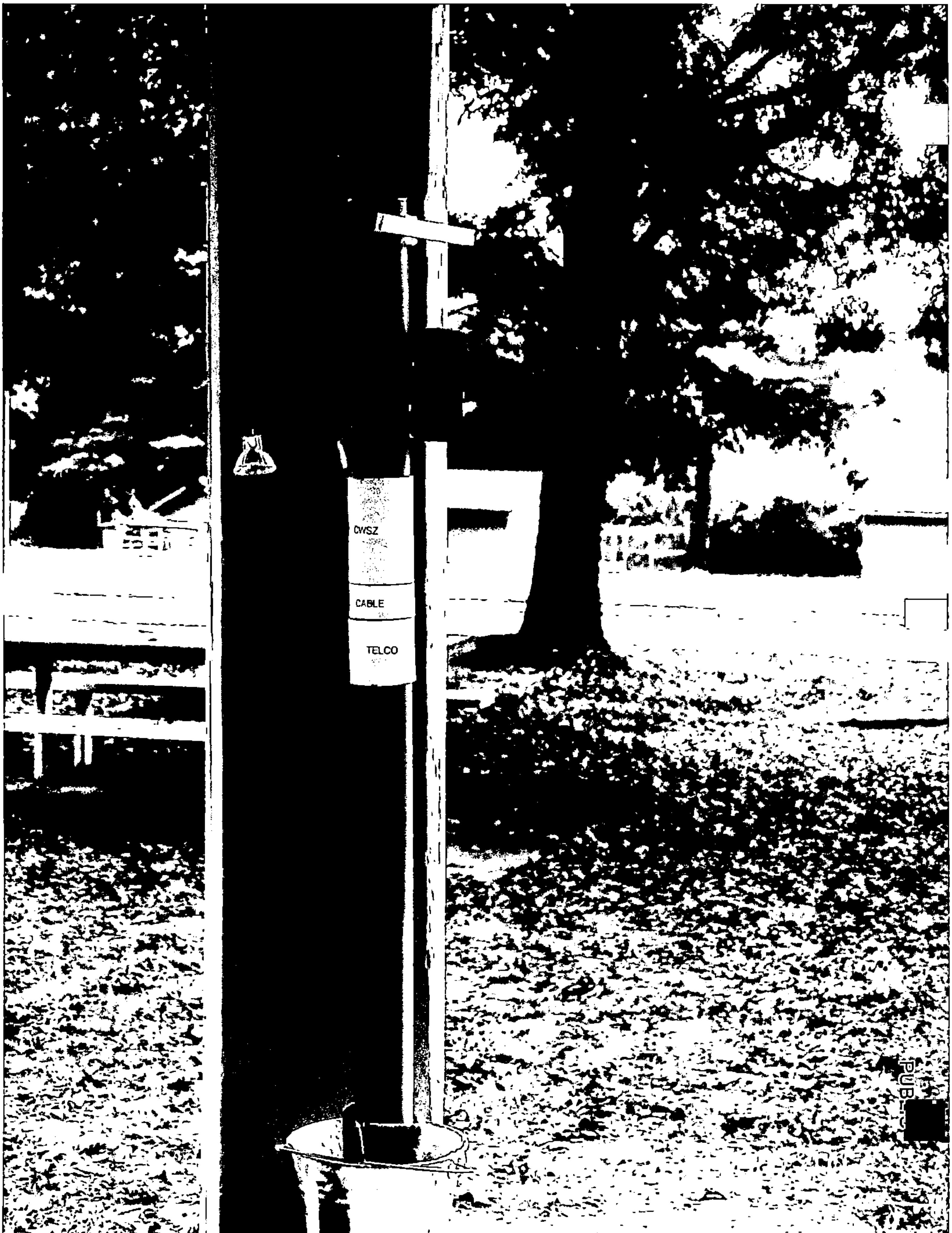
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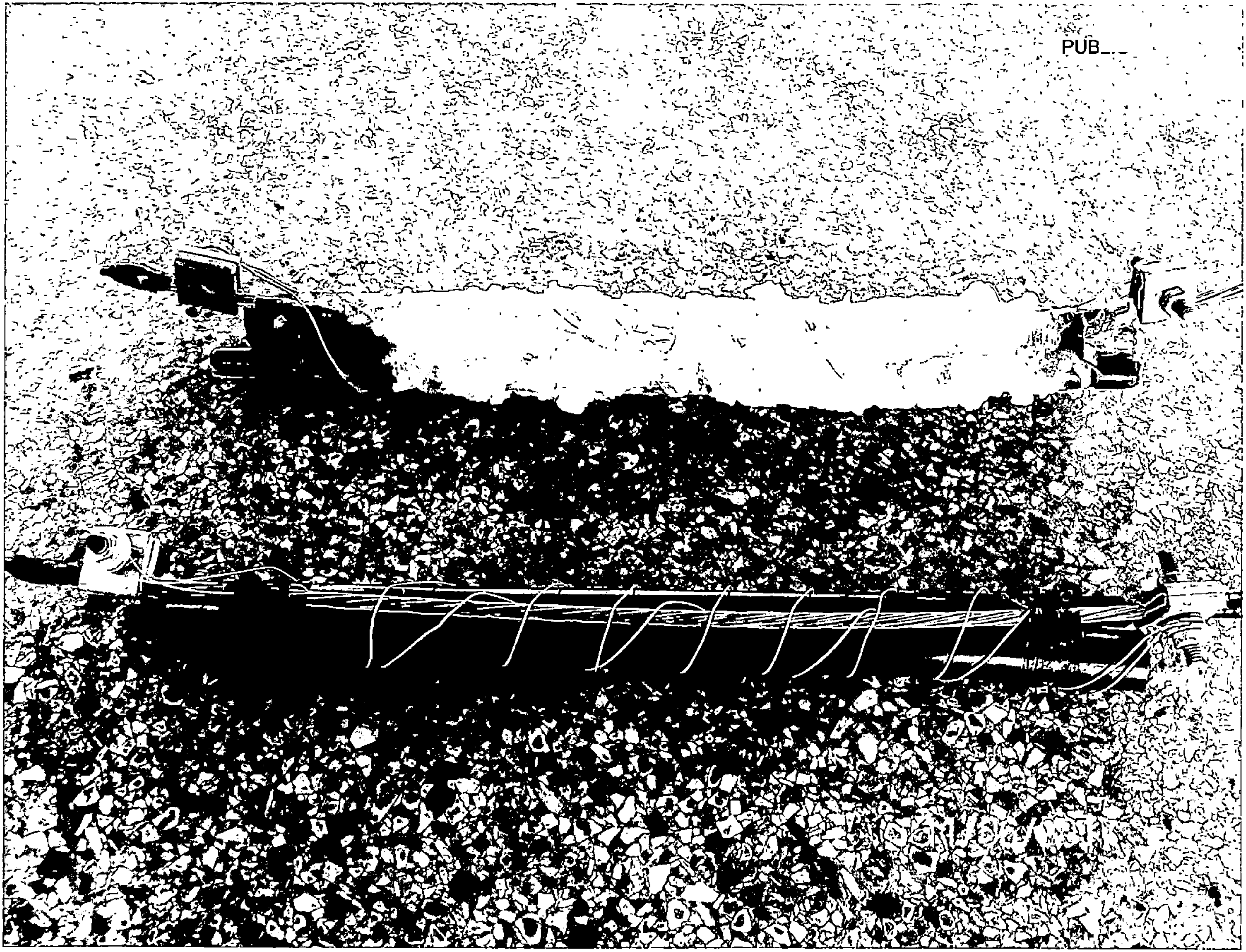
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PUBLIC F/A

EXHIBIT WA-25.2

PUBLIC

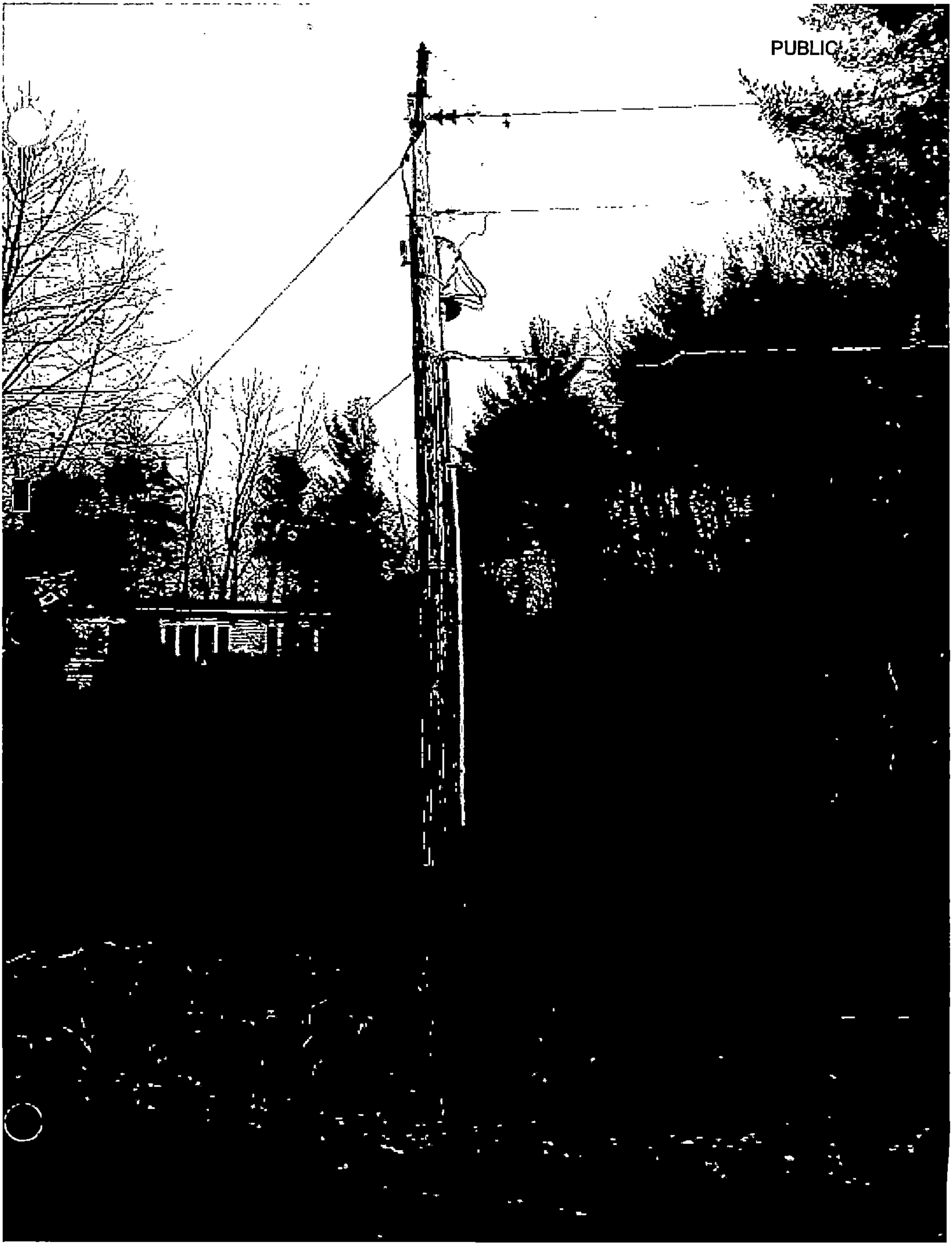

EXHIBIT WA-25.3

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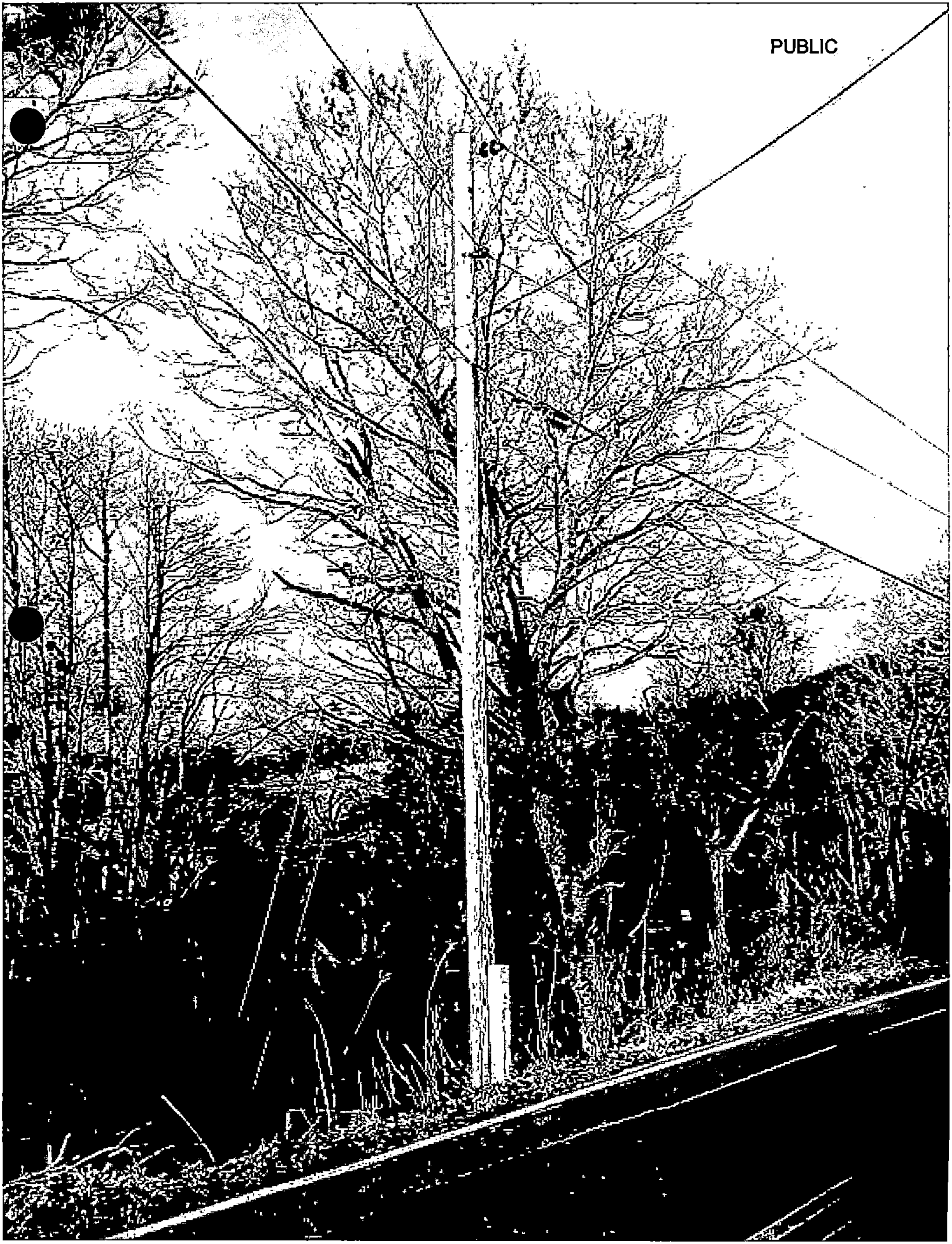


PUBLIC I/A

EXHIBIT WA-26

Pole and Conduit Rental Calculation Information

(Dollars in thousands & Operational Data in whole numbers)

COMPANY: AT&T / BELLSOUTH CORPORATION
STUDY AREA: NORTH CAROLINA
PERIOD: From: Jan 2016 To: Dec 2016
COSA: SBNC
SUBMISSION: 1
Page 1 of 1

Row	Row Title (a)	Amount (b)
Financial Information ($000)		
100	Telecommunications Plant-in-Service	8,009,850
101	Gross Investment - Poles	108,196
102	Gross Investment - Conduit	244,189
200	Accumulated Depreciation - Total Plant-in-Service	6,494,987
201	Accumulated Depreciation - Poles	105,230
202	Accumulated Depreciation - Conduit	118,800
301	Depreciation Rate - Poles	5.70
302	Depreciation Rate - Conduit	1.90
401	Net Current Deferred Operating Income Taxes - Poles	-
402	Net Current Deferred Operating Income Taxes - Conduit	-
403	Net Current Deferred Operating Income Taxes - Total	-
404	Net Non-Current Deferred Operating Income Taxes - Poles	2,343
405	Net Non-Current Deferred Operating Income Taxes - Conduit	5,288
406	Net Non-Current Deferred Operating Income Taxes - Total	173,460
501.1	Pole Maintenance Expense	2,449
501.2	Pole Rental Expense	15,030
501	Pole Expense	17,479
502.1	Conduit Maintenance Expense	1,109
502.2	Conduit Rental Expense	36
502	Conduit Expense	1,145
503	General & Administrative Expense	39,194
504	Operating Taxes	96,185
Operational Data (Whole numbers)		
601	Equivalent Number of Poles	235,763
602	Conduit System Trench Kilometers	2,732
603	Conduit System Duct Kilometers	15,842
700	Additional Rental Calculation Information	N/A

PUBLIC I/A

EXHIBIT WA-27

SagLine

Thursday, November 02, 2017

File:

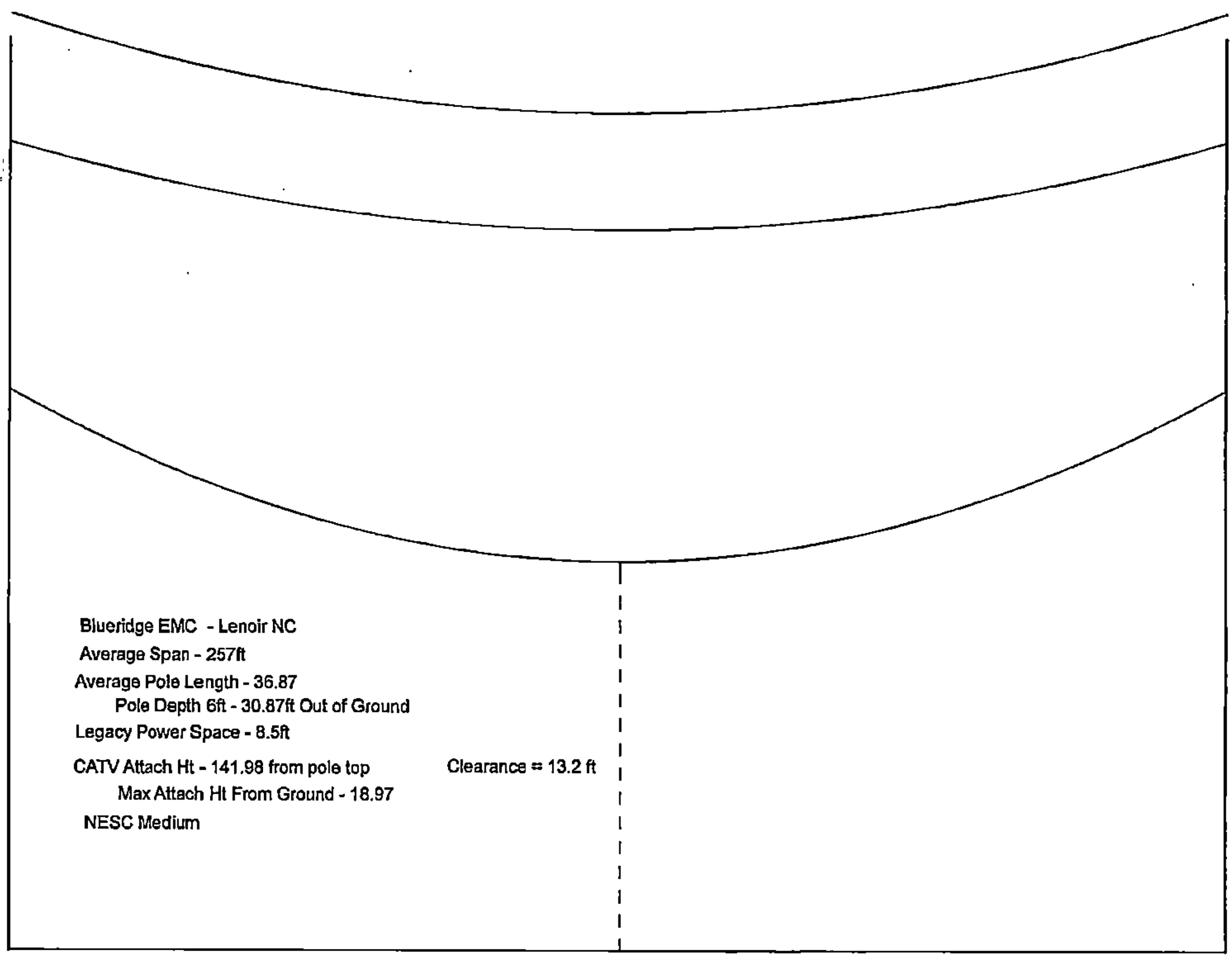
Span Length (ft): 257

Circuit 1

Primary Conductor: 4 ACSR (7/1)	Sag (in): 40 @ 167° F	Ruling Span (ft): 250
Neutral Conductor: 4 ACSR (7/1)	Sag (in): 35 @ 32° F	Ruling Span (ft): 250

Cable - 1 Sag (in): 69

ANS PL - Length (ft): 40	Setting Depth (Ft): 9.2	Elevation (ft): 0
ADJ PL - Length (ft): 40	Setting Depth (Ft): 9.2	Elevation (ft): 0



ANS PL

ADJ I

PUBLIC I/A

EXHIBIT WA-28

Reports of

Joint General Committee

of

Edison Electric Institute

and

Bell Telephone System

on

Physical Relations Between Electrical Supply and Communication Systems

REISSUED
JULY 1945

Additional copies of this report may be obtained by Power Companies from the Edison Electric Institute (Publication No. M5) and by Associated Bell Companies from the Department of Operation and Engineering of the American Telephone and Telegraph Company.

REPORTS OF JOINT GENERAL COMMITTEE *of* EDISON ELECTRIC INSTITUTE *and* BELL TELEPHONE SYSTEM

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PRINTED IN U. S. A.

JOINT GENERAL COMMITTEE
OF
EDISON ELECTRIC INSTITUTE
AND BELL TELEPHONE SYSTEM

New York, July 9, 1945.

MEMBER COMPANIES OF E.E.I.
ASSOCIATED COMPANIES OF BELL SYSTEM:

For a number of years the following reports of the Joint General Committee of the NELA and Bell Telephone System have formed a satisfactory basis for the coordination of the electrical facilities of electric supply companies and communication facilities of the Bell System.

Principles and Practices for the Inductive Coordination of Supply and Signal Systems — December 9, 1922.

Principles and Practices for the Joint Use of Wood Poles of Supply and Communication Companies — Feb. 15, 1926.

Allocation of Costs Between Supply and Communication Companies — October 15, 1926.

The supply of copies of the original issue of these reports has been exhausted and accordingly they have been reprinted. In this reissue the three reports have been included under a single cover. A few editorial changes have been made which involve no change in substance.

H. B. Bryans
W. H. Sammis
E. C. Stone
Edison Electric Institute Representatives

M. R. Sullivan
K. S. McHugh
Bell System Representatives

JOINT GENERAL COMMITTEE

FOREWORD

The Principles and Practices which are now being reissued under a single cover have, during the past two decades, contributed greatly to the successful operations of the power and telephone industries, and because they have promoted cooperation between these industries, they have benefited the general public. It seems appropriate in connection with this reissue to review the development of these Principles and Practices however, for brevity, omitting mention of all but the original organization.

Previous to 1921, structural and inductive interference problems were giving rise to increasing numbers of controversies between Bell Telephone Companies and Power Companies throughout the country. Early in 1921, therefore, a group of power and telephone men met to discuss the possibilities of a basis for an engineering solution of the problems concerned. Mr. Owen D. Young presided at that meeting and there was formed the Joint General Committee of the National Electric Light Association and Bell Telephone System with the following membership:

Messrs. O. D. YOUNG, *Chairman*,
General Electric Company,

R. H. BALLARD,
Southern California Edison Company,

M. R. BUMP,
H. L. Doherty & Company,

H. M. BYLLESBY, Represented by R. F. Pack,
H. M. Byllesby & Company,

J. J. CARTY,
American Telephone and Telegraph Company,

BANCROFT GHERARDI,
American Telephone and Telegraph Company,

E. K. HALL,
American Telephone and Telegraph Company,

L. H. KINNARD,
The Bell Telephone Company of Pennsylvania,

MARTIN J. INSULL,
Middle West Utilities Company,

ROBERT LINDSAY,
Cleveland Electric Illuminating Company,

BEN S. READ,
The Mountain States Telephone and Telegraph Company,

PAUL SPENCER,
United Gas Improvement Company,

GUY E. TRIPP,
Westinghouse Electric & Manufacturing Company,

M. H. AYLESWORTH, *Secretary*,
National Electric Light Association,

Messrs. Bump, Pack and Gherardi were designated as an Engineering Subcommittee representing both interests with instructions to classify the types of situations in which engineering or technical conflicts were arising. They selected a committee of engineers whose instructions were to proceed with a classification of the types of problems concerned under two divisions (a) those for which a standard had been accepted by both parties and (b) those for which there were no existing standards. Their further instructions were to approach the various problems in the broadest possible spirit of cooperation, with the double objectives of the removal of causes of friction and the early development of mutually satisfactory practices. This committee of engineers consisted of Messrs. H. P. Charlesworth, S. P. Grace, H. S. Osborne and H. S. Warren, representing the Bell Telephone System and Messrs. W. J. Canada, A. E. Silver and F. H. Lane, representing the NELA. Mr. H. L. Wills later succeeded Mr. Canada.

The Engineering Subcommittee in its first report found that the National Electrical Safety Code provided an acceptable guide to practice for problems involving crossings, conflicting construction and jointly occupied poles, and recommended, as to parallel construction, general principles pointing the way to the satisfactory solution of specific cases. After further work the subcommittee prepared the more comprehensive reports which are generally known as the Principles and Practices, and which with minor editorial changes are reproduced in this booklet.

Early in its work the Engineering Subcommittee found that there was need for mutually acceptable technical data to aid in the solution of both electrical and structural coordination problems. Accordingly, the Joint Subcommittee on Development and Research was organized in 1923. Its factual reports have greatly facilitated the solution of coordination problems by the power and telephone companies and have enabled them to arrive at sound engineering answers to the new problems which have accompanied advances in the power and communication arts.

FOR THE
INDUCTIVE COORDINATION OF SUPPLY AND COMMUNICATION SYSTEMS

Scope.

These principles and practices are intended to apply to all new installations, extensions and reconstructions and to the maintenance, operation and changes of all communication and supply systems where inductive coordination may be required now or later to prevent interference with the rendering or providing of supply or communication service.

PRINCIPLES

Duty of Coordination.

(a) In order to meet the reasonable service needs of the public, all supply and communication circuits with their associated apparatus should be located, constructed, operated and maintained in conformity with general coordinated methods which maintain due regard to the prevention of interference with the rendering of either service. These methods should include limiting the inductive influence of the supply circuits or the inductive susceptiveness of the communication circuits or the inductive coupling between circuits or a combination of these, in the most convenient and economical manner.

(b) Where general coordinated methods will be insufficient, such specific coordinated methods suited to the situation should be applied to the systems of either or both kinds as will most conveniently and economically prevent interference, the methods to be based on the knowledge of the art.

Cooperation.

In order that full benefit may be derived from these principles and in order to facilitate their proper application, all utilities between whose facilities inductive coordination may now or later be necessary, should adequately cooperate along the following lines:

(a) Each utility should give to other utilities in the same general territory advance notice of any construction or change in construction or in operating conditions of its facilities concerned, or likely to be concerned, in situations of proximity.

(b) If it appears to any utility concerned that further consideration is necessary, the utilities should confer and cooperate to secure inductive coordination in accordance with the principles set forth herein.

(c) To assist in promoting conformity with these principles, an arrangement should be set up between all utilities whose facilities occupy the same general territory, providing for the interchange of pertinent data and information including that relative to proposed and existing construction and changes in operating conditions concerned or likely to be concerned in situations of proximity.

Choice Between Specific Methods.

When specific coordinated methods are necessary and there is a choice between specific methods, those which provide the best engineering solution should be adopted.

(a) The specific methods selected should be such as to meet the service requirements of both systems in the most convenient and economical manner without regard to whether they apply to supply systems or communication systems or both.

(b) In determining what specific methods are most convenient and economical in any situation for preventing interference, all factors for all facilities concerned should be taken into consideration including present factors and those which can be reasonably foreseen.

(c) In determining whether specific methods, where necessary, shall be wholly by separation or partly by methods based on less separation, the choice should be such as to secure the greatest present and future economy and convenience in the rendering of both services.

Inductive Coordination for Existing Construction.

(a) Utilities operating supply or communication circuits should exercise due diligence in applying coordinated methods, as occasion may rise, in accordance with these principles, to existing construction.

(b) When supply or communication circuits are generally reconstructed, or when associated apparatus is rearranged or added, or when any change is made in the arrangement or characteristics of circuits, the new or changed parts should be brought into conformity with these principles.

Coordinated Locations for Lines.

Utilization of the highways is essential to the economical and efficient extension, operation and maintenance of supply and communication facilities. To avoid unduly increasing the number or difficulty of situations of inductive or other exposure incident to the use of the same highway by two different kinds of facilities, all lines should, in general, be located as follows:

(a) General Location.

(1) Where the conditions and character of the circuits permit, joint use of poles by communication and supply circuits is generally preferable to separate lines when justified by considerations of safety, economy and convenience, and presuming satisfactory agreement between the parties concerned as to terms and conditions.

(2) Where communication circuits and supply circuits on the same highway are not to occupy joint poles or where either kind of circuit is alone on a highway, all communication circuits should be placed on one side of the highway and all supply circuits should be placed on the other side, so that, as far as practicable, one side of any section of a highway will be available as the communication side and one side as the supply side.

(3) Unnecessary crossings from side to side of the highway should be avoided.

(b) Detailed Location.

(1) Local Communication Lines.

Where to be located on the same highway with local supply lines, joint use is generally preferable to separate lines, except sometimes in rural districts and except where the character of circuits involved makes separate lines on opposite sides of the highway more desirable.

Where to be located on the same highway with transmission lines, separate lines on opposite sides of the highway are generally preferable unless a large number of service wire crossings would be involved, in which case, joint use or other arrangements may be preferable.

(2) Toll or Through Communication Lines.

Where to be located on the same highway with local supply lines or lower voltage transmission supply lines, separate lines on opposite sides of the highway are generally preferable, unless a large number of service wire crossings would be involved, in which case, joint use or other arrangements may be preferable.

Where proposed for location on the same highway or to follow the same general direction with higher voltage transmission supply lines, cooperative consideration should determine whether such locations should be used, and if so, what specific coordinated methods are necessary. Where to be located on the same highway with higher voltage transmission supply lines, separate lines on opposite sides of the highway are preferable.

(3). Local Supply Lines.

Where to be located on the same highway with local communication lines, joint use is generally preferable to separate lines except sometimes in rural districts and except where the character of circuits involved makes separate lines on opposite sides of the highway more desirable.

Where to be located on the same highway with toll or through communication lines, separate lines on opposite sides of the highway are generally preferable, unless a large number of service wire crossings would be involved, in which case, joint use or other arrangements may be preferable.

(4) Transmission Supply Lines.

Where to be located on the same highway with local communication lines or shorter toll or shorter trunk communication lines, separate lines on opposite sides of the highway are generally preferable unless a large number of service wire crossings would be involved, in which case, joint use or other arrangements may be preferable.

Where proposed for location on the same highway or to follow the same general direction with longer toll or through communication lines, cooperative consideration should determine whether such locations should be used and if so, what specific coordinated methods are necessary. Where to be located on the same highway with longer toll or through communication lines, separate lines on opposite sides of the highway are preferable.

(5) Avoidance of Overbuilding.

Overbuilding of one line by another should be avoided, where practicable. Where necessary for the two kinds of lines to occupy the same side of a highway, joint use is generally preferable to overbuilding.

(c) OTHER RIGHTS OF WAY.

The foregoing principles, although specifically mentioning highways, should also, when applicable, govern situations involving private rights of way near to each other or to highways.

Deferred General Coordination.

While communication or supply lines when alone should conform to general coordinated methods, such lines, pending the incoming or development of the other kinds of lines, may, if deemed economically advantageous, occupy locations or use types of facilities, construction and operating methods other than those conforming to general coordinated methods. However, the location and character of such facilities should be altered when and as necessary to conform to these methods upon the incoming or development of another kind of facility conforming to general coordinated methods.

Special Location and Types.

When coordination of supply and communication lines of particular types cannot be technically and economically established under the methods of coordination covered by these principles, special cooperative consideration should be given to determining what location and type of construction should be established for each line of such type.

PRACTICES

INTRODUCTORY.

These recommended practices supplement, and are intended to be in accord with, the principles given in the foregoing. They are based on experience, and their application, in connection with the principles on "Coordinated Location of Lines" will effectively promote the inductive coordination of supply and communication systems.

In the development of these detailed practices, it has been found advisable to proceed step by step along two well defined subdivisions, namely, practices based on qualitative considerations, and those based on quantitative values. The practices given herewith cover qualitative considerations and form a basis for the later adoption of definite quantitative values where they may properly apply. It is recognized that in the growth and development of the respective utilities and as the development of the art progresses, other satisfactory methods will doubtless be devised. The fact that particular methods are specified herein does not preclude the use of other mutually satisfactory methods, nor their incorporation in these practices as they may be agreed upon.

In order that the above considerations may be carried out it is intended that the joint work on practices will be continued and that additional material will be issued from time to time as it becomes available. In the preparation of these practices, certain factors were encountered which, due to lack of complete information, could not be as fully covered at this time as their importance in inductive coordination merits. Among these factors are included certain features of the protection of communication systems, the selectivity of communication apparatus, the transposing of supply circuits outside of inductive exposures and the question of single versus multiple grounding in supply systems.

In order that the full intent of the principles may be carried out, the practices hereinafter specified as "General Coordinated Methods" should be applied to all communication and supply systems, except as deviations may be made under the principle of "Deferred Coordination." In cases of inductive exposure, where these general coordinated methods are insufficient, such of the practices hereinafter specified as "Specific Coordinated

Methods" should, in addition, be applied as will provide the best engineering solution.

MUTUALLY APPLICABLE PRACTICES

Notice and Cooperation.

Utilities between whose facilities inductive coordination is, or later may become, necessary should each give to the other advance notice of any construction or changes in construction or operation of their respective facilities. The utilities should cooperate in determining and carrying out those methods which provide the best engineering solution in each case, and to this end there should be complete interchange of information.

Limitation of Influence and Susceptiveness.

In designing, specifying or otherwise determining the location, construction and arrangement of supply or communication circuits or the quality, arrangement and suitability of materials or apparatus to be used in, or associated with, communication or supply circuits and in operating and maintaining lines and apparatus, all factors which would contribute to inductive influence or inductive susceptiveness during either normal or abnormal conditions should be limited in so far as is necessary and practicable.

Changes in Systems or Methods.

In changing systems or methods of operation, precaution should be taken to avoid increasing, and an effort made to decrease, if practicable, the influence or susceptiveness. Any abnormal condition which increases these factors should be promptly remedied. If the service requirements prevent a prompt remedy of such condition, effort should be made to reduce these effects by such other methods as are available.

Operating Instructions.

Communication companies should adopt operating instructions, specifically outlining the procedure for notification of supply companies when inductive disturbances arise on toll circuits that appear to be incidental to abnormal power influence and supply companies should adopt operating rules which outline the desirable procedure for their operators during times when a supply circuit is abnormally unbalanced.

Records.

A record should be kept by the communication companies of disturbances on communication circuits, and the supply companies should keep a record of accidental or transient conditions on supply circuits, so that a study of such disturbances which appear to be due to accidental or transient conditions will be facilitated.

Mechanical Construction.

The mechanical design and construction of communication and supply systems should conform to good modern practice.

Maintenance.

Efforts should be made to anticipate and forestall failure of lines or equipment. Defective equipment should not be continued in service and repairs or renewals should be promptly made.

Tree Trimming.

Trees should be trimmed as necessary, due consideration being given clearances to meet weather conditions. Due diligence should be exercised in obtaining permission to trim trees when such permission is needed and such trimming should be done in accordance with good modern practice.

Insulation.

Insulators and insulating material used on communication and supply circuits should be designed, constructed and maintained so as to provide adequate mechanical and electrical strength.

PRACTICES APPLICABLE TO COMMUNICATION SYSTEMS

General Coordinated Methods

The following practices should be applied to all communication systems, except as deviations may be made under the principle of deferred coordination.

Power Level and Sensitivity.

The power level and sensitivity of communication circuits should be, so far as is practicable, designed and maintained at the standard recommended for the class of service involved.

Protection.

Protective devices should be such that they will not interrupt the communication circuits by operating at unnecessarily low voltages or currents.

Protective devices should be, so far as practicable, so designed, constructed and installed as not to unbalance the communication circuits.

The same type of heat coil or fuse should be used in all wires of a circuit.

Reasonable care should be used in the maintenance of all protective apparatus to avoid conditions which will unbalance or interrupt the communication circuits.

Inspections.

Adequate field inspection and routine tests of lines and apparatus should be made with a view to maintaining the electrical balance and efficiency of the circuits.

Discontinuities.

Discontinuities should be limited to the number required by the conditions.

LINES.

In order to minimize line unbalances, the resistance, inductance, capacitance and leakage conductance of one side of a circuit, in each section thereof, should be equal respectively to the corresponding quantities in the other side of the same section of the circuit in so far as is necessary and practicable.

Some of the methods and means which should be followed for the purpose of minimizing unbalance in lines are as follows:

Transpositions.

The capacitances to earth of the two sides of a telephone circuit should be suitably balanced by transpositions. Before a communication line is placed in service, a check should be made to insure that the transpositions are properly installed and correctly located.

Excessive Spacing.

Excessive spacing of conductors should be avoided. This does not mean that the spacing should be less than that required by considerations of safety, service and the future requirements of the circuits.

Derived Circuits.

In the creation of circuits from one or more circuits without adding line conductors, due regard should be given to avoiding unnecessary increases in susceptiveness.

Phantom circuits should be created only from similar adjacent pairs. Branches connected to but one side of a phantom circuit should be avoided unless connected through isolating transformers.

If one side circuit of a phantom group is loaded, the other side should be loaded at the same loading points, such loading to have closely the same electrical characteristics.

Phantom circuits should in general be used only for toll or trunk circuits except in cases of long rural circuits.

Connections.

Effort should be made to prevent the introduction of unbalance by contact resistance.

All joints in toll cables should be soldered or welded. All joints in open-wire toll conductors should be made with sleeves or should be well soldered or welded.

All wires should be properly cleaned to secure good contact before the joints are made.

All test connections, terminal boxes and associated wiring should be designed, constructed, installed and maintained so as to minimize the unbalances of the conductors.

Conductors.

Conductors of the same material and commercial size should be used in the two sides of the circuit at any point.

Ground Return Circuits.

Ground return telephone circuits should not be employed.

Use of Cable.

Consideration should be given to placing circuits in cable at the time of rebuilding heavy open wire subscribers' lines.

APPARATUS.

All apparatus electrically connected to a communication circuit should be so designed, constructed, installed and maintained as to minimize, in so far as is necessary and practicable, unbalance of the series impedance and admittance to earth of the two sides of the circuit.

Some of the methods and means which should be followed for the purpose of minimizing unbalance in equipment are as follows:

Phantom Circuit Apparatus.

Balancing resistance or other compensating apparatus should be inserted in the through side of a phantom group at the point where the other side circuit is terminated.

If one circuit of a phantom group is equipped with composite sets or composite ringers, the other side should be similarly equipped and the sets or ringers used on the two sides of the phantom group at any given point should have closely the same impedance characteristics.

Series Apparatus.

Where series apparatus, such as series condensers of a composite set is applied to toll circuits, those parts inserted in each side of a circuit should have closely the same electrical characteristics.

Coils.

Loading coils should be so designed, constructed and installed as to insert closely equal impedance in each wire of a circuit. Loading coils should be located as nearly as practicable at neutral or balanced points of the transposition system. In the design, construction, installation and maintenance of loading coils, efforts should be made to secure permanency of characteristics.

The coils employed for phantoming, compositing, simplexing or sectionalizing communication circuits should be as closely balanced as practicable. If in any case unbalanced coils are necessary, they should be isolated by properly balanced repeating coils.

The windings of retardation coils connected to the two sides of the same metallic circuit should have closely equal self-impedances. The coils of the different circuits should be equipped with suitable cases or so installed as to have negligible mutual impedances.

Condensers.

The condensers employed in composite sets, signaling devices, etc., should have adequate balance of admittance to ground.

Ringing and Signaling Equipment.

The unbalance introduced by ringing or signaling equipment should be limited, in so far as is necessary and practicable.

Central Office Circuits.

Central office circuits are to be so designed, installed and maintained that any connection between toll circuits and subscribers' circuits may be made through repeating coils.

Attention should be given to the control of unbalance in cords and central office wiring.

Effort should be made to prevent the introduction of unbalance by contact resistance.

Ground Connections.

Ground connections, if employed on equipment connected to toll circuits, should be in the balanced or neutral position of the circuit.

Specific Coordinated Methods

The specific practices outlined here are to be used in addition to the general practices to supplement the latter in so far as may be necessary and practicable in cases where communication and supply lines are involved, or are about to be involved, in inductive exposures.

All of these practices are not required to be applied in any one specific case, but in each instance that practice or those practices in combination should be selected which will under the conditions afford the best engineering solution.

Power Level and Sensitivity.

Consideration should be given to maintaining in the communication circuits as high a power level and such a degree of sensitivity as is consistent with good economics.

Selective and Other Special Devices.

Consideration should be given to the use of such devices as neutralizing transformers, sectionalizing transformers, filters, resonant shunts or drainage coils in any case where they may offer benefit and the service requirements of the circuit will permit.

Rerouting Service.

If abnormal conditions should temporarily prevent the use of a certain line and the effect of the abnormal conditions can be avoided only by temporarily rerouting the supply or communication service over a route not involved in the inductive exposure, consideration should be given to the adoption of this expedient. Where the rerouting of either service is impracticable, the choice as to which service is to be temporarily suspended should be governed by the relative importance to the public of the respective services affected.

Records.

Routine measurements of insulation, conductor resistance, balance and induction should be made on toll circuits involved in inductive exposures and records kept of the readings.

A record should be kept of abnormal conditions in toll circuits involved in inductive exposures where a study of such conditions is advisable. Such records should as fully as practicable include time, duration, circuit designation, location, probable cause and effect of the abnormal condition and how the circuits were cleared.

All the above records or a convenient summary thereof should be available for the purpose of analyzing causes and effects of disturbances.

Lines.

Configuration.

Where service requirements permit a choice of configuration of a communication circuit or a group of communication circuits consideration should be given to the selection of a configuration such as to limit susceptiveness.

Cable.

Consideration should be given to the use of cable within an inductive exposure.

Where communication circuits are carried in aerial cable, consideration should be given to the use of properly arranged and installed grounds on cable sheaths or other methods of shielding.

Coordinated Transpositions.

Consideration should be given to the use of transpositions in supply or communication circuits, or both, within inductive exposures, for the purpose of limiting the coupling. Such transpositions should be installed at suitable intervals, the location to be such as the local conditions demand. Where transpositions are installed in both supply and communication circuits within inductive exposures, they should be properly coordinated.

NOTE: Care should be taken in the installation of transpositions that, so far as practicable, the transpositions are located nearest the theoretically correct point. In determining the most economical scheme of transpositions effort should be made to utilize as many as practicable of any existing transpositions. Where the transpositions required within an inductive exposure impair the general transposition scheme of communication or supply circuits outside the limits of inductive exposure, the necessary readjustment of transpositions should be made in the section or sections of line adjacent to inductive exposure. Uniformity of separation generally assists in the attainment of coordination. If discontinuities are of sufficient magnitude to substantially affect the coupling, sections between such points should be treated independently.

APPARATUS.

Party Line Ringers.

Consideration should be given to the use of high impedance substation party line ringers or their equivalent.

Central Office Equipment.

Consideration should be given to equipping toll circuits which may be switched to other toll circuits with repeating coils. In those cases where the design of a central office is such that there is a possibility that toll circuits may be switched directly to local circuits, consideration should be given to the use of repeating coils if their omission would contribute to interference.

Where series apparatus is applied to local communication circuits, consideration should be given to so arranging it that equal impedances are inserted in each side of the circuit where necessary and practicable.

Ground Connections.

Ground connections if employed on equipment connected to local communication circuits should so far as is practicable be at neutral or balanced points.

PRACTICES APPLICABLE TO SUPPLY SYSTEMS

GENERAL COORDINATED METHODS

The following practices should be applied to all supply systems except as deviations may be made under the principle of deferred coordination.

Residual Voltages and Currents.

Residual voltages and currents should be limited as far as is necessary and practicable.

Unsymmetrical loads between phases should be avoided in so far as is practicable where they would give rise to residual currents or voltages.

NOTE: Circuit conditions may cause a residual voltage to appear on a three-phase system. If the neutral of the system is grounded at one point, residual current may flow and the residual voltage may be increased or decreased. In this case, the residual current may consist in part of current through the total direct admittance of the system to ground due to voltages impressed between the three conductors and ground. It may also consist in part of unbalanced charging current to ground due to voltages impressed upon unbalanced direct admittances of the three conductors to ground. The former will not be affected by transpositions while the latter may be reduced or eliminated by equalization of the conductor admittances to ground.

If the system is operated without a neutral ground, the residual voltage would be reduced by equalizing the admittances of the conductors to earth.

If the phases are not symmetrically loaded and two or more neutrals of the same electrically connected system are grounded, residual currents will flow. However, substantial residual currents due to unsymmetrical loads will not flow if the system has a single or no neutral ground.

Single phase taps from 3-phase circuits have inherently a residual voltage; such taps, if long, tend to appreciably unbalance the 3-phase circuit to which they are connected.

If the neutral of a system is grounded at two or more points, the residual voltage or the residual current may be increased or decreased. Whether the total influence of the system is increased or decreased will depend upon local conditions.

Discontinuities.

Discontinuities should be limited to the number required by the conditions.

Switching.

In all switching operations care should be taken to limit, so far as is practicable, the production of transient disturbance leading to excessive momentary influence.

Care should be taken to avoid repeatedly energizing at normal voltage a transmission supply circuit in order to locate a fault. It is sometimes practicable to locate such faults by means of lower voltage testing methods.

Maintenance.

In the maintenance of supply circuits, attention should be given to the prevention of mechanical or electrical failures which would lead to residual voltages or residual currents of substantial magnitude. When supply circuits become unbalanced, due to any cause, every reasonable effort should be made to remedy the unbalanced condition promptly.

Contact Resistance.

Care should be taken to avoid contact resistance which would affect influence.

LINES.

In order to reasonably limit the residual current and voltages arising from line unbalances, the resistance, inductance, capacitance and leakage conductance of the several conductors in each section of a circuit should, so far as is necessary and practicable, be equal respectively to the corresponding quantities in any other conductor of the same section of the circuit.

Some of the methods and means for limiting unbalance in lines are described below.

Configuration.

Where there is a choice between two or more types of configuration, consideration should be given to use where practicable of such configuration of a supply circuit or a group of supply circuits as provides the superior balance.

Excessive Spacing.

Excessive spacing of conductors should be avoided. This does not mean that the spacing should be less than required by considerations of safety, service, and the future requirement of the circuits.

Transpositions.

Capacitances to earth of the conductors of transmission supply circuits should be suitably balanced by transpositions so far as is necessary and practicable.

Branch Circuits.

Where branches employing less than the total number of phase wires are to be used, they should be so planned as not to give rise to excessive residual voltages or currents on the three-phase system.

Series Lighting Circuits.

In the construction or rearrangement of series street lighting circuits, unbalances which materially contribute to inductive influence should be avoided.

PUBLIC

Three-Phase, Four-Wire Systems.

If three-phase, four-wire grounded neutral supply circuits are used, the neutral wire should be continuous except in case of a three-phase branch which is either operated non-grounded or is grounded only at symmetrical load points.

Ground Return Circuits.

Ground return circuits or ground return branches of multi-wire supply circuits should not be employed. This does not apply to track return circuits.

APPARATUS.

NOTE: It is recognized as commercially impossible to build rotating machinery entirely free from harmonics. It is further recognized that some distortion of wave form—and consequent introduction of harmonics—is inherent with power transformers which must employ iron in their magnetic circuits. However, in both these cases the introduction of harmonics can, to a considerable extent, be controlled within the limits of commercial design and practice. So, the above provisions are intended to secure the attention which this matter deserves because of its basic importance and its reaction on the necessity for other methods.

Rotating Machinery.

Synchronous machines should be specified and selected so as to have a wave form in which the harmonic components are limited so far as necessary and practicable.

Induction motors and generators should be selected which cause the least practicable amount of harmonic voltages and currents on the system to which they are connected.

Transformers.

In order that the wave form of voltage and current may be affected as little as practicable by transformers, such apparatus should not be designed so as to operate at excessive magnetic densities. In the installation, connection, and operation of transformers, care should be taken to avoid excessive over-voltages or excessive magnetizing currents.

When star connected transformers or autotransformers are employed with a grounded neutral on the side connected to a line circuit, low impedance closely coupled tertiary windings or delta-connected secondary windings, or other suitable means for adequately limiting the triple harmonic components of residual current or voltages should be employed.

Where open delta transformer banks are used, they should be distributed symmetrically among the phases in so far as necessary and practicable.

Care should be taken that the individual units in each grounded neutral bank of transformers connected to a transmission supply circuit are substantially alike as to electrical characteristics and that they are similarly connected.

Switches.

Each switch controlling the supply of energy to transmission supply circuits should have all poles arranged for gang operation. So far as is practicable, these switches should be automatic for short circuits between phases and from phase to ground.

Protective Apparatus.

Protective apparatus should be such that it will not unnecessarily add to transient disturbance, and should so far as practicable forestall or limit such transient disturbances.

Routine inspection of lightning arresters should be provided, and the periodic charging, where such is required, should conform to good practice.

Arresters should be maintained in good condition. Arresters which have been temporarily withdrawn from service should not be replaced in service until they are in proper operating condition.

Where lightning arresters requiring periodic charging are employed on a supply system involved in an inductive exposure, they should be equipped with auxiliary resistances and contacts.

Routine inspection or tests should be made to determine whether or not adjustments in all protective apparatus are properly maintained.

Abnormal Conditions.

Reasonable means should be provided to prevent the continuation in operation of faulty apparatus or lines for such periods or under such conditions as lead to excessive influence.

Reliable indicating or recording devices should be installed at the source of transmission supply circuits to show abnormal operating conditions.

Series Lighting Circuits.

Consideration should be given to the use of types of equipment in series street lighting circuits which, so far as practicable, have a minimum distorting effect on the voltage and current wave shape of the lighting circuit, both during times of normal operation and times of lamp outages.

Ground Connections.

Ground connections, if employed on apparatus connected to transmission supply circuits, should be made in the balanced or neutral position in the circuit. This precludes the use of grounded open star transformer connections.

Specific Coordinated Methods

The specific practices outlined herein are to be used in addition to the general practices to supplement the latter so far as may be necessary and practicable in cases where communication and supply lines are involved, or are about to be involved, in inductive exposures.

All of these practices are not required to be applied in any one specific case, but in each instance that practice or those practices in combination should be selected which will under the conditions afford the best engineering solution.

Lines.

Configuration.

Where physical and economic conditions permit a choice of configuration of supply circuits within inductive exposures the configuration should be selected so as to limit the influence.

Branch Circuits.

Consideration should be given to the isolation of branch circuits consisting of less than the total number of wires of the main circuit, resulting in substantial balance, by means of transformers when such main or branch circuits are involved in inductive exposures.

Consideration should be given to the isolation of loops of series lighting circuits.

Coordinated Transpositions.

Consideration should be given to the use of transpositions in supply or communication circuits, or both, within inductive exposures, for the purpose of limiting the coupling. Such transpositions should be installed at suitable intervals, the location to be such as the local conditions demand. Where transpositions are installed in both supply and communication circuits within inductive exposures, they should be properly coordinated.

NOTE: Care should be taken in the installation of transpositions that where practicable the transpositions are located nearest the theoretically correct point. In general, transpositions may be omitted at the junction points of successive sections which are suitably balanced. In determining the most economical scheme of transpositions effort should be made to utilize as many as practicable of any existing transpositions. Where the transpositions required within an inductive exposure impair the general transposition scheme of communication or supply circuits outside the limits of inductive exposure, the necessary readjustment of transpositions should be made in the section or sections of line adjacent to inductive exposure. Uniformity of separation generally assists in the attainment of coordination. If discontinuities are of sufficient magnitude to substantially affect the coupling, sections between such points should be treated independently.

Rerouting Service.

If abnormal conditions should temporarily prevent the use of a certain line and the effect of the abnormal conditions can be avoided only by temporarily rerouting the supply or communication service over circuits not involved in the inductive exposure, consideration should be given to the adoption of this expedient. Where the rerouting of either service is impracticable the choice as to which service is to be temporarily suspended should be governed by the relative importance to the public of the respective services affected.

APPARATUS.

Wave Shape.

Where a ground connection used on the armature winding of an alternating current generator or motor electrically connected to supply circuits results in triple harmonics on circuits involved in inductive exposures, means should be employed to reduce the triple harmonics as far as may be necessary and practicable.

Rectifiers, arc furnaces and other apparatus which distort the voltage or current wave form of a supply circuit involved in an inductive exposure, should be equipped when and as necessary and practicable with suitable auxiliary apparatus to prevent such distortion.

Where the service conditions permit, consideration should be given to special means and devices for reducing the amplitude of harmonics on systems involved in inductive exposures.

Reasonable efforts should be made to promptly replace out-lamps on circuits equipped with individual transformers or bridged reactance coils.

Transformers.

Consideration should be given to the use of closed delta connection on main transformer supply banks or large distribution banks where necessary and practicable in preference to open delta.

Lightning Arresters.

Where, notwithstanding compliance with the paragraph regarding equipment of the arresters, interference arises at time of charging lightning arresters, charging should be done at such times as will result in minimum interference to both services.

Switches.

Consideration should be given to the installation of at least one oil-break switch, or its approved equivalent, to control the supply circuit involved in an inductive exposure.

Current Limiting Devices.

Consideration should be given to the use, so far as necessary and practicable, of current limiting devices in either the line wires or the neutral of transmission supply circuits.

Ground Connections.

Ground connections if employed on apparatus connected to local supply circuits should, so far as practicable, be made at the neutral or balanced point of the circuit.

Records.

A record should be kept of all abnormal conditions on transmission supply circuits involved in inductive exposures, where a study of such conditions is advisable. Such records should, as fully as practicable, include time and duration, circuit designation, location, probable causes and effect of abnormal conditions and how cleared.

All of the above records, or a convenient summary thereof, should be available for the purpose of analyzing cause and effect of disturbances.

DEFINITIONS

For the purpose of these principles and practices, the following terms are used with meanings as given in these definitions:

Inductive Coordination.

The location, design, construction, operation and maintenance of supply and communication systems in conformity with harmoniously adjusted methods which will prevent inductive interference.

General Coordinated Methods.

Those methods reasonably available for general application to supply or communication systems, which contribute to inductive coordination without specific consideration to the requirements for individual inductive exposures.

Specific Coordinated Methods.

Those additional methods applicable to specific situations where general coordinated methods are inadequate.

Inductive Interference.

An effect arising from the characteristics and inductive relations of supply and communication systems of such character and magnitude as would prevent the communication circuits from rendering service satisfactorily and economically if methods of inductive coordination were not applied.

Inductive Exposure.

A situation of proximity between supply and communication circuits under such conditions that inductive interference must be considered.

Inductive Susceptiveness.

Those characteristics of a communication circuit with its associated apparatus which determine, so far as such characteristics can determine, the extent to which it is capable of being adversely affected in giving service, by a given inductive field.

Inductive Influence.

Those characteristics of a supply circuit with its associated apparatus that determine the character and intensity of the inductive field which it produces.

Inductive Coupling.

The interrelation of neighboring supply and communication circuits by electric or magnetic induction or both.

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Configuration.

The geometrical arrangement of the conductors of a circuit including the size of the wires and their relative positions with respect to other conductors and the earth.

Electrically Connected.

Connected by means of a conducting path or through a condenser as distinguished from connection merely through electromagnetic induction.

Transposition.

An interchange of position of conductors of a circuit between successive lengths.

Coordinated Transpositions.

Transpositions which are installed in either supply or communication circuits or in both for the purpose of reducing inductive coupling and which are located effectively with respect to the discontinuities in both the supply and communication circuits.

Discontinuity.

A point at which there is an abrupt change in the physical relations of supply and communication circuits or in electrical constants of either circuit which would materially affect the coupling.

Transpositions are not rated as discontinuities, although technically included in the definition, because of their application to coordination.

Residual Voltage.

The residual voltage of a supply circuit is the vector sum of the voltages to ground of the several wires. In a three-phase system it is in effect a single phase voltage equal to one-third of the residual voltage, impressed between the wires in multiple and the ground.

Residual Current.

The residual current of a supply circuit is the vector sum of the currents in the several wires and is equivalent to a single phase current having the wires in multiple as one side and the ground as the other.

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Power Level.

The level of the electrical power flowing in a communication circuit. At any point the power level depends on the conditions of input and of losses between the point of input and the designated point.

In telephone practice the power level of a circuit is usually referred to the power level in a given circuit assuming that the acoustic input into the circuit under consideration is of a given amount and the same as the input into the reference circuit.

Sensitivity.

The sensitivity of a telephone circuit or a part thereof is the ratio of the electrical or the acoustic output to the electrical input.

Selectivity.

That property of apparatus or a circuit which permits the transmission or conversion of currents of different frequencies in differing degrees.

INDUCTIVE COORDINATION
ALLOCATION OF COSTS
BETWEEN
SUPPLY AND COMMUNICATION COMPANIES

The Reports of the Joint General Committee on Principles and Practices for Inductive Coordination have established the broad basis for the solution of inductive coordination problems from a physical standpoint based on the present state of the art. From the start, however, it has been recognized that the question of allocation of costs enters into the problem in an important way and in this connection the letter transmitting the first report contained the following statement:

> "Your Committee, as soon as standards of construction and operation are adopted, will consider whether principles can be established to aid in the fair allocation of costs of coordinative measures. In the meantime, your Committee believes that with the cooperative spirit which now is evident a mutually equitable adjustment can and should be made in each specific case. It is understood that any adjustments made will not be considered as precedents by either party to the prejudice of future understandings."

It is understood that, generally speaking, the respective utilities have been handling the allocation of costs in specific cases along the above recommended lines. However, in some cases difficulty has been encountered in endeavoring to reach an equitable adjustment; in fact, negotiations regarding the allocation of costs have in some cases unduly influenced the technical work on the specific situations involved and have tended to retard or prevent agreement on the best engineering solution.

This question has received careful consideration for some time and as a result certain suggestions have been made which will be helpful to the supply utilities and communication utilities as a guide in arriving at an equitable apportionment of the costs of methods of inductive coordination in situations where the two utilities have not already arrived at a mutually satisfactory plan for handling the allocation of costs.

In arriving at conclusions on this matter of allocation of costs, the following were carefully considered. The solution to the problem of inductive coordination should, of course, be based on the service needs of both parties and on the overall cost rather than on any consideration of in what plant the changes shall be made or how the costs are to be allocated. This is in accordance with the section on "Choice Between Specific Methods" contained in the Principles and Practices for the Inductive Coordination of Supply and Communication Systems and it is obvious that the approach to the problem should be such as to offer every incentive to obtaining the best engineering solution. It was the consideration of these facts that suggested the method herein outlined for the allocation of costs.

As has been stated in previous reports, each party should be the judge of its own service requirements but as covered in the Principles and Practices above referred to, each party also has a duty of coordination as shown by the following quotation:

> "In order to meet the reasonable service needs of the public, all supply and communication circuits with their associated apparatus should be located, constructed, operated and maintained in conformity with general coordinated methods which maintain due regard to the prevention of interference with the rendering of either service. These methods should include limiting the inductive influence of the supply circuits or the inductive susceptiveness of the communication circuits or the inductive coupling between circuits or a combination of these, in the most convenient and economical manner."

In other words, there are certain things indicated in connection with the classes of circuits covered in the Principles and Practices above referred to which each utility should do in its system in a general way which will promote inductive coordination.

These measures, however, cannot take account of the problems which arise in specific cases, and this was also recognized in the principles on Duty of Coordination already referred to as follows:

> "Where general coordinated methods will be insufficient, such specific coordinated methods suited to the situation should be applied to the systems of either or both kinds as will most conveniently and economically prevent interference, the methods to be based on the knowledge of the art."

These specific methods cannot be embodied in the general design of either plant because their nature and the necessity of their application are contingent upon the conditions of the specific situations which may arise and which generally cannot be foreseen. It is the equitable apportionment of the cost of these latter items which has apparently given rise to such differences of opinion as have existed between representatives of the two industries on this subject.

Taking into account all the foregoing factors, the plan suggested for use in connection with new construction is as follows:

1. Each utility should at its own expense design, construct, operate and maintain its plant in accordance with general coordinated methods.

2. Specific methods of coordination should be paid for by such equitable apportionment of the costs as may be agreed to by the utilities affected. It may be found reasonable in some cases for each party to bear the costs of such specific methods of coordination as result in net capital additions in its own plant; care must be exercised, however, that this be not carried to a point where the best engineering solution is prejudiced. In cases where it is not clear as to what constitutes an equitable apportionment a fifty-fifty division of the costs may be found the most practicable solution.

3. All carrying charges, repair, operating or other current expenses incident to specific coordinated methods and all subsequent replacement costs arising after and due to the installation of specific coordinated methods should be borne by the utility on whose system the costs are incurred.

The above outlined plan has the advantage that it can in no way prejudice the application of the best engineering solution because it makes each party have a direct interest in reducing the total cost of specific coordinated methods rather than in whether or not the expense is incurred in one plant or the other or both.

In applying this suggested general plan for the allocation of costs of specific methods of coordination, it is assumed the four following conditions will be met:

1. That each system has complied with the requirements for general coordination.
2. That the best engineering solution of the specific problem has been determined.
3. That the costs to be allocated are net costs and, therefore, exclude all items of betterment.
4. That the costs are computed on a uniform and mutually acceptable basis for both direct and indirect charges.

In situations involving extensions to existing systems or the cleaning up of existing exposures it is recognized that such existing systems may not comply entirely with general coordinated methods, and that the method suggested above for new construction may require some modification to adapt it to existing situations. Such problems involve consideration of whether or not both systems should be brought into compliance with general coordinated methods or whether some other plan is the best engineering solution. This point, together with the history of the case and any contemplated plans either party may have for changes in its system, will have a bearing on what constitutes an equitable apportionment of the costs.

PRINCIPLES AND PRACTICES FOR THE JOINT USE OF WOOD POLES BY SUPPLY AND COMMUNICATION COMPANIES

INTRODUCTORY

These Principles and Practices cover the general engineering and operating features involved in the joint use of wood poles and are intended to be in conformity with the broad principles heretofore mutually agreed upon by the Joint General Committee.

The Principles set forth in a broad and general manner the basic fundamentals involved in the intercompany relationships on joint use of poles. The two groups of utilities recognize their responsibility to serve the public safely, adequately and economically. It is therefore essential that any arrangement entered into be such as to best facilitate the present and future rendering of both classes of service.

Practices are recommendations which cover in a more specific way the general ground included in the Principles and are based on an analysis of practical operating experience with joint use of poles. It is recommended that they be used as a guide in the preparation of new agreements for the joint use of poles and in the modification of existing agreements where it is desired by either party to bring such existing agreements into conformity with these Principles and Practices.

PRINCIPLES

1. **Duties.**

Each party should:

(a) Be the judge of the quality and requirements of its own service, including the character and design of its own facilities.

(b) Provide and maintain facilities adequate to meet the service requirements including such future modifications in these facilities as changing conditions indicate to be necessary and proper.

(c) Determine the character of its own circuits and structures to be placed or continued in joint use, and determine the character of the circuits and structures of others with which it will enter into or continue in joint use.

(d) Cooperate with the other party so that in carrying out the foregoing duties, proper consideration will be given to the mutual problems which may arise and so that the parties can jointly determine the best engineering solution in situations where the facilities of both are involved.

2. Establishing, Maintaining and Terminating Joint Use.

Joint consideration by both parties of safety, service, economy, convenience and the trend toward higher distribution voltages should determine:

(a) When joint use should be employed, taking into account present conditions and those which can be reasonably foreseen, including the possibility of reverting to separate lines.

(b) The best engineering solution for the coordinated arrangement and design of facilities in joint use.

(c) The administrative methods for entering into, carrying on and terminating joint use.

3. Local Contact.

All parties at interest in a locality should maintain close cooperation and each notify the others of any intent to build new lines or to reconstruct existing lines, as an aid to orderly planning and the utilization of joint use where advantageous.

4. Contracts.

General contracts for joint use, if entered into, should define conditions for entering into joint use, for operating in joint use, for terminating joint use and for a practical procedure for modifying facilities in joint use from time to time.

In either general or specific contracts, any provisions treating of the character of circuits on poles for joint use should be so drawn as not to restrict changes in the character of the circuits of either party, except that it should be recognized that such changes may involve the modification or abandonment of joint use in specific cases.

Each specific instance of contemplated initial or modified joint use, whether embracing a single pole, a group of poles or an entire line, should be considered, as to acceptance, as a separate and distinct case, with the right of refusal by either party, and if accepted should be in writing.

Joint use now exists and gives satisfaction in many localities under one of two general plans, one a "Space Rental Plan" and the other a "Joint Ownership Plan." In addition, joint use is sometimes effected on an "Attachment" or "Contact Rental" basis, and sometimes under a "Permanent Rights" agreement, which is a modification of the "Joint Ownership Plan." The Joint Ownership Plan and the Space Rental Plan have in general proved the more simple and convenient working arrangements.

5. Costs.

The allocation of costs between the parties at interest should be prima facia, reasonable and equitable, taking into account all factors involved.

6. Legal Considerations.

Legal questions, including the sufficiency of right-of-way grants held by the parties and the protection of title or property of both parties in the case of mortgages, sales, mergers or consolidations entered into by either party should be given due consideration in the preparation of contracts.

In any terms of the contract dealing with liability for personal or property damage, care should be taken that such terms are not disadvantageous to either party.

7. Periodical Readjustment of Contracts.

Provision should be made for review and revision from time to time of those stipulations of a contract treating of conditions of a varying nature and particularly of items of expense to be apportioned between the parties, such as the cost of poles and rentals which are dependent on material and labor prices.

8. **Construction and Inductive Coordination.**

The construction and inductive coordination employed in joint use should be in accordance with mutually acceptable practices and in conformity with such recommendations of the Joint General Committee as are issued from time to time.

PRACTICES

1. **Territory Covered by Agreement.**

Agreements should preferably cover all existing wood poles of each of the parties and any other wood poles hereafter erected or acquired by either of them within a certain described territory, except those which carry circuits of a character that the parties wish to keep out of joint use.

NOTE: It is recognized that there are exceptional situations where it may not be desirable to make general agreements covering a given territory, as, for example, where the major portion of the poles of one of the parties carry circuits for which joint use is not generally advantageous. Such cases may be more satisfactorily handled by agreements covering a specific line or certain specific poles.

2. **Types of Joint Use Agreements.**

Joint use agreement should preferably be of a type under which each of the parties shares equitably in the cost of joint poles. This may be accomplished in either of the following ways:

(a) Space rental under which form of agreement the licensee rents space on the pole of the Owner and pays a rental per pole which is based on the amount of space reserved. A much used form of this is the so called "flat rental per pole" where the division is practically equal and the rental is approximately equal to one-half the average annual charges on a pole which is stipulated as the standard of reference.

(b) Joint ownership, under which form of agreement each of the parties owns a half interest in each joint pole and pays one-half the cost in place of the pole which is stipulated as the standard of reference.

NOTE: A permanent rights agreement is a modification of the joint ownership agreement which has been used occasionally under which each of the parties retains sole ownership of certain of the poles and the other party purchases a permanent right of occupancy. The other arrangements are the same as in a joint ownership agreement.

Rentals based on individual contacts or attachments are not generally recommended for joint pole agreements, as such a basis involves the expense and obligations arising from periodical inventories of the attachments. It is also difficult to establish rental rates for the many kinds of individual attachments which will continue to be equitable and mutually satisfactory. Furthermore, this basis does not have the advantage of providing a suitable space for the present and future requirements of each party. However, such a basis may sometimes be found satisfactory for an individual agreement where only a small number of poles is involved.

3. Conditions Relating to Joint Use of Poles.

It is recognized that there are very substantial advantages to both utilities in the employment of jointly occupied poles where the conditions and character of circuits permit. The conditions determining the necessity or desirability of joint use depends upon the service requirements to be met by both parties including considerations of safety and economy. Each party is the judge of what the character of its circuits should be to meet its service requirements and as to whether or not these service requirements can be properly met by the joint use of poles.

(a) It is recommended that joint use should be entered into in preference to separate pole lines on the same street or highway where the combination of circuits is such as to make further cooperative study of the problem unnecessary and in other cases where a cooperative study shows that joint use is economical and is the best engineering solution.

(b) Each party should retain the right to remain out of joint use with such of its pole lines as are necessary for its own sole use or in other cases where in its judgment the proper rendering of its service now or in the future requires separate lines.

(c) It is recognized that joint use is advisable but that it is necessary that when employed it should meet the service requirements of both parties and that any statement made as to conditions under which joint use is desirable is likely to change as time goes on and as service conditions and the state of the art change.

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(d) Based upon the present state of the art, the Supply Utilities and the Communication Utilities have stated as to their respective circuits (See appendices 1 and 2) the present limitations within which each group recommends that joint use be entered into.

(e) In any case where it is necessary that the two kinds of lines occupy the same side of the highway joint use is generally preferable to overbuilding.

(f) It is recognized that situations will sometimes arise in rural districts where greater economy can be obtained with separate lines than with a joint line and without sacrificing safety or service. It is also recognized that a utility will find in some cases that it is necessary to construct a line which is to carry such number and weight of attachments that joint use would not be economical or desirable. In such cases it is not intended to recommend joint use of poles in preference to other arrangements which would be more advantageous.

4. Cooperation to Establish Joint Use.

(a) When any party to a joint use agreement is about to erect a new pole line or to extend or reconstruct an existing pole line within the territory covered by the agreement, notice in advance should be given to the other party to the agreement, such notice showing the proposed location and character of the new poles. The parties should then cooperate to determine whether or not joint use of the poles should be established.

(b) When any party to a joint use agreement desires to occupy space on any existing poles of the other party within the territory covered by the agreement, notice should be given the owner of said poles and the parties should then cooperate to determine whether or not joint use of poles should be established.

5. Avoidance of Conflicting Lines.

Where joint use of poles is not to be established or where in accordance with Section 6 of these Practices joint use is to be terminated, the parties should make every reasonable effort to avoid the establishment of conflicting lines.

6. Procedure When Character of Circuits Is Changed.

When either party desires to change the character of its circuits on jointly used poles it shall so notify the other party and the parties shall cooperate to determine whether or not joint use of the poles involved shall be continued. If it is not agreed to continue joint use of the said poles, the parties shall then cooperate to determine the most practical and economical method of effectively providing for separate lines. The party whose circuits are to be moved shall promptly carry out the necessary work and the parties shall cooperate to determine the equitable apportionment of the net expense involved in such relocation. In the event of a disagreement as to what constitutes an equitable apportionment of such expense the following arrangements are recommended:

(a) In the case of a space rental agreement, the licensee shall bear the said net expense.

(b) In the case of a joint ownership agreement the said net expense shall be divided equally between the parties.

Unless otherwise agreed by the parties, ownership of any new line constructed under the foregoing provision in a new location shall rest in the party for whose use it is constructed. The net cost of establishing service in the new location should be exclusive of any increased cost due to the substitution for the existing facilities of other facilities of a substantially new or improved type or of increased capacity, but should include the new pole line, the cost of removing attachments from the old poles to the new location and the cost of placing the attachments on the poles in the new location.

7. Ownership of Poles Under a Space Rental Agreement.

In any case where the parties to a space rental agreement shall conclude arrangements for the joint use of any new poles to be erected, the ownership of such new poles should be determined by mutual agreement. In case of failure to agree, the party then owning the smaller number of joint poles under the agreement should erect the poles and be the owner thereof.

NOTE: It has been found to be of advantage under this form of agreement to have each party own approximately one-half the total number of jointly used poles, as this tends to equalize the investment of the two parties. Furthermore, this has the advantage of reducing the intercompany billing and the exchange of money between the parties. This division of ownership should preferably be accomplished by each party owning certain continuous lines rather than having the ownership of the poles in a given line divided.

8. Joint Fundamental Plan.

An effective way of handling the proper development of joint pole lines in a given territory is through the full application of the principles on cooperation including advance notice, advance planning and the interchange of information. Experience has shown that this can be accomplished through a joint fundamental plan of the present and future developments of the overhead systems of the respective parties. Through such joint planning it will be generally found possible to avoid any difficult situations in locating the lines and the application of these Principles and Practices to both the present and future developments can be carried out in the most effective and economical manner.

9. Specifications for Joint Pole Construction.

It is intended that complete specifications covering recommended practices for joint use of poles under various conditions will be prepared as soon as practicable. Until such time as these specifications are issued, it is recommended that the National Electrical Safety Code be used as a guide to practice.

Existing joint pole construction should be brought into conformity with the recommended practices in an orderly and systematic manner. This may be accomplished by a provision in the agreement that a certain percentage of the existing construction be brought into conformity with the recommended practices each year.

10. Inductive Coordination for Circuits on Jointly Used Poles.

The "Principles and Practices for the Inductive Coordination of Supply and Communication Systems" as issued from time to time by the Joint General Committee should be followed.

APPENDIX 1

Supply Utilities Statement.

In the present state of the art and subject to the limitations of the Principles and Practices of which this is an appendix, the Supply Utilities are willing to enter into joint use of poles generally, irrespective of the character of the Communication Utilities circuits with the clear understanding that these Principles and Practices do not limit such changes to higher voltages as may be desirable in the future as the most advantageous means of serving their customers but provide for such changes in location or construction as may be necessary to meet the changed conditions.

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EXHIBIT WA-29

JOINT USE OF POLES IN RURAL AREAS

A Report of the Joint Subcommittee on Joint Use of Poles for Rural Power and Telephone Circuits Edison Electric Institute and Bell Telephone System

Summary

This is a final report of the Joint Subcommittee on Joint Use of Poles for Rural Power and Telephone Circuits. The first report consisted of a preliminary issue of Part 5 "Special Considerations for Long Span Joint Use" of the Joint Pole Practices. This report reviews the factors concerned in the relative economies of joint construction vs. separate power and telephone line construction in sparsely settled rural areas and makes recommendations concerning further joint work on rural joint use matters.

October 1951

Copies of this report may be obtained by Power Companies from the Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y. (Publication 51-19) and by Associated Bell Companies from the Department of Operation and Engineering of the American Telephone and Telegraph Company, 195 Broadway, New York 7, N. Y.

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JOINT USE OF POLES IN RURAL AREAS

Under date of October 29, 1945, the Joint Committee on Plant Coordination issued a report covering the construction and maintenance of jointly used pole lines carrying supply and communication circuits which was designated as "Joint Pole Practices." These Practices are divided into four parts intended for application under the various conditions which obtain generally in urban and suburban areas. Because of limited experience it was not practicable to include in the Joint Pole Practices requirements covering long span joint use such as obtains in rural areas. Provisions were, therefore, made for a Part 5 which could be added later to cover the clearance and other requirements involved in such joint use.

Early in 1946, the Subcommittee on Joint Use of Poles for Rural Power and Telephone Circuits was formed and instructed to study the factors involved in the joint use of poles for rural power and telephone circuits including the guidance of trial installations with the objective of developing:

(a) Suitable specifications for the construction of long span joint use.

(b) The economies of rural joint use as compared with separate lines.

(c) Sound and equitable principles and practices for guidance in negotiating administrative and contractual relations.

These instructions also included application of available methods of inductive coordination and electrical protection on the power and telephone circuits.

Specifications

Under date of April 10, 1946, the Subcommittee on Joint Use of Poles for Rural Power and Telephone Circuits submitted tentative specifications for long span joint construction. These specifications were prepared in the form of Part 5 of the Joint Pole Practices and were intended to be used in combination with such of the other requirements of the Joint Pole Practices as apply.

In line with the recommendations of the Subcommittee, the Joint Committee on Plant Coordination issued Part 5 for field trial on May 6, 1946, and copies were sent to Member Companies of the Edison Electric Institute and Associated Companies of the Bell Telephone System.

Basic Considerations

In its studies of long span joint use, the Subcommittee has found it convenient to group the factors concerned under three headings, namely, Structural Coordination, Electrical Protection and Inductive Coordination.

Structural Coordination

The important factors involving Structural Coordination in long span joint use are:

1. Separations between power and telephone wires at the pole and in the span.
2. Clearances of power and telephone wires above highways and above ground along highways and over ways generally.
3. Pole sizes to provide required strengths and wire clearances.

Minimum requirements covering these factors are contained in Part 2 of the 5th (Current) Edition of the National Electrical Safety Code. Joint use has been employed in urban and suburban areas for many years, and patterns of joint use have been developed which have proven generally satisfactory in such areas. With the development of relatively small, high strength power wires, the construction of power lines in span lengths 2 to 5 times longer than those normally used in urban areas, became practicable. Also, the development of improved high strength telephone wires made practicable the construction of correspondingly long span open wire telephone lines. Joint use with such wires in long spans was not contemplated in Part 2 of the Current Edition of the National Electrical Safety Code and the need of guides, particularly concerning separations between power and telephone wires at the pole and in the span, was indicated. Part 5 of the Joint Pole Practices referred to above, was intended for this purpose.

Electrical Protection

Previous to 1930 a large percentage of power distribution circuits involved in joint use ranged between 2300 and 4800 volts and adequate practices for such joint use had been developed based on experience. However, the situation was less clear where higher distribution voltages were involved, and the Joint Subcommittee on Development and Research consequently undertook a study of the problem, the results of which were given in Provisional Report 19, entitled "Joint Use of Poles - Telephone Circuits and 6.6 and 13.2 Kv Power Circuits - Safety Features." Out of these studies there developed the following basic concepts which facilitated the extension of joint use with power circuits in higher voltage categories.

1. Protection of telephone plant in joint use requires coordination of protective devices in both the power and telephone circuits.

2. Such coordination consists in essence of provision for positive deenergization of the power circuit in case of fault to ground, and limitation of the voltages on the telephone plant in case of accidental contact to the range of safe operating characteristics of telephone protective equipment. On open wire telephone circuits this involves the use of auxiliary protectors associated with telephone line wires which will (a) limit the voltage at the telephone station to the protective equipment operating range and (b) provide for impedance to ground low enough and with current carrying capacity high enough to assure the operation of power protective equipment in the event of accidental contact. On telephone cable and associated drop wire, the effective grounding of the telephone cable sheath -- in some cases bonding the sheath to the multi-grounded neutral of the power system -- provides suitable limitation of impressed voltage.

The auxiliary protector used on open wire telephone circuits where exposed to contact with higher voltage conductors, has been standardized and is known as the 99A protector. It consists of three carbon cylinders, each about 5/8 inch in diameter, and 1/2 inch long, inclosed in a mounting suitable for attachment to a pole or telephone crossarm. The carbon cylinders are spaced to give approximately 3000-volt gaps. Two of the cylinders are connected to the wires of the telephone circuit concerned and the third is grounded, where practicable to a grounding wire which is also connected to the multi-grounded neutral of the power system.

These methods of protection, developed primarily for application to joint use in urban and suburban areas, are equally applicable to joint use in rural areas where higher voltage multi-grounded neutral distribution circuits are employed. In rural areas, however, where telephone circuits may be involved in considerable lengths of joint use, the matter of electric or magnetic induced voltages on telephone wires may be of importance. To take care of this problem, there has been developed a drainage protector for use on open wire telephone circuits. This device is in two forms, one consisting of a resistor in series with a capacitor and the other of a reactor in series with a capacitor, the combination tuned to 60 cycles. Since these drainage devices are connected between each wire of a telephone circuit and ground, it is important that their bridging impedance be high so as not to cause high telephone transmission losses and low as regards impedance to ground, so as to limit induced voltages to ground. The device with resistors is known as the 104A telephone protector and the one with reactors is known as the 108A telephone protector. The 104A is designed for electric induction only; the 108A, while designed primarily for electric induction, is also effective for magnetic induction if the impedance of the line to which it is connected is relatively high.

In urban and suburban areas, joint use largely involves telephone cables and relatively short extensions of open wire. Where these open wire extensions are joint with higher voltages, 99A protectors are usually employed but drainage protectors are seldom required. In rural areas, where open wire telephone circuits are usually relatively long, both types of protectors are indicated where higher voltage power circuits are involved. Where the power circuit operates at less than 3000 volts to ground, 99A protectors are not applicable but drainage protectors may be indicated.

Inductive Coordination

The principal problem of inductive coordination in rural joint use involves "noise induction" in open wire telephone circuits. Studies in this connection indicate the importance of the following:

1. That the power circuits concerned have reasonably low values of harmonics.

2. That the telephone circuits be well balanced as regards impedance to ground and that they be adequately transposed throughout the extent of joint use and other parallel construction.

Well balanced telephone equipment both at telephone central offices and at telephone stations are indicated where rural power and telephone circuits operate in the same territory in joint use or in parallel construction. A system of telephone circuit transpositions, known as the R System, has been developed which is applicable to open wire telephone circuits in either paralleling construction or joint use and has been found to be effective when employed in combination with well balanced equipment at the central office and at subscriber stations as referred to above. With this system of telephone transpositions, each telephone circuit is transposed at alternate poles if long span construction is used; with short span construction transpositions are made at about the same linear intervals, rather than at alternate poles. Where two or more circuits are involved, the transposition locations are staggered to minimize telephone cross-talk induction. An important feature of the system is the use of a tandem-type transposition bracket.

Trial Installations

During 1946, a number of trial installations of long span higher voltage rural joint use were constructed. Data on five of these installations, three in the light and medium loading districts and two in the heavy loading district, were made the subject of a paper on Joint Use of Pole Lines for Rural Services presented at the 1947 Winter meeting of the American Institute of Electrical Engineers by Messrs J W Campbell of the American Telephone and Telegraph Company, L W Hill of the Carolina Telephone and Telegraph Company, L M Moore of the Rural Electrification Administration and H J Scholz of the Commonwealth and Southern Corporation. (Transactions of the American Institute of Electrical Engineers, Vol. 66, pp 519-524, 1947.) This paper described the means employed in the five installations for the coordination of construction, electrical protection and induction and gave the results of noise measurements on the telephone circuits in each instance. This paper indicated that the trials made up to that time had demonstrated the feasibility of higher voltage long span joint use in rural areas.

In many locations throughout the country, particularly surrounding larger cities, joint use has extended into rural areas with the same pattern of construction and the same power system voltage as employed in the urban areas. In more thinly populated rural areas, long span higher voltage joint use has been constructed in many instances. It is estimated that at present there are of the order of 2,000,000 poles jointly used in rural areas in the United States and that about 300,000 of these involve joint use of the long span higher voltage type.

Economies of Rural Joint Use as Compared with Separate Lines

In its studies of the relative economies of rural joint lines as compared with separate lines, the Subcommittee has confined its considerations primarily to situations such as obtain in thinly settled rural areas where higher voltage power circuits, long spans and long open wire telephone circuits are indicated. In considering the costs of joint lines as compared with separate lines in such situations, certain elements of cost are involved which are not present in the same degree in urban types of joint use. The procedure has, therefore, been to investigate the cost of separate rural power and telephone lines including in each case the cost of poles in place, the cost of rights-of-way, initial clearing, recurrent trimming, and added costs such as are involved where the lines cross each other. On joint lines there have been included the costs of poles in place, rights-of-way, initial clearing, recurrent trimming and additional electrical protection. For situations in which joint use is established on existing rural power lines there has also been included in the joint line costs, the added cost to the Telephone Company of stringing wire under energized power wires and the added cost of rearrangement of power facilities, added poles and pole replacements. Thus the effort has been to compare the over-all costs of separate rural power and telephone pole lines with the over-all costs of joint pole lines in the same territory.

These cost items vary considerably depending on the circumstances which obtain in different territories. For example, initial clearing and recurrent trimming costs may be high in some localities and low in others. The cost of poles in place vary considerably in different parts of the country. In general, however, the factors which cause these variations apply to the lines built separately by the Power and Telephone Companies and to joint lines.

In addition to the factors reviewed above and to which dollar values can be assigned, there are also certain other items, important in the consideration of joint versus separate lines, but to which it is not practicable to assign dollar values.

In its studies of relative economies the Subcommittee has been guided by the following factors.

1. So far as the inductive influence of the power system and the inductive susceptiveness of the telephone system are concerned, these would equate to the same problem in joint use as in parallel construction on the opposite side of the highway. Therefore, joint use as of itself would not add to the cost of inductive coordination in joint construction.

2. As regards electrical protection, since the protective devices usually employed on the rural power system provide for de-energization at times of ground faults, and since the protective devices designed for use on telephone circuits result in ground impedances such as are usually employed by power companies in this connection, no additional expense on the power system pertinent to joint use would be involved. On the telephone system there would be involved the expense of a greater number of 99A protectors and drainage protectors than would be required for separate lines.

3. In constructing lines in rural areas there are usually involved rights-of-way, initial clearing and subsequent trimming costs. These costs would be applicable to separate lines and to joint lines.

4. In establishing new separate rural power and telephone lines, crossings of the two lines are involved at intervals, as for example at cross roads, service drops, etc. A certain amount of expense would be involved to provide the required strengths, clearances and electrical protection at many of these crossings. Such expense, assumed paid by the second comer, would be chargeable to the cost of separate lines.

5. The joint lines has been assumed to be a line suitable for both services without regard to height or class of poles, i.e., no normal joint pole.

6. In establishing joint use on existing lines, some rearrangement of existing facilities, replacement of poles, and provision of additional poles may be required. Such expense would be chargeable to the cost of the joint line.

7. The stringing of telephone wires under energized power conductors requires particular care to prevent contacts between the telephone wires and energized power wires which add to the cost of stringing telephone wires. In building new joint use lines, the work could be so planned as to avoid this added expense in connection with the telephone wires to be installed initially.

8. Since the number of poles per mile used by power and telephone companies on their normal separate line construction may differ, and since many of the cost items mentioned in the preceding can best be compared on a unit length of line basis, it is convenient to make cost comparisons on the basis of annual charges per mile. This permits the direct inclusion in the comparison of the annual cost of recurrent trimming where this item is of importance.

9. There is likely to be more costly damage and greater delay in clearing trouble due to storms when power and telephone wires are attached to the same poles. However, it was not practicable to arrive at a suitable valuation of this item.

With these factors considered, the studies of the Subcommittee have led to the conclusion that, in general, joint use in sparsely settled rural areas may offer opportunities for dollar economies. These opportunities for dollar economies are, of course, greatest where new joint lines are constructed. Where existing power lines are to be rearranged for joint use opportunities for dollar economies will be considerably reduced. Where existing rural telephone lines or existing rural power and telephone lines are involved, joint use, in general, offers no dollar economies but in some instances, may be the best engineering solution to specific problems.

Joint Use Arrangements in Rural Areas

The EEI-Bell System "Principles and Practices for the Joint Use of Wood Poles by Supply and Communication Companies" as issued by the Joint

General Committee in 1926 and reissued without change in 1945, has formed the basis for a large percentage of the more than 300 joint use agreements now in effect between power and telephone companies in the United States. These agreements have established general patterns as to form which are adaptable to the conditions obtaining primarily in urban and suburban areas. As affecting thinly settled rural areas, a sufficient number of agreements have not so far been executed to establish a general pattern for such specific joint use. However, it is believed that the first sentence of Item 2 of the EEI-Bell System Practices referred to above should form a reasonable basis for joint use arrangements in rural areas. This sentence is as follows: "Joint Use Agreement should preferably be of a type under which each of the parties shares equitably in the cost of joint poles."

Recommendations

In completing its assignments, the Subcommittee makes the following recommendations:

1. That this report be issued to the power and telephone companies as a Subcommittee Report.

2. That consideration be given to combining trial Part 5 covering long span joint construction, with the Joint Pole Practices and that in this connection, consideration also be given to such of the recommendations contained in Provisional Report No. 32 of the Joint Subcommittee on Development and Research entitled "Factors Which Influence Pole Height in the Rural Joint Use of Poles" as are mutually acceptable.

3. That work be continued through appropriate channels with the objective of promoting safety and economy in joint use.

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EXHIBIT WA-30.1

WA Exhibit No. 30.1 - APPA Rental Rate Calculation
Blue Ridge EMC
FY 2014 Data

Line #	Description	Amount	Definition
	Attacher Responsibility Percentage		
1	Space occupied	1.11	Per audit
2	Unusable Space	30.63	Calculation-Includes Safety Space
3	Unusable Space Factor	35.39%	Line 2 / Line 6 / Line 7
4	Usable Space	6.2	(Pole Height - Unusable)
5	Usable Space Factor	3.01%	(Line 1 / Line 4) x (Line 4 / Line 6)
6	Pole Height	36.83	Calculated with CPR Detail
7	Number of Attachers	2.35	Calculated using GIS data
8	**Attacher responsibility percentage**	**38.40%**	**Line 3 plus Line 5**
	Gross Cost of a Bare Pole		
9	Gross pole investment (Acct. 364)	49,295,043	
10	Appurtenance factor	87.00%	
11	Gross pole investment allocable to attachments	42,886,688	Line 9 x Line 10
12	Total number of poles	107,751	
13	**Gross cost of a bare pole**	**$398.02**	Line 11/Line 12
	Gross Carrying Charge		
14	Total general and administrative	10,164,119	
15	Total electric plant in service	425,883,764	
16	**Administrative carrying charge**	**2.39%**	Line 14 / Line 15
17	Maintenance expense for overhead lines	7,674,619	
18	Pole investment in Accts. 364, 365, & 369	158,218,973	
19	**Maintenance carrying charge**	**4.85%**	Line 17 / Line 18
20	Depreciation rate for gross pole investment	3.60%	
21	**Depreciation carrying charge**	**3.60%**	Line 20
22	Taxes (Accts. 408.1 + 409.1 + 410.1 + 411.4 - 411.1)	2,160,782	
23	Total utility plant in service	425,883,764	
24	**Taxes carrying charge**	**0.51%**	Line 22 / Line 23
25	Applicable rate of return (default)	11.25%	Presumption
26	Gross Pole Investment	$ 49,295,043.19	Line 9
27	Net Pole Investment	$ 32,539,753.16	
28	**Return carrying charge**	**7.43%**	(Line 25 x Line 26) / Line 27
29	**Total carrying charges**	**18.77%**	Line 16 + Line 19 + Line 21 + Line 24 + Line 28
	RATE		
30	**Attacher responsibility percentage**	**38.40%**	Line 8
31	**Gross cost of a bare pole**	**$398.02**	Line 13
32	**Total carrying charges**	**18.77%**	Line 29
33	**Pole attachment rental rate**	**28.69**	Line 30 x Line 31 x Line 32

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EXHIBIT WA-30.2

PUBLIC

WA Exhibit No. 30.2 - APPA Rental Rate Calculation
Blue Ridge EMC
FY 2015 Data

Line #	Description	Amount	Definition
	Attacher Responsibility Percentage		
1	Space occupied	1.11	Per audit
2	Unusable Space	30.61	Calculation-Includes Safety Space
3	Unusable Space Factor	35.35%	Line 2 / Line 6 / Line 7
4	Usable Space	6.24	(Pole Height - Unusable)
5	Usable Space Factor	3.01%	(Line 1 / Line 4) x (Line 4 / Line 6)
6	Pole Height	36.85	Calculated with CPR Detail
7	Number of Attachers	2.35	Calculated using GIS data
8	**Attacher responsibility percentage**	**38.36%**	**Line 3 plus Line 5**
	Gross Cost of a Bare Pole		
9	Gross pole investment (Acct. 364)	50,390,546	
10	Appurtenance factor	87.29%	
11	Gross pole investment allocable to attachments	43,984,989	Line 9 x Line 10
12	Total number of poles	108,086	
13	**Gross cost of a bare pole**	**$406.94**	Line 11/Line 12
	Gross Carrying Charge		
14	Total general and administrative	9,870,339	
15	Total electric plant in service	440,866,858	
16	**Administrative carrying charge**	**2.24%**	Line 14 / Line 15
17	Maintenance expense for overhead lines	7,951,569	
18	Pole investment in Accts. 364, 365, & 369	164,546,374	
19	**Maintenance carrying charge**	**4.83%**	Line 17 / Line 18
20	Depreciation rate for gross pole Investment	3.60%	
21	**Depreciation carrying charge**	**3.60%**	Line 20
22	Taxes (Accts. 408.1 + 409.1 + 410.1 + 411.4 - 411.1)	1,477,001	
23	Total utility plant in service	440,866,858	
24	**Taxes carrying charge**	**0.34%**	Line 22 / Line 23
25	Applicable rate of return (default)	11.25%	Presumption
26	Gross Pole Investment	$ 50,390,545.70	Line 9
27	Net Pole Investment	$ 32,466,328.65	
28	**Return carrying charge**	**7.25%**	(Line 25 x Line 26) / Line 27
29	**Total carrying charges**	**18.25%**	Line 16 + Line 19 + Line 21 + Line 24 + Line 28
	RATE		
30	**Attacher responsibility percentage**	**38.36%**	Line 8
31	**Gross cost of a bare pole**	**$406.94**	Line 13
32	**Total carrying charges**	**18.25%**	Line 29
33	**Pole attachment rental rate**	**28.50**	Line 30 x Line 31 x Line 32

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EXHIBIT WA-30.3

PUBLIC

WA Exhibit No. 30.3 - APPA Rental Rate Calculation
Blue Ridge EMC
FY 2016 Data

Line #	Description	Amount	Definition
	Attacher Responsibility Percentage		
1	Space occupied	1.11	Per audit
2	Unusable Space	30.59	Calculation-Includes Safety Space
3	Unusable Space Factor	35.31%	Line 2 / Line 6 / Line 7
4	Usable Space	6.28	(Pole Height - Unusable)
5	Usable Space Factor	3.01%	(Line 1 / Line 4) x (Line 4 / Line 6)
6	Pole Height	36.87	Calculated with CPR Detail
7	Number of Attachers	2.35	Calculated using GIS data
8	**Attacher responsibility percentage**	**38.32%**	**Line 3 plus Line 5**
	Gross Cost of a Bare Pole		
9	Gross pole investment (Acct. 364)	51,209,182	
10	Appurtenance factor	87.41%	
11	Gross pole investment allocable to attachments	44,762,968	Line 9 x Line 10
12	Total number of poles	108,330	
13	**Gross cost of a bare pole**	**$413.21**	Line 11/Line 12
	Gross Carrying Charge		
14	Total general and administrative	9,666,925	
15	Total electric plant in service	454,916,323	
16	**Administrative carrying charge**	**2.12%**	Line 14 / Line 15
17	Maintenance expense for overhead lines	8,486,535	
18	Pole investment in Accts. 364, 365, & 369	168,093,587	
19	**Maintenance carrying charge**	**5.05%**	Line 17 / Line 18
20	Depreciation rate for gross pole Investment	3.60%	
21	**Depreciation carrying charge**	**3.60%**	Line 20
22	Taxes (Accts. 408.1 + 409.1 + 410.1 + 411.4 - 411.1)	1,698,970	
23	Total utility plant in service	454,916,323	
24	**Taxes carrying charge**	**0.37%**	Line 22 / Line 23
25	Applicable rate of return (default)	11.00%	Presumption
26	Gross Pole Investment	$ 51,209,181.87	Line 9
27	Net Pole Investment	$ 32,011,587.29	
28	**Return carrying charge**	**6.88%**	(Line 25 x Line 26) / Line 27
29	**Total carrying charges**	**18.02%**	Line 16 + Line 19 + Line 21 + Line 24 + Line 28
	RATE		
30	**Attacher responsibility percentage**	**38.32%**	Line 8
31	**Gross cost of a bare pole**	**$413.21**	Line 13
32	**Total carrying charges**	**18.02%**	Line 29
33	**Pole attachment rental rate**	**28.54**	Line 30 x Line 31 x Line 32

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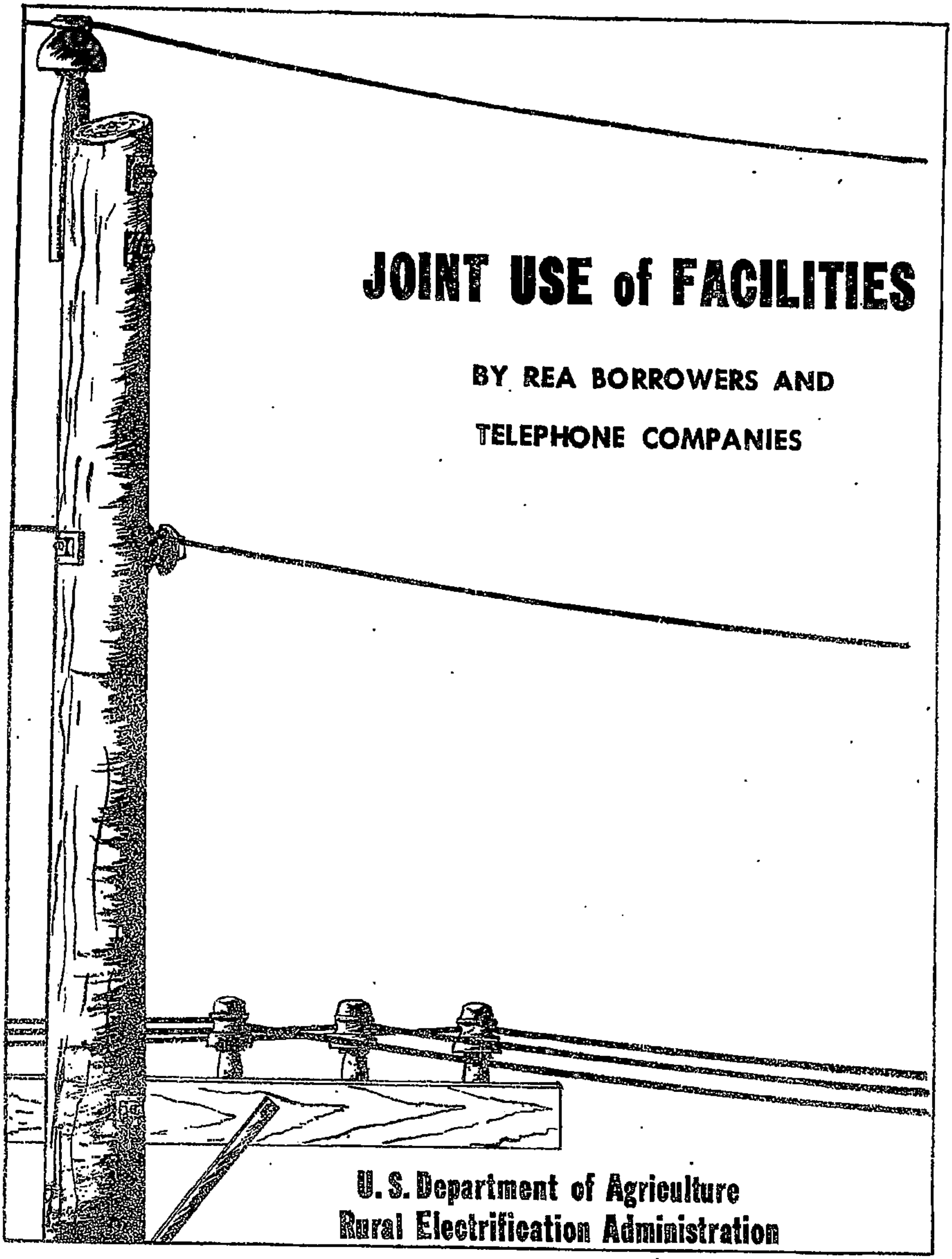
EXHIBIT WA-31



JOINT USE of FACILITIES

BY REA BORROWERS AND TELEPHONE COMPANIES

U. S. Department of Agriculture
Rural Electrification Administration

CONSIDERATIONS INVOLVED IN JOINT USE OF FACILITIES BY REA BORROWERS AND TELEPHONE COMPANIES

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CONSIDERATIONS INVOLVED IN JOINT USE OF FACILITIES BY REA BORROWERS AND TELEPHONE COMPANIES

Introduction

Joint use of facilities by power and telephone systems has been found to be feasible in rural areas with the development of high strength telephone wires that can match rural power line spans and the development of generally accepted construction standards and safety devices to minimize any possible hazards. The power line carrier telephone system, wherein the power wires act as guides for carrier radio waves, is another recent development having application in rural areas.

Joint use raises for REA borrowers questions of policy with respect to (1) protecting and advancing the interests of their members in connection with telephone rates and area coverage, (2) uniform relations with local telephone companies in their areas that may include mutuals, independents and members of the Bell Telephone System, and (3) development of engineering, construction and operating practices in cooperation with the local telephone companies that will make joint use an asset to all. Joint use raises for REA questions with respect to use of loan funds and protection of the Government's interests in borrowers' systems as they may be affected by joint use arrangements.

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The joint use contract forms, copies of which were distributed to all borrowers with the Administrator's memorandum of July 3, 1947, were designed to include desirable legal, business and technical factors to provide adequate protection for REA borrowers and to establish a practical working framework for relations between REA borrowers and their local telephone companies when they wish to engage in joint use of facilities.

I. Objective of Joint Use of Facilities

The primary objective of joint use of facilities is to achieve savings in cost by eliminating one pole line. Elimination of structural conflicts as well as local regulations may also require or make joint use desirable.

The costs as well as the savings of joint use construction should be shared equitably by the power and telephone suppliers. Where the savings are appreciable, it can well mean that both services can be extended into areas where construction might not otherwise be economically feasible. Therefore, even though power system poles are already in place and can accommodate telephone facilities with little, if any, extra cost, telephone companies should be required to make payments representing their fair share of the costs of the poles so that savings can accrue to the consumers of electricity as well as to the telephone subscribers. In other words, the power consumers should not be asked to subsidize telephone subscribers.

II. REA Financing as Related to Joint Use Facilities

As a general rule, an REA borrower should not invest REA loan funds in joint use facilities in a given area to a greater extent than would have been required to provide facilities capable of rendering electric service alone in the same given area. This will raise no serious problem since the pole sizes in common use by REA borrowers are capable of accommodating certain telephone facilities and the contracts provide that the telephone companies shall pay any additional capital outlays required as well as rentals for the benefits they secure from the use of REA borrowers' poles and wires. Moreover, since telephone companies may also set and own joint use poles, an REA borrower should actually have a lesser investment in pole plant than would be required for separate line construction considering an area as a whole.

III. Telephone Company Qualifications

The sample forms of contracts and the recommended payments contained therein are predicated on the assumption that the telephone supplier is fully competent to carry its part of responsibility and that the REA borrower will not be put to any additional expense by reason of the telephone supplier's lack of knowledge or competence. Therefore, REA borrowers, before entering joint use agreements, should satisfy themselves that:

A. the telephone company concerned is a financially responsible organization which is fully capable of bearing its proper share of the costs and responsibilities for any possible hazards.

B. the telephone company has available a qualified engineering and construction force to assure that its facilities on joint use lines will be installed in accordance with accepted construction standards and safety practices.

C. the telephone company has a maintenance and operations force capable, where necessary, of maintaining its own facilities when installed jointly with power lines.

IV. Insurance

The contract forms have no clauses concerning insurance coverage on the assumption that each party will carry its usual insurance and that in the event of any claims, liability will be assessed according to the legal responsibility that is determined.

REA borrowers should satisfy themselves that the local telephone companies with which they share joint use facilities either

A. provide adequate reserves for insurance, or

B. carry adequate insurance policies.

The Bell Telephone System, for example, is self insured and sets aside reserves against losses. However, smaller telephone companies should be required to have liability insurance coverage comparable to that carried by REA borrowers.

V. Safety

It cannot be too strongly emphasized that proper precautions should be taken in joint use construction to minimize possible hazards to both telephone and power linemen as well as to consumers. Adequate standards of safety can be established by observation of the proper construction, maintenance and safety practices and installation of power and telephone protective devices. The telephone companies should be held completely responsible for installation and operation of their own facilities (except as otherwise provided for carrier telephone facilities) and borrowers who find it necessary to advise their local telephone companies on proper construction and safety practices would be best advised themselves not to engage in joint use construction with such companies in view of the risks and costs involved.

All wires and appurtenances on joint use poles should be treated as hot when performing line work.

VI. Description of Contracts

A. Power Line Carrier Facilities, REA Form DS-209.

The highlights of this form of contract are

1. The telephone company is given the right to transmit communications over the power lines at frequencies in the 150-500 KC band, but there is to be no interference with the use of frequencies by the REA borrower outside that band.

2. The telephone company is given the right to have attached to the power lines and poles such equipment as is necessary to provide for carrier telephone service. All such equipment is furnished or paid for by and remains the property of the telephone company but for safety reasons most installation and maintenance of equipment installed on power system facilities is to be performed by the REA borrower in behalf of the telephone company.

3. The telephone company will reimburse the REA borrower for all expenses incurred to accommodate the telephone facilities and will pay an annual fee for each pole on which telephone equipment is installed. To simplify billing, unit telephone equipment assemblies have been established and uniform telephone company payments for installation, removal and maintenance work performed by the REA borrower in connection with such units have been suggested in Exhibit B. These payments make allowance for average labor, material, transportation and overhead costs. If experience discloses that they vary too greatly from actual costs in any particular area, either party may request a revision annually.

The annual charge of $1.00 for each pole of the REA borrower upon which the telephone company has attachments amounts to a leasing fee. The fee of

$1.00 is purely nominal in view of the fact that there is no experience with the actual operation of carrier telephone systems on which there could be based an exact determination of any cost savings of this method of providing telephone service that might be shared between the telephone company and REA borrower.

Power consumption payments are based on estimates of the average power losses caused by the various types of telephone company equipment connected to or inserted in the power lines. The maintenance visit payment has been established to cover any work done by the Cooperative on any specific request from the Telephone Company. It is anticipated that maintenance jobs generally will involve single locations and that the work can be done in a single visit. The largest part of the cost of the maintenance visit is in travel time and motor vehicle expense, whether the trip involves replacement of a capacitor fuse or complete replacement of an isolating choke assembly.

4. If work is to be performed by the REA borrower on behalf of the telephone company that is not covered by the unit assemblies and costs set forth in

Exhibit B, additional reimbursement should be agreed upon. This would include, for example, replacement of poles or the initial installation of poles of greater height or class to accommodate the telephone company.

5. The contract term is 5 years and thereafter until terminated by 1 year's notice by either party.

6. All construction must be in accordance with the National Electrical Safety Code. The specifications and schematics of Exhibit A are illustrative only. A separate document entitled "CONSIDERATIONS OF MUTUAL INTEREST TO REA BORROWERS AND TELEPHONE COMPANIES IN INSTALLING AND MAINTAINING EQUIPMENT USED FOR CARRIER TELEPHONE SERVICE" is attached, dated July 9, 1947. This document provides installation drawings and engineering information that can be readily changed when justified without necessitating changes in the basic contract.

B. General Agreement for Joint Use of Wood Poles, REA Form DS-210.

This form of contract is intended to be used in areas where widespread joint use of facilities is contemplated to achieve savings in pole plant costs. This form of contract provides that:

1. Each party may own joint use poles and license the other to make attachments thereto.

2. Each party reserves the right to exclude any of its facilities from joint use.

3. Each party is responsible for the installation and maintenance of its own facilities on the joint poles. The owner is to maintain its poles.

4. The owner will install a normal joint pole, as defined, which is suggested as a 35-foot, class 6 pole for new construction. If a pole of greater height and class than normal is required, the additional investment in excess of the cost of a normal pole is paid by the party requiring it. A shorter or lighter pole than normal may be installed by mutual agreement when suitable for specific locations.

   <u>NOTE</u>: Class 6 is the suggested strength for a normal pole on the assumption that the normal pole will carry the usual single-phase power circuit plus four (4) telephone wires.

5. Where existing poles must be replaced to make them suitable for joint use, the owner will set new normal poles and assume the cost of transferring its own facilities to the new poles. The licensee will pay the owner the value in place of the replaced poles, plus the cost of removal less salvage, as provided in Article VIII and Appendix A of the contract. If poles more costly than normal poles are required to meet the licensee's needs, the licensee will also pay the excess costs. In addition, where an existing pole must be replaced to accommodate the licensee's service drop, the licensee will also pay the owner the difference between the cost of the new pole and a new pole of the same size as the replaced pole. Appendix A of the contract establishes tables of costs to permit ready calculation of payments due.

6. When poles must be erected between existing poles to make a line suitable for joint use, they will be erected at the sole expense of the licensee but will be the property of the owner. Each party will install its own attachments to such poles.

7. The licensee will pay a standard annual rental fee per pole to the owner for the privilege of occupying joint poles. Poles used for the sole

purpose of providing clearance between the facilities of the two parties, such as secondaries and services, are not considered as joint poles and are not subject to rental fees. To simplify agreement on whether a pole provides clearance or support, the following interpretation is suggested. Where individual services of either party (secondaries for the REA borrower and service wires for the telephone company) are involved, single pole crossover attachments shall be treated as clearance attachments under the provisions of Article VIII without regard to any support which may be supplied by the crossing pole. The term "service wires" for the telephone company means a service to a single subscriber which may consist of either insulated or open wire conductors.

The fees suggested in Appendix B of the contract are designed to reflect and share the savings in cost realized by joint use of poles. The fees are based on average costs per mile of separate and joint pole lines in various sections of the country and make allowance for costs to the owner and licensee of modifying existing line to allow joint use, as well as making allowance for extra costs to the licensee of making arrangements to occupy joint poles.

The rental fees payable by REA borrowers to telephone companies are higher than those they receive because rural telephone systems ordinarily employ smaller poles than power lines and incur a larger increase in cost than power systems in supplying poles suitable for rural joint use. The rental fees may be adjusted by mutual agreement at any time after 5 years from the signing of the contract and at subsequent intervals of not less than 5 years.

8. The first page of Appendix B is self-explanatory in its description of the basic principles followed in arriving at the rental payments suggested in Appendix B. While the telephone cost figures employed were those appropriate to Bell System Companies, the same principles can be used for determining equitable rental payments for joint use with any telephone company.

The following example of rental calculations will illustrate the method utilized in arriving at the suggested payments in Appendix B:

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Sample Calculations of Telephone Company Rental Payment to REA Borrower

Separate rural telephone pole line (Note 1)	$350 per mile
Separate rural power pole line (Note 1)	$450 per mile
Sum of separate pole line costs	$800 per mile
Power System owned pole line suitable for joint use	$540 per mile
Added Telephone Company costs on joint line (Note 2)	$100 per mile
Added Power System costs on joint line (Note 3)	$ 10 per mile
Total	$650 per mile
Total Savings to both organizations $800 - $650	$150 per mile
Telephone Company's share of savings based on respective cost of separate lines: $\frac{350}{800}$ or 44% (Note 4)	$ 66 per mile
Assumed annual charge (Note 5)	10%

Tel. Rent per mile	Equals	Annual charge saved by Tel. Co. through not having to build a separate line	Less	Telephone Company's share	of	Total savings in annual charges
Tel. Rent per mile	Equals	10% of ($350-100)	Less	44%	of	10% of $150
Tel. Rent per mile	Equals	$25.00	Less	$6.60	Equals	$18.40

At 14 poles per mile, the rental payment is $\frac{\$18.40}{14}$ Equals approximately $1.30 per pole.

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Note 1: Per mile costs are those of bare poles in place, including right-of-way, clearing, engineering and overhead in addition to direct installation labor and material costs. Such costs will be mutually agreed upon when joint use contract is executed.

Note 2: Includes such factors as:

(1) Allowance for Telephone Company's share of costs for additional poles (if required) for Telephone Company's benefit

(2) Allowance for additional cost of stringing telephone wire under energized power circuits

(3) Additional protection features (99A and 104A protectors) on telephone circuits

(4) Allowance for engineering and survey costs.

Note 3: Includes only item (2) of Note 7.

Note 4: An average value of 45% was used in the agreement form.

Note 5: No specific annual charge is fixed in the agreement. In the negotiations with the Bell System, a range of annual charges was considered as well as the appropriateness of a differential between the annual charges that apply to telephone company and REA borrower operations. However, the use of 10% results in rentals approximately equivalent to those in the agreed upon table in Appendix B of the contract form.

Note 6: Includes only item (3) of Note 2

Sample Calculations of REA Borrower Rental Payment to Telephone Company.

Separate rural telephone pole line	\$350 per mile
Separate rural power pole line	\$450 per mile
Sum of separate pole line costs	\$800 per mile
Telephone Company owned pole line suitable for joint use	\$540 per mile
Added Telephone Company costs on joint line (Note 6)	\$ 20 per mile
Added Power System costs on joint line (Note 7)	\$ 90 per mile
Total	\$650 per mile
Total Savings to both organizations \$800 - \$650	\$150 per mile
Power System share of savings based on respective cost of separate lines: $\frac{\$450}{\$800}$ or 56% (Note 8)	\$ 84 per mile
Assumed annual charge (Note 5)	10%

Power System Rent per mile	Equals	Annual charge saved by Power System through not having to build a separate line	Less	Power System's share	of	Total savings in annual charges
Power System Rent per mile	Equals	10% of (\$450-90)	Less	56%	of	10% of \$150
Power System Rent per mile	Equals	\$36.00	Less	\$8.40	Equals	\$27.60

At 14 poles per mile, the rental payment is $\frac{\$27.60}{14}$ Equals approximately \$2.00 per pole.

Note 7: Includes such factors as:

(1) Allowance for additional cost of placing facilities over telephone wires

(2) Attachments on additional poles

(3) Allowance for engineering and survey costs.

Note 8: An average value of 55% was used in the agreement form.

9. The contract term is 25 years and thereafter until terminated by 3 years' notice by either party.

C. Application -- Permit for Joint Use of Poles, REA Form DS-211.

This form of contract was developed for use where widespread joint use of poles is not contemplated. It will find use in such cases as the elimination of structural difficulties that may arise at crossing points or when common occupancy of a few poles on one side of a highway is necessary. It is also a convenient means of recording those poles that are in joint use. This form of contract provides that:

1. The licensee shall reimburse the owner for any work necessary to make poles suitable for joint occupancy.

2. A nominal fee of $1.00 per pole is established as the annual rental. No differential in rental fees payable

by telephone companies and REA borrowers is warranted here since the owner is reimbursed at the outset for any extra costs.

3. No rental fee is payable for clearance attachments of service drops of either party.

4. The owner may revoke the attachment permit on 60 days' notice and the licensee may terminate the permit on 30 days' notice.

VII. Procedure for Executing Contracts

The contract forms for Power Line Carrier Facilities, Form DS-209, and for Joint Use of Wood Poles, Form DS-210, provide for approval by the Administrator of REA. In accordance with the usual procedures, three copies of a contract signed by the parties thereto should be forwarded to the Engineering Division of REA. Two approved copies will be returned to the borrower; one for the borrower's files and one for the telephone company. If an officer other than the President or Vice-President of a telephone company signs the contract, evidence of the officer's authorization to sign on behalf of the company should be attached unless otherwise filed with REA.

The form of Application-Permit for Joint Use of Specific Poles, Form DS-211, does not call for submission to REA for approval and will be subject only to review in the field by the Engineering Division.

Under the contracts for Power Line Carrier Facilities, Form DS-209, and for Joint Use of Wood Poles, Form DS-210, a specific request and authorization must be made each time it is desired to make attachments to poles and wires. The REA borrower and telephone company should establish procedures complementary to the contracts for establishing working relationships.

VIII. Construction Standards

Any type of joint use of poles should conform to the requirements of the National Electrical Safety Code except as the requirements of local authority may be more stringent.

1. For power line carrier installations, installation drawings and other engineering information are supplied in the attached document dated July 9, 1947, and entitled "Considerations of Mutual Interest to REA Borrowers and Telephone Companies in Installing and Maintaining Equipment Used for Carrier Telephone Service."

2. For joint use of poles, suggested standards based on the National Electrical Safety Code are contained in E.E.I. Publication No. M12, "Joint Pole Practices for Supply and Communication Circuits" and Part 5 thereof entitled "Special Considerations for Long Span Joint

Use." These are available from Bell System companies and from the Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y., at a price of $1.25.

IX. Billing and Accounting

Exhibit B of the agreement form for Power Line Carrier Facilities, REA Form DS-209, and Appendix A of the agreement form for Joint Use of Wood Poles, REA Form DS-210, are designed to simplify and expedite the billing procedures for amounts that may be due the owner from the licensee for work done to make facilities suitable for joint use. Any cost figures or values that are left blank in the sample forms should be supplied from locally applicable data. Thus, the billing for work to be done in modifying existing lines can be predetermined and differences of opinion with respect to the charges in individual cases can be minimized. On the average, billings should approximate actual costs even though individual cases may show wide differences.

The internal accounting of REA borrowers need not be complicated by the billing procedures established under the joint use contracts and should be undertaken in the usual manner to reflect actual costs as closely as is warranted.

A. Accounting for Changes in Plant

All changes in size or location of poles owned by REA cooperatives should be handled for accounting purposes in accordance with the Manual of Work Order Procedure and Related Instructions. Thus, if a pole is removed and replaced, a retirement and construction work order should be prepared and cost recorded in the appropriate work in progress account in the usual manner. Amounts to be received from the telephone companies in accordance with the terms of the contracts are to be based on the costs as agreed upon in the contracts and will not, therefore, be the same costs as reflected on construction and retirement work orders. Any payments received from the telephone companies in connection with plant changes should be credited to Account 144, Retirement Work in Progress. If the amount received is more than sufficient to cover any balance in this account because of such charges, the difference should be debited to Account 144 and credited to Account 265.1/393, Donations in Aid of Construction.

B. Accounting for Revenues and Expenses

1. Telephone Company Rental Payments.

Revenues to be received from the telephone company for pole rentals should be credited to Account 610, Rent from Electric Property and charged to Account 125.2, Other Accounts Receivable. The contract provisions dealing with rental payments require that a complete record be kept of all poles of either party which are in joint use; that any rentals to be billed shall be on a yearly basis according to the number of joint poles in use on the day preceding the specified billing date. The rent per pole will be in accordance with the contract appendices. Payments by borrowers for taxes and assessments on their own property should normally be charged to appropriate tax expense.

2. Installation and Maintenance Work for Telephone Companies.

All revenues and expenses involved in installation, repair or maintenance of the telephone company's attachments to poles, or for other work done for the telephone company on a reimbursable basis as provided for in the contracts, should be included in appropriate separate subaccounts of 520.1 and 520.2. Charges to telephone companies for maintenance service should be debited to Account 125.2, Other Accounts Receivable, when the credit to Account 520.1 is recorded.

3. Energy Sales.

   Amounts to be received from the telephone company for electric energy consumed in connection with carrier service should be credited to Account 608, Other Electric Service, and charged to Account 125.2, Other Accounts Receivable.

4. Payments to Telephone Companies.

   Payments to a telephone company for rental of its poles or for its plant changes necessitated because of the joint use agreement are to be charged to the appropriate rent expense account, namely, 776, Rents. Payments to telephone companies for tree trimming and other normal operating or maintenance work done by them for a borrower should be charged to appropriate expense accounts.

C. Capital Credits

Any revenues received as pole rentals or for electric energy losses in connection with carrier service should not be included in the base for patronage capital distribution.

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UNITED STATES DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION
WASHINGTON 25, D. C.

September 1, 1950

To : All REA Borrowers

From : George W. Haggard, Deputy Administrator

Subject: Joint Use of Borrowers' Wood Poles by Telephone Systems
Requirement of REA Approval
Use of REA Form DS-211

Under date of July 3, 1947, there were transmitted to all REA borrowers sample forms of contracts covering joint-use arrangements with telephone companies. At the same time, a bulletin entitled "Joint Use of Facilities by REA Borrowers and Telephone Companies" was circulated. This bulletin describes the contract forms and their use and purpose in detail. On December 22, 1949, there was transmitted to all REA borrowers a memorandum relating to the joint-use arrangements and suggesting forms of amendments of the joint-use contracts to effectuate area coverage telephone service.

Forms DS-209 and DS-210, as amended to include area-coverage provisions, are the contract forms to be employed for joint-use arrangements which are entered into for the purpose of permitting use by telephone companies of REA-financed facilities to furnish subscriber telephone service. These forms require REA approval before they become effective. This requirement is imposed pursuant to the provisions of REA security documents in which borrowers agree not to enter into contracts for the use by others of any of their property without REA approval.

There have come to REA's attention numerous instances where joint-use contacts have been made by telephone companies for subscriber telephone service without proper authorization and approval. In some cases, such contacts have been made without authorization by the borrower; in others, upon oral authorization, or by written permission but not by contract on Form DS-209 or Form DS-210, or pursuant to contract on Form DS-209 or Form DS-210 but without REA approval, or by permit on Form DS-211. All such contacts made for subscriber telephone service must be considered unauthorized except where made pursuant to a properly executed and approved contract or a contract entered into by the predecessor owner of systems or facilities acquired by an REA borrower.

There appears to be some misunderstanding of the use and purpose of Form DS-211. Some borrowers have used this form to permit pole contacts on their systems by telephone companies for subscriber telephone service. Form DS-211 is not intended and should not be used for this purpose. As stated in the bulletin on "Joint Use of Facilities by REA Borrowers and

Telephone Companies" (p. 16) it is intended for use in such cases "as the elimination of structural difficulties that may arise at crossing points or when common occupancy of a few poles on one side of a highway is necessary." This permit form prescribes only a nominal rental fee since it contemplates reimbursement of the owner of the poles for costs involved in rearrangements, etc., required for the joint use.

A survey is now being conducted by the REA Engineering Division to determine the extent to which joint use is practiced and to appraise its usefulness and effectiveness. Reports already received show cases of unauthorized attachment, including many in which Form DS-211 was improperly employed instead of Form DS-210 which requires REA approval. This practice should be discontinued forthwith as it has resulted in the assumption by REA-financed systems, in some instances, of costs which would have been borne by the telephone system if the proper contract form had been used.

Borrowers which have improperly used Form DS-211 for joint use for subscriber telephone service, or where facilities have been contacted without authorization, should wherever possible negotiate a joint-use agreement on the appropriate form, Form DS-210, with the area-coverage amendment, submit it to REA for approval, and arrange for reimbursement by the telephone company involved of any expenditures incurred by the REA borrower in connection with joint use which would have been charged to the telephone company if the proper form of contract had been employed at the outset. It should be noted that the permits granted under Form DS-211 are revocable at any time upon 60 days' notice by the owner of the facilities.

It is recognized that joint-use arrangements properly entered into can effect economies which can be equitably shared and can contribute toward the conservation of materials and manpower which are so urgently needed today. However, the disadvantages and burdens which are entailed by improper joint-use agreements which do not provide for the equitable sharing of benefits and which do not assure telephone service to the widest practicable number of rural users, far outweigh the advantages. For this reason strict adherence to the principles which have been established for such arrangements is indicated.

The cooperation of all REA borrowers is solicited for the field engineers who are now conducting joint-use field surveys.

George W Haggard

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UNITED STATES DEPARTMENT OF AGRICULTURE

RURAL ELECTRIFICATION ADMINISTRATION

WASHINGTON 25, D. C.

May 14, 1951

To: REA Borrowers

From: George W. Haggard, Acting Administrator

Subject: Joint Use of Wood Poles by Power and Telephone Systems: Area Coverage

a. General

By memorandum dated December 22, 1949, REA imposed as a condition of its approval of joint-use contracts the inclusion of amendments designed to assure the availability of adequate telephone service to the widest practicable number of users of such service. This memorandum is issued to clarify several points as to the area-coverage requirement in connection with joint use of wood poles. It also furnishes an alternative form of amendment to Form DS-210 which may be used instead of the amendment appearing in the December 22, 1949 memorandum.

b. Borrower's Responsibility Regarding Joint Use

It is initially the borrower's responsibility, as owner of the electric system, to determine whether or not it desires to enter into a joint-use agreement. In making the decision, due consideration should be given to the following important factors:

1. Is joint use generally in the best interests of all of the member-owners of the electric system?

2. Do the economic benefits at least equal or exceed the additional costs incurred under the joint-use agreement?

3. Will the agreement actually result in an appreciable increase in telephone service in the area, without avoidable discrimination against some member-owners?

4. Will the economic benefits and increased telephone service justify the additional safety hazards to electric system personnel involved in maintenance and operation of jointly used facilities?

5. Will the economic and telephone service benefits justify the additional physical burden on the electrical facilities and the hazards of sleet and ice which may be multiplied by the addition of telephone circuits?

Once a decision is made by an electrical borrower to enter into a joint-use agreement, it must be submitted to REA for approval before becoming effective.

c. Situations Where the Area-Coverage Amendments Are Not Required

Area-coverage amendments need not be incorporated in agreements which have already been approved by REA or in agreements for joint use in special situations not involving telephone service to additional subscribers. Examples of such special situations are as follows:

1. Joint use on facilities specially constructed for service to telephone installations, such as to radio relay towers, repeater stations, etc.

2. Joint use required because of necessity for relocating a power or telephone line, or both, due to highway widening or relocation.

3. Joint use required by structural conflicts or where common occupancy of more than a few poles on one side of a highway is involved. (Form DS-211 is to be used where occupancy of only a few poles is involved.)

Joint use in such cases as these may be covered by a special form of agreement which will contain the terms agreed upon or by an appropriate adaptation of one of the present joint-use forms. In any case, the agreement should be restricted to the specific joint use and to the specific electric facilities involved, the location of which should be shown on a map or sketch attached to the agreement as an exhibit. Where appropriate, the existing situation should be shown as well as the changes covered by the agreement, including the type of telephone facilities to be installed. For this purpose, a detail map of the portion of the electric system involved may be used. Joint-use agreements covering these special situations shall be submitted to REA for approval.

d. Situations Where the Area-Coverage Amendments Are Required

The area-coverage amendments set forth in our December 22, 1949 memorandum or in paragraph "e" of this memorandum are required in all cases where the joint-use agreement:

1. Was not approved by REA prior to October 28, 1949, the effective date of Public Law 423, amending the Rural Electrification Act of 1936; and

2. Involves the furnishing of local telephone service to additional subscribers.

Borrowers wishing to assure themselves of a systematic program of area-coverage telephone service throughout the common service area should continue to insist on the area-coverage amendment and procedures established in the December 22, 1949 memorandum as a condition to joint use of their wood poles by a telephone company. A copy of the December 1949 amendment to the DS-210 agreement is attached hereto.

Borrowers wishing to permit the use of their poles by a telephone company on a project-by-project basis may use the DS-210 form of agreement with the amendment of Articles IV and V described in paragraph "e" hereof.

e. Alternative Form of Area-Coverage Amendment Which May be Used in Place of December 1949 Amendments

Where the parties do not wish to use the December 1949 amendment and procedure, and where borrowers are willing to permit the use of their wood poles by a telephone company on a project-by-project basis, the form of amendment of Articles IV and V of the DS-210 agreement attached to this memorandum may be used.

The procedure established herein for initiating joint use in the area to be included in a particular telephone company project involves two distinct steps for each such project. First, the telephone company submits a map showing generally the territorial limits of the proposed project together with a written request conforming to Appendix C (attached hereto) for permission to use the borrower's poles. These must be submitted to REA for approval, accompanied by the borrower's recommendation. The second step is the submission by the telephone company to the borrower, upon completion of the project canvass and the engineering work, of detailed construction plans and drawings together with a map showing the final territorial limits of the project.

Where the final map, submitted to the borrower as part of the second step, varies substantially from the map submitted as part of the first step, the telephone company's request (conforming to Appendix C) should be resubmitted to REA for approval, accompanied by the borrower's recommendation. In such cases, the reason for the change in the project limits should be stated.

While no specific type of map is required to be submitted by the telephone company in connection with its request on the Appendix C form, the area covered by the request and its relationship to the borrower's entire service area should be clearly shown. The borrower's system map may be used for this purpose. The map should show the entire common service area of the parties, i.e., the telephone company's service area to the extent it is included within the borrower's service area, and the specific portion of the common service area covered by the telephone company's request.

Where these forms and procedures are employed, the borrower shall, in each instance when submitting the telephone company's request on the Appendix C form, or any revision thereof, together with the map or maps, to REA for approval, include a statement which:

1. Sets forth the circumstances under which a portion only of the borrower's service area was selected for the joint-use program.

2. Establishes that the proposed joint use is consistent with and will not bar development of area-coverage telephone service in adjoining areas.

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3. Where the joint-use proposal represents the first step in a program which will ultimately be extended throughout the borrower's service area, presents all available information on the entire program.

4. Recommends approval by REA of the telephone company request.

All documents and information, both of the telephone company and of the borrower, should be submitted in triplicate.

f. Procedure for Executed Joint-Use Agreements Not Approved by REA

A number of executed agreements covering joint use of wood poles (Form DS-210) which were under consideration by REA on October 28, 1949, or which were received after that date without the area-coverage amendment, were returned to borrowers without REA approval with a recommendation that the amendment be added and the agreements resubmitted to REA for approval.

Borrowers still holding such agreements may, at their option:

1. Insist on the December 1949 area-coverage amendment and submit the agreements when the amendment is executed.

2. Resubmit the agreements with the May 1951 amendment executed, either with or without requests of the telephone company for permission to undertake joint use on a particular project.

3. Where joint use on wood poles has already been accomplished under an unapproved joint-use agreement, or without an agreement but in contemplation of the execution and approval of an agreement, the borrower should attempt to work out with the telephone company an area-coverage telephone service program covering the areas in which joint use has been accomplished. The May 1951 amendment and procedure may be used for this purpose. Until the joint-use agreement, as amended, and the telephone company's request for permission to use borrowers' wood poles, are approved by REA, no additional joint use should be permitted. In all cases where joint use was undertaken without approved contracts, borrowers should collect all rentals due and unpaid since the pole contacts were initially made.

It is of the utmost importance in all cases (i) that all pole contacts be recorded; (ii) that additional pole contacts, if any may be made, be permitted only upon compliance with the requirements of Articles IV and V that written application be made and written permission be given; and (iii) that REA approval be obtained where required.

Borrowers having special joint-use problems which do not appear to be covered by this memorandum should present a full statement thereof, together with their recommendation, to the Engineering Division.

Attachments

George W Haggard

Amendment to
REA Form DS-210
(12-49)

JOINT USE OF FACILITIES

RURAL ELECTRIC POWER SYSTEMS

TELEPHONE SYSTEMS

AMENDMENT TO FORM OF GENERAL AGREEMENT FOR JOINT USE OF POLES

The Cooperative and the Telephone Company agree that the following amendments shall be a part of the Agreement between the parties dated ______________________________, 19_____:

1. Add a new subsection, lettered "(c)," to Article I, reading as follows:

"(c) It is the intention of the parties that adequate telephone service shall be made available to the widest practicable number of rural users in the above territory. Exhibits 1 and 2, attached hereto and made part hereof, state the present programs of the Telephone Company and of the Cooperative, respectively, for extending telephone and electric service in the above territory during the first five years of this agreement, and show the general location and number of persons to be served and the estimated dates when they will be served. If required to carry out the foregoing intention of the parties, additional five-year programs for extending telephone and electric service in the above territory shall be furnished by each party to the other at least ninety (90) days prior to the expiration of the programs then in effect under the provisions of this section, and shall be identified as supplements to Exhibits 1 and 2."

2. Add a new subsection, lettered "(c)," to Article XIII, reading as follows:

"(c) Failure of either party for a period of ____ months to comply substantially with its current program for extending telephone or electric service, as set forth in Exhibits 1 and 2, or supplements thereto, shall, at the election of the other party, and after due notice thereof in writing, constitute a default under Section (a) of this Article."

Executed on the ______ day of ________________________ 19____.

(Seal) ________________________________

By________________________________

ATTEST:

____

(Seal) ________________________________

By________________________________

ATTEST:

____

Amendment to
REA Form DS-210
(5-51)

JOINT USE OF FACILITIES

RURAL ELECTRIC POWER SYSTEMS

TELEPHONE SYSTEMS

AMENDMENT TO FORM OF GENERAL AGREEMENT FOR JOINT USE OF WOOD POLES

The Cooperative and the Telephone Company agree that the following amendments shall be a part of the Agreement between the parties dated ________________, 19 ___:

1. Amend Article IV to read as follows:

ARTICLE IV

ESTABLISHING JOINT USE OF EXISTING POLES

(a) Before the Telephone Company shall make use of the poles of the Cooperative under this Agreement, it shall request permission therefor in writing on the form attached hereto and identified as Appendix C, and shall comply with the procedure set forth in said Appendix C. During any period in which the Cooperative is a borrower from the Rural Electrification Administration, the Cooperative shall, before granting its permission for such use, submit the Telephone Company's request, and any revisions thereof, to the Administrator of the Rural Electrification Administration for written approval, together with the Cooperative's recommendation. The right of the Telephone Company as licensee to use such poles in accordance with the terms of its request and of this Agreement shall be conditioned upon such approval by the Administrator of the Rural Electrification Administration.

(b) Whenever either party desires to reserve space for its attachments on any pole owned by the other party, either as initial space or additional space on such pole, it shall make written application therefor, specifying the location of the poles in question, the amount of space desired on each pole, and the number and character of the circuits to be placed thereon. If, in the judgment of the owner, the poles are necessary for its own sole use, or joint use under the circumstances is undesirable, the owner shall have the right to reject the application. In any event, within a reasonable period after the receipt of such application the owner shall notify the applicant in writing whether the application is approved or rejected. Rights of the Telephone Company as licensee hereunder shall be conditioned upon compliance by the parties with the provisions of Section (a) of this Article. Upon receipt of notice from the owner that the application has been approved, and after the completion of any transferring or rearranging which is required to permit the attaching of the applicant's circuits on such poles, including any necessary pole replacements, the applicant shall have the right as licensee hereunder to use such space in accordance with the terms of the application and of this Agreement.

(c) Whenever any jointly used pole or any pole about to be so used under the provisions of this Agreement is insufficient in height or strength for the existing attachments and for the proposed additional attachments thereon, the owner shall promptly replace such pole with a new pole of the necessary height and strength and shall make such other changes in the existing pole line in which such pole is included as the conditions may then require.

(d) Each party shall place, transfer and rearrange its own attachments, place guys to sustain any unbalanced loads caused by its attachments, and perform any tree trimming or cutting incidental thereto. Each party shall at all times execute such work promptly and in such manner as not to interfere with the service of the other party.

(e) The cost of establishing the joint use of existing poles, including the making of any necessary pole replacements, shall be borne by the parties hereto in the manner provided in Article VIII--Division of Costs.

2. Amend Article V to read as follows:

ARTICLE V

ESTABLISHING JOINT USE OF NEW POLES

(a) Whenever either party hereto requires new pole facilities for an additional pole line, an extension of an existing pole line, or in connection with the reconstruction of an existing pole line, it shall promptly notify the other party to that effect in writing (verbal notice subsequently confirmed in writing may be given in cases of emergency), stating the proposed location and character of the new poles and the character of circuits it intends to use thereon and indicating whether or not such pole facilities will be, in the estimation of the party proposing to construct the new pole facilities, susceptible of joint use. Within a reasonable period after the receipt of such notice, the other party shall reply in writing, stating whether it does, or does not, desire space on the said poles and, if it does desire space thereon, the character of the circuits it desires to use and the amount of space it wishes to reserve. If such other party requests space on the proposed new poles and if the character and number of its circuits and attachments are such that the party proposing to construct the new pole facilities does not consider joint use undesirable, then it shall erect poles suitable for such joint use, subject, however, to the provisions of Section (b) of this Article, and subject further to the condition that requests by the Telephone Company for space on proposed new poles of the Cooperative under this Agreement shall be made in writing on the form attached hereto and identified as Appendix C, and shall comply with the procedure set forth in said Appendix C. During any period in which the Cooperative is a borrower from the Rural Electrification Administration, the Cooperative shall, before granting its permission for such use, submit the Telephone Company's request, and any revisions thereof, to the Administrator of the Rural Electrification Administration for written approval, together with the Cooperative's recommendation. The right of the Telephone Company as licensee to use such poles in accordance with the terms of its request and of this Agreement shall be conditioned upon such approval by the Administrator of the Rural Electrification Administration. The applicant for space on the poles shall be promptly notified in writing of the action taken on the application.

(b) In any case where the parties hereto shall conclude arrangements for the joint use of any new poles to be erected, and the party proposing to construct the new pole facilities already owns more than its proportionate share of joint poles, the parties shall take into consideration the desirability of having the new pole facilities owned by the party owning less than its proportionate share of joint poles so as to work towards such a division of ownership of the joint poles that neither party shall be obligated to pay to the other any rentals because of their respective use of joint poles owned by the other.

(c) Each party shall place its own attachments on the new joint poles and place guys to sustain any unbalanced loads caused by its attachments. The owner shall, however, provide the initial clearing of the right-of-way, and tree trimming, which shall at least meet the requirements of the other party. Each party shall execute its work promptly and in such manner as not to interfere with the service of the other party.

(d) The cost of establishing the joint use of new poles including costs incurred in the retirement of existing poles shall be borne by the parties hereto in the manner provided in Article VIII--Division of Costs.

Executed on the _____ day of ________________________, 19 ___.

	______________________________
(Seal)	By____________________________
ATTEST:	
______________________________	
	______________________________
(Seal)	By____________________________
ATTEST:	
______________________________	

APPENDIX C

_______________________________ (Name of Telephone Company)

_______________________________ (Location)

Request No. _______

_______________________________ (Date)

To_______________________________ (Name of Cooperative)

_______________________________ (Location)

This is to request your permission for this Company to use jointly certain of your poles under the terms and conditions of the General Agreement for Joint Use of Wood Poles which has been executed by your Cooperative and this Company.

The poles for which this permission is requested are located generally within the limits of the extension-of-service project in the territory indicated by the attached map, which also bears the above date and Request Number.

If permission to use these poles is given by you, this Company intends to canvass fully the territory generally within the project limits and if construction of the project by use of your poles for our attachments is begun, will furnish telephone service to all establishments therein desiring service, subject to its tariff rates and regulations. Our present plan is to start the work involved in this project about _______________ (Month-Year) and complete the work about _______________ (Month-Year).

If permission to use these poles is given by you, this Company proposes to prepare and furnish to you detailed construction plans and drawings to indicate specifically your poles that we wish to use jointly, in accordance with the procedure provided in Article IV or V of the Agreement, as the case may be, together with a map showing the final project limits as determined after engineering is complete. If the final project limits vary substantially from the project limits shown on the map attached hereto, it is understood that this Company will request your further permission to use poles within the territory indicated on the final map.

If the joint use proposed is agreeable to your Cooperative please signify your approval on the second copy of this request in the space provided and return that copy to this Company.

____
(Name and Title of Telephone Company Employee making this request)

To______________________________ ____________________________
(Name of Telephone Company) (Location)

This is to advise you that your Request No. _______, to use jointly certain poles of this Cooperative to furnish telephone service to rural users, as stated therein, is agreeable to this Cooperative and has been approved by the Administrator of the Rural Electrification Administration as indicated below. You may proceed with such joint use of poles on the terms and conditions of the General Agreement for Joint Use of Wood Poles now in effect between us, and under the conditions outlined in your request.

______________________________ ____________________________
(Name of Cooperative) (Date)

____
(Name and Title of Cooperative Representative)

- -

REA PROJECT__________________________________

On the basis of the information submitted by the Telephone Company and the Cooperative, the granting of the above request by the Cooperative is hereby approved.

____
For Claude R. Wickard, Administrator
Rural Electrification Administration

DATED____________________

UNITED STATES DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION
WASHINGTON 25, D.C.

May 14, 1951

To: REA Borrowers

From: George W. Haggard, Acting Administrator

Subject: Joint Use of Wood Poles by Power and Telephone Systems: Construction Practices

Article III of Form DS-210 establishes specifications for joint use of wood poles which provide adequate clearance and strength requirements for safety purposes. Recent consideration of these provisions indicates the need for clarifying the strength requirements.

The specifications referred to in Article III establish a margin of strength for assumed transverse storm loadings of 2 and require replacement of poles when a margin of strength of 1-1/3 is reached. However, it appears that the specifications are capable of being, and have been interpreted to permit the addition of wires so long as the margin of strength is not reduced below 1-1/3, the point at which pole replacement is required.

REA believes that, in general, the margin of strength to withstand assumed storm loading of its borrowers' poles should not be reduced below 2 through the attachment of additional wire circuits, whether the circuits added are electric or telephone circuits. This margin is determined in terms of the transverse load on the pole under assumed storm conditions related to the ultimate fiber stress of the kind of wood pole involved. Methods of calculating this margin are discussed in the National Electrical Safety Code. For the purpose of determination of this margin on an existing pole line of an REA borrower, the poles should be considered as having the same strength as when new.

The design of REA borrowers' pole lines in accordance with REA standards normally results in a factor of strength in the poles in excess of the minimum requirements of the National Electrical Safety Code to withstand the assumed storm loadings. Any additional wires attached to existing poles will increase the load on the pole and consequently decrease the margin of strength above that required to withstand assumed storm loadings. This is true, of course, whether the circuits added are secondaries, additional phase wires or telephone circuits. This was recognized throughout the discussions and considerations which resulted in REA approval of joint use of borrowers' wood poles.

Since the second paragraph of Article III contemplates agreements to construction practices supplementing the requirements of the National Electrical Safety Code, to be accepted in writing by both parties to the Form DS-210 contract, it is recommended that existing contracts be supplemented in writing by adoption of the "Agreement to Construction Practices Supplementing the

Provisions of Article III of General Agreement for Joint Use of Wood Poles", attached hereto. It should be noted that this supplement relates only to the establishment of joint use of wood poles in the future under joint-use agreements which have already been executed. However, where joint use has been accomplished in anticipation of, but prior to, the execution or approval of a DS-210 contract, this supplement may be used in submitting such contracts for REA approval in place of the amendment to Article III.

Joint-use contracts on Form DS-210 executed in the future should incorporate the "Amendment to Article III of General Agreement for Joint Use of Wood Poles" attached hereto.

Attachments

George W Haggard

Supplement to
REA Form DS-210
(5-51)

JOINT USE OF FACILITIES

RURAL ELECTRIC POWER SYSTEMS

TELEPHONE SYSTEMS

AGREEMENT TO CONSTRUCTION PRACTICES SUPPLEMENTING THE PROVISIONS OF ARTICLE III OF GENERAL AGREEMENT FOR JOINT USE OF WOOD POLES

The parties to the General Agreement for Joint Use of Wood Poles, executed on ____________________, hereby agree, pursuant to Article III thereof, that the following construction practice shall govern the establishment of joint use of wood poles in the future, and shall be applicable both to poles installed new for joint use and poles installed initially for electric circuits alone:

The total transverse and vertical loads for all conductors attached to a pole jointly used under this agreement shall not, under the assumed storm loadings of the National Electrical Safety Code for the area in which the pole is located, exceed fifty (50) percent of the ultimate fiber stress of the supporting pole. In case of existing pole lines, the strength of the pole shall be assumed to be the same as when new.

Executed on the _____ day of ______________________________ 19 ____.

____

By____________________________

____

By____________________________

Amendment to
REA Form DS-210
(5-51)

JOINT USE OF FACILITIES

RURAL ELECTRIC POWER SYSTEMS

TELEPHONE SYSTEMS

AMENDMENT TO ARTICLE III OF GENERAL AGREEMENT FOR JOINT USE OF WOOD POLES

The Cooperative and the Telephone Company agree that the following amendment shall be a part of the Agreement between the parties dated ____________, 19__:

Insert the following paragraph between the first and second paragraphs of Article III:

"In establishing joint use of wood poles whether installed new for joint use or installed initially for electric circuits alone, the total transverse and vertical loads for all conductors attached to a pole covered by this agreement shall not, under the assumed storm loadings of the National Electrical Safety Code for the area in which the pole is located, exceed fifty (50) percent of the ultimate fiber stress of the supporting pole. In the case of existing pole lines, the strength of the pole shall be assumed to be the same as when new."

Executed on the ______ day of ______________________________ 19 _____.

____

(Seal) By______________________________

ATTEST:

____

____

(Seal) By______________________________

ATTEST:

____

UNITED STATES DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION
WASHINGTON 25, D. C.

May 14, 1951

To: REA Borrowers

From: George W. Haggard, Acting Administrator

Subject: Joint Use of Wood Poles by Power and Telephone Systems: Determination of Rentals

Several inquiries have been received as to whether the provisions of Article XI(d) for establishing and adjusting pole rentals permit variations from the table of rentals appearing in Appendix B attached to Form DS-210. Paragraph 8 on page 12 of the REA document entitled "Joint Use of Facilities by REA Borrowers and Telephone Companies" specifically states as follows:

> "While the telephone cost figures employed (in arriving at the rental payments suggested in Appendix B) were those appropriate to Bell System Companies, the same principles can be used for determining equitable rental payments for joint use with any telephone company."

On pages 13 to 16 of this document appear sample calculations of telephone and cooperative rental payments.

While it is desirable that rental rates be kept uniform on a particular cooperative system, where it appears that the basic factors entering into determination of the rental rate vary from those which were used in establishing the table of rental payments appearing in Appendix B, which reflect telephone cost figures appropriate to Bell System Companies, the borrower and the telephone company seeking joint use are at liberty to make their own calculations using both electric and telephone cost figures appropriate to the particular systems involved. In making any variations from the table of rental payments appearing in Appendix B, borrowers are cautioned in making their calculations of rental payments to give effect to the principle of reflecting and sharing the savings in cost realized by joint use of poles. In submitting to REA for approval Form DS-210 contracts which provide rentals other than those appearing in the table in Appendix B, borrowers should supply the detailed calculations which produced the agreed rentals. In all cases, borrowers are urged to give careful consideration to the various factors involved in joint use of facilities as set forth in the above-mentioned document.

George W Haggard

JOINT USE OF FACILITIES

RURAL ELECTRIC POWER SYSTEMS

TELEPHONE SYSTEMS

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FORM OF GENERAL AGREEMENT FOR

JOINT USE OF WOOD POLES

FORM OF APPLICATION PERMIT FOR

JOINT USE OF SPECIFIC POLES

PUBLIC

F-47 ?

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FORM OF APPLICATION PERMIT FOR JOINT USE OF SPECIFIC POLES, REA Form DS-211

PUBLIC

A Form DS-210
6-47)

FORM OF GENERAL AGREEMENT FOR JOINT USE OF WOOD POLES

PREAMBLE

_____________, a corporation organized under the laws of the State of ________, (hereinafter called the "Cooperative"), and _____________, a corporation organized under the laws of the State of __________, (hereinafter called the "Telephone Company"), desiring to cooperate in the joint use of their respective poles, erected or to be erected within the areas in which both parties render service in the State(s) of _____________, whenever and wherever such use shall, in the estimation of both parties, be compatible with their respective needs, do hereby, in consideration of the premises and the mutual covenants herein contained, covenant and agree for themselves and their respective successors and assigns as follows:

PREAMBLE

The Preamble describes the parties to the Agreement and designates the State in which each of the parties is organized. Moreover, for the sake of emphasis, the territorial limitations of the Agreement are set out in the Preamble even though Article I of the Agreement also describes it.

ARTICLE I

SCOPE OF AGREEMENT

(a) This Agreement shall be in effect in the areas in which both of the parties render service in the State(s) of _________, and shall cover all wood poles of the parties now existing or hereafter erected in the above territory when said poles are brought under this Agreement in accordance with the procedure hereinafter provided.

ARTICLE I

Article I is designed to set out at the inception of the contract the territorial limitation of the Agreement. It should describe the States in which the Cooperative already has distribution facilities or where it intends to have distribution facilities. It is intended that the Agreement will apply to the entire territory served in common by the Cooperative and the Telephone Company.

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 ...y of its facilities from joint use.

should hav... he right to exclude from joint use any of its own facilities where joint use seems undesirable.

ARTICLE II

EXPLANATION OF TERMS

For the purpose of this agreement, the following terms shall have the following meanings:

1. A JOINT POLE is a pole jointly used by both parties.

2. A NORMAL JOINT POLE is a pole which is just tall enough to provide normal spaces, as normal space is hereinafter defined, for the respective parties and just strong enough to meet the requirements of the specifications mentioned in Article III for the attachments ordinarily placed by the parties in their respective normal spaces. Such pole for the purpose of this agreement shall be a _____ foot class _____ wood pole as classified by the pole classification tables of the American Standards Association.

3. SPACE is the linear portion of a joint pole parallel to its axis reserved for the exclusive use of one of the parties (subject only to the exceptions provided for by the specifications mentioned in Article III which in certain instances permit the making of cer-

ARTICLE II

Article II defines some of the words which are most commonly used in the agreement and which would seem to call for definitions in order to prevent any possible misunderstanding. Obviously, technical words are used throughout the agreement and there might be some question as to why all such words were not defined. The answer is that it must be taken for granted that some words have a general meaning and are clear to all parties so that an attempt to define them would be totally unnecessary.

Naturally, the type of pole that will be used to support the joint use will vary according to the locality and the exigencies of the situation. However, generally speaking, the normal joint pole will be a 35-foot class 6 pole.

It is believed that the definition of "space" is self-explanatory. The specifications mentioned in this definition are the specifications of the National Electrical Safety Code or the requirements of public authorities.

tain attachments by one party in the space reserved for the other party).

4. NORMAL SPACE is the following described space:

a. For the Cooperative the uppermost _____ feet, measured from top of pole.

b. For the Telephone Company a space of _____ feet, at a sufficient distance below the space of the Cooperative to provide at all times the minimum clearance required by the specifications mentioned in Article III and at a sufficient height above ground to provide the proper vertical clearance above ground or track rails for the lowest horizontally run line wires or cables attached in such space.

The foregoing definition of "a normal joint pole" is not intended to preclude the use of joint poles shorter or of less strength than the normal joint pole in locations where such poles will meet the requirements of the parties hereto.

The above assignment of space is not intended to preclude the use of vertical runs or the mounting of such equipment

Presuming that a 35-foot class 6 pole is used, the normal space that a cooperative would occupy would be the uppe most 4 feet, whereas, the tele phone company would occupy a space of 2 feet below the spac of the cooperative. The distance between the space of the cooperative and the space of t telephone company would be determined by clearance requirements depending upon the volt of the power line, span length type of conductors, and the lo ing district. In actual case this distance may be anything from the Code minimum of 40 inches to 6 or 8 feet or even more, depending on factors men tioned in the preceding senten

The next to last paragraph of this Article is designed to permit a certain elasticity in the choice of poles and to pave a way for an agreement between the parties as to the use of poles shorter than the ones defined as normal joint poles. For example, on longer span lines 35-foot poles may be nec essary to provide proper clea above ground because of the greater sag in the conductors; on shorter span lines 30-foot poles would, in many cases, be adequate; also if poles are located

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 ...ers on the lower portions of the pole when mutually agreeable.

primarily along private property on the rear of residential lots, it may be possible to use 30 or even 25-foot poles to advantage.

ARTICLE III

SPECIFICATIONS

Except as otherwise provided in Section (e) of Article VII, referring to construction temporarily exempt from the application of the specifications mentioned herein, the joint use of the poles covered by this Agreement shall at all times be in conformity with accepted modern methods such as those suggested in Edison Electric Institute Publication No. M12 and shall at all times conform to the requirements of the National Electrical Safety Code, Fifth Edition, and subsequent revisions thereof, except where the lawful requirements of public authorities may be more stringent, in which case the latter will govern.

Modifications of, additions to, or construction practices supplementing wholly or in part the requirements of the National Electrical Safety Code, shall, when accepted in writing by both parties hereto through their agents authorized to approve such changes, likewise govern the joint use of poles.

ARTICLE III

The construction and operation of the system should at all times be governed by the National Electrical Safety Code. In some cases, however, public rules and regulations make it necessary to go beyond the requirements of the Code. In this event, of course, the parties have no choice except to comply with the more strict rules and regulations. If the Code is more strict than the requirements of public laws, the Code should govern. In other words, it is always the more stringent requirement that applies.

The last paragraph in the Article was inserted to pave the way for agreements between the parties looking towards the adoption of practices necessitated by peculiar conditions which necessitate modifying and supplementing requirements of the Code.

ARTICLE IV

ESTABLISHING JOINT USE OF EXISTING POLES

(a) Whenever either party desires to reserve space for its attachments on any pole owned by the other party, either as initial space or additional space on such pole, it shall make written application therefor, specifying the location of the poles in question, the amount of space desired on each pole, and the number and character of the circuits to be placed thereon. If, in the judgement of the owner, the poles are necessary for its own sole use, or joint use under the circumstances is undesirable, the owner shall have the right to reject the application. In any event, within 10 days after the receipt of such application the owner shall notify the applicant in writing whether the application is approved or rejected. Upon receipt of notice from the owner that the application has been approved, and after the completion of any transferring or rearranging which is required to permit the attaching of the applicant's circuits on such poles, including any necessary pole replacements, the applicant shall have the right as licensee hereunder to use such space in accordance with the terms of the application and of this agreement.

ARTICLE IV

(a) In order to promote the keeping o accurate records, the contract provides tha a written application to enter into joint u shall be made. Inasmuch as the parties a at liberty to refuse to use certain poles jointly, the party to which the application is addressed, that is the owner of the pole has the right to reje the application and t refuse to enter into the joint use of the poles identified in such application. In order that the applicant may be assured o a definite answer, to enable it to make oth plans in the event th application is reject it is provided that t application must be co sidered and the applicant notified in writing within ten (10) d after its receipt. I the application is approved, the owner is obligated to rearrang its circuits in such manner as to permit th joint use.

Whenever any jointly used pole or any pole about to be so used under the provision of this agreement is insufficient in height or strength for the existing attachments and for the proposed additional attachments thereon, the owner shall promptly replace such pole with a new pole of the necessary height and strength and shall make such other changes in the existing pole line in which such pole is included as the conditions may then require.

(c) Each party shall place, transfer and rearrange its own attachments, place guys to sustain any unbalanced loads caused by its attachments, and perform any tree trimming or cutting incidental thereto. Each party shall at all times execute such work promptly and in such manner as not to interfere with the service of the other party.

(d) The cost of establishing the joint use of existing poles, including the making of any necessary pole replacements, shall be borne by the parties hereto in the manner provided in Article VIII - Division of Costs.

ARTICLE V

ESTABLISHING JOINT USE OF NEW POLES

(a) Whenever either party hereto requires new pole facilities for an additional

(b) One of the first things that has to be done in order to permit joint use is to make certain that the poles which will support the joint use are adequate in height and strength. For that reason it is provided that the owner shall promptly replace any existing poles which do not have such adequate height or strength. The amount, if any, to be paid the owner for installing a new pole is covered in Article VIII.

(c) Inasmuch as the cooperative is best qualified to attach the electric circuits to the poles and the telephone company is best qualified to attach the telephone circuits, it is contemplated that each party will do the necessary rearranging and attaching of its circuits.

(d) This section is inserted for the purpose of making clear that Article IV does not relate to the apportionment of costs, but is concerned merely with the methods to be followed in establishing joint use of existing poles.

ARTICLE V

(a) Article IV presupposed that the poles that were contemplated for joint use were existing poles pole line, an extension of an existing pole line, or in connection with the reconstruction of an existing pole line, it shall promptly notify the other party to that effect in writing (verbal notice subsequently confirmed in writing may be given in cases of emergency), stating the proposed location and character of the new poles and the character of circuits it intends to use thereon and indicating whether or not such pole facilities will be, in the estimation of the party proposing to construct the new pole facilities, susceptible of joint use. Within 10 days after the receipt of such notice, the other party shall reply in writing, stating whether it does, or does not, desire space on the said poles and, if it does desire space thereon, the character of the circuits it desires to use and the amount of space it wishes to reserve. If such other party requests space on the proposed new poles and if the character and number of its circuits and attachments are such that the party proposing to construct the new pole facilities does not consider joint use undesirable, then it shall erect poles suitable for such joint use, subject, however, to the provisions of Section (b)

forming a part of an existing line. Article V goes on to provide that whenever either party is considering the construction of new pole facilities (including new poles to replace existing ones), the question whether such new facilities should be made susceptible of joint use should be considered. Obviously, this has manifest advantages for if poles are to be jointly used by both parties, it is certainly to their best interest that they be erected with the joint use in view. Otherwise, it might be necessary to reconstruct an entire line after it had once been built, in order to permit the joint use of poles. As neither party is under an obligation to undertake joint use in any particular instance, the party constructing the new facilities may consider that the poles are not susceptible of joint use and so inform the other party. Such information should be supplied in all cases, for it might be that, in a particular instance, there would be a compelling reason for unde taking joint use which if brought to the attention of the party contemplating the construction of the lines, would make it change its opinion. If the poles are susceptible of joint use, the party proposing to construct the new facilities should notify the other party in sufficient time to

The applicant for space on the poles shall be promptly notified in writing of the action taken on the application.

(b) In any case where the parties hereto shall conclude arrangements for the joint use of any new poles to be erected, and the party proposing to construct the new pole facilities already owns more than its proportionate share of joint poles, the parties shall take into consideration the desirability of having the new pole facilities owned by the party owning less than its proportionate share of joint poles so as to work towards such a division of ownership of the joint poles that neither party shall be obligated to pay to the other any rentals because of their respective use of joint poles owned by the other.

(c) Each party shall place its own attachments on the new joint poles and place guys to sustain any unbalanced loads caused by its attachments. The owner shall, however, provide the initial clearing of the right-of-way, and tree trimming, which shall at least meet the requirements of the other party. Each party shall execute its work promptly and in such manner as not to interfere with the service of the other party.

permit such other party to consider the desirability of joint use. In order that the party proposing to construct or reconstruct the line may not be delayed, the agreement provides that the prospective licensee reply within ten (10) days after receiving notice of the proposed new construction whether it does or does not desire to use the new pole.

(b) This section is intended to lay the foundation for an agreement. However, it does not impose an obligation on either party. In view of the possibility that a cooperative might not be in a position to construct a new line at any given time, as such construction necessarily depends upon the availability of funds and prior approval by REA, it would be inadvisable to obligate either of the parties in this respect.

(c) This provision is the same as section (c) of Article IV. Except that as to new joint poles the initial right-of-way clearing and tree trimming is to be done by the owner. Thereafter it is to be done by the party requiring it.

(d) The cost of establishing the joint use of new poles including costs incurred in the retirement of existing poles shall be borne by the parties hereto in the manner provided in Article VIII - Division of Costs.

(d) This provision was inserted for the same reason as section (d) of Article IV was inserted -- namely, to make it clear that this Article provided a method for establishing joint use and did not deal with allocation of costs.

ARTICLE VI

RIGHT OF WAY FOR LICENSEE'S ATTACHMENTS

While the owner and licensee will cooperate as far as may be practicable in obtaining rights-of-way for both parties on joint poles, the owner does not warrant or assure to the licensee any right-of-way privileges or easements on, over or across streets, alleys and public thoroughfares, and private or publicly owned property, and if the licensee shall at any time be prevented from placing or maintaining its attachments on the owner's poles, no liability on account thereof shall attach to the owner of the poles.

ARTICLE VI

Considering that the cooperative is often granted easements by private land owners without charge, for the sole reason that the cooperative is a non-profit undertaking, the cooperative would not be in a position to license or assign the use of the right of way obtained by it to a utility, such as the telephone company, as that might constitute a breach of faith on its part. Hence, the cooperative, if it permits the telephone company to use its poles cannot guarantee the adequacy or legal sufficiency of the right of way.

Notwithstanding the foregoing cooperation between the telephone company and the cooperative in solving mutual right-of-way problems is not only desirable but imperative. However, methods by which this cooperation can be achieved will differ so much from place to place and time to time as to make it impossible to set them out in an agreement of this nature

ARTICLE VII

MAINTENANCE OF POLES AND ATTACHMENTS

(a) The owner shall maintain its joint poles in a safe and serviceable condition and in

ARTICLE VII

(a) It seems clear that the owner of the poles should have the duty of maintaining such poles in a serviceable condition and section (a) so provides.

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... the specifications mentioned in Article III and shall replace, reinforce or repair such of these poles as become defective.

(b) When replacing a jointly used pole carrying terminals of aerial cable, underground connection, or transformer equipment, the new pole shall be set in the same hole which the replaced pole occupied unless special conditions make it necessary or mutually desirable to set it in a different location.

(b) Where a pole that has to be replaced carries terminals of aerial cable, underground connection or transformer equipment it may be necessary to make alterations in the facilities if the pole is moved to another location, which would not have been necessary had the pole not been relocated. Therefore, it is provided that if a pole carrying terminals of aerial cables, underground connection or transformer equipment is replaced, the new pole generally should be set in the same hole.

(c) Whenever it is necessary to replace or relocate a jointly used pole, the owner shall, before making such replacement or relocation, give notice thereof in writing (except in case of emergency, when verbal notice will be given and subsequently confirmed in writing) to the licensee, specifying in such notice the time of such proposed replacement or relocation and the licensee shall at the time so specified transfer its attachments to the new or relocated joint pole.

(c) As has been heretofore pointed out, the cooperative is best qualified to install, rearrange or transfer its own attachments and the telephone company to do likewise with its facilities. For that reason it is provided that when a pole is to be replaced or relocated, the licensee is to be notified so as to have an opportunity to perform the work required in transferring its attachments to the new or relocated pole.

(d) Except as otherwise provided in Section (e) of this Article, each party shall at all times maintain all of its attachments,

(d) The reason for the inclusion of this provision is evident and therefore no comment is necessary.

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and perform any necessary tree trimming or cutting incidental thereto, in accordance with the specifications mentioned in Article III and shall keep them in safe condition and in thorough repair. Nothing in the foregoing shall preclude the parties hereto from making any mutually agreeable arrangement for jointly contracting for or otherwise providing for maintenance trimming.

(e) Any existing joint use construction of the parties hereto which does not conform to the specifications mentioned in Article III shall be brought into conformity therewith as soon as practicable.

When such existing construction shall have been brought into conformity with said specification, it shall at all times thereafter be maintained as provided in Sections (a) and (d) of this Article.

(f) The cost of maintaining poles and attachments and of bringing existing joint use construction into conformity with said specifications shall be borne by the parties hereto in the manner provided in Article VIII - Division of Costs.

(e) Sometimes, in connectio with the acquisition of facilitie it is found that the lines acquir have not been maintained and oper ated in accordance with the strict specifications mentioned in Artic III. Naturally any dangerous condition should be remedied at once. It is often impossible, however, to remedy all of the deficiencies and to bring the construction up to Code standards immediately. Nevertheless it is clear that as soon as it is practicable the lines should be rehabilitated to meet the applicabl specifications.

(f) This section is inserted to show that this Article deals with methods of maintenance rather than with the apportionment of costs.

ARTICLE VIII

DIVISION OF COSTS

(a) The cost of erecting new joint poles coming under this agreement, to construct

ARTICLE VIII

(a) Subsection 1. No comment is needed as it is clear that the owner should pay for the

... to make extensions to existing pole lines, or to replace existing poles, shall be borne by the parties as follows:

1. A normal joint pole, or joint pole smaller than the normal, shall be erected at the sole expense of the owner.

2. A pole larger than the normal, the extra height or strength of which is due wholly to the owner's requirements, including requirements as to keeping the owner's wires clear of trees, shall be erected at the sole expense of the owner.

3. In the case of a pole larger than the normal, the extra height or strength of which is due wholly to the licensee's requirements, including requirements as to keeping the licensee's wires clear of trees, the licensee shall pay to the owner a sum equal to the difference between the cost in place of such pole and the cost in place of a normal joint pole, the rest of the cost of erecting such pole to be borne by the owner, except in so far as otherwise provided in Section (c) of this Article.

construction of a normal joint pole.

Subsection 2. It is likewise clear that the owner should pay the entire cost of a pole, the extra height or strength of which is due wholly to its own requirements.

Subsection 3. If the extra height or strength of a pole is owing entirely to the licensee's requirements, it is only equitable that the licensee shall pay the owner the extra cost of installing such a pole. It should be noted that the differences calculated between the cost in place of a pole and the cost in place of a normal joint pole takes into consideration the labor costs involved in installation. For example, if it becomes necessary to use a 45-foot class 6 pole which costs $20 in place, whereas a normal joint pole costs $15, the licensee would pay the owner $5.

From a comparison of sub
section 3 of section (a) with
section (c), it will be seen
that subsection 3 contemplate
the erection of a new pole ma
necessary by the needs of the
owner and licensee jointly.
Section (c), as will be seen
later, deals with the replace
of existing poles to serve th
convenience of the licensee.

4. In the case of a pole larger than the normal, the extra height or strength which is due to the requirements of both parties or the requirements of public authorities or of property owners, (other than requirements with regard to keeping the wires of one party only clear of trees,) the difference between the cost in place of such pole and the cost in place of a normal joint pole shall be shared in the ratio of fifty five percent by the Cooperative and forty five percent by the Telephone Company, the rest of the cost of erecting such pole to be borne by the owner.

Subsection 4. It is equ
able that where the extra hei
or strength of the pole is du
to the requirements of both p
ties or of third parties, bot
parties should share the extr
cost involved.

5. A pole erected between existing poles to provide sufficient clearance and furnish adequate strength to support the circuits of both the owner and licensee, which it would have been unnecessary to erect if joint use had not been undertaken, shall be erected at the sole expense of the licensee.

Subsection 5. To provide
for the support of the facilit
of the licensee, it may become
necessary to install so-called
"intermediate" poles. If such
poles would not have been nec-
essary for the operation of th
owner's facilities there is no
reason why the licensee should
not pay the entire cost of in-
stalling such poles. This sub-
section provides for such a co
tingency.

(b) Any payments for poles made by the licensee under any foregoing provisions of this Article shall not entitle the licensee to the ownership of any part of said poles for which it has contributed in whole or in part.

(b) This provision makes it clear that the payments made by the licensee will not entitle it to the ownership of any pole.

(c) Where an existing jointly used pole or a non-joint pole is prematurely replaced by a new one solely for the benefit of the licensee, the cost of the new pole shall be divided as specified in Section (a) of this Article and the licensee shall also pay its owner the value in place of the replaced pole, plus the cost of removal less the salvage value of such pole. The replaced pole shall be removed and retained by its owner.

(c) It may sometimes happen that one party will apply for the joint use of poles already in the ground which are perfectly serviceable from the owner's standpoint, and that such joint use will necessitate the replacement of such poles with poles of greater height and strength. In such cases if the pole in place still was in good condition and its replacement would not have been necessary, the owner should not be called upon to bear the entire cost of removal and installation. Hence, this section provides a formula whereby the cost can be equitably apportioned. How this formula works can best be shown by way of illustration. Let us suppose that the owner has installed a normal joint pole with a life expectancy of 20 years. Let us further suppose that, in order to meet the licensee's needs, it will be necessary to install a 45-foot class 6 pole, the same type of pole as was considered in the comment on subsection (a) 3. Let us further suppose that the salvage value of the existing pole is \$5 and that the value in place of the existing pole is \$10 (the reason that \$10 is assigned as its value in place rather than $15 mentioned in the comment on subsection (a) 3, is that we are presuming that the pole has depreciated in value). Let us further suppose that the cost of removal is $5. With these figures in mind, the amounts due by the licensee to the owne would be calculated as follows: $5 (the excess cost of a new pole as specified in section (a plus $10, plus $5, minus $5. Th means that the licensee would pay the owner $15.

(d) Each party shall place, maintain, rearrange, transfer and remove its own attachments at its own expense except as otherwise expressly provided.

(d) This language is included to make certain that the shall be no misunderstanding that the installation and maintenance of the attachments is a duty incumbent upon each party.

(e) The expense of maintaining joint poles shall be borne by the owner thereof except that the cost of replacing poles shall be borne by the parties hereto in the manner provided in Sections (a) and (c) of this Article.

(e) It is desirable to make it clear that the owner must carry the burden of maintaining the poles.

(f) Where service drops of one party crossing over or under lines of the other party are attached to the other party's poles, either directly or by means of a pole top extension fixture, the cost shall be borne as follows:

(1) Pole top extension fixtures shall be provided and installed at the sole expense of the party using them.

(2) Where an existing pole is replaced with a taller one to provide the necessary clearance the party owning the service drop

(f) Subdivisions 1 and 2 In some cases it is advisable, in order to maintain proper cl ances, for a service drop of one party to be attached to th pole of another party. In a sense that is a form of joint use, and therefore, the provisions of this agreement should when not inconsistent, apply. Naturally, if in order to make such attachments possible, the owner of a pole has to replace it, the cost of making such re placement should be shared by the licensee.

pay to the party owning the pole a sum equal to the difference in cost in place between the new pole and a new pole of the same size as the replaced pole, together with a sum representing the value in place of the replaced pole plus the cost of removal less the salvage value of such pole, the owner of the pole to remove and retain such pole.

(g) When, in order to improve an existing condition considered undesirable by both parties, existing poles of one of the parties are abandoned in favor of combining lines on poles of the other party, the then value in place of the abandoned poles plus the cost of removal less the salvage value of such poles shall be shared in the ratio of fifty five percent by the Cooperative and forty five percent by the Telephone Company.

(h) Payments made by either party to the other under the provisions of this Article shall be based on the table of values listed in Appendix A.

ARTICLE IX

PROCEDURE WHEN CHARACTER OF CIRCUITS IS CHANGED

When either party desires to change the character of its circuits on jointly used poles, such party shall give _______ days' notice to the other party of such contemplated change and in the event that the party agrees in writing to joint use with

ARTICLE IX

It sometimes happens that the owner of the line or the licensee desires to change the character of the circuits. There are so many types of situations that might arise that it is impossible to try to provide for procedures by which each of the situations

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such changed circuits, then the joint use of such poles shall be continued with such changes in construction as may be required to meet the terms of the specifications mentioned in Article III for the character of circuits involved and such other changes as may be agreed upon. The parties shall cooperate to determine the equitable apportionment of the net expense of such changes. In the event, however, that the other party fails within _____ days from receipt of such notice to agree in writing to such change in character of circuits, then both parties shall cooperate in accordance with the following plan:

1. The parties hereto shall determine the most practical and economical method of effectively providing for separate lines, either overhead or underground, and the party whose circuits are to be moved shall promptly carry out the necessary work.

2. The net cost of re-establishing such circuits in the new location as are necessary to furnish the same business facilities that existed in the joint use section at the time such change was decided upon, shall be borne by the licensee; provided, however, that the owner shall bear an

should be met in an agreement of this type. Therefore, about the most that can be done is to stipulate that the parties shall cooperate in an effort to determine the equitable apportionment of the expense incident to the changes.

In some cases it may be utterly impossible to continue the joint use in view of the proposed change of character of the circuits. When this is the case, of course, it will be necessary to construct separate lines. Inasmuch as the licensee's rights are subordinate to those of the owner, cost of re-establishing the circuits in a new location should in most instances be assumed by the licensee. However, there may be cases where the assumption of the entire cost by thelicensee will work a hardship upon it. For exampl let us suppose that the owner allowed the licensee, at considerable cost, to install circuits on a given line, and then, within two months' time the owner decides to change the character of its circuits so as to make it impossible t maintain the joint use. In such a case the licensee, in addition to being faced with the cost of constructing new lines and relocating its faci ties on them, might lose completely the investment it mad in undertaking joint use, suc as the payments it made to th owner pursuant to Article VII Hence, it is only just that in such cases the owner shoul assume an equitable portion of the expense. In view of the varying circumstances that are likely to be met, it is manifestly impossible to provide any formula whereby the amount could be calculated. Therefore, all that

 ...able share of such cost wherever the change was occasioned by the necessities of the owner and the licensee would suffer a hardship in having to assume the entire burden of the cost of reestablishing the circuits.

can be done is to provide that the owner shall bear an equitable share and trust to the good will of the parties to effect a solution.

Unless otherwise agreed by the parties, ownership of any new line or underground facilities constructed under the foregoing provisions in a new location shall vest in the party for whose use it is constructed.

ARTICLE X

ABANDONMENT OF JOINTLY USED POLES

(a) If the owner desires at any time to abandon any jointly used pole, it shall give the licensee notice in writing to that effect at least _____ days prior to the date on which it intends to abandon such pole. If at the expiration of said period the owner shall have no attachments on such pole but the licensee shall not have removed all of the attachments therefrom, such pole shall thereupon become the property of the licensee, and the licensee shall save harmless the former owner of such pole from all obligation, liability, damages, cost, expenses or charges incurred thereafter, and not arising out of anything theretofore occurring, because of, or arising out of, the presence or condition of such

ARTICLE X

(a) The time may come when the owner of a section of joint use line may wish to abandon the operation of its circuits on that line. However, to take the poles down might work a hardship on the licensee as it may need the poles for the operation of its own circuits. For that reason, Article X has been drafted so as to permit the licensee to acquire the poles upon their abandonment by the Owner.

pole or of any attachments thereon; and shall pay the owner the then value in place of the pole to the licensee but in no case an amount less than the net salavage value of the pole to the owner as provided in Appendix A attached hereto. The former owner shall further evidence transfer of title to the pole by means of a bill of sale. Credit shall be allowed for any payments which the licensee may have made under the provisions of Article VIII - Division of Costs, when the pole was originally set.

(b) The licensee may at any time abandon the use of a joint pole by giving due notice thereof in writing to the owner and by removing therefrom any and all attachments it may have thereon. The licensee shall in such case pay to the owner the full rental for said pole for the then current year.

(b) Conversely, th licensee may wish at so time to abandon the use of a joint pole for its circuits. However, ina much as the owner will still retain possession of the line, the owner will not be prejudiced such abandonment so lon as the owner is appropri ately advised.

ARTICLE XI

RENTALS

(a) On or about____ of each year the parties acting in cooperation shall, subject to the provisions of Section (b) of this Article, tabulate the total number of joint poles in use as of the preceding day, and the number of poles on which either party as licensee removed all of its attachments during the twelve preceding

ARTICLE XI

(a) It would be manifestly desirable to have the telephone compa and the Cooperative each own a proportionate number of joint poles so that the payment of rental would be unnecess and the use of one set o poles would balance the of the other. However, will probably be impossi to achieve such a proportionate distribution

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 tabulation shall indicate the number of poles which each party owns on which rentals are to be paid by the other party.

and for that reason a tabulation should be made to determine which of the two parties owns more than its proportionate share of poles used jointly. Theoretically, it might be desirable to make such tabulation as of January 1 so as to make the rentals coincide with the calendar year. However, the spring season is the season in which the greatest bulk of the changes is made and for that reason, July 1 is, from the practical standpoint, the more desirable date to adopt for the making of a tabulation.

(b) For the purpose of such tabulation, any pole used by the licensee for the sole purpose of attaching wires or cables thereto, either directly or by means of a pole top extension fixture, in order to provide clearance between the facilities of the two parties as distinguished from providing support for such wires or cables, shall not be considered as a joint pole.

(c) If there is provision under a separate agreement between the Telephone Company and the Cooperative for facilities associated with power line carrier systems, the rental provisions of the agreement of which this article forms a part shall apply for poles on which both types of facilities are present, and no other rentals shall apply. The rental provisions of this agreement shall not apply however, where only those facilities directly associated with power line carrier systems are involved.

(d) The rentals per pole due from either party as licensee to the other party as owner shall be based on the equitable sharing of the economies of joint use as provided for in Appendix B. Subject

(d) The amount of rental that should be paid for each pole will necessarily vary according to circumstances. In most cases a rental per pole will probably be equitable.

to the provisions of Article XII, $____ per annum shall be paid by the Cooperative for each jointly used pole owned by the Telephone Company and $_____ per annum shall be paid by the Telephone Company for each jointly used pole owned by the Cooperative. The smaller total sum shall be deducted from the larger and the Cooperative or the Telephone Company, as the case may be, shall pay to the other the difference between such amounts.. The rental herein provided for shall be paid within 10 days after the bill has been submitted.

ARTICLE XII

PERIODICAL ADJUSTMENT OF RENTALS

(a) At any time after 5 years from the date of this agreement and at intervals of not less than 5 years thereafter, the rentals applicable under this agreement shall be subject to joint review and adjustment as provided for under Section (b) of this Article upon the written request of either party. In case of adjustment of rentals as herein provided, the new rentals agreed upon shall apply starting with the annual bill next rendered and continuing until again adjusted.

ARTICLE XII

At some future time, it may become advisable to reconsider the rentals paid and to arrange for a change in the amount of rentals. Article XII is mean to pave the way for such reconsideratio and to bring any changed rentals aut matically within th terms of the contra

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All adjustments of rentals shall be in accord with the provisions of Appendix B, and any changes shall take into account the cost factors originally involved in all joint use existing at that time under this agreement.

ARTICLE XIII

DEFAULTS

(a) If either party shall default in any of its obligations under this agreement and such default continues thirty (30) days after due notice thereof in writing by the other party, the party not in default may suspend the rights of the party in default in so far as concerns the granting of future joint use and if such default shall continue for a period of _____ days after such suspension, the party not in default may forthwith terminate this agreement as far as concerns the future granting of joint use.

(b) If either party shall make default in the performance of any work it is obligated to do under this agreement at its sole expense, the other party may elect to do such work, and the party in default shall reimburse the other party for the cost thereof. Failure on the part of the defaulting party to make such payment within _____ days upon presentation of bills therefor, shall, at the election of the other party, constitute a default under Section (a) of this Article.

ARTICLE XIII

(a) It is to be supposed that neither party will ever default in its obligations under the contract. As there is a possibility of such defaults occurring, however, the contingency should be provided for in the agreement. Therefore, section (a) of Article XIII has been drafted to protect the party who has lived up to its obligations by allowing it to suspend and eventually terminate the agreement in so far as the granting of future joint use is concerned.

(b) One of the particular defaults that might occur is one resulting from failure of one of the parties to perform any work which it is obligated to perform at its own expense. Rather than invoking the remedies provided for by the preceding section, which might work a hardship on the defaulting party not commensurate with the breach of its

obligations, section (t
provides that one of th
parties may perform the
work itself and then bi
the defaulting party.
Naturally, the party no
in default should be ex
tremely careful in exer
cising this privilege
and should exercise it
only as the last re-
source for the telephon
company may not be
qualified to perform w
on the electric line a
the cooperative may no
be qualified to perfor
work on the telephone
line.

ARTICLE XIV

EXISTING RIGHTS OF OTHER PARTIES

(a) If either of the parties hereto has, prior to the execution of this agreement, conferred upon others, not parties to this agreement, by contract or otherwise, rights or privileges to use any poles covered by this agreement, nothing herein contained shall be construed as affecting such rights or privileges, and either party hereto shall have the right, by contract or otherwise, to continue and extend such existing rights or privileges, it being expressly understood, however, that for the purpose of this agreement, the attachments of any such outside party, except those of a municipality or other public authority, shall be treated as attachments belonging to the grantor, and the rights, obligations, and liabilities hereunder of

ARTICLE XIV

(a) At the time
agreement is entered i
one of the parties may
have already obligated
itself to permit the u
of the joint poles by
some third party, and
may be necessary or de
sirable to extend or c
tinue that permission
even after the date of
the agreement. In or
to protect the other
party to the agreement
section (a) provides
the facilities of the
third party shall be c
sidered as those of th
party having granted
privilege.

...respect to such attachments shall be the same as if it were the actual owner thereof.

(b) Where municipal regulations require either party to allow the use of its poles for fire alarm, police, or other like signal systems, such use shall be permitted under the terms of this Article, provided attachments of such parties are placed and maintained in accordance with the specifications mentioned in Article III.

(b) The purpose of this section is so clear as not to need any comment.

ARTICLE XV

ASSIGNMENT OF RIGHTS

Except as otherwise provided in this agreement, neither party hereto shall assign or otherwise dispose of this agreement or any of its rights or interests hereunder, or in any of the jointly used poles, or the attachments or rights of way covered by this agreement, to any firm, corporation or individual, without the written consent of the other party except to the United States of America or any agency thereof; provided, however, that nothing herein contained shall prevent or limit the right of either party to mortgage any or all of its property, rights, privileges, and franchises, or lease or transfer any of them to another corporation organized for the purpose of conducting a business of the same general character as that of such party, or to enter into any merger or consolidation; and, in case of the foreclosure of such mortgage; or in case of such lease, transfer,

ARTICLE XV

The preparation of the paragraph in regard to the assignment of rights is necessarily difficult in a situation such as this. An absolute prohibition against the assignment of the rights conferred by the contract without the written consent of the other party might work a considerable hardship on the party who is desirous of making such an assignment as it might limit the disposition of its properties. However, it is equally true that allowing a party to assign its rights under the contract to a third party without the consent of the other party to the contract might work a considerable hardship on the latter inasmuch as it might be faced with the prospect of attempting to maintain joint use with an merger, or consolidation, its rights and obligations hereunder shall pass to, and be acquired and assumed by, the purchaser on foreclosure, the transferee, lessee, assignee, merging or consolidating company, as the case may be; and provided, further, that subject to all of the terms and conditions of this agreement, either party may permit any corporation conducting a business of the same general character as that of such party, and owned, operated, leased and controlled by it, or associated or affiliated with it in interest, or connecting with it, the use of all or any part of the space reserved hereunder on any pole covered by this agreement for the attachments used by such party in the conduct of its said business; and for the purpose of this agreement, all such attachments maintained on any such pole by the permission as aforesaid of either party hereto shall be considered as the attachments of the party granting such permission, and the rights, obligations and liabilities of such party under this agreement, with respect to such attachments, shall be the same as if itwere the actual owner thereof.

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irresponsible organization with whom it would not have entered into a contract originally. Hence, this Article has been drafted with the thought of attempting to permit the assignment under certa[in] circumstances, that is where the organization assuming the rights assigned will be a responsible organization conducting a business [of] the same general character as that of its predecessor.

ARTICLE XVI

WAIVER OF TERMS OR CONDITIONS

The failure of either party to enforce or insist upon compliance with any of the terms or conditions of this agreement shall not constitute a general waiver or relinquishment of any such terms or conditions, but the same shall be and remain at all times in full force and effect.

ARTICLE XVI

This Article XVI is inserted to make certain that if one of the parties, in the interest of harmony and in view of the particular situation, waives a condition in the agreement, such waiver will not be considered as a general waiver applicable to all similar situations in the future.

ARTICLE XVII

PAYMENT OF TAXES

Each party shall pay all taxes and assessments lawfully levied on its own property upon said jointly used poles, and the taxes and the assessments which are levied on said joint poles shall be paid by the owner thereof, but any tax, fee, or charge levied on owner's poles solely because of their use by the licensee shall be paid by the licensee.

ARTICLE XVII

The purpose of this Article is so obvious as not to need any comments.

ARTICLE XVIII

BILLS AND PAYMENT FOR WORK

Upon the completion of work performed hereunder by either party, the expense of which is to be borne wholly or in part by the other party, the party performing the work shall present to the other party within _____ days after the completion of such work an itemized statement of

ARTICLE XVIII

This Article is inserted to insure business relationships in the payment of reimbursable items. The number of days that should be inserted in the blanks will vary according to circumstances. Probably the insertion of the number 10 in the blanks would provide a suitable time.

the costs and such other party shall within ______ days after such statement is presented pay to the party doing the work such other party's proportion of the cost of said work.

ARTICLE XIX

SERVICE OF NOTICES

Whenever in this agreement notice is provided to be given by either party hereto to the other, such notice shall be in writing and given by letter mailed, or by personal delivery, to the Cooperative at its office at ________ ________________________________, or to the Telephone Company at its office at ________ ________________________________, as the case may be, or to such other address as either party may from time to time designate in writing for that purpose.

ARTICLE XIX

This Article i[s] inserted to make c[er]tain that there wil[l] not be any dispute [a]s to the proper place for the service of notice.

ARTICLE XX

TERM OF AGREEMENT

Subject to the provisions of Article XIII, Defaults, herein, this Agreement shall remain in effect until terminated at the end of 25 years from the date hereof or thereafter upon the giving of written notice to the other party not less than three years prior to the date of termination.

ARTICLE XX

The Agreement [is] made to run for 25 [years] and as long therea[fter] as the parties may [de]sire. The type of arrangement contem[plated] in the contract is [one] that involves long range planning and [in]vestment and there[fore] does not lend itse[lf] to a short term.

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ARTICLE XXI

EXISTING CONTRACTS

All existing agreements between the parties hereto for the joint use of poles are by mutual consent hereby abrogated and superseded by this Agreement.

Nothing in the foregoing shall preclude the parties to this agreement from preparing such supplemental operating routines or working practices as they mutually agree to be necessary or desirable to effectively administer the provisions of this agreement.

ARTICLE XXI.

This Agreement is intended to cover the entire arrangement between the parties. Therefore, this Article provides that any existing agreements between the parties with respect to the joint use of poles are ended and this Agreement takes their place.

ARTICLE XXII

APPROVAL OF ADMINISTRATOR

This Agreement, and any amendment thereof, shall be effective subject to the condition that, during any period in which the Cooperative is a borrower from the Rural Electrification Administration, the agreement and any amendment thereof shall have the approval in writing of the Administrator of the Rural Electrification Administration.

In witness whereof, the parties hereto, have caused these presents to be executed in triplicaté, and their corporate seals to be affixed thereto by their respective officers thereunto duly uauthorized, on the _____ day of ______________________, 19 .

____

By____________________________

(Seal)

Attest:

____

____

By____________________________

(Seal)

Attest:

____

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APPENDIX A

This Appendix contains tables of pole values to be used in dividing costs as provided under Article VIII. It also outlines the steps for adjusting such values to determine any payments that the licensee must make to the owner to defray costs of premature replacement of poles to accommodate the licensee.

A. Tabulation of New Pole Costs.

The following tabulation shall list mutually agreed upon average costs in place of new poles of all kinds of timber, including only such cost items as are repetitive when poles are replaced.

Table 1

Height \ Class	1	2	3	4	5	6	7	8	9	10
20'										
22'										
25'										
30'										
35'										
40'										
45'										
50'										
55'										
60'										

B. Age Factors for Modifying Values of Poles.

1. The following table of age factors shall be used in adjusting pole costs in Table 1 to arrive at current values in place of existing poles coming under the provisions of this agreement.

Table 2

Age of Pole	0-3 years	4-9 years	10-15 years	16-21 years	22-27 years	over 27 years
Factor	1.0	.8	.6	.4	.2	0

C. Cost Level Factor.

1. The values obtained from B are to be modified further by the following factors to allow for periodic variation in pole cost levels.

Table 3

For poles set prior to Jan. 1, 1937	.5
For poles set between Jan. 1, 1937 and Jan. 1, 1945.	.7
For poles set between Jan. 1, 1945 and	1.0
For poles set between and	

2. It is intended that additional factors will be added to cover future long term changes in costs.

D. Salvage Value of Poles.

1. A figure of 70% of current material costs shall be used for computing salvage values of poles which have been installed not exceeding 10 years. Average values for all kinds of timber shall be used. The follow-

ing table sets forth mutually agreed upon salvage values.

Table 4

Height \ Class	1	2	3	4	5	6	7	8	9	10
20'										
22'										
25'										
30'										
35'										
40'										
45'										
50'										
55'										
60'										

2. For poles installed longer than 10 years it shall be assumed that the salvage value is equal to the cost of removal.

Note: This is based on assumption that owner should bear an increasing portion of cost of removal as poles age.

1. The following table sets forth mutually agreed upon total costs of removing poles.

Table 5

Height	Cost of Removal
25' or less	
30'	
35'	
40'	
45'	
50'	
55'	

Note:
Annual variations in costs of removal neglected.

F. Anchors.

1. The cost in place of all anchors regardless of size, type or number of thimbles shall be deemed to be ____ for use in applying the provisions of this agreement.

APPENDIX B

This appendix describes the basic principles and guides which have been used under this agreement in setting the rents specified in Article XI and which are to be used in making periodical adjustments of rentals as provided for in Article XII.

Under these principles the rentals are intended, in so far as it is practicable, to result in a sharing of the economies realized by the joint use of pole plant in proportion to the relative costs of separate pole line construction.

The procedures outlined herein take into account the following objectives:

1. An equitable division of savings regardless of the number of jointly used poles owned by each party.

2. Rental rates applicable universally in the area covered by the agreement regardless of whether the pole lines involved are initially constructed with joint use in view or are existing lines modified for joint use.

3. Appropriate allowance in the rental rates for additional costs incurred by each party in supplying 'normal joint poles', as defined in the agreement, and the costs of other items required in the joint use of poles which would not be incurred in separate line construction.

4. Rentals based on the costs of "typical miles" of separate lines, of newly constructed joint lines and of existing lines modified to make them suitable for joint use. The 'per mile' value of rentals are then reduced to 'per pole' values for purposes of simplifying tabulations and to provide for the joint use of scattered poles.

The rentals are the dollar values resulting from the licensee paying to the owner as annual rental, an amount representing the annual charge on a separate line for the licensee less the sum of (a) the annual charges on the additional costs incurred by the licensee in establishing joint use and (b) the licensee's share of savings. This share is the ratio of the licensee's typical separate line costs to the sum of the typical separate line costs of each of the parties.

The annual rent payable can also be stated as follows:

Licensee's annual rent	Equals	Annual charges saved by licensee through not having to build a separate line	Less	Licensee's appropriate percentage	Of	Total savings in annual charges realized through joint use

The cost in place of a line of poles is made up of a number of factors including such items as right-of-way solicitation, clearing, staking, direct labor and material costs of bare poles in place and pro rata shares of construction supervision and overhead. These costs, for a specific area, may differ considerably from corresponding costs in other parts of the country. These variations in pole line costs will, however, affect both power and telephone lines to about the same degree.

The parties to this contract will mutually agree on the average cost of a typical mile of 35 foot, class 6 poles in place in their common area. Below are tabulated appropriate rentals over a range of typical mile costs. From this tabulation the parties shall use the rental payments associated with the value nearest to the agreed upon average cost.

RENTAL PAYMENTS

Where the mutually agreed upon average cost per mile of 35 foot class 6 poles in place approximates	The telephone company's annual rental payment per pole to the cooperative will be	The cooperative's annual rental payment per pole to the telephone company will be
$350*	$1.00	$1.70
$410	1.10	1.80
$470	1.20	1.90
$530	1.30	2.00
$590	1.40	2.10
$650	1.50	2.20
$710	1.60	2.30
$770**	1.70	2.40

* Rentals associated with this amount are minimum and applicable for all lower costs.
**If average costs are substantially higher than this value, appropriate rentals should be determined by agreement.

Printed in U.S.A.

PUBLIC

Form of
Application——Permit

For Joint Use of Poles.

No..................

To.. hereinafter referred to as the Licensor; the applicant hereunder being hereinafter referred to as the Licensee.

....

....

The following application is made for the use of your pole plant located as follows:

....

No. of Poles	Pole Numbers	Type of Attachments	Annual Rental

Pole locations and work to be performed are shown on the above diagram.

Licensee's initial payment, if any$________________

The joint occupancy herein provided for and the work to be done hereunder shall be subject to the terms and conditions on the reverse side hereof, which shall constitute a specified agreement in connection herewith and shall supersede, except as to matters not covered herein, any provisions in other contracts, if any, heretofore entered into between the parties hereto or their predecessor companies.

Recommended by:____________________________ Application made__________19__,By

Approved by:____________________________ ____________________________

THE ABOVE APPLICATION IS ACCEPTED AND THE PERMIT REQUESTED IS HEREBY GRANTED

By____________________________
Title

____________________________19__,By

Approved by:____________________________ By____________________________
Title

TERMS AND CONDITIONS

1. CONSIDERATION. In consideration of the right to attach and maintain at its sole expense, attachments on the poles of the Licensor, the Licensee promises and agrees to pay the initial payment, if any, shown on the face hereof, within 30 days of its receipt of the Licensor's bill therefor; and likewise promises and agrees to pay the Licensor annually upon the 31st day of December the yearly rental(s) specified on the face of this agreement.

These rentals shall be based on the following:

a. For attachments of facilities owned by the Telephone Company to poles owned by the Cooperative. 1.00 per pole

b. For attachments of facilities owned by the Cooperative to poles owned by the Telephone Company. 1.00 per pole

(There will be no charge for clearance attachments of service drops of either party.)

Yearly payments hereunder shall be made on December 31st of each year in which this permit is exercised; rental charges being based upon the Licensee's occupation of the Licensor's pole as of July 1st in said calendar year.

All payments for rental under this agreement shall be based upon a minimum period of one year except that should the Licensor revoke this permit before the expiration of any calendar year, then and not otherwise, the Licensor shall reduce the yearly rental by an amount proportionate to the interval from the last day of the month in which attachments were discontinued to the end of the said year.

2. SPECIFICATIONS. Attachments shall at all times be in conformity with accepted modern methods such as those suggested in Edison Electric Institute Publication No. M12 and shall at all times conform to the requirements of the National Electrical Safety Code, Fifth Edition and subsequent revisions thereof, except where the lawful requirements of public authorities may be more stringent, in which case the latter will govern.

3. LICENSEE'S RIGHT TO TERMINATE. This agreement may be terminated by the Licensee upon thirty days' notice to the Licensor. All obligations of the Licensee, hereunder, shall continue until its attachments are completely removed.

4. LICENSOR'S RIGHT TO REVOKE. The Licensor may revoke this permit at any time upon written notice, and the Licensee shall remove its wires and other attachments from said pole(s) within sixty days from the date of said notice.

5. LICENSOR'S RIGHT TO ABANDON. The Licensor may abandon any said pole at any time upon written notice to the Licensee. The Licensee shall, within sixty days after such notice, either purchase the pole from the Licensor or remove its attachments therefrom, and the failure of the Licensee to remove its attachments within said sixty days shall be deemed an election to purchase the pole at a price equal to its then value in place.

6. DEFAULT. If the Licensee shall make default in any of its obligations under this contract, and such default continues for thirty days after written notice thereof from the Licensor, all rights of the Licensee hereunder, including its right to occupy said poles, shall be suspended until such default has been remedied.

7. ASSIGNMENT. Licensee shall not assign, transfer or sub-let any of the privileges described in this agreement without the written consent of the Licensor.

8. LICENSOR'S RESPONSIBILITY. The Licensor shall not be liable to the Licensee for any interruption to, nor interference with the operations of the wires of the Licensee on said poles caused by the operations of the Licensor; nor shall the Licensor be responsible for any loss or damage caused by objection to the stringing of said wires, by any corporation or person owning property on which, or abutting upon which, said pole line or fixtures thereon, or any part thereof, is located, or because of interference with said pole line, wires or fixtures thereon by any third person, or because of the objections or interference of any public authorities. It is expressly agreed that the Licensor is not obligated to secure or guarantee any right-of-way or franchise for the Licensee, and no use, however extended, of the Licensor's poles under this agreement shall be taken as creating or vesting in the Licensee any right, title or interest to said poles, or any right, title and interest in any franchise right or easement which the Licensor may possess.

REA Form DS-210
(8-47)

GENERAL AGREEMENT

FOR

JOINT USE OF WOOD POLES

BETWEEN

....

....

AND

....

....

Date ....

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REA Form DS-210
(8-47)

GENERAL AGREEMENT FOR JOINT USE OF WOOD POLES

PREAMBLE

...., a corporation organized under the laws of the State of ...., (hereinafter called the "Cooperative"), and ...., a corporation organized under the laws of the State of ...., (hereinafter called the "Telephone Company"), desiring to cooperate in the joint use of their respective poles, erected or to be erected within the areas in which both parties render service in the State(s) of ...., whenever and wherever such use shall, in the estimation of both parties, be compatible with their respective needs, do hereby, in consideration of the premises and the mutual covenants herein contained, covenant and agree for themselves and their respective successors and assigns as follows:

ARTICLE I

SCOPE OF AGREEMENT

(a) This Agreement shall be in effect in the areas in which both of the parties render service in the State(s) of.., and shall cover all wood poles of the parties now existing or hereafter erected in the above territory when said poles are brought under this Agreement in accordance with the procedure hereinafter provided.

(b) Each party reserves the right to exclude any of its facilities from joint use.

ARTICLE II

EXPLANATION OF TERMS

For the purpose of this Agreement, the following terms shall have the following meanings:

1. A JOINT POLE is a pole jointly used by both parties.
2. A NORMAL JOINT POLE is a pole which is just tall enough to provide normal spaces, as normal space is hereinafter defined, for the respective parties and just strong enough to meet the requirements of the specifications mentioned in Article III for the attachments ordinarily placed by the parties in their respective normal spaces. Such pole for the purpose of this Agreement shall be a .... foot class .... wood pole as classified by the pole classification tables of the American Standards Association.
3. SPACE is the linear portion of a joint pole parallel to its axis reserved for the exclusive use of one of the parties (subject only to the exceptions provided for by the specifications mentioned in Article III which in certain instances permit the making of certain attachments by one party in the space reserved for the other party).
4. NORMAL SPACE is the following described space:

a. For the Cooperative the uppermost .... feet, measured from top of pole.

b. For the Telephone Company a space of .... feet, at a sufficient distance below the space of the Cooperative to provide at all times the minimum clearance required by the specifications mentioned in Article III and at a sufficient height above ground to provide the proper vertical clearance above ground or track rails for the lowest horizontally run line wires or cables attached in such space.

The foregoing definition of "a normal joint pole" is not intended to preclude the use of joint poles shorter or of less strength than the normal joint pole in locations where such poles will meet the requirements of the parties hereto.

The above assignment of space is not intended to preclude the use of vertical runs or the mounting of such equipment as terminals or meters on the lower portions of the pole when mutually agreeable.

ARTICLE III

SPECIFICATIONS

Except as otherwise provided in Section (e) of Article VII, referring to construction temporarily exempt from the application of the specifications mentioned herein, the joint use of the poles covered by this Agreement shall at all times be in conformity with accepted modern methods such as those suggested in Edison Electric Institute Publication No. M12 and shall at all times conform to the requirements of the National Electrical Safety Code, Fifth Edition, and subsequent revisions thereof, except where the lawful requirements of public authorities may be more stringent, in which case the latter will govern.

Modifications of, additions to, or construction practices supplementing wholly or in part the requirements of the National Electrical Safety Code, shall, when accepted in writing by both parties hereto through their agents authorized to approve such changes, likewise govern the joint use of poles.

ARTICLE IV

ESTABLISHING JOINT USE OF EXISTING POLES

(a) Whenever either party desires to reserve space for its attachments on any pole owned by the other party, either as initial space or additional space on such pole, it shall make written application therefor, specifying the location of the poles in question, the amount of space desired on each pole, and the number and character of the circuits to be placed thereon. If, in the judgment of the owner, the poles are necessary for its own sole use, or joint use under the circumstances is undesirable, the owner shall have the right to reject the application. In any event, within 10 days after the receipt of such application the owner shall notify the applicant in writing whether the application is approved or rejected. Upon receipt of notice from the owner that the application has been approved, and after the completion of any transferring or rearranging which is required to permit the attaching of the applicant's circuits on such poles, including any necessary pole replacements, the applicant shall have the right as licensee hereunder to use such space in accordance with the terms of the application and of this Agreement.

(b) Whenever any jointly used pole or any pole about to be so used under the provision of this Agreement is insufficient in height or strength for the existing attachments and for the proposed additional attachments thereon, the owner shall promptly replace such pole with a new pole of the necessary height and strength and shall make such other changes in the existing pole line in which such pole is included as the conditions may then require.

(c) Each party shall place, transfer and rearrange its own attachments, place guys to sustain any unbalanced loads caused by its attachments, and perform any tree trimming or cutting incidental thereto. Each party shall at all times execute such work promptly and in such manner as not to interfere with the service of the other party.

(d) The cost of establishing the joint use of existing poles, including the making of any necessary pole replacements, shall be borne by the parties hereto in the manner provided in Article VIII—Division of Costs.

ARTICLE V

ESTABLISHING JOINT USE OF NEW POLES

(a) Whenever either party hereto requires new pole facilities for an additional pole line, an extension of an existing pole line, or in connection with the reconstruction of an existing pole line, it shall promptly notify the other party to that effect in writing (verbal notice subsequently confirmed in writing may be given in cases of emergency), stating the proposed location and character of the new poles and the character of circuits it intends to use thereon and indicating whether or not such pole facilities will be, in the estimation of the party proposing to construct the new pole facilities, susceptible of joint use. Within 10 days after the receipt of such notice, the other party shall reply in writing, stating whether it does, or does not, desire space on the said poles and, if it does desire space thereon, the character of the circuits it desires to use and the amount of space it wishes to reserve. If such other party requests space on the proposed new poles and if the character and number of its circuits and attachments are such that the party proposing to construct the new pole facilities does not consider joint use undesirable, then it shall erect poles suitable for such joint use, subject, however, to the provisions of Section (b) of this Article. The applicant for space on the poles shall be promptly notified in writing of the action taken on the application.

(b) In any case where the parties hereto shall conclude arrangements for the joint use of any new poles to be erected, and the party proposing to construct the new pole facilities already owns more than its proportionate share of joint poles, the parties shall take into consideration the desirability of having the new pole facilities owned by the party owning less than its proportionate share of joint poles so as to work towards such a division of ownership of the joint poles that neither party shall be obligated to pay to the other any rentals because of their respective use of joint poles owned by the other.

(c) Each party shall place its own attachments on the new joint poles and place guys to sustain any unbalanced loads caused by its attachments. The owner shall, however, provide the initial clearing of the right-of-way, and tree trimming, which shall at least meet the requirements of the other party. Each party shall execute its work promptly and in such manner as not to interfere with the service of the other party.

(d) The cost of establishing the joint use of new poles including costs incurred in the retirement of existing poles shall be borne by the parties hereto in the manner provided in Article VIII—Division of Costs.

ARTICLE VI

RIGHT OF WAY FOR LICENSEE'S ATTACHMENTS

While the owner and licensee will cooperate as far as may be practicable in obtaining rights-of-way for both parties on joint poles, the owner does not warrant or assure to the licensee any right-of-way privileges or easements on, over or across streets, alleys and public thoroughfares, and private or publicly owned property, and if the licensee shall at any time be prevented from placing or maintaining its attachments on the owner's poles, no liability on account thereof shall attach to the owner of the poles.

ARTICLE VII

MAINTENANCE OF POLES AND ATTACHMENTS

(a) The owner shall maintain its joint poles in a safe and serviceable condition and in accordance with the specifications mentioned in Article III and shall replace, reinforce or repair such of these poles as become defective.

(b) When replacing a jointly used pole carrying terminals of aerial cable, underground connection, or transformer equipment, the new pole shall be set in the same hole which the replaced pole occupied unless special conditions make it necessary or mutually desirable to set it in a different location.

(c) Whenever it is necessary to replace or relocate a jointly used pole, the owner shall, before making such replacement or relocation, give notice thereof in writing (except in case of emergency, when verbal notice will be given and subsequently confirmed in writing) to the licensee, specifying in such notice the time of such proposed replacement or relocation and the licensee shall at the time so specified transfer its attachments to the new or relocated joint pole.

(d) Except as otherwise provided in Section (e) of this Article, each party shall at all times maintain all of its attachments, and perform any necessary tree trimming or cutting incidental thereto, in accordance with the specifications mentioned in Article III and shall keep them in safe condition and in thorough repair. Nothing in the foregoing shall preclude the parties hereto from making any mutually agreeable arrangement for jointly contracting for or otherwise providing for maintenance trimming.

(e) Any existing joint use construction of the parties hereto which does not conform to the specifications mentioned in Article III shall be brought into conformity therewith as soon as practicable.

When such existing construction shall have been brought into conformity with said specification, it shall at all times thereafter be maintained as provided in Sections (a) and (d) of this Article.

(f) The cost of maintaining poles and attachments and of bringing existing joint use construction into conformity with said specifications shall be borne by the parties hereto in the manner provided in Article VIII—Division of Costs.

PUBLIC

ARTICLE VIII

DIVISION OF COSTS

(a) The cost of erecting new joint poles coming under this Agreement, to construct new pole lines, to make extensions to existing pole lines, or to replace existing poles, shall be borne by the parties as follows:

1. A normal joint pole, or joint pole smaller than the normal, shall be erected at the sole expense of the owner.

2. A pole larger than the normal, the extra height or strength of which is due wholly to the owner's requirements, including requirements as to keeping the owner's wires clear of trees, shall be erected at the sole expense of the owner.

3. In the case of a pole larger than the normal, the extra height or strength of which is due wholly to the licensee's requirements, including requirements as to keeping the licensee's wires clear of trees, the licensee shall pay to the owner a sum equal to the difference between the cost in place of such pole and the cost in place of a normal joint pole, the rest of the cost of erecting such pole to be borne by the owner, except in so far as otherwise provided in Section (c) of this Article.

4. In the case of a pole larger than the normal, the extra height or strength which is due to the requirements of both parties or the requirements of public authorities or of property owners, (other than requirements with regard to keeping the wires of one party only clear of trees), the difference between the cost in place of such pole and the cost in place of a normal joint pole shall be shared in the ratio of fifty five percent by the Cooperative and forty five percent by the Telephone Company, the rest of the cost of erecting such pole to be borne by the owner.

5. A pole erected between existing poles to provide sufficient clearance and furnish adequate strength to support the circuits of both the owner and licensee, which it would have been unnecessary to erect if joint use had not been undertaken, shall be erected at the sole expense of the licensee.

(b) Any payments for poles made by the licensee under any foregoing provisions of this Article shall not entitle the licensee to the ownership of any part of said poles for which it has contributed in whole or in part.

(c) Where an existing jointly used pole or a non-joint pole is prematurely replaced by a new one solely for the benefit of the licensee, the cost of the new pole shall be divided as specified in Section (a) of this Article and the licensee shall also pay its owner the value in place of the replaced pole, plus the cost of removal less the salvage value of such pole. The replaced pole shall be removed and retained by its owner.

(d) Each party shall place, maintain, rearrange, transfer and remove its own attachments at its own expense except as otherwise expressly provided.

(e) The expense of maintaining joint poles shall be borne by the owner thereof except that the cost of replacing poles shall be borne by the parties hereto in the manner provided in Sections (a) and (c) of this Article.

(f) Where service drops of one party crossing over or under lines of the other party are attached to the other party's poles, either directly or by means of a pole top extension fixture, the cost shall be borne as follows:

(1) Pole top extension fixtures shall be provided and installed at the sole expense of the party using them.

(2) Where an existing pole is replaced with a taller one to provide the necessary clearance the party owning the service drop shall pay to the party owning the pole a sum equal to the difference in cost in place between the new pole and a new pole of the same size as the replaced pole, together with a sum representing the value in place of the replaced pole plus the cost of removal less the salvage value of such pole, the owner of the pole to remove and retain such pole.

(g) When, in order to improve an existing condition considered undesirable by both parties, existing poles of one of the parties are abandoned in favor of combining lines on poles of the other party, the then value in place of the abandoned poles plus the cost of removal less the salvage value of such poles shall be shared in the ratio of fifty five percent by the Cooperative and forty five percent by the Telephone Company.

(h) Payments made by either party to the other under the provisions of this Article shall be based on the table of values listed in Appendix A.

to con-
xisting

ARTICLE IX

PROCEDURE WHEN CHARACTER OF CIRCUITS IS CHANGED

When either party desires to change the character of its circuits on jointly used poles, such party shall give..................days notice to the other party of such contemplated change and in the event that the party agrees in writing to joint use with such changed circuits, then the joint use of such poles shall be continued with such changes in construction as may be required to meet the terms of the specifications mentioned in Article III for the character of circuits involved and such other changes as may be agreed upon. The parties shall cooperate to determine the equitable apportionment of the net expense of such changes. In the event, however, that the other party fails within.............. days from receipt of such notice to agree in writing to such change in character of circuits, then both parties shall cooperate in accordance with the following plan:

1. The parties hereto shall determine the most practical and economical method of effectively providing for separate lines, either overhead or underground, and the party whose circuits are to be moved shall promptly carry out the necessary work.

2. The net cost of re-establishing such circuits in the new location as are necessary to furnish the same business facilities that existed in the joint use section at the time such change was decided upon, shall be borne by the licensee; provided, however, that the owner shall bear an equitable share of such cost wherever the change was occasioned by the necessities of the owner and the licensee would suffer a hardship in having to assume the entire burden of the cost of re-establishing the circuits.

Unless otherwise agreed by the parties, ownership of any new line or underground facilities constructed under the foregoing provisions in a new location shall vest in the party for whose use it is constructed.

ARTICLE X

ABANDONMENT OF JOINTLY USED POLES

(a) If the owner desires at any time to abandon any jointly used pole, it shall give the licensee notice in writing to that effect at least..........days prior to the date on which it intends to abandon such pole. If at the expiration of said period the owner shall have no attachments on such pole but the licensee shall not have removed all of the attachments therefrom, such pole shall thereupon become the property of the licensee, and the licensee shall save harmless the former owner of such pole from all obligation, liability, damages, cost, expenses or charges incurred thereafter, and not arising out of anything theretofore occurring, because of, or arising out of, the presence or condition of such pole or of any attachments thereon; and shall pay the owner the then value in place of the pole to the licensee but in no case an amount less than the net salvage value of the pole to the owner as provided in Appendix A attached hereto. The former owner shall further evidence transfer of title to the pole by means of a bill of sale. Credit shall be allowed for any payments which the licensee may have made under the provisions of Article VIII—Division of Costs, when the pole was originally set.

(b) The licensee may at any time abandon the use of a joint pole by giving due notice thereof in writing to the owner and by removing therefrom any and all attachments it may have thereon. The licensee shall in such case pay to the owner the full rental for said pole for the then current year.

ARTICLE XI

RENTALS

(a) On or about.............................. of each year the parties acting in cooperation shall, subject to the provisions of Section (b) of this Article, tabulate the total number of joint poles in use as of the preceding day, and the number of poles on which either party as licensee removed all of its attachments during the twelve preceding months, which tabulation shall indicate the number of poles which each party owns on which rentals are to be paid by the other party.

(b) For the purpose of such tabulation, any pole used by the licensee for the sole purpose of attaching wires or cables thereto, either directly or by means of a pole top extension fixture, in order to provide clearance between the facilities of the two parties as distinguished from providing support for such wires or cables, shall not be considered as a joint pole.

(c) If there is provision under a separate agreement between the Telephone Company and the Cooperative for facilities associated with power line carrier systems, the rental provisions of the Agreement of which this article forms a part shall apply for poles on which both types of facilities are present, and no other rentals shall apply. The rental provisions of this Agreement shall not apply however, where only those facilities directly associated with the power line carrier systems are involved.

(d) The rentals per pole due from either party as licensee to the other party as owner shall be based on the equitable sharing of the economies of joint use as provided for in Appendix B. Subject to the provisions of Article XII, $............per annum shall be paid by the Cooperative for each jointly used pole owned by the Telephone Company and $............per annum shall be paid by the Telephone Company for each jointly used pole owned by the Cooperative. The smaller total sum shall be deducted from the larger and the Cooperative or the Telephone Company, as the case may be, shall pay to the other the difference between such amounts. The rental herein provided for shall be paid within 10 days after the bill has been submitted.

ARTICLE XII

PERIODICAL ADJUSTMENT OF RENTALS

(a) At any time after 5 years from the date of this Agreement and at intervals of not less than 5 years thereafter, the rentals applicable under this Agreement shall be subject to joint review and adjustment as provided for under Section (b) of this Article upon the written request of either party. In case of adjustment of rentals as herein provided, the new rentals agreed upon shall apply starting with the annual bill next rendered and continuing until again adjusted.

(b) All adjustments of rental shall be in accord with the provisions of Appendix B, and any changes shall take into account the cost factors originally involved in all joint use existing at that time under this Agreement.

ARTICLE XIII

DEFAULTS

(a) If either party shall default in any of its obligations under this Agreement and such default continues thirty (30) days after due notice thereof in writing by the other party, the party not in default may suspend the rights of the party in default in so far as concerns the granting of future joint use and if such default shall continue for a period of..... .....days after such suspension, the party not in default may forthwith terminate this Agreement as far as concerns the future granting of joint use.

(b) If either party shall make default in the performance of any work it is obligated to do under this Agreement at its sole expense, the other party may elect to do such work, and the party in default shall reimburse the other party for the cost thereof. Failure on the part of the defaulting party to make such payment within ..... .days upon presentation of bills therefor shall, at the election of the other party, constitute a default under Section (a) of this Article.

ARTICLE XIV

EXISTING RIGHTS OF OTHER PARTIES

(a) If either of the parties hereto has, prior to the execution of this Agreement, conferred upon others, not parties to this Agreement, by contract or otherwise, rights or privileges to use any poles covered by this Agreement, nothing herein contained shall be construed as affecting such rights or privileges, and either party hereto shall have the right, by contract or otherwise, to continue and extend such existing rights or privileges, it being expressly understood, however, that for the purpose of this Agreement, the attachments of any such outside party, except those of a municipality or other public authority, shall be treated as attachments belonging to the grantor, and the rights, obligations, and liabilities hereunder of the grantor in respect to such attachments shall be the same as if it were the actual owner thereof.

(b) Where municipal regulations require either party to allow the use of its poles for fire alarm, police, or other like signal systems, such use shall be permitted under the terms of this Article, provided attachments of such parties are placed and maintained in accordance with the specifications mentioned in Article III.

ARTICLE XV

ASSIGNMENT OF RIGHTS

Except as otherwise provided in this Agreement, neither party hereto shall assign or otherwise dispose of this Agreement or any of its rights or interests hereunder, or in any of the jointly used poles, or the attachments or rights of way covered by this Agreement, to any firm, corporation or individual, without the written consent of the other party, except to the United States of America or any agency thereof; provided, however, that nothing herein contained shall prevent or limit the right of either party to mortgage any or all of its property, rights, privileges, and franchises, or lease or transfer any of them to another corporation organized for the purpose of conducting a business of the same general character as that of such party, or to enter into any merger or consolidation; and, in case of the foreclosure of such mortgage; or in case of such lease, transfer, merger, or consolidation, its rights and obligations hereunder shall pass to, and be acquired and assumed by, the purchaser on foreclosure, the transferee, lessee, assignee, merging or consolidating company, as the case may be; and provided, further, that subject to all of the terms and conditions of this Agreement, either party may permit any corporation conducting a business of the same general character as that of such party, and owned, operated, leased and controlled by it, or associated or affiliated with it in interest, or connecting with it, the use of all or any part of the space reserved hereunder on any pole covered by this Agreement for the attachments used by such party in the conduct of its said business; and for the purpose of this Agreement, all such attachments maintained on any such pole by the permission as aforesaid of either party hereto shall be considered as the attachments of the party granting such permission, and the rights, obligations and liabilities of such party under this Agreement, with respect to such attachments, shall be the same as if it were the actual owner thereof.

ARTICLE XVI

WAIVER OF TERMS OR CONDITIONS

The failure of either party to enforce or insist upon compliance with any of the terms or conditions of this Agreement shall not constitute a general waiver or relinquishment of any such terms or conditions, but the same shall be and remain at all times in full force and effect.

ARTICLE XVII

PAYMENT OF TAXES

Each party shall pay all taxes and assessments lawfully levied on its own property upon said jointly used poles, and the taxes and the assessments which are levied on said joint poles shall be paid by the owner thereof, but any tax, fee, or charge levied on owner's poles solely because of their use by the licensee shall be paid by the licensee.

ARTICLE XVIII

BILLS AND PAYMENT FOR WORK

Upon the completion of work performed hereunder by either party, the expense of which is to be borne wholly or in part by the other party, the party performing the work shall present to the other party within..............days after the completion of such work an itemized statement of the costs and such other party shall within..............days after such statement is presented pay to the party doing the work such other party's proportion of the cost of said work.

ARTICLE XIX

SERVICE OF NOTICES

Whenever in this Agreement notice is provided to be given by either party hereto to the other, such notice shall be in writing and given by letter mailed, or by personal delivery, to the Cooperative at its office at ...., or to the Telephone Company at its office at ...., as the case may be, or to such other address as either party may from time to time designate in writing for that purpose.

ARTICLE XX

TERM OF AGREEMENT

Subject to the provisions of Article XIII; Defaults, herein, this Agreement shall remain in effect until terminated at the end of 25 years from the date hereof or thereafter upon the giving of written notice to the other party not less than three years prior to the date of termination.

ARTICLE XXI

EXISTING CONTRACTS

All existing agreements between the parties hereto for the joint use of poles are by mutual consent hereby abrogated and superseded by this Agreement.

Nothing in the foregoing shall preclude the parties to this Agreement from preparing such supplemental operating routines or working practices as they mutually agree to be necessary or desirable to effectively administer the provisions of this Agreement.

ARTICLE XXII

APPROVAL OF ADMINISTRATOR

This Agreement, and any amendment thereof, shall be effective subject to the condition that, during any period in which the Cooperative is a borrower from the Rural Electrification Administration, the Agreement and any amendment thereof shall have the approval in writing of the Administrator of the Rural Electrification Administration.

In witness whereof, the parties hereto, have caused these presents to be executed in triplicate, and their corporate seals to be affixed thereto by their respective officers thereunto duly authorized, on the..........day of.., 19....

....

(Seal) By..

Attest:

....

....

(Seal) By..

Attest:

....

APPENDIX A

This Appendix contains tables of pole values to be used in dividing costs as provided under Article VIII. It also outlines the steps for adjusting such values to determine any payments that the licensee must make to the owner to defray costs of premature replacement of poles to accommodate the licensee.

A. Tabulation of New Pole Costs.

The following tabulation shall list mutually agreed upon average costs in place of new poles of all kinds of timber, including only such cost items as are repetitive when poles are replaced.

Table 1

Height	CLASS									
	1	2	3	4	5	6	7	8	9	10
20'										
22'										
25'										
30'										
35'										
40'										
45'										
50'										
55'										
60'										

B. Age Factor for Modifying Values of Poles.

1. The following table of age factors shall be used in adjusting pole costs in Table 1 to arrive at current values in place of existing poles coming under the provisions of this Agreement.

Table 2

Age of Pole	0-3 years	4-9 years	10-15 years	16-21 years	22-27 years	over 27 years
Factor	1.0	.8	.6	.4	.2	0

C. Cost Level Factor.

1. The values obtained from B are to be modified further by the following factors to allow for periodic variation in pole cost levels.

Table 3

For poles set prior to Jan. 1, 1937		
For poles set between Jan. 1, 1937	and Jan. 1, 1945	.5
For poles set between Jan. 1, 1945	and	.7
For poles set between	and	1.0

2. It is intended that additional factors will be added to cover future long term changes in costs.

D. Salvage Value of Poles.

1. A figure of 70% of current material costs shall be used for computing salvage values of poles which have been installed not exceeding 10 years. Average values for all kinds of timber shall be used. The following table sets forth mutually agreed upon salvage values.

Table 4

Height	CLASS									
	1	2	3	4	5	6	7	8	9	10
20'										
22'										
25'										
30'										
35'										
40'										
45'										
50'										
55'										
60'										

2. For poles installed longer than 10 years it shall be assumed that the salvage value is equal to the cost of removal.

Note: This is based on assumption that owner should bear an increasing portion of cost of removal as poles age.

E. Cost of Removal.

1. The following table sets forth mutually agreed upon total costs of removing poles.

Table 5

Height	Cost of Removal
25' or less	
30'	
35'	
40'	
45'	
50'	
55'	

Note:
Annual variations in costs of removal neglected.

F. Anchors.

1. The cost in place of all anchors regardless of size, type or number of thimbles shall be deemed to be..........for use in applying the provisions of this Agreement.

APPENDIX B

This Appendix describes the basic principles and guides which have been used under this Agreement in setting the rents specified in Article XI and which are to be used in making periodical adjustments of rentals as provided for in Article XII.

Under these principles the rentals are intended, in so far as it is practicable, to result in a sharing of the economies realized by the joint use of pole plant in proportion to the relative costs of separate pole line construction.

The procedures outlined herein take into account the following objectives:

1. An equitable division of savings regardless of the number of jointly used poles owned by each party.

2. Rental rates applicable universally in the area covered by the Agreement regardless of whether the pole lines involved are initially constructed with joint use in view or are existing lines modified for joint use.

3. Appropriate allowance in the rental rates for additional costs incurred by each party in supplying 'normal joint poles', as defined in the Agreement, and the costs of other items required in the joint use of poles which would not be incurred in separate line construction.

4. Rentals based on the costs of "typical miles" of separate lines, of newly constructed joint lines and of existing lines modified to make them suitable for joint use. The 'per mile' values of rentals are then reduced to 'per pole' values for purposes of simplifying tabulations and to provide for the joint use of scattered poles.

The rentals are the dollar values resulting from the licensee paying to the owner, as annual rental, an amount representing the annual charge on a separate line for the licensee less the sum of (a) the annual charges on the additional costs incurred by the licensee in establishing joint use and (b) the licensee's share of the total annual savings. This share is the ratio of the Licensee's typical separate line costs to the sum of the typical separate line costs of each of the parties.

The annual rent payable can also be stated as follows:

Licensee's annual rent	Equals	Annual charges saved by licensee through not having to build a separate line	Less	Licensee's appropriate percentage.	Of	Total savings in annual charges realized through joint use

The cost in place of a line of poles is made up of a number of factors including such items as right-of-way solicitation, clearing, staking, direct labor and material costs of bare poles in place and pro rata shares of construction supervision and overhead. These costs, for a specific area, may differ considerably from corresponding costs in other parts of the country. These variations in pole line costs will, however, affect both power and telephone lines to about the same degree.

The parties to this contract will mutually agree on the average cost of a typical mile of 35 foot, class 6 poles in place in their common area. Below are tabulated appropriate rentals over a range of typical mile costs. From this tabulation the parties shall use the rental payments associated with the value nearest to the agreed upon average cost.

RENTAL PAYMENTS

Where the mutually agreed upon average cost per mile of 30 foot class 6 poles in place approximates	The Telephone Company's annual rental payment per pole to the Cooperative will be	The Cooperative's annual rental payment per pole to the Telephone Company will be
$350*	$1.00	$1.70
410	1.10	1.80
470	1.20	1.90
530	1.30	2.00
590	1.40	2.10
650	1.50	2.20
710	1.60	2.30
770**	1.70	2.40

*Rentals associated with this amount are minimum and applicable for all lower costs.
**If average costs are substantially higher than this value, appropriate rentals should be determined by agreement.

 I/A

EXHIBIT WA-32

the utility's pole-related costs are allocated to a given attaching entity. These three components are multiplied in a simple straightforward manner.

Expressed as an equation, the FCC Cable Rate formula is as follows:

Cable Rate Formula =
Net Bare Pole Cost (NBP) x Carrying Charge Factor (CCF) x Space Allocation Factor (SAF)
Where the SAF = Space Occupied by Attacher / Usable Space on Pole

Using the widely accepted FCC presumptions of a 37.5-foot joint use pole, with 13.5 feet of usable space, 24 feet of unusable space,[21] and 1 foot of space occupied by the attacher, the cost allocation factor—applicable to the costs of the entire pole—is 1/13.5 share or 7.41%.[22] As with any presumptive value in the formula, to the extent there is actual (or statistically significant) utility or attacher specific data to support the use of alternative space presumptions those can be used in lieu of the FCC's established space presumptions subject to Commission oversight. So, for example, if actual data exists to support use of a 35-foot joint use pole with 11 feet of usable space and 24 feet of unusable space, the space allocation factor would be 1/11 share or 9.09%. The allocation of the costs of the entire pole under the Cable Rate using FCC space presumptions is illustrated graphically in Exhibit PDK-3 to this testimony.

V. ECONOMIC RATIONALE FOR THE CABLE RATE'S PROPORTIONAL COST ALLOCATOR

Q. The defining feature of the Cable Rate methodology is its third component, i.e., the space allocation factor used to allocate the annual costs attributable

[21] This corresponds to 18 feet above ground clearance and 6 feet of below ground support.
[22] *See* 47 C.F.R. § 1.1418.

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EXHIBIT WA-33

PUB

Blue Ridge EMC
Rental Rate Formula Comparison
FY 2014, 2015, 2016

	APSC			TVA			APPA			FCC Telecom Plus			FCC Cable Only		
	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016
Space Allocation:															
Space occupied by attacher	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Safety Space				3.33	3.33	3.33									
Usable Space							6.20	6.24	6.28				9.53	9.57	9.61
Usable Space Factor							3.01%	3.01%	3.01%						
Unusable space (Support)	30.63	30.61	30.59	27.30	27.28	27.26	30.63	30.61	30.59	27.30	27.28	27.26			
Unusable Space Allocation Factor	66.67%	66.67%	66.67%				35.39%	35.35%	35.31%	1.00	1.00	1.00			
Number of attaching entities	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35			
Pole height	36.83	36.85	36.87	36.83	36.85	36.87	36.83	36.85	36.87	36.83	36.85	36.87			
Space Allocation % - Licensee	**26.61%**	**26.58%**	**26.55%**	**41.25%**	**41.21%**	**41.16%**	**38.40%**	**38.36%**	**38.32%**	**34.56%**	**34.51%**	**34.47%**	**11.65%**	**11.60%**	**11.55%**
Net Cost of Bare Pole	**$262.73**	**$262.19**	**$258.30**	**$262.73**	**$262.19**	**$258.30**	**$398.02**	**$406.94**	**$413.21**	**$262.73**	**$262.19**	**$258.30**	**$262.73**	**$262.19**	**$258.30**
Carrying Charges:															
Administrative	3.49%	3.33%	3.24%	3.49%	3.33%	3.24%	2.39%	2.24%	2.12%	3.49%	3.33%	3.24%	3.49%	3.33%	3.24%
Maintenance	6.81%	6.84%	7.30%	6.80%	6.83%	6.91%	4.85%	4.83%	5.05%	6.81%	6.84%	7.30%	6.81%	6.84%	7.30%
Depreciation	5.45%	5.59%	5.76%	5.45%	5.59%	5.76%	3.60%	3.60%	3.60%	5.45%	5.59%	5.76%	5.45%	5.59%	5.76%
Taxes	0.74%	0.50%	0.57%	0.74%	0.50%	0.57%	0.51%	0.34%	0.37%	0.74%	0.50%	0.57%	0.74%	0.50%	0.57%
Return on Investment	8.00%	8.00%	8.00%	8.50%	8.50%	8.50%	7.43%	7.25%	6.88%	11.25%	11.25%	11.00%	11.25%	11.25%	11.00%
Total Carrying Charges	**24.49%**	**24.26%**	**24.87%**	**24.99%**	**24.76%**	**24.98%**	**18.77%**	**18.25%**	**18.02%**	**27.74%**	**27.51%**	**27.87%**	**27.74%**	**27.51%**	**27.87%**
Rate	**$17.12**	**$16.91**	**$17.05**	**$27.08**	**$26.75**	**$26.56**	**$28.69**	**$28.50**	**$28.54**	**$25.19**	**$24.90**	**$24.81**	**$8.49**	**$8.37**	**$8.31**

FCC CABLE-ONLY RATE
Blue Ridge EMC
FY 2014 Data

Line #	Description	Amount	Definition
	Attacher Responsibility Percentage		
1	Space occupied	1.11	Per audit
2	Total usable space	9.53	Calculation-includes Safety Space
3	**Attacher responsibility percentage**	**11.65%**	Line 1/Line 2
	Net Cost of a Bare Pole		
4	Gross pole investment (Acct. 364)	49,295,043	
5	Accumulated depreciation for poles	16,755,290	
6	Accumulated deferred income taxes	0	
7	Net pole investment	32,539,753	Line 4 - Line 5 - Line 6
8	Appurtenance factor	87.00%	
9	Net pole investment allocable to attachments	28,309,585	Line 7 x Line 8
10	Total number of poles	107,751	
11	**Net cost of a bare pole**	**$262.73**	Line 9/Line 10
	Carrying Charge		
12	Total general and administrative	10,164,119	
13	Total electric plant in service	425,883,764	
14	Total electric plant accumulated depreciation	134,648,942	
15	Total electric plant accumulated deferred income taxes	0	
16	**Administrative carrying charge**	**3.49%**	Line 12/(Line 13 - Line 14 - Line 15)
17	Maintenance expense for overhead lines	7,674,619	
18	Pole investment in Accts. 364, 365, & 369	158,218,973	
19	Depreciation (poles) related to Accts. 364, 365, & 369	45,505,682	
20	Accumulated deferred income taxes for 364, 365, & 369	0	
21	**Maintenance carrying charge**	**6.81%**	Line 17/(Line 18 - Line 19 - Line 20)
22	Gross pole investment (Acct. 364)	49,295,043	
23	Net pole investment	32,539,753	Line 7
24	Depreciation rate for gross pole Investment	3.60%	
25	**Depreciation carrying charge**	**5.45%**	(Line 22/Line 23) x Line 24
26	Taxes (Accts. 408.1 + 409.1 + 410.1 + 411.4 - 411.1)	2,160,782	
27	Total utility plant in service	425,883,764	
28	Total company accumulated depreciation	134,648,942	
29	Total company accumulated deferred income taxes	0	
30	**Taxes carrying charge**	**0.74%**	Line 26/(Line 27 - Line 28 - Line 29)
31	Applicable rate of return (default)	11.25%	Presumption
32	**Return carrying charge**	**11.25%**	
33	**Total carrying charges**	**27.74%**	Line 16 + Line 21 + Line 25 + Line 30 + Line 32
	RATE		
34	**Attacher responsibility percentage**	**11.65%**	Line 3
35	**Net cost of a bare pole**	**$262.73**	Line 11
36	**Total carrying charges**	**27.74%**	Line 33
37	**Pole attachment rate for cable-only**	**8.49**	Line 34 x Line 35 x Line 36

FCC CABLE-ONLY RATE
Blue Ridge EMC
FY 2015 Data

Line #	Description	Amount	Definition
	Attacher Responsibility Percentage		
1	Space occupied	1.11	Per audit
2	Total usable space	9.57	Calculation-includes Safety Space
3	**Attacher responsibility percentage**	**11.60%**	Line 1/Line 2
	Net Cost of a Bare Pole		
4	Gross pole investment (Acct. 364)	50,390,546	
5	Accumulated depreciation for poles	17,924,217	
6	Accumulated deferred income taxes	0	
7	Net pole investment	32,466,329	Line 4 - Line 5 - Line 6
8	Appurtenance factor	87.29%	
9	Net pole investment allocable to attachments	28,339,266	Line 7 x Line 8
10	Total number of poles	108,086	
11	**Net cost of a bare pole**	**$262.19**	Line 9/Line 10
	Carrying Charge		
12	Total general and administrative	9,870,339	
13	Total electric plant in service	440,866,858	
14	Total electric plant accumulated depreciation	144,871,920	
15	Total electric plant accumulated deferred income taxes	0	
16	**Administrative carrying charge**	**3.33%**	Line 12/(Line 13 - Line 14 - Line 15)
17	Maintenance expense for overhead lines	7,951,569	
18	Pole investment in Accts. 364, 365, & 369	164,546,374	
19	Depreciation (poles) related to Accts. 364, 365, & 369	48,323,315	
20	Accumulated deferred income taxes for 364, 365, & 369	0	
21	**Maintenance carrying charge**	**6.84%**	Line 17/(Line 18 - Line 19 - Line 20)
22	Gross pole investment (Acct. 364)	50,390,546	
23	Net pole investment	32,466,329	Line 7
24	Depreciation rate for gross pole Investment	3.60%	
25	**Depreciation carrying charge**	**5.59%**	(Line 22/Line 23) x Line 24
26	Taxes (Accts. 408.1 + 409.1 + 410.1 + 411.4 - 411.1)	1,477,001	
27	Total utility plant in service	440,866,858	
28	Total company accumulated depreciation	144,871,920	
29	Total company accumulated deferred income taxes	0	
30	**Taxes carrying charge**	**0.50%**	Line 26/(Line 27 - Line 28 - Line 29)
31	Applicable rate of return (default)	11.25%	Presumption
32	**Return carrying charge**	**11.25%**	
33	**Total carrying charges**	**27.51%**	Line 16 + Line 21 + Line 25 + Line 30 + Line 32
	RATE		
34	**Attacher responsibility percentage**	**11.60%**	Line 3
35	**Net cost of a bare pole**	**$262.19**	Line 11
36	**Total carrying charges**	**27.51%**	Line 33
37	**Pole attachment rate for cable-only**	**8.37**	Line 34 x Line 35 x Line 36

FCC CABLE-ONLY RATE
Blue Ridge EMC
FY 2016 Data

Line #	Description	Amount	Definition
	Attacher Responsibility Percentage		
1	Space occupied	1.11	Per Audit
2	Total usable space	9.61	Calculated - Includes Safety Space
3	**Attacher responsibility percentage**	**11.55%**	Line 1/Line 2
	Net Cost of a Bare Pole		
4	Gross pole investment (Acct. 364)	51,209,182	
5	Accumulated depreciation for poles	19,197,595	
6	Accumulated deferred income taxes	0	
7	Net pole investment	32,011,587	Line 4 - Line 5 - Line 6
8	Appurtenance factor	87.41%	
9	Net pole investment allocable to attachments	27,981,967	Line 7 x Line 8
10	Total number of poles	108,330	
11	**Net cost of a bare pole**	**$258.30**	Line 9/Line 10
	Carrying Charge		
12	Total general and administrative	9,666,925	
13	Total electric plant in service	454,916,323	
14	Total electric plant accumulated depreciation	156,430,349	
15	Total electric plant accumulated deferred income taxes	0	
16	**Administrative carrying charge**	**3.24%**	Line 12/(Line 13 - Line 14 - Line 15)
17	Maintenance expense for overhead lines	8,486,535	
18	Pole investment in Accts. 364, 365, & 369	168,093,587	
19	Depreciation (poles) related to Accts. 364, 365, & 369	51,825,495	
20	Accumulated deferred income taxes for 364, 365, & 369	0	
21	**Maintenance carrying charge**	**7.30%**	Line 17/(Line 18 - Line 19 - Line 20)
22	Gross pole investment (Acct. 364)	51,209,182	
23	Net pole investment	32,011,587	Line 7
24	Depreciation rate for gross pole investment	3.60%	
25	**Depreciation carrying charge**	**5.76%**	(Line 22/Line 23) x Line 24
26	Taxes (Accts. 408.1 + 409.1 + 410.1 + 411.4 - 411.1)	1,698,970	
27	Total utility plant in service	454,916,323	
28	Total company accumulated depreciation	156,430,349	
29	Total company accumulated deferred income taxes	0	
30	**Taxes carrying charge**	**0.57%**	Line 26/(Line 27 - Line 28 - Line 29)
31	Applicable rate of return (default)	11.00%	Presumption
32	**Return carrying charge**	**11.00%**	
33	**Total carrying charges**	**27.87%**	Line 16 + Line 21 + Line 25 + Line 30 + Line 32
	RATE		
34	**Attacher responsibility percentage**	**11.55%**	Line 3
35	**Net cost of a bare pole**	**$258.30**	Line 11
36	**Total carrying charges**	**27.87%**	Line 33
37	**Pole attachment rate for cable-only**	**8.31**	Line 34 x Line 35 x Line 36

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EXHIBIT WA-34

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EXHIBIT WA-35

MCNAIR, MCLEMORE, MIDDLEBROOKS & CO., LLP
CERTIFIED PUBLIC ACCOUNTANTS
A PARTNERSHIP INCLUDING A PROFESSIONAL CORPORATION

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July 23, 1998

Ms. Roberta D. Purcell
Assistant Administrator
Program Accounting and Regulatory Analysis
USDA-RUS, Room 4063
14th & Independence Ave., SW
Washington, D.C. 20250

Dear Ms. Purcell:

As we previously discussed, the Georgia cooperatives are negotiating a joint use agreement with BellSouth.

BellSouth has stated "Booked cost is the only acceptable cost for calculation of joint use rental" (Exhibit A). The cooperatives disagree with this position based on the following:

- Cooperatives have used average historical cost for retirements. This is the method of retirement provided for in RUS Bulletin 1767B-2, 8.4.4 (Exhibit B). This method has been consistently applied by all the cooperatives and has resulted in plant being retired at a value higher than the original cost. The effect is to understate gross plant, accumulated depreciation expense and depreciation rates.

- The Investor-Owned Utilities (IOUs) in Georgia utilize vintage retirement rather than average historical cost.

- Based on data obtained from FERC Form 1, pole costs for IOUs in Georgia range from approximately $485 (Exhibit C) to $525 (Exhibit D) per pole. Pole cost utilizing book values for Georgia cooperatives is approximately $210 per pole (Exhibit E). The cooperatives and IOUs to a great degree utilize common suppliers and contractors to obtain, install and remove poles. The conclusion is the methodology for retiring plant is the primary cause of the significantly lower book costs for the cooperatives.

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- The cooperative's do not have vintage retirement unit costs, so in order to establish the cost of poles currently in place, we utilized the following alternative costing methodology. Costing methodology was to:

  - Select 3 cooperatives (urban, suburban, rural) representing approximately 20% of the joint use poles.
  - Determine 1997 pole cost.
  - Obtain additions and retirement data for over 30 years for selected cooperatives.
  - Have an independent statistician apply the additions and retirements to the Iowa survivor curve in a program maintained by the Interstate Commerce Commission (Exhibit F).
  - Utilize the Iowa survivor curve data to determine the number of surviving poles by year installed.
  - Utilize the Handy Whitman Index for wooden utility poles (see attachment) in the South Atlantic Region to determine post cost for years prior to 1997 (Exhibit G).

- The result indicated the average pole cost for the cooperatives in the sample, exclusive of anchor and guys, was $233 for poles 35' and under and $412 for 40' poles (Exhibit H).

Based on the information provided, would you let me know if RUS recognizes the cost discrepancies which result from utilizing historical average costing for retirement purposes and recognizes that vintage retirement provides better cost data and your opinion as to whether our alternative approach based on data available provides better costing data than the utilization of average historical cost for retirements. In addition, would you recommend cooperatives convert from the current method to vintage retirement and if so, what data is necessary from RUS's perspective in order to convert. Please give me a call if you have any questions or need any additional information.

Respectfully,

J. Randolph Nichols

JRN/lja

Enclosures

cc: Tim Clower (Enclosures)
Will Arnett (Enclosures)
Mike Whiteside
Hugh Richardson

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AUDIT

USDA

United States Department of Agriculture
Rural Development

Rural Business-Cooperative Service • Rural Housing Service • Rural Utilities Service
Washington, DC 20250

AUG - 4 1998

Mr. J. Randolph Nichols
McNair, McLemore, Middlebrooks & Co., LLP
P.O. Box 1
Macon, Georgia 31202

Dear Mr. Nichols:

We have reviewed the information included in your letter dated July 23, 1998, and offer the following comments.

The Uniform System of Accounts as set forth in 7 CFR Part 1767, Accounting Requirements for RUS Electric Borrowers, establishes the requirement that all Rural Utilities Service (RUS) electric borrowers establish continuing property records (CPRs). The Uniform System of Accounts does not, however, specify a method for establishing and maintaining those records. In the 1930s, 1940s, and 1950s, when many of the RUS electric cooperatives were founded, plant costs were relatively stable from year to year and inflationary trends were nonexistent. Because the RUS systems were small with few employees, RUS developed an average-cost CPR system that required a minimal amount of recordkeeping. Each time a unit was added to plant, its cost was factored into the average cost of all units within that CPR category. When a unit was retired, it was retired at the then-current, average cost of the units within the CPR.

As indicated in your letter, RUS Bulletin 1767 B-2, Work Order Procedure (Electric), still provides for the use of the average cost method. During times of rising costs, however, the average cost method materially understates plant values. Typically, it is the older, lower cost units that are first retired on a system. When these units are retired at an inflated average cost, one that is more reflective of current-day prices, the system value is inappropriately reduced. For example, a pole originally recorded on a cooperative's books and records at $100 may be retired at an average cost of $300. In so doing, plant is understated by $200 as a result of that one retirement.

It is for this reason that RUS is actively encouraging its borrowers to adopt vintage year property records. Under a vintage-year property record system, all plant items within a CPR that are placed in service in a single year are considered to be a distinct group for depreciation purposes (e.g. all poles placed in service in 1995 would represent one vintage while poles placed in service in 1996 would represent another). When a unit is retired, it is retired at the vintage's average cost thereby more accurately reflecting its actual cost.

Studies have shown that any RUS cooperative utilizing an average-cost CPR system will have an undervalued system. Systems in areas that have experienced significant growth during the last 20 years will be materially undervalued. When RUS borrowers have performed system-wide inventories to establish vintage year property records, recorded plant values have ranged from between 50 and 65 percent of their actual original cost.

As indicated in your letter, vintage-year property values can be established utilizing the Iowa survivor curves. With the information available from a borrower's records, the number of units and dollars installed each year as well as the number and dollar balances at year's end can be determined. We can also determine the total number of units retired; however, we will not know in which year the unit retired was first placed into service (vintage year). From this information, simulated vintage-year plant records can be developed through a type of regression analysis. By taking the known additions and ending balance for each year, we can "simulate" the vintage retirements that would occur under the retirement pattern of each of the Iowa curves. Each simulated curve is then matched against actual data to determine the best curve fit.

Based upon the information provided with your letter, it appears that the Georgia cooperatives have performed a similar procedure in determining their pole values. The data presented is consistent with the data and conclusions that have been drawn from depreciation studies performed by RUS cooperatives throughout the country. If you have any questions or if we can be of any further assistance, please contact us.

Sincerely,

Roberta D Purcell

ROBERTA D. PURCELL
Assistant Administrator
Program Accounting and
Regulatory Analysis

Respondent's Cross Exhibit 1
--1A

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service

RUS BULLETIN 1728F-804

SUBJECT: **Specifications and Drawings for 12.47/7.2 kV Line Construction**

Incorporated by reference in 7 CFR Part 1728

TO: All RUS Electric Borrowers
RUS Electric Staff

EFFECTIVE DATE: October 2005

OFFICE OF PRIMARY INTEREST: Distribution Branch, Electric Staff Division

FILING INSTRUCTIONS: This bulletin is a revision of previous RUS Bulletin 50-3 (D-804), (dated May 9, 1983) "Specifications and Drawings for 12.5/7.2 kV Line Construction" and has been renumbered, renamed and updated as RUS Bulletin 1728F-804, "Specifications and Drawings for 12.47/7.2 kV Line Construction." Replace previous Bulletin 50-3 with this bulletin. This bulletin should be filed with 7 CFR 1728.

PURPOSE: The specifications and drawings of this bulletin have been published to set forth RUS requirements, specifications and standards for the construction of 12.47/7.2 kV overhead electric distribution lines and associated equipment and construction assembly units that RUS electric borrowers install.

GENERAL: This new bulletin 1728F-804 was derived from previous RUS Bulletin 50-3 identified above. Listed below are some of the significant changes and additions that were made during the update of this bulletin:

(a) RUS has discontinued 82 assemblies and 24 guide drawings previously in Bulletin 50-3. Borrowers shall no longer use these discontinued assemblies and guide drawings for new construction.

(b) A total of 167 assemblies and 8 guide drawings were re-used, redrawn, and renumbered using the new RUS standard numbering format. (New Exhibit 5 at the end of the bulletin briefly explains the new numbering format.) The new drawings of these re-used assemblies and guide drawings show in parentheses the old assembly and guide drawing numbers from Bulletin 50-3. Borrowers must use the new assembly and guide drawing numbers, however, ***borrowers may elect to continue using the old numbers of these assembly and guide drawings, but only for the 167 assemblies and 8 guide drawings and their old numbers if they make the following changes:***

(1) Make washer additions or changes on 37 of the re-used assemblies, and,

(2) Make other slight material changes to 35 of the old assemblies.

(c) Exhibit 3 at the end of this bulletin tabulates: (1) all of the discontinued assemblies and guide drawings of old Bulletin 50-3, (2) all of the re-used assemblies and guide drawings with both their old and new numbers, and (3) the required washer and material changes (if any) in the transition from the re-used old assembly to the new assembly.

(d) This new bulletin contains a total of 214 new assemblies (95 of which are narrow profile assemblies) and 32 new guide drawings.

(e) The bulletin has been reformatted into 19 separate sections or categories. Each of the sections contains an index of drawings and the construction drawings of assemblies designed to perform a similar function. Ten of the sections contain new and revised construction specifications and informational details pertaining to the assemblies within the section.

(f) "Design parameters", which define and usually limit maximum line angles or mechanical loading (tension), have been added to most of the drawings.

(g) New tables have been added to define maximum line angles on pole top assemblies and permitted unbalanced conductor tensions on crossarm assemblies. Page 1 of Exhibit 1 documents the formula and data used to determine the maximum line angles in the tables in Exhibit 1. Exhibit 2 documents the formula and data used to determine permitted unbalanced conductor tensions on crossarms.

(h) Each drawing has been given a new, shorter, and more uniform title or name.

(i) Three sets of coordinated "narrow profile," one, two and three-phase assemblies for all line angles have been incorporated into this bulletin.

(j) New specifications explaining the conditions that borrowers may modify the assemblies and drawings of this bulletin are provided in the "General Construction Specifications."

(k) New specifications and conditions for the use of stirrups were added in Section L.

(l) New specifications and conditions for grounding or insulating guy wires were added in Section G.

Curtis M. Anderson

Curtis M. Anderson
Acting Administrator
Rural Utilities Service

April 1, 2005

Date

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1-d	*Narrow Profile Assemblies Grouped by Bracket Configuration*
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B	TWO-PHASE PRIMARY POLE TOP ASSEMBLY UNITS Index B Two-Phase Primary Pole Top Construction Drawings
C	THREE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS Index C Three-Phase Primary Pole Top Construction Drawings
D	DOUBLE-CIRCUIT PRIMARY POLE TOP ASSEMBLY UNITS Index D Double-Circuit Primary Pole Top Construction Drawings
E	GUYING ASSEMBLY UNITS Index E *Construction Specifications for Guys* Guying Construction Drawings
F	ANCHOR ASSEMBLY UNITS Index F *Construction Specifications for Anchoring* *Soil Classifications (Table)* Anchor Construction Drawings
G	TRANSFORMER ASSEMBLY UNITS Index G *Construction Specifications for Transformers* Transformer Construction Drawings
H	GROUNDING ASSEMBLY UNITS Index H *Construction Specifications for Grounding* Grounding Construction Drawings

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P PROTECTION ASSEMBLY UNITS
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Q METERING ASSEMBLY UNITS
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S SECTIONALIZING ASSEMBLY UNITS
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	Calculation of Maximum Line Angles
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	Table V: Maximum Line Angles (Pin Insulators) - 2,000 lbs./Conductor
	Table VI: Maximum Line Angles (Spool Insulators) - 1,500 lbs./Conductor
	Table VII: Maximum Line Angles (Spool Insulators) - 2,250 lbs./Conductor
2	LONGITUDINAL LOADING ON CROSSARM ASSEMBLIES
	TABLE A: Permitted Unbalanced Conductor Tension - (1 phase/side of pole)
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3	DISPOSITION OF ASSEMBLIES IN BULLETIN 50-3 (D 804)
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5	RUS STANDARD FORMAT AND MEANING OF OVERHEAD DISTRIBUTION ASSEMBLY NUMBERS
6	TABLE OF SELECTED SI TO METRIC CONSVERSIONS

GENERAL CONSTRUCTION SPECIFICATIONS

All construction shall be performed in a safe, thorough, and skillful manner in accordance with the staking sheets, plans and specifications, and the construction drawings.

The provisions of 7 CFR 1724.50, "Compliance with National Electrical Safety Code (NESC)" apply to all borrower electric system facilities regardless of the source of financing. A borrower must ensure that its electric system including all distribution, transmission, and generating facilities, is designed, constructed, operated, and maintained in accordance with all of the applicable provisions of:

(1) the most current provisions of the NESC, and

(2) all applicable and current electrical and safety requirements of any State or local governmental entity.

Any electrical standard requirements established by RUS are in addition to, and not a substitution for nor modification of (1) and (2) listed immediately above.

The permitted loading, strength, and spacing (separation) of structures, assemblies and conductors shown on the assembly drawings in this bulletin are based on and are in compliance with the 2002 Edition of the NESC.

Copies of the NESC may be obtained from the Institute of Electrical and Electronics Engineers, Inc., (IEEE) at the following address:

IEEE Customer Service
445 Hoes Lane, PO Box 1331
Piscataway, NJ 08855-1331
Telephone: 1-800-678-4333

Overhead distribution circuits shall be constructed with not less than the Grade C strength requirements as described in section 26, Strength Requirements, of the NESC when subjected to the loads specified in NESC Section 25, Loadings for Grades B and C. Distribution lines that underbuild transmission circuits or that cross over limited access highways and railroad tracks shall be constructed with not less than the Grade B strength requirements as described in NESC Section 26.

The drawings of equipment and materials shown in the construction assemblies depict the general categories of items found in RUS Informational Publication 202-1, "List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers" ("List of Materials"). Any drawing of any piece of equipment or material that resembles a specific product of a manufacturer is unintentional.

GENERAL CONSTRUCTION SPECIFICATIONS (*Cont.*)

Materials to be used for construction are designated by one or two lower-case alphabetic characters shown on the drawings and in the "ITEM" column in the drawing material blocks. For example, "b" designates a steel, pole top pin. A borrower shall use, at its discretion, any of the applicable pole top pins from category "b" of the "List of Materials

The drawings in this bulletin show the use of two, 4 1/4 inch, American National Standards Institute (ANSI) Class 52-9A suspension insulators for 12.47/7.2 kV primary deadends. However, borrowers may alternatively use two, 6-inch, ANSI Class 52-1 suspension insulators, or one polymer distribution insulator, all of which are contained in category "k" in the "List of Materials." In the case of polymer insulators, the quantity ("QTY") of the insulators to be used must be modified accordingly in the material blocks of the drawings.

Normally crossarm pins and post-type insulators come equipped with washers and locknuts. Thus, the washers and locknuts for crossarm pins are not tallied in the "QTY" (quantity) columns in the material boxes on the construction drawings. However, the crossarm pin washers and locknuts are shown on the construction drawings in parenthesis to depict proper construction. If crossarm pins or post type insulators are purchased without washers, locknuts or studs, the quantity totals in the material boxes on the construction drawings will need to be adjusted accordingly.

Locknuts shall be installed on all threaded material and hardware in addition to nuts and washers. The threads on installed bolts shall protrude past the lock washers a minimum of one inch but not more than two inches.

Sometimes it may be prudent or necessary to modify RUS standard distribution assemblies to solve encountered construction problems. For example, a standard C6.1 assembly may need to be modified with heavy-duty crossarm braces (assembly W3.2) to support large conductors. RUS has not produced the scores of new assemblies like the example because the resulting bulletin would be quite unwieldy. Therefore, borrowers themselves may develop and use assemblies similar to the example without additional RUS approval. Borrowers' assemblies not specifically approved by RUS shall not have component spacing less than, or permitted longitudinal loads (strengths) greater than those on correlated RUS standard assemblies. Borrowers need to properly account for the new assembly material and assign assembly numbers recognizably different than RUS standard assembly numbers.

RUS approval and assembly number changes are not required to add the following types of information to RUS assembly drawings: material inventory numbers, bolt lengths, jumper wire sizes, types of connectors, armor rods, etc.

CONDUCTOR INSTALLATION SPECIFICATIONS

Conductors shall be handled with care and shall not be trampled on or run over by vehicles. Each reel shall be examined and the wire shall be inspected for cuts, kinks, or other damage. Damaged portions shall be cut out and the conductor spliced. The conductors shall be pulled over suitable rollers or stringing blocks properly mounted on the pole or crossarm to prevent binding or damage while stringing.

Conductors shall be sagged evenly and in accordance with the conductor manufacturer's recommendations. The air temperature at the time and place of sagging shall be determined by the use of a certified thermometer. The sag of all conductors after stringing shall be in accordance with the engineer's instructions.

For new construction, splices shall be no closer than 1,000 feet from one another and there shall be no more than 3 splices per mile in any primary phase or neutral conductor. Furthermore, splices shall not be located within 10 feet of any supporting structure. For all construction, splices shall not be located in Grade B crossing spans and preferably not in adjacent spans. Splices shall be installed in accordance with the manufacturer's specifications and recommendations.

All conductors shall be cleaned thoroughly by wirebrushing before splicing or installing connectors or clamps. A suitable oxidation inhibitor shall be applied before splicing or applying connectors over aluminum conductor.

CONSTRUCTION SPECIFICATIONS FOR POLE TOP ASSEMBLIES

The neutral conductor shall be installed on the same side (preferably the roadside) of all tangent and small angle poles throughout each line section. See "Construction Specifications for Poles and Crossarms" in Section W of this bulletin for additional pole and crossarm construction specifications.

Neutral attachments may be lowered on standard pole top assemblies a distance not exceeding 2 feet for the purpose of economically meeting conductor clearance requirements of the NESC.

Neutral attachments may be lowered on standard pole top assemblies a distance not exceeding an additional 6 feet for the purpose of performing construction and future line maintenance on these assemblies from bucket trucks designed for such work.

The conductor shall be tied to the top groove of pin-type or post-type insulators on tangent poles. On angle structures the conductor shall be tied on the side of the insulator opposite the direction of the strain. Pin-type and post-type insulators shall be tight on the pins and brackets, respectively, and the top groove shall be in line with the conductor after tying. Borrowers shall not allow any upstrain on pin-type or post-type insulators.

A 3 inch by 3 inch (minimum), square, curved washer (item "d") shall be used abutting the pole when installing primary deadend, neutral deadend and guy assemblies directly to the pole. These washers mitigate the crushing of wood fibers and facilitate the permitted longitudinal loads shown on the construction drawings.

A 2 ¼ inch (minimum) square washer shall be placed under the shoulder of 7.2 kV crossarm insulator pins whose surface area abutting the crossarm is less than 4 square inches. These washers mitigate the crushing of wood fibers and facilitate the permitted transverse loading shown in the maximum line angle tables in Exhibit 1.

The maximum line angles on tangent construction assemblies shall be limited to 5 degrees for small conductors and 2 degrees for conductors larger than # 1/0 because of likely slippage of the neutral conductor off of a spool-type insulator. Furthermore, based on additional calculations by the design engineer, these maximum line angles may need to be reduced for NESC Grade B construction.

Deadend and suspension angle pole top assemblies attached directly to poles shall be designed to hold the sum of all expected loads multiplied by the appropriate overload factors of NESC Table 253-1.

RUS has applied the applicable strength factors for Grade C construction from NESC Table 261-1A in the calculations for permitted longitudinal loading shown in the design parameters on the drawings. The permitted longitudinal loading on primary deadend assemblies attached directly to poles is based on 50 percent of the rated ultimate strength of the suspension insulators shown on the assembly drawings.

CONSTRUCTION SPECIFICATIONS FOR POLE TOP ASSEMBLIES *(cont.)*

The maximum line angles for pole top primary assemblies in the tables in Exhibit 1 are based on the RUS designated maximum load on crossarm insulator pins, post type insulators, or pole top pins and the assumed conductor tensions tabulated on page 1 of Exhibit 1. The applicable overload factors from NESC Table 253-1, for Grade C construction, have already been applied in the calculations for the maximum line angles. For large conductor sizes, the design engineer may need to calculate new (smaller) maximum line angles for NESC Grade B construction.

The permitted unbalanced conductor tensions on primary deadend assemblies attached to crossarms are based on the results of the equations and methodology explained in Exhibit 2 of this bulletin. RUS has applied the overload factors of NESC Table 253-1 and used the assumed conductor tensions tabulated on page 1 of Exhibit 1 to calculate the permitted unbalanced conductor tensions shown in Tables A and B of Exhibit 2 of this bulletin. The permitted unbalanced conductor tensions on crossarm assemblies shall be reduced by 40 percent for NESC Grade B construction.

RUS categorizes conductor sizes as follows:

- **Small conductors** are conductors with a rated breaking strength of less than 4,500 pounds (20,000 newtons), e.g., 1/0 Aluminum Conductor - Steel Reinforced (ACSR) and smaller.

- **Large conductors** are conductors with a rated breaking strength of 4,500 pounds (20,000 newtons) or greater but less than 10,000 pounds (45,000 newtons), e.g., 2/0 ACSR through 4/0 ACSR or 336.4 kcmil (18/1) ACSR.

- **Extra large conductors** are conductors with a rated breaking of 10,000 pounds (45,000 newtons) or greater, e.g., 266.8 kcmil (26/7) ACSR and larger.

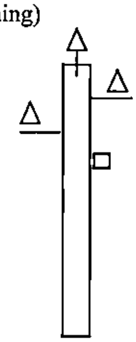
Primary pole top assemblies identified as "large conductors" in the drawing titles shall be used to support large and extra large conductors. Large conductor assemblies may also be used for small conductors. Furthermore, large and extra large conductors may be installed on assemblies not designated as large conductors provided that the expected transverse or longitudinal loads (multiplied by the appropriate NESC overload factors) do not exceed the permitted loads or tensions shown on the design parameters of the drawings. For any conductor size, the horizontal, vertical or transverse loads shall not exceed the permitted strength of crossarms, crossarm pins, insulators, or insulator bracket assemblies. Usually, extra large conductors require that pin type and post type insulators have a "C" neck for conductor sizes up through 477.0 (18/1) ACSR and "J" necks for conductor sizes up to 795 kcmil, depending on the armor rods selected.

NARROW PROFILE ASSEMBLIES GROUPED BY BRACKET CONFIGURATION

"STANDARD" ASSEMBLIES (1-foot, 9-inch spacing)

(APPLICATIONS: Convert existing standard 1-phase; Standard pole framing)

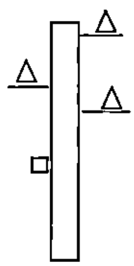
MAX. LINE ANGLES	1-PHASE	2-PHASE	3-PHASE
Tangent	A1.1, A1.2	**B1.1N, B1.2N**	**C1.1N, C1.2N**
"	A1.1P, A1.2P	**B1.1NP, B1.2NP**	**C1.1NP, C1.2NP**
" (NESC Grade B)	A2.1, A2.2	**B2.1N, B2.2N**	**C2.1N, C2.2N**
" (NESC Grade B)	A2.1P, A2.2P	**B2.1NP, B2.2NP**	**C2.1NP, C2.2NP**
Table I	A1.3	**B1.3N**	**C1.3N**
Table II	A1.3P	**B1.3NP**	**C1.3NP**
Table III	A2.3	**B2.3N**	**C2.3N**
Table III			**C2.3NG**
Table IV	A2.3P	**B2.3NP**	**C2.3NP**



"STAGGERED" ASSEMBLIES (2-foot spacing)

(APPLICATIONS: New construction; Transmission underbuild)

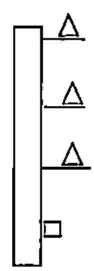
MAX. LINE ANGLES	1-PHASE	2-PHASE	3-PHASE
Tangent	**A1.4N, A1.5N**	**B1.4N, B1.5N**	**C1.4N, C1.5N**
"	**A1.4NP, A1.5NP**	**B1.4NP, B1.5NP**	**C1.4NP, C1.5NP**
" (NESC Grade B)	**A2.4N, A2.5N**	**B2.4N, B2.5N**	**C2.4N, C2.5N**
" (NESC Grade B)	**A2.4NP, A2.5NP**	**B2.4NP, B2.5NP**	**C2.4NP, C2.5NP**
Table II	**A1.6N**	**B1.6N**	**C1.6N**
Table II	**A1.6NP**	**B1.6NP**	**C1.6NP**
Table IV	**A2.6N**	**B2.6N**	**C2.6N**
Table IV	**A2.6NP**	**B2.6NP**	**C2.6NP**



"VERTICAL" ASSEMBLIES (4-foot spacing)

(APPLICATIONS: Large line angles; Tree and building clearances)

MAX. LINE ANGLES	1-PHASE	2-PHASE	3-PHASE
Tangent	(Same as "Staggered" Assemblies)	**B1.7N, B1.8N**	**C1.7N, C1.8N**
"		**B1.7NP, B1.8NP**	**C1.7NP, C1.8NP**
" (NESC Grade B)		**B2.7N, B2.8N**	**C2.7N, C2.8N**
" (NESC Grade B)		**B2.7NP, B2.8NP**	**C2.7NP, C2.8NP**
Table II		**B1.9N**	**C1.9N**
Table II		**B1.9NP**	**C1.9NP**
Table IV		**B2.9N**	**C2.9N**
Table IV		**B2.9NP**	**C2.9NP**



MISC. ASSEMBLIES

A1.04N, A1.04NP	Single support brackets and insulators (Single-phase, Table II)
A2.04N, A2.04NP	Double support brackets and insulators (Single-phase, Table IV)
A5.3NG	Single-phase tap guide (Narrow profile)
A5.4NG	Single-phase tap guide with cutout and arrester (Narrow profile)
D1.4N, D1.4NP	Single support - Double-circuit ("Staggered assembly", Tangent)
D1.45, D1.5NP	Single support - Double-circuit ("Staggered assembly", Tangent)
D2.9N, D2.9NP	Double support - Double-circuit ("Vertical assembly", Table IV)
P1.1NG	Surge arrester on narrow profile bracket (Single-phase, Guide)
S1.1N	Cutout on narrow profile bracket (Single-phase)

Note: Number suffixes "N", "P", and "G" denote Narrow profile assembly, Post type insulator assembly, and Guide drawing (no materials), respectively.

INDEX A

SINGLE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

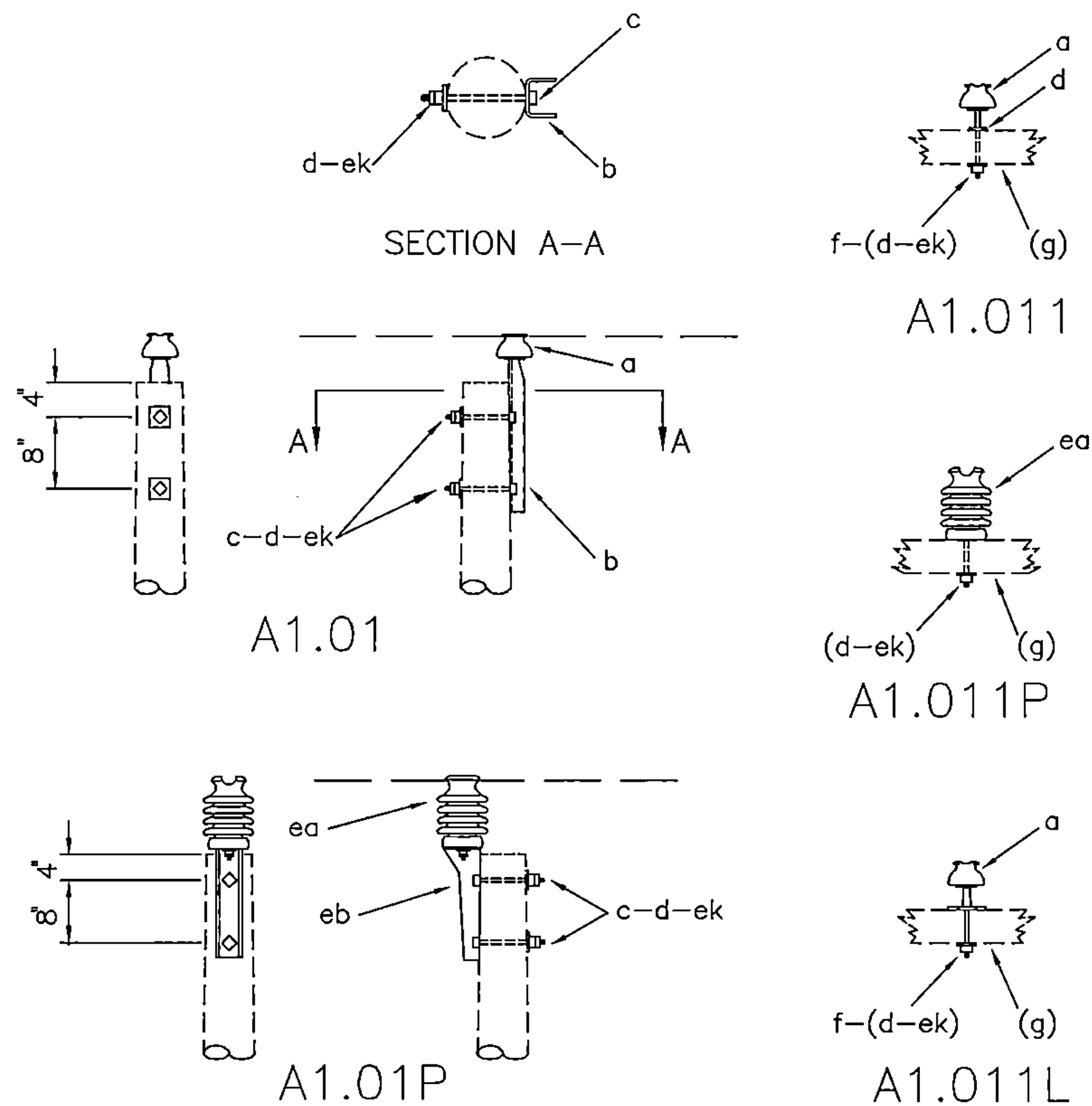
DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804	**Bulletin 50-3**	
(New)	(Old)	
A1.01	(M5-2)	SINGLE SUPPORT - PRIMARY
A1.01P	(M5-18)	
A1.011	(M5-5)	
A1.011P	(M5-7)	
A1.011L		
A1.04N		SINGLE SUPPORT – NARROW PROFILE
A1.04NP		
A1.1	(A1)	SINGLE SUPPORT (TANGENT)
A1.2	(A1A)	
A1.1P	(A1P)	SINGLE SUPPORT (TANGENT) (POST INSULATORS)
A1.2P	(A1AP)	
A1.3		SINGLE SUPPORT
A1.3P		SINGLE SUPPORT (POST INSULATORS)
A1.4N		SINGLE SUPPORT – NARROW PROFILE (TANGENT)
A1.5N		
A1.4NP		SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
A1.5NP		
A1.6N		SINGLE SUPPORT – NARROW PROFILE
A1.6NP		SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
A1.11	(A9-1)	SINGLE SUPPORT ON CROSSARM
A1.11P	(A9-1P)	SINGLE SUPPORT ON CROSSARM (POST INSULATORS)
A1.12G		SINGLE PHASE JUNCTION GUIDE
A2.01		DOUBLE SUPPORT - PRIMARY
A2.01P		
A2.021		
A2.021P		
A2.04N		DOUBLE SUPPORT – NARROW PROFILE
A2.04NP		
A2.1	(A1-1)	DOUBLE SUPPORT (TANGENT)
A2.2	(A1-1A)	

SINGLE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
A2.1P A2.2P	(A1-1P) (A1-1AP)	DOUBLE SUPPORT (TANGENT) (POST INSULATORS)
A2.3	(A2)	DOUBLE SUPPORT
A2.3P	(A2P)	DOUBLE SUPPORT (POST INSULATORS)
A2.4N A2.5N		DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
A2.4NP A2.5NP		DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
A2.6N		DOUBLE SUPPORT – NARROW PROFILE
A2.6NP		DOUBLE SUPPORT – NARROW PROFILE (POST INSULATORS)
A2.21	(A9)	DOUBLE SUPPORT ON CROSSARMS
A2.21P	(A9P)	DOUBLE SUPPORT ON CROSSARMS (POST INSULATORS)
A3.1 A3.2 A3.3	(A3)	SUSPENSION ANGLE
A3.4 A3.5 A3.6 A3.7 A3.8 A3.9		SUSPENSION ANGLE
A4.1	(A4)	DEADEND ANGLE (90° - 150°)
A4.2		DEADEND ANGLE (15° - 90°)
A5.01 A5.02 A5.03	(M5-24) (M5-8)	SINGLE DEADENDS
A5.1 A5.2 A5.3	(A5) (A5-2)	SINGLE DEADENDS

SINGLE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
A5.4		SINGLE DEADENDS
A5.5		
A5.6		
A5.7		
A5.8		
A5.9		
A5.2G		SINGLE PHASE TAP GUIDE
A5.3NG		SINGLE PHASE TAP GUIDE – NARROW PROFILE
A5.4NG		SINGLE PHASE TAP GUIDE – NARROW PROFILE (WITH CUTOUT AND ARRESTER)
A5.21	(A7)	SINGLE DEADEND ON CROSSARMS
A5.31	(A7-1)	
A6.1	(A6)	DOUBLE DEADEND (STRAIGHT)
A6.2		DOUBLE DEADEND (FEED THROUGH)
A6.21	(A8)	DOUBLE DEADEND ON CROSSARMS
A6.22G		DOUBLE DEADEND GUIDE (FEED THROUGH ON CROSSARMS)



	ASSEMBLY: A1.	01	01P	011	011P	011L
ITEM	MATERIAL	QTY	QTY	QTY	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	1		1		1
b	Pin, pole top, 20"	1				
c	Bolt, machine, 5/8" x req'd length	2	2			
d	Washer, square, 2 1/4"	2	2	1		
f	Pin, crossarm steel, 5/8" x 10 3/4"			1		
f	Pin, crossarm steel, clamp type					1
ea	Insulator, post type (12.47/7.2 kV)		1		1	
eb	Bracket, pole top		1			
ek	Locknuts	2	2			

ASSEMBLY NUMBERS	
NEW	(OLD)
A1.01	(M5−2)
A1.01P	(M5−18)
A1.011	(M5−5)
A1.011P	(M5−7)
A1.011L	

DESIGN PARAMETERS:

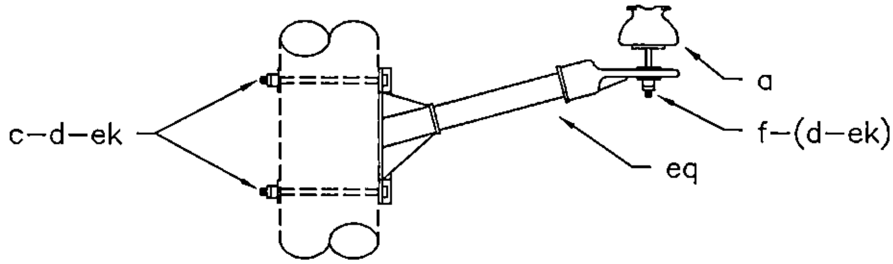
A1.01: See TABLE I
A1.01P: See TABLE II
A1.011: See TABLE II
A1.011P: See TABLE II
A1.011L: See TABLE III

SINGLE SUPPORT−PRIMARY

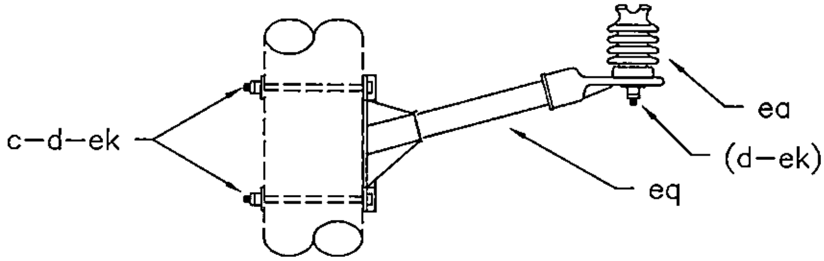
APRIL 2005
RUS

1 − PHASE PRIMARY
12.47/7.2 kV

A1.01,A1.01P
A1.011,A1.011P
A1.011L



A1.04N



A1.04NP

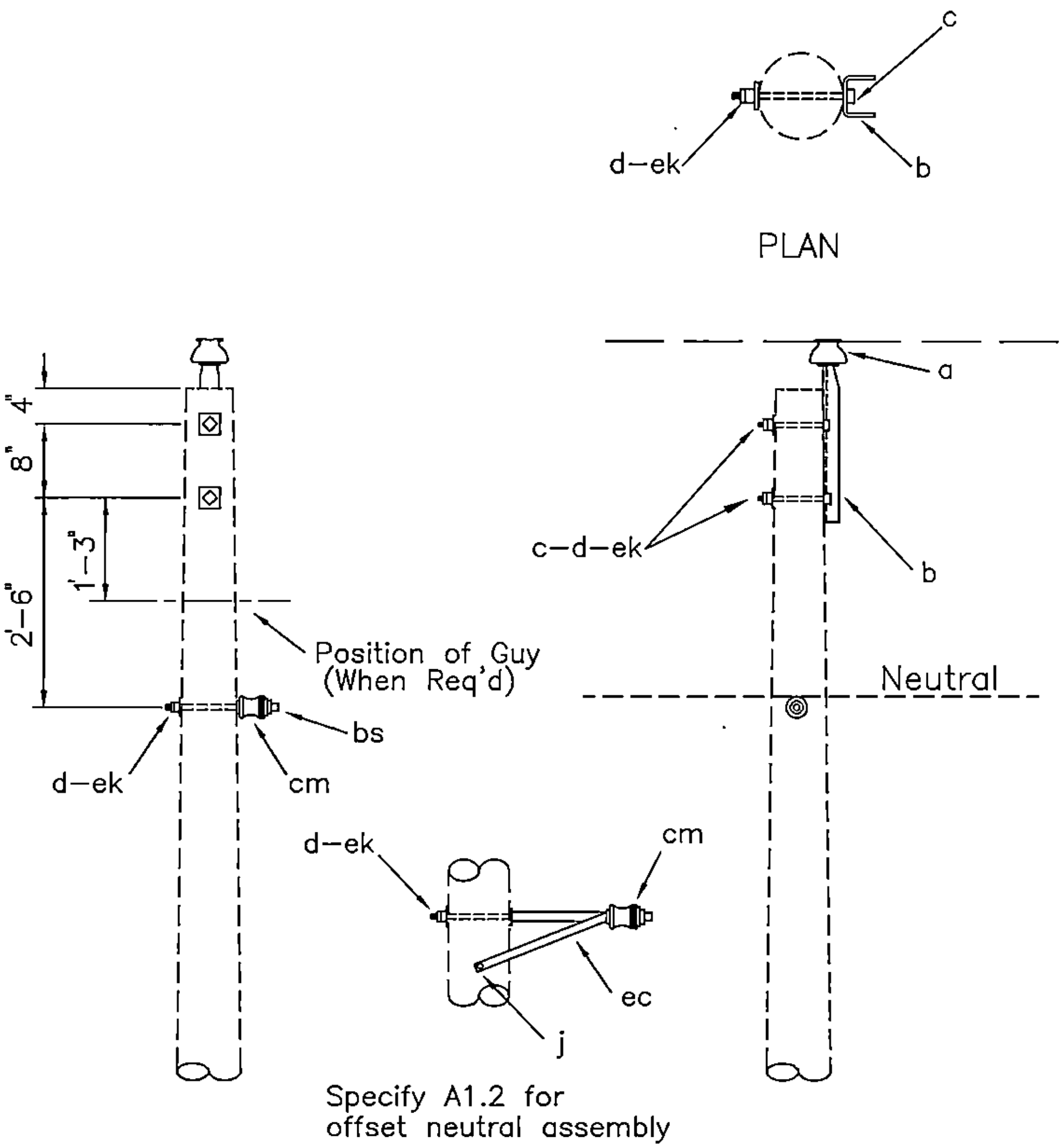
ITEM	MATERIAL (ASSEMBLY: A1.)	04N QTY	04NP QTY	
a	Insulator, pin type (12.47/7.2 kV)	1		
c	Bolt, machine, 5/8" x req'd length	2	2	
d	Washer, square 2 1/4"	2	2	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(1)		(If req'd)
ea	Insulator, post type (12.47/7.2kV)		1	
ek	Locknuts	2	2	
eq	Bracket, insulator/equipment	1	1	

Design Parameters:

MAXIMUM LINE ANGLES:
See Table II

SINGLE SUPPORT–NARROW PROFILE

APRIL 2005	1 – PHASE PRIMARY	A1.04N
RUS	12.47/7.2 kV	A1.04NP



ITEM	MATERIAL	A1.1 QTY	A1.2 QTY
	ASSEMBLY:	A1.1	A1.2
a	Insulator, pin type (12.47/7.2 kV)	1	1
b	Pin, pole top, 20"	1	1
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	3	3
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	3	3

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

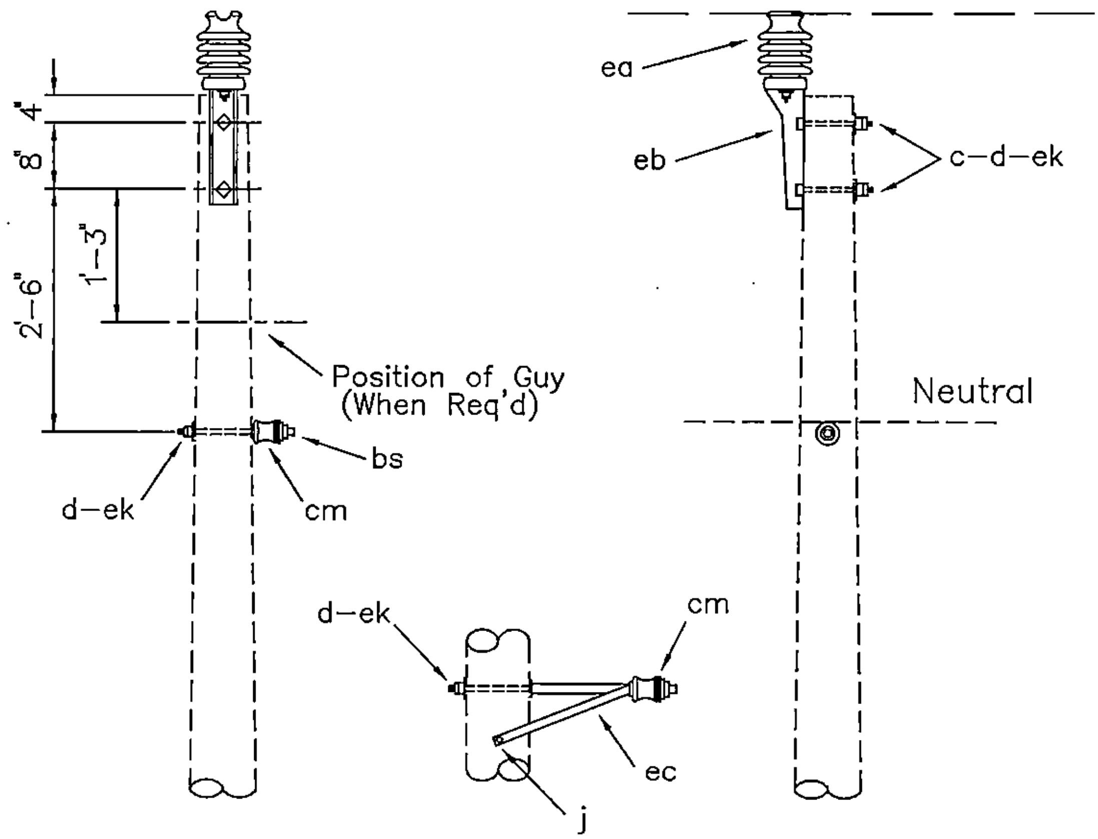
SINGLE SUPPORT
(TANGENT)

APRIL 2005

RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A1.1 (A1)
A1.2 (A1A)



Specify A1.2P for
offset neutral assembly

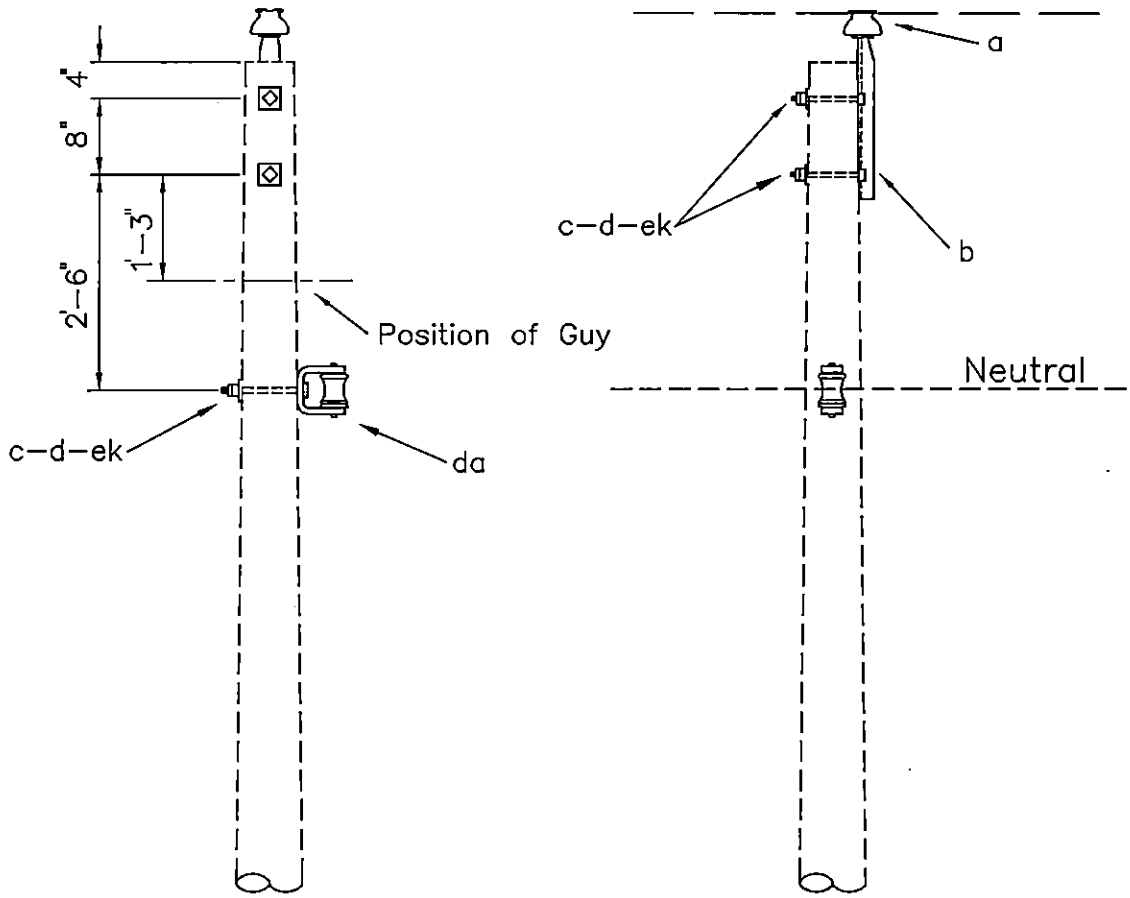
ITEM	MATERIAL (ASSEMBLY: A1)	.1P QTY	.2P QTY
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	3	3
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	1	1
eb	Bracket, pole top	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	3	3

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT (TANGENT)
(POST INSULATORS)

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	A1.1P (A1P) A1.2P (A1AP)



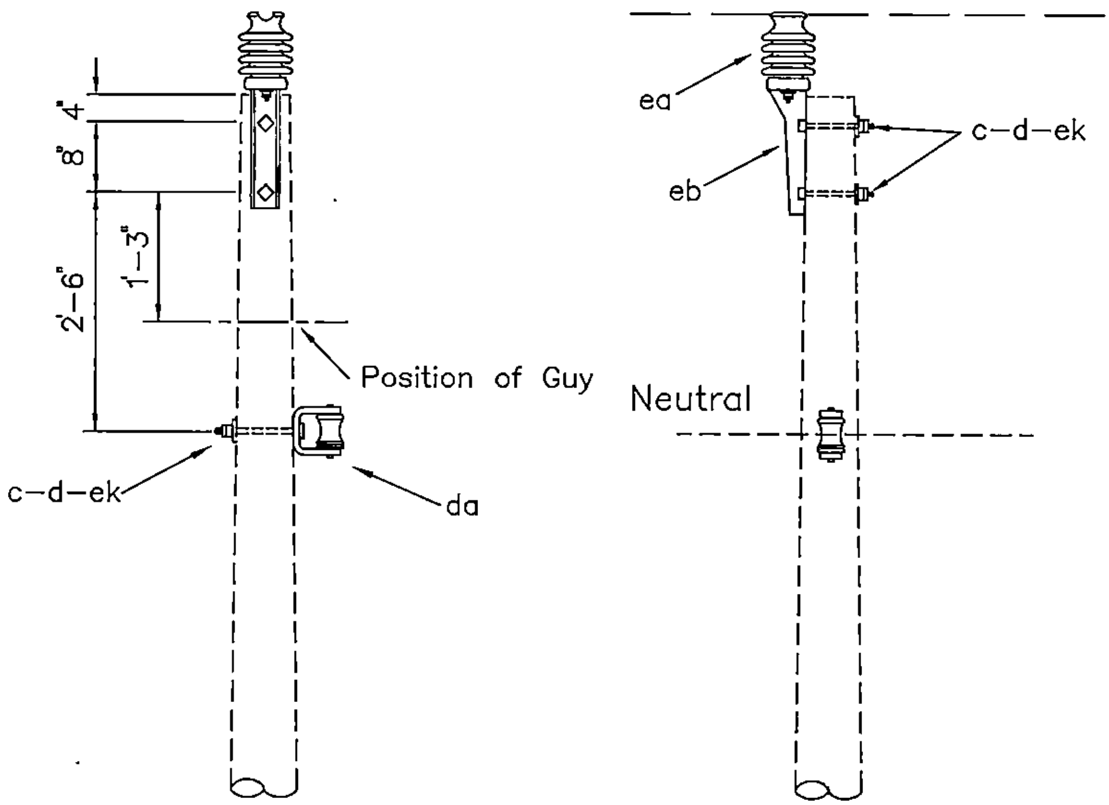
ITEM	QTY	MATERIAL
a	1	Insulator, pin type (12.47/7.2 kV)
b	1	Pin, pole top, 20"
c	3	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
da	1	Bracket, insulated
ek	3	Locknuts

DESIGN PARAMETERS:

See TABLE I

SINGLE SUPPORT

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	A1.3



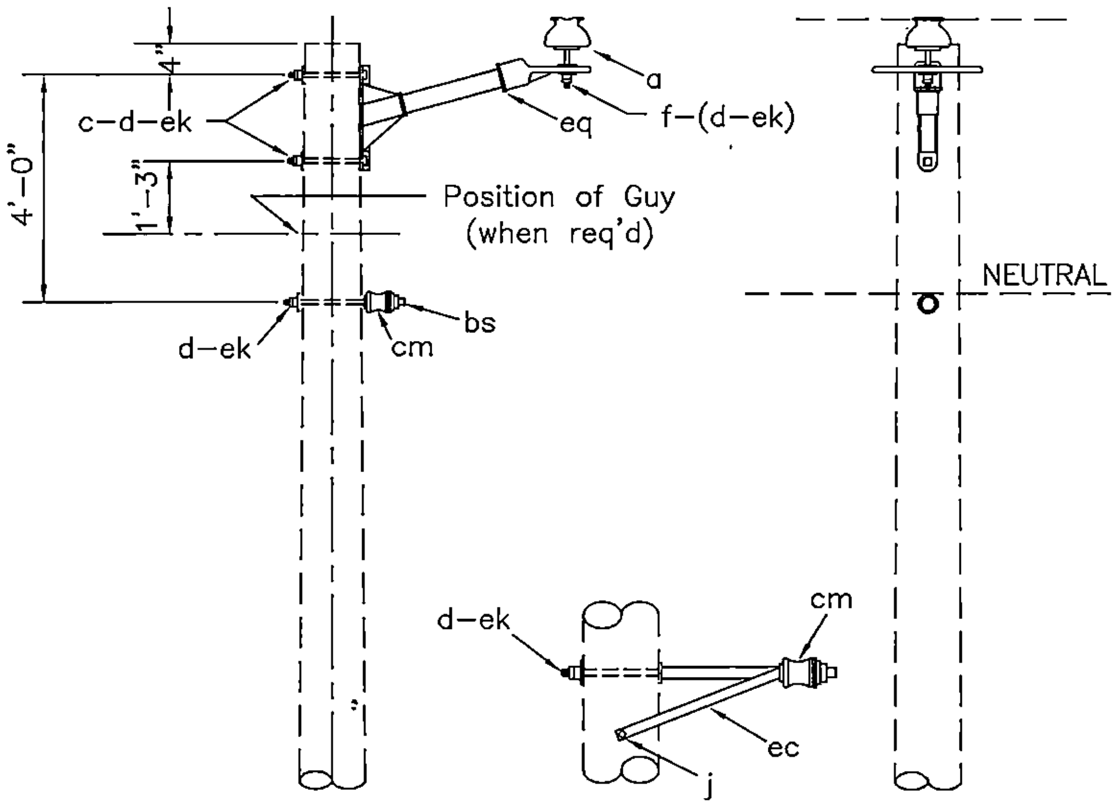
ITEM	QTY	MATERIAL
c	3	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
da	1	Bracket, insulated
ea	1	Insulator, post type (12.47/7.2 kV)
eb	1	Bracket, pole top
ek	3	Locknuts

DESIGN PARAMETERS:

See TABLE II

SINGLE SUPPORT
(POST INSULATORS)

APRIL 2005	1 – PHASE PRIMARY	
RUS	12.47/7.2 kV	A1.3P



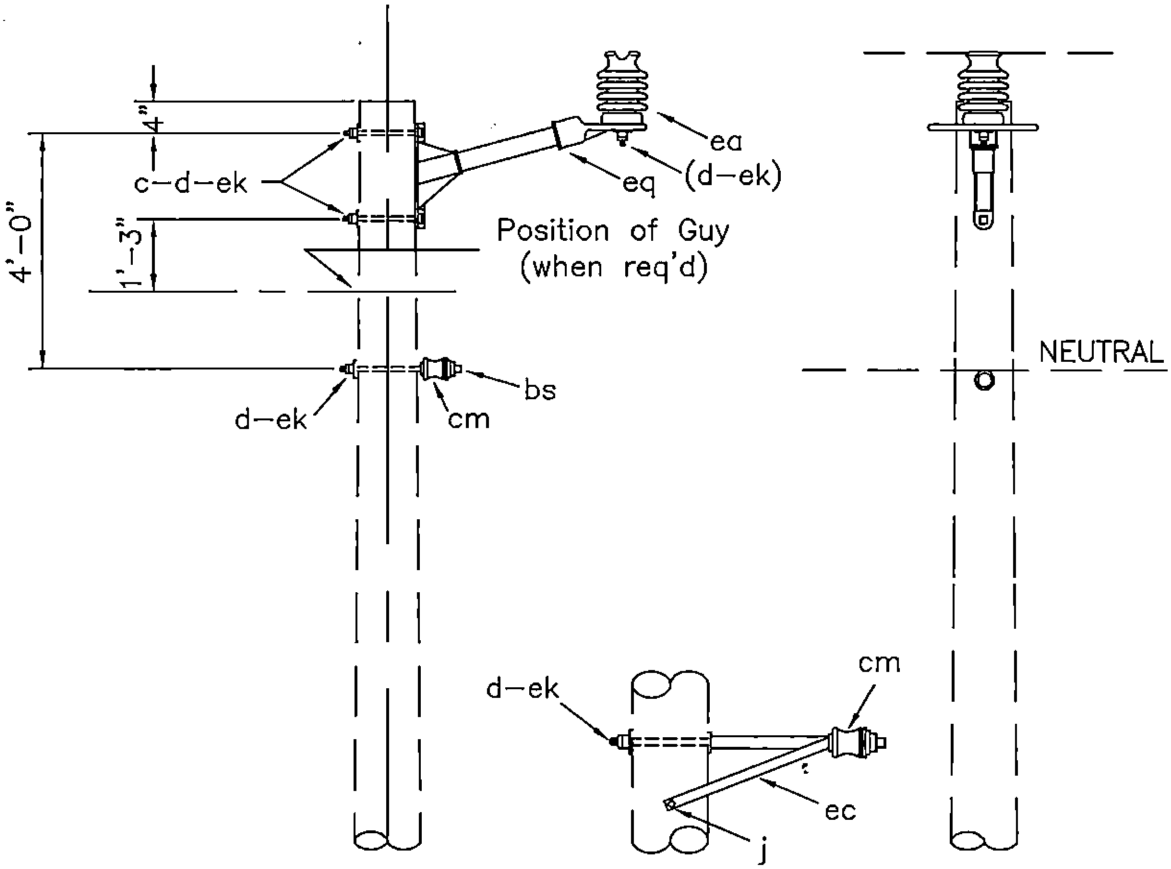
Specify A1.5N for
offset neutral assembly

ITEM	MATERIAL Assembly: A1.	4N QTY	5N QTY	
a	Insulator, pin type ('12.47/7.2 kV)	1	1	
c	Bolt, machine, 5/8" x req'd length	2	2	
d	Washer, square 2 1/4"	3	3	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(1)	(1)	(If req'd)
j	Screw, lag, 1/2" x 4"		2	
bs	Bolt, single, upset	1		
cm	Insulator, spool, 3"	1	1	
ec	Bracket, offset neutral		1	
ek	Locknuts	3	3	
eq	Bracket, insulator/equipment	1	1	

Design Parameters:
Maximum Line Angles
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT)

APRIL 2005	1 – PHASE PRIMARY	A1.4N
RUS	12.47/7.2 kV	A1.5N



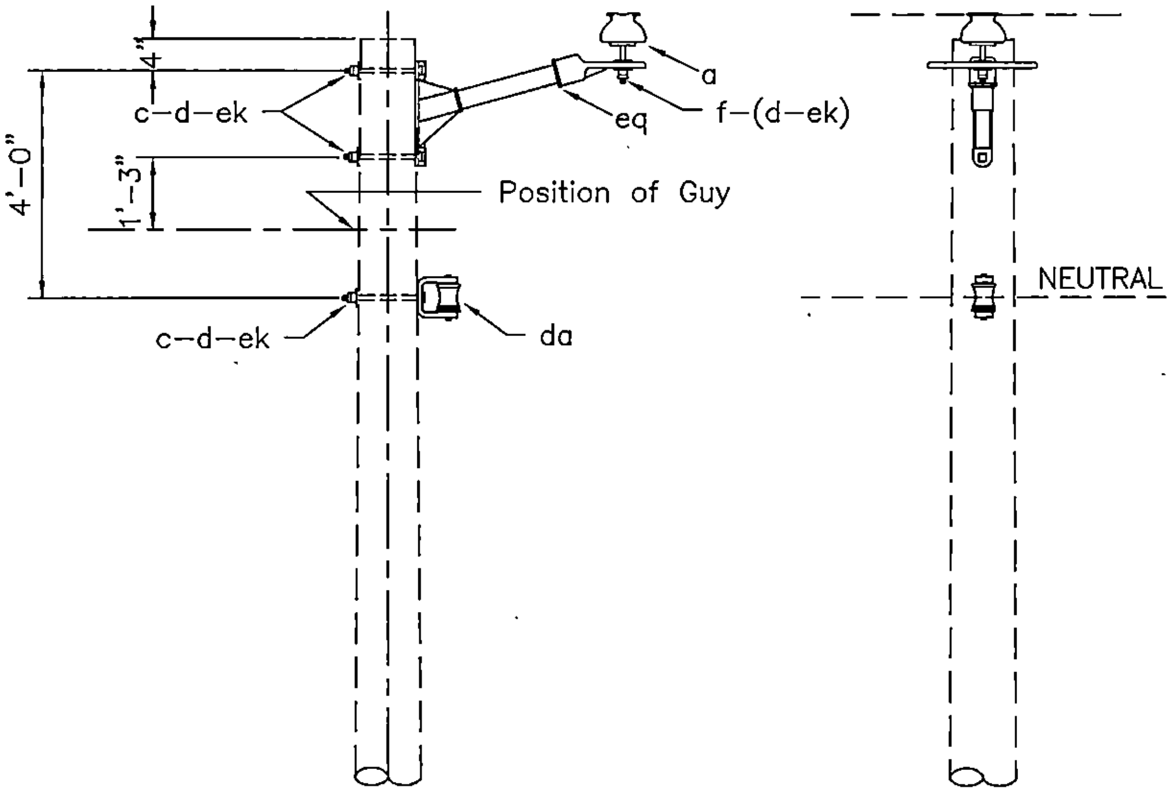
Specify VA1.5NP for
offset neutral assembly

Assembly: VA1.		4NP	5NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	3	3
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	3	3
eq	Bracket, insulator/equipment	1	1

Design Parameters:
Maximum Line Angles
5° – Small conductors
2° – Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005	1 – PHASE PRIMARY	A1.4NP
RUS	12.47/7.2 kV	A1.5NP



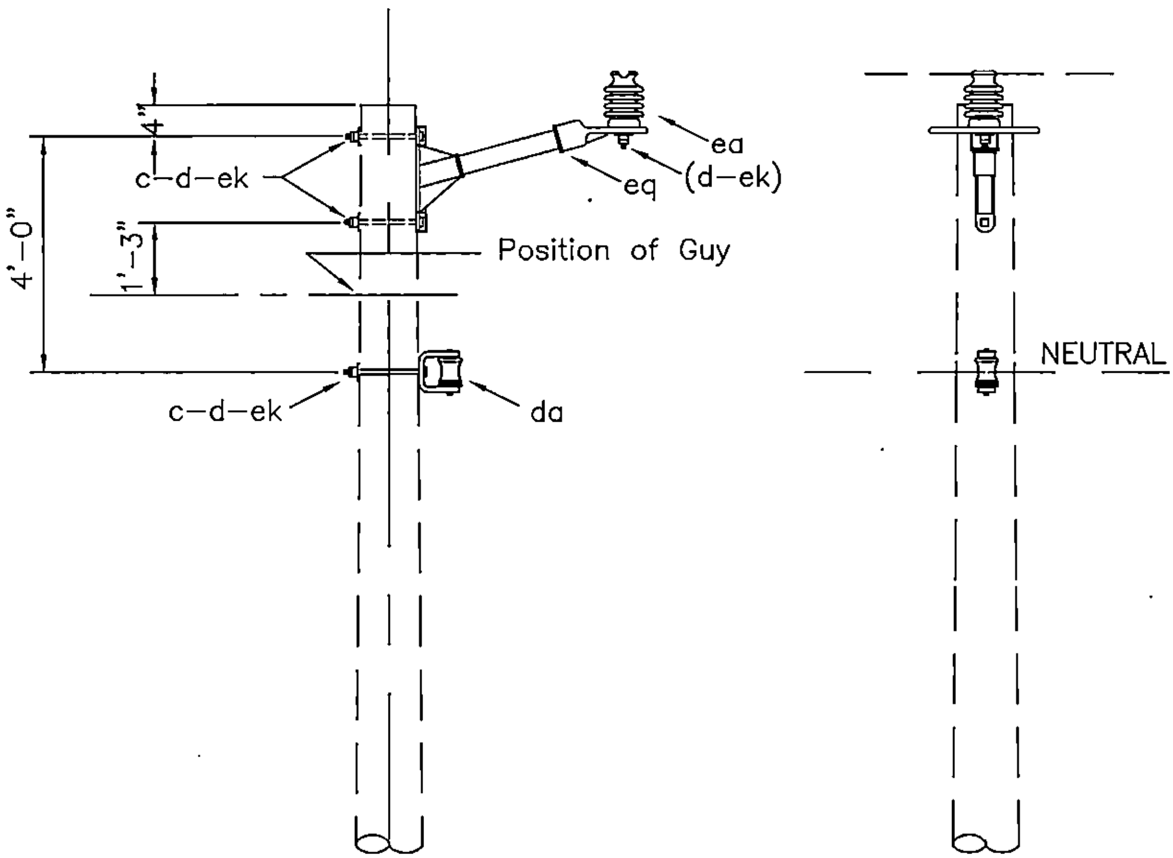
Assembly: A1. 6N

ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	1	
c	Bolt, machine, 5/8" x req'd length	3	
d	Washer, square 2 1/4"	3	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(1)	(If req'd)
da	Bracket, insulated	1	
ek	Locknuts	3	
eq	Bracket, insulator/equipment	1	

Design Parameters:
Maximum Line Angles
See TABLE II

SINGLE SUPPORT–NARROW PROFILE

APRIL 2005	1 – PHASE PRIMARY 12.47/7.2 kV	A1.6N
RUS		



Assembly: A1.6NP

ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	3
d	Washer, square 2 1/4"	3
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	1
ek	Locknuts	3
eq	Bracket, insulator/equipment	1

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE II

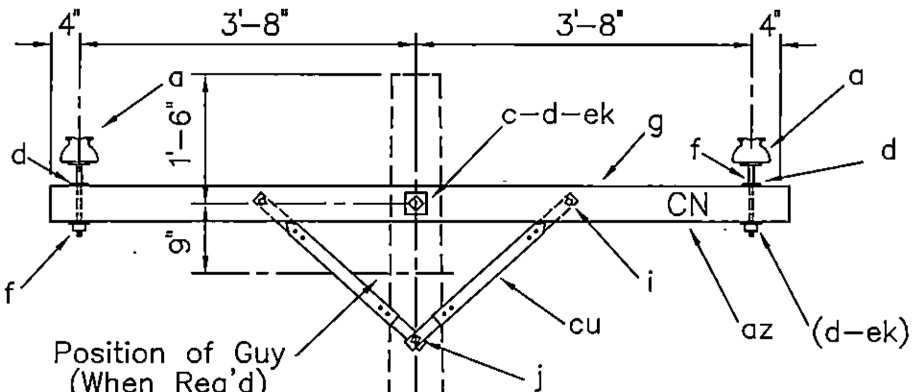
SINGLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005

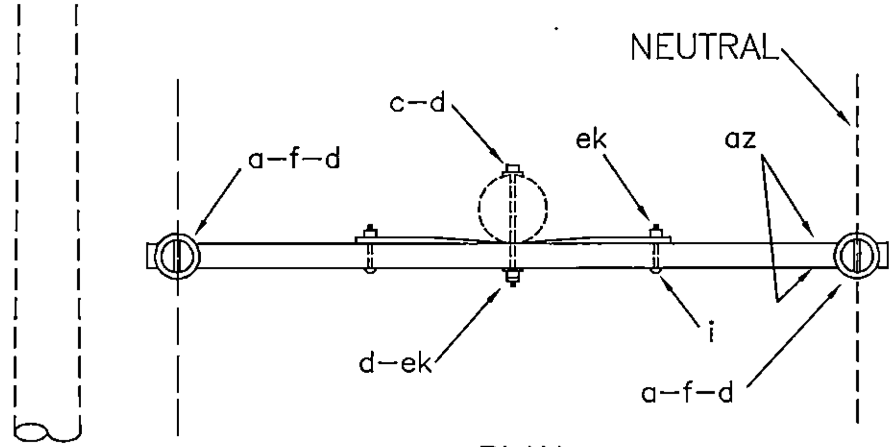
RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A1.6NP



NOTE:
Install either identification letters (az) or white insulator in neutral position.



PLAN

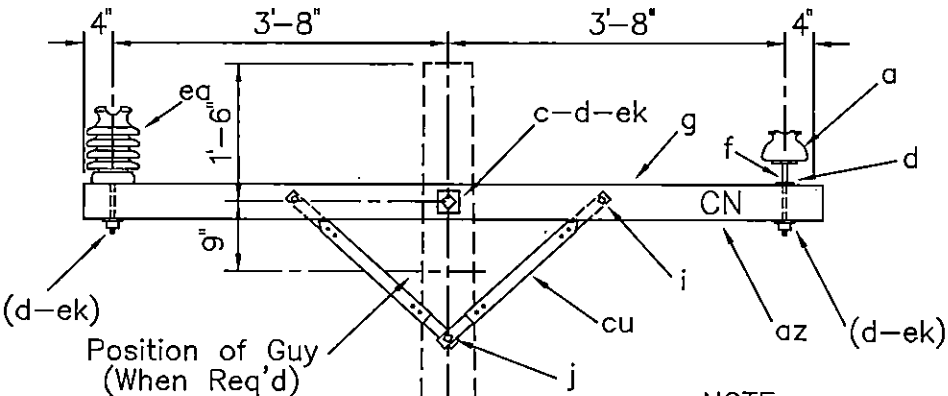
ITEM	QTY	MATERIAL
a	1	Insulator, pin type, 15 kV, white
a	1	Insulator, pin type (12.47/7.2 kV)
c	1	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
f	2	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
az	4	Letters, 2" C, 2" N, with 1" nails
cu	2	Brace, 28"
ek	3	Locknuts

DESIGN PARAMETERS:

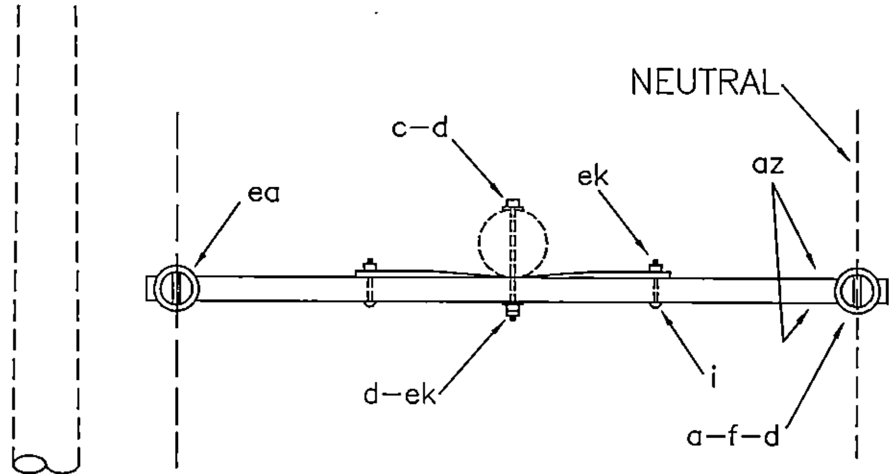
See TABLE II

SINGLE SUPPORT ON CROSSARM

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	A1.11 (A9–1)



NOTE:
Install either identification letters (az) or white insulator in neutral position.



PLAN

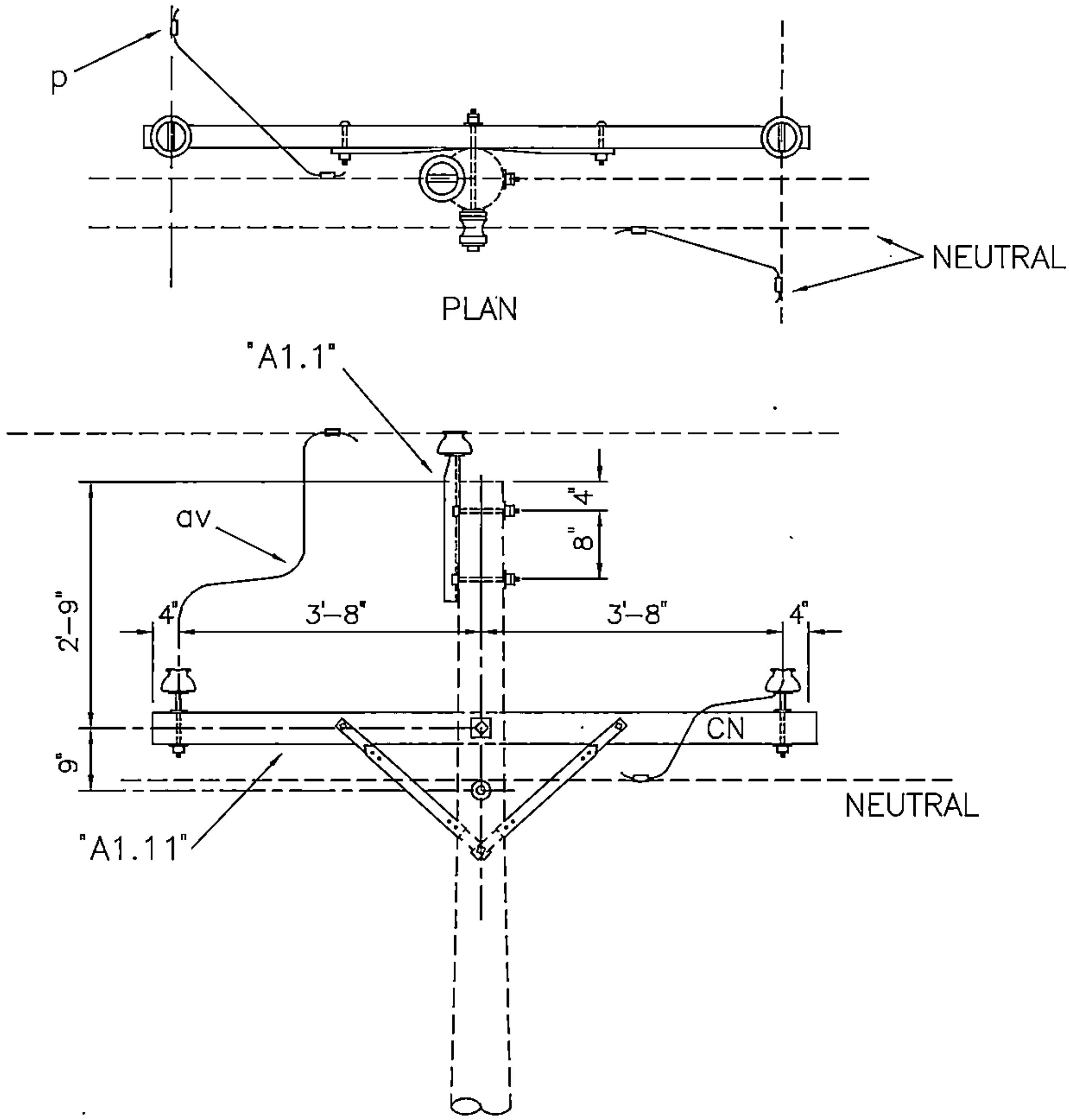
ITEM	QTY	MATERIAL
a	1	Insulator, pin type, 15 kV, white
c	1	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
f	1	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
az	4	Letters, 2" C, 2" N, with 1" nails
cu	2	Brace, 28"
ea	1	Insulator, post type (12.47/7.2 kV)
ek	3	Locknuts

DESIGN PARAMETERS:

See TABLE II

SINGLE SUPPORT ON CROSSARM
(POST INSULATORS)

APRIL 2005	1 – PHASE PRIMARY	
RUS	12.47/7.2 kV	A1.11P (A9-1P)



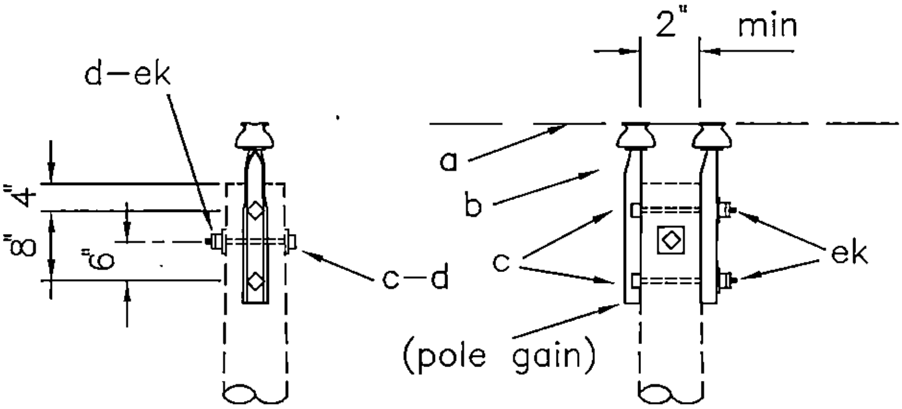
ITEM	QTY	MATERIAL
	1	A1.1 Primary Assembly
	1	A1.11 Primary Assembly
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

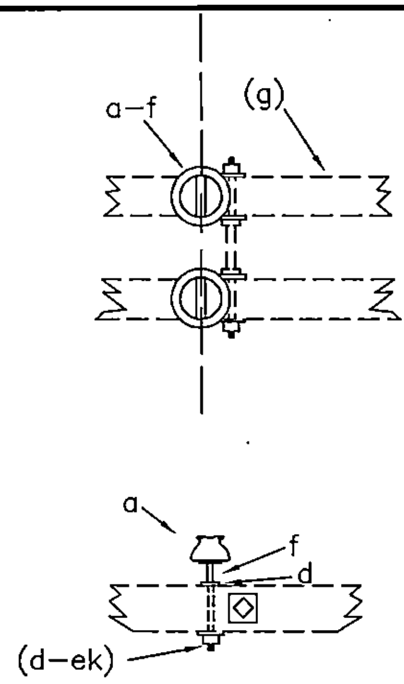
See: "A1.1"
"A1.11"

SINGLE PHASE JUNCTION GUIDE

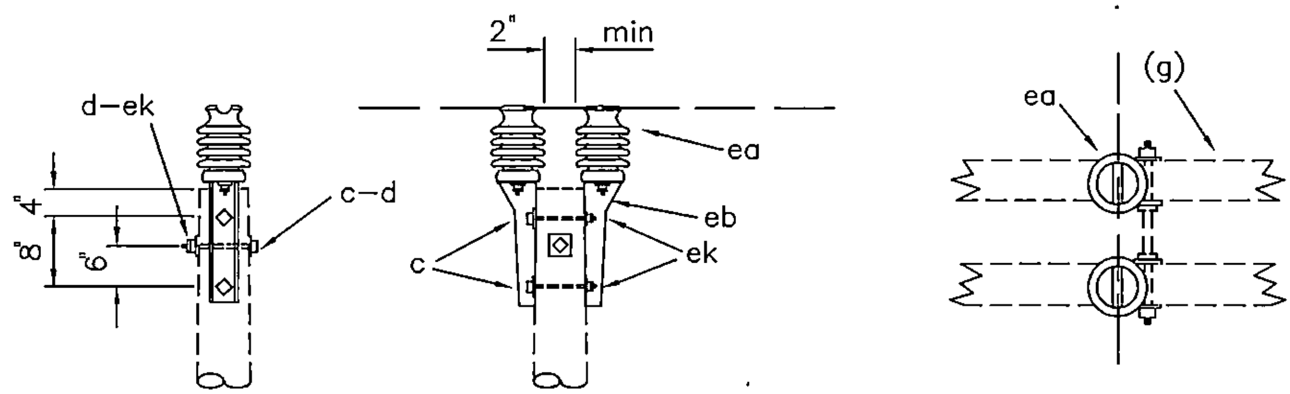
APRIL 2005	1 – PHASE PRIMARY	
RUS	12.47/7.2 kV	A1.12G



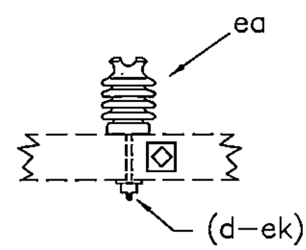
A2.01



A2.021



A2.01P



A2.021P

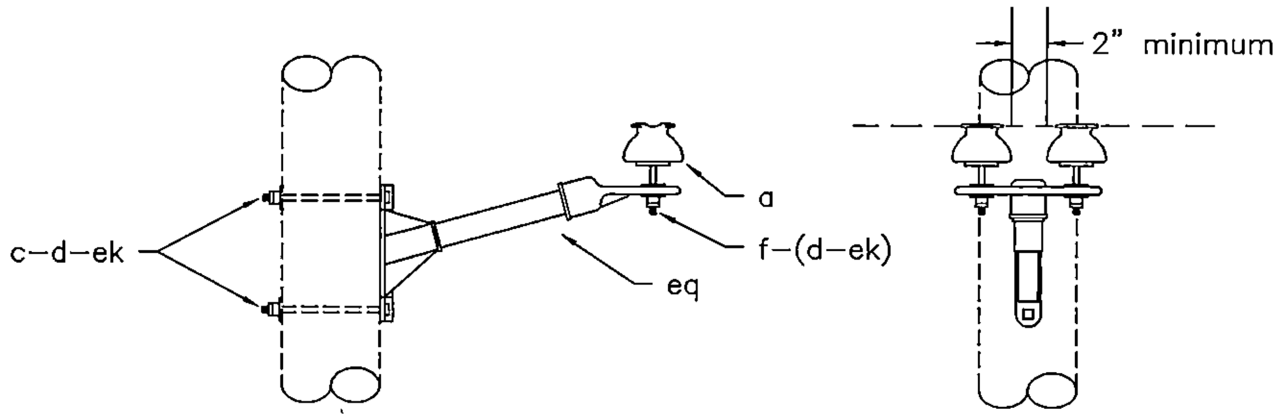
ITEM	ASSEMBLY: A2. MATERIAL	01 QTY	01P QTY	021 QTY	021P QTY
a	Insulator, pin type (12.47/7.2 kV)	2		2	
b	Pin, pole top, 20	2			
c	Bolt, machine, 5/8" x req'd length	3	3		
d	Washer, square, 2 1/4"	2	2	2	
f	Pin, crossarm steel, 5/8" x 10 3/4"			2	
ea	Insulator, post type (12.47/7.2 kV)		2		2
eb	Bracket, pole top		2		
ek	Locknuts	3	3		

DESIGN PARAMETERS:

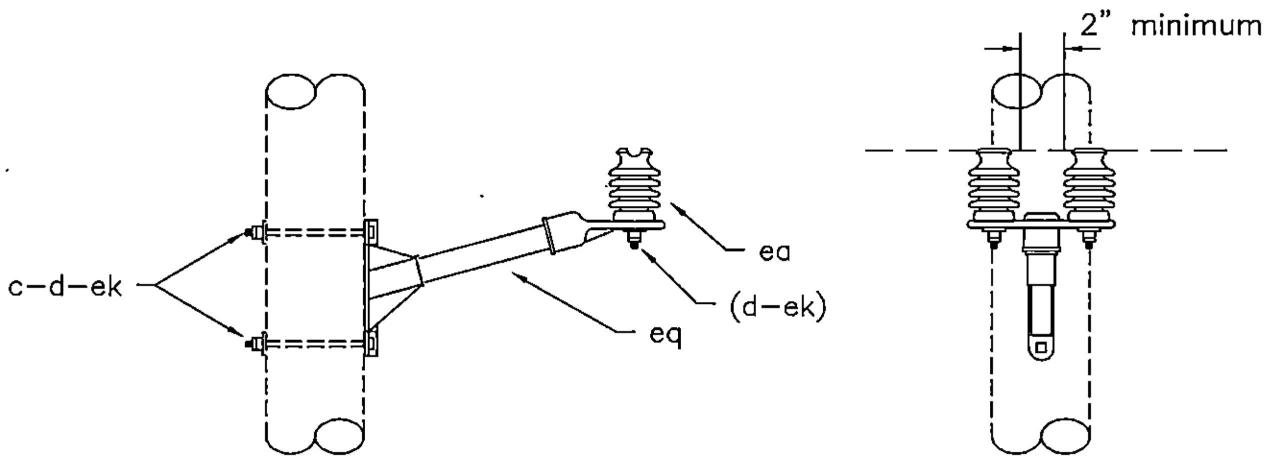
A2.01: See TABLE III
A2.01P: See TABLE IV
A2.021: See TABLE IV
A2.021P: See TABLE IV

DOUBLE SUPPORT–PRIMARY

APRIL 2005	1 – PHASE PRIMARY	A2.01,A2.01P
RUS	12.47/7.2 kV	A2.021,A2.021P



A2.04N



A2.04NP

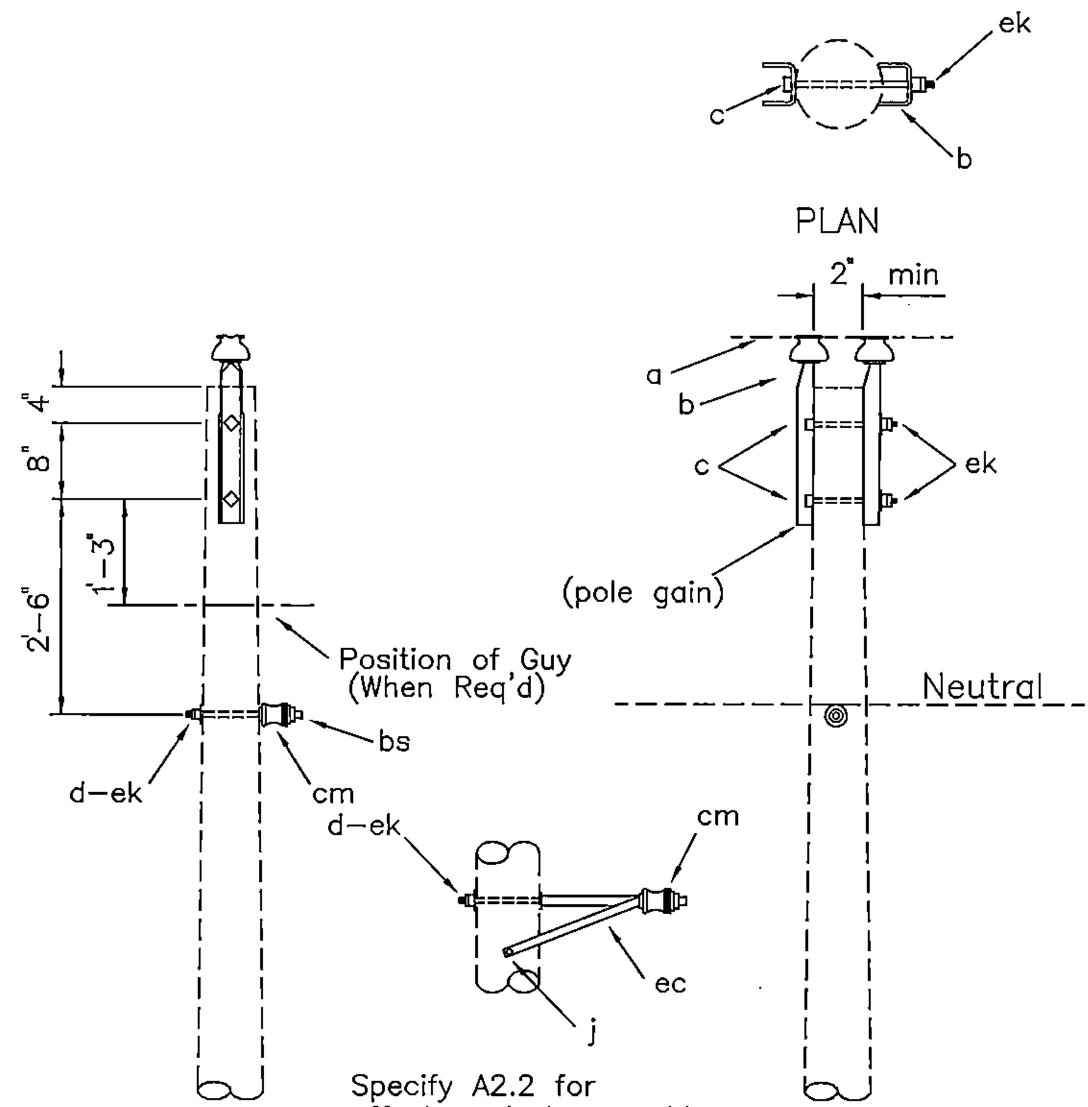
	ASSEMBLY: A2.	04N	04NP
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	2	
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	2	2
f	Pin, crossarm, 5/8" x 6 1/2"	2	
ea	Insulator, post type (12.47/7.2kV)		2
ek	Locknuts	2	2
eq	Bracket, insulator/equipment	1	1

Design Parameters:

MAXIMUM LINE ANGLES:
See Table IV

DOUBLE SUPPORT–NARROW PROFILE

APRIL 2005	1 – PHASE PRIMARY	A2.04N
RUS	12.47/7.2 kV	A2.04NP



Specify A2.2 for offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

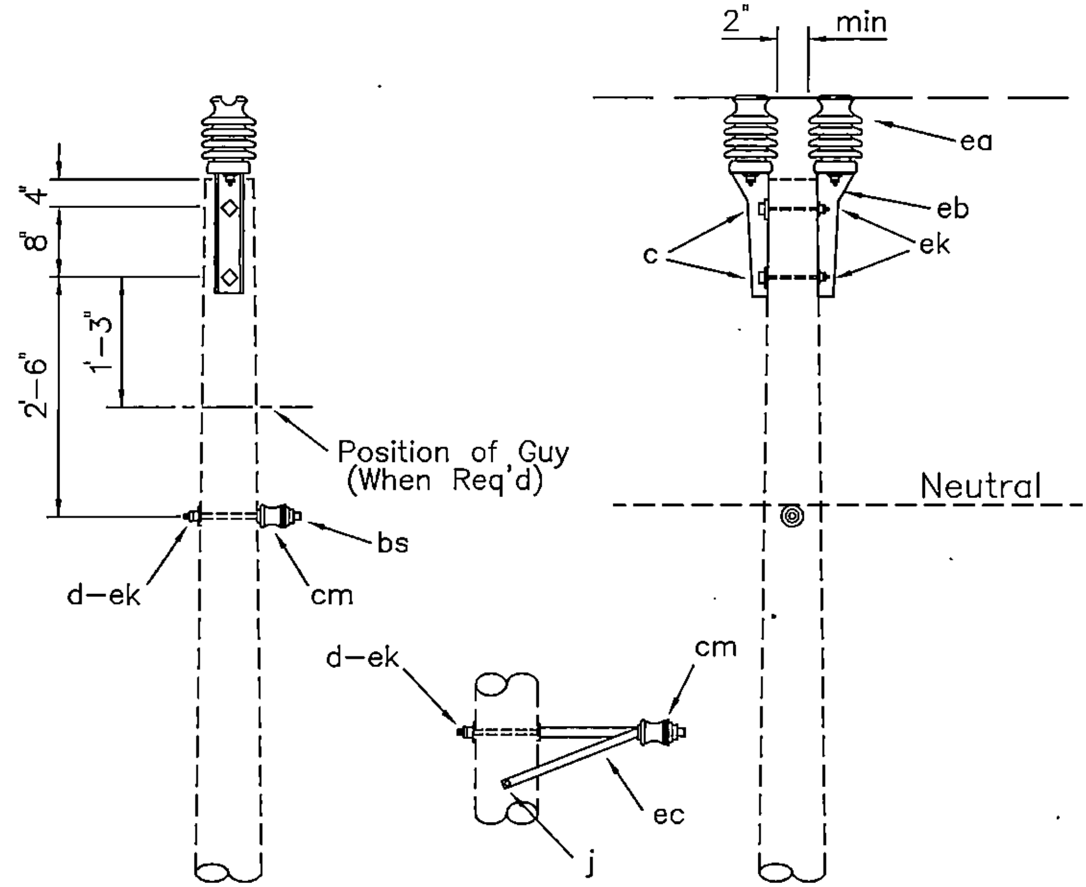
	ASSEMBLY:	A2.1	A2.2
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	2	2
b	Pin, pole top	2	2
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	1	1
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	3	3

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT
(TANGENT)

APRIL 2005	1 – PHASE PRIMARY	A2.1 (A1–1)
RUS	12.47/7.2 kV	A2.2 (A1–1A)



Specify A2.2P for offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

	ASSEMBLY: A2	.1P	.2P
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	1	1
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	2	2
eb	Bracket, pole top	2	2
ec	Bracket, offset neutral		1
ek	Locknuts	3	3

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

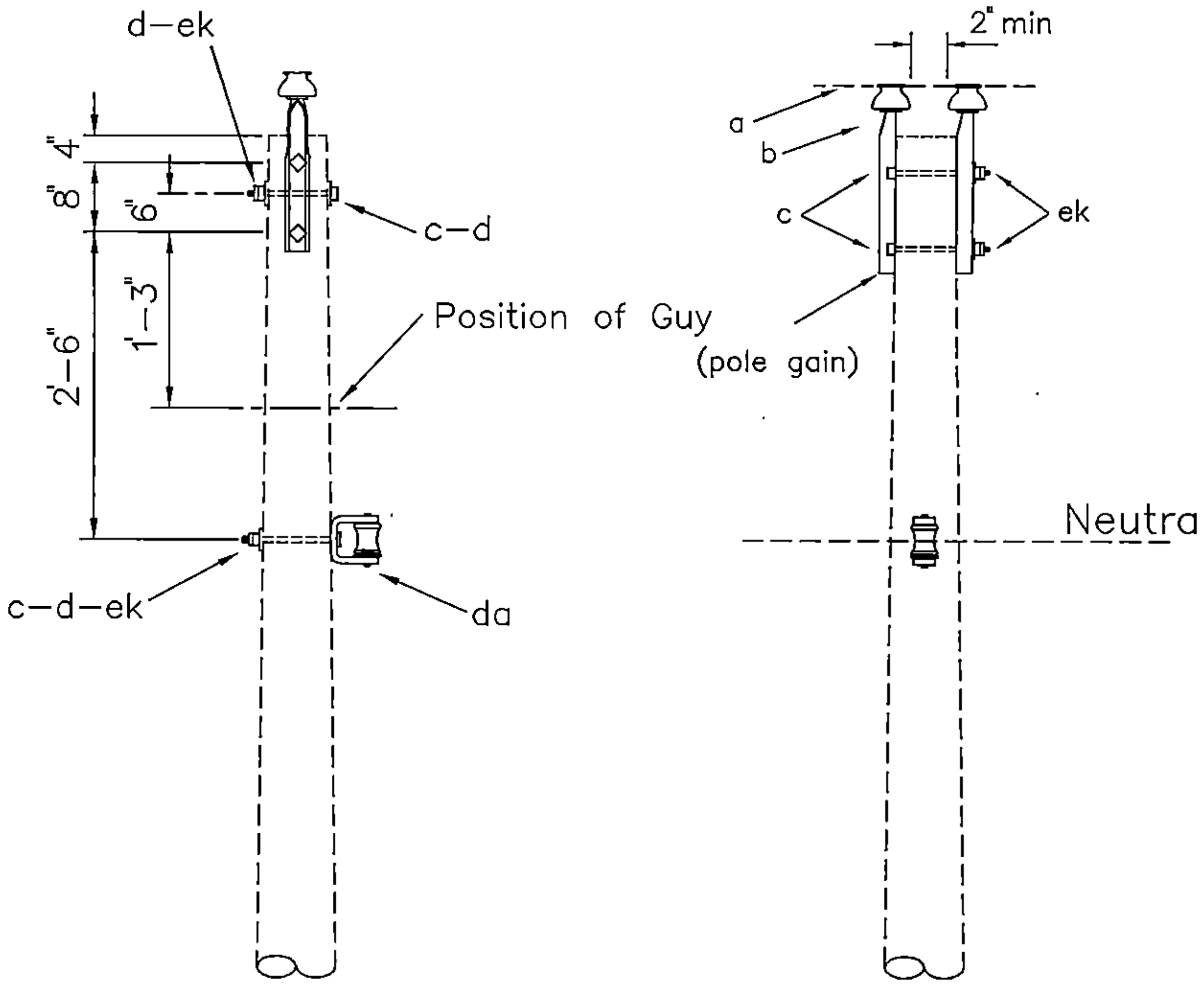
DOUBLE SUPPORT – (TANGENT) (POST INSULATORS)

APRIL 2005

RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A2.1P (A1-1P)
A2.2P (A1-1AP)



ITEM	QTY	MATERIAL
a	2	Insulator, pin type (12.47/7.2 kV)
b	2	Pin, pole top
c	4	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
da	1	Bracket, insulated
ek	4	Locknuts

DESIGN PARAMETERS:

See TABLE III

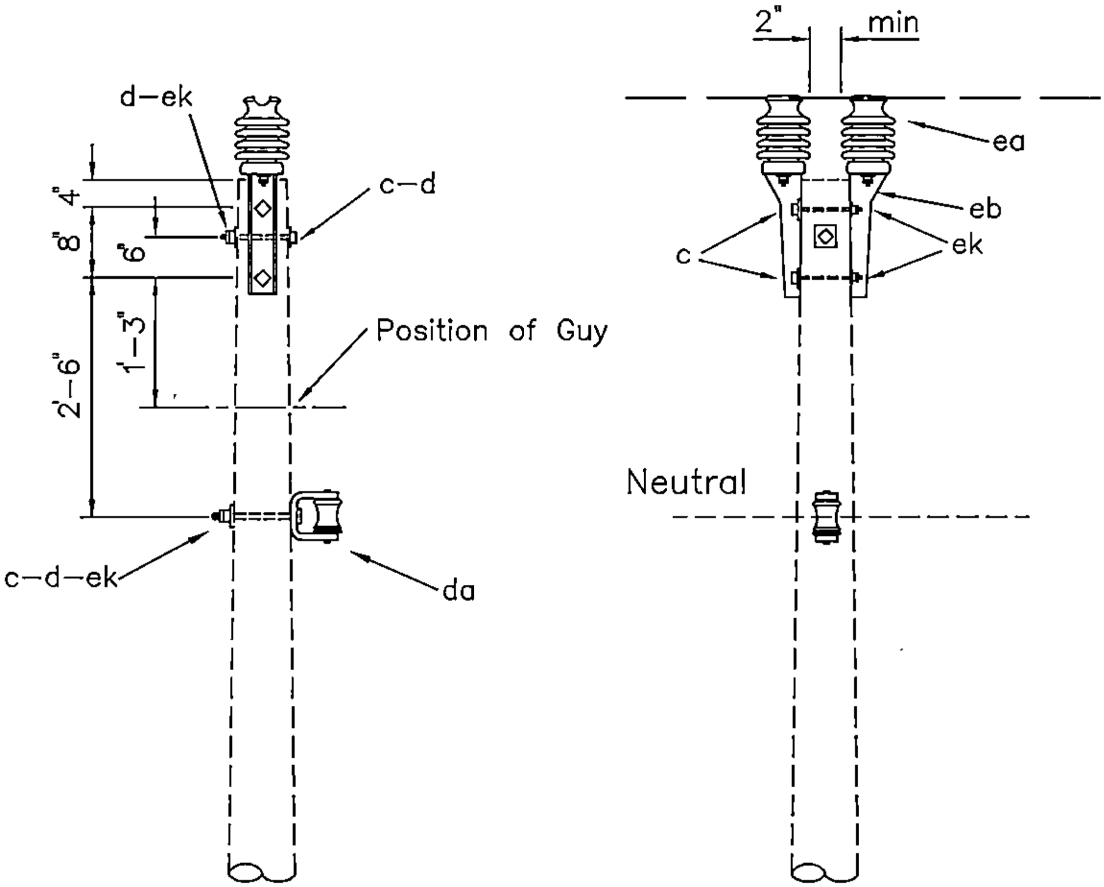
DOUBLE SUPPORT

APRIL 2005

RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A2.3 (A2)



ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
da	1	Bracket, insulated
ea	2	Insulator, post type (12.47/7.2 kV)
eb	2	Bracket, pole top
ek	4	Locknuts

DESIGN PARAMETERS:

See TABLE IV

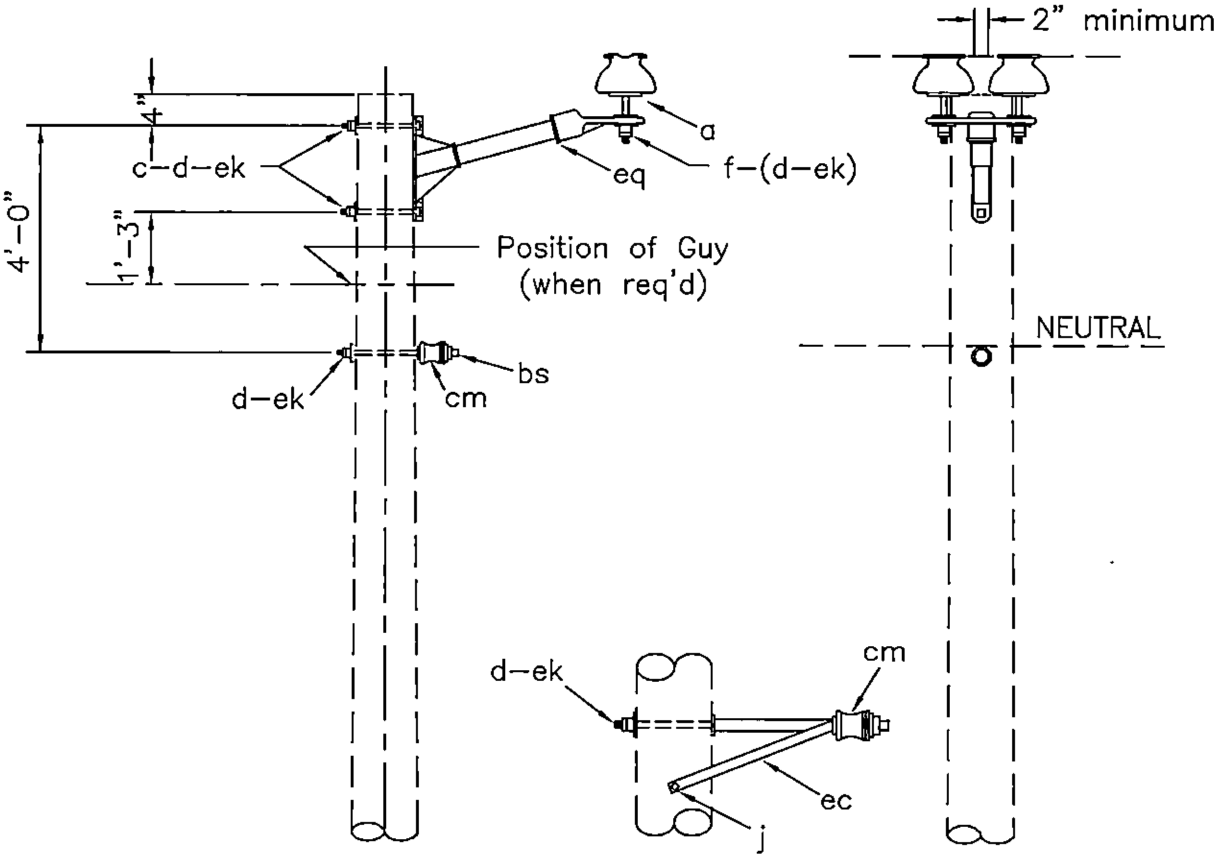
DOUBLE SUPPORT
(POST INSULATORS)

APRIL 2005

RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A2.3P (A2P)



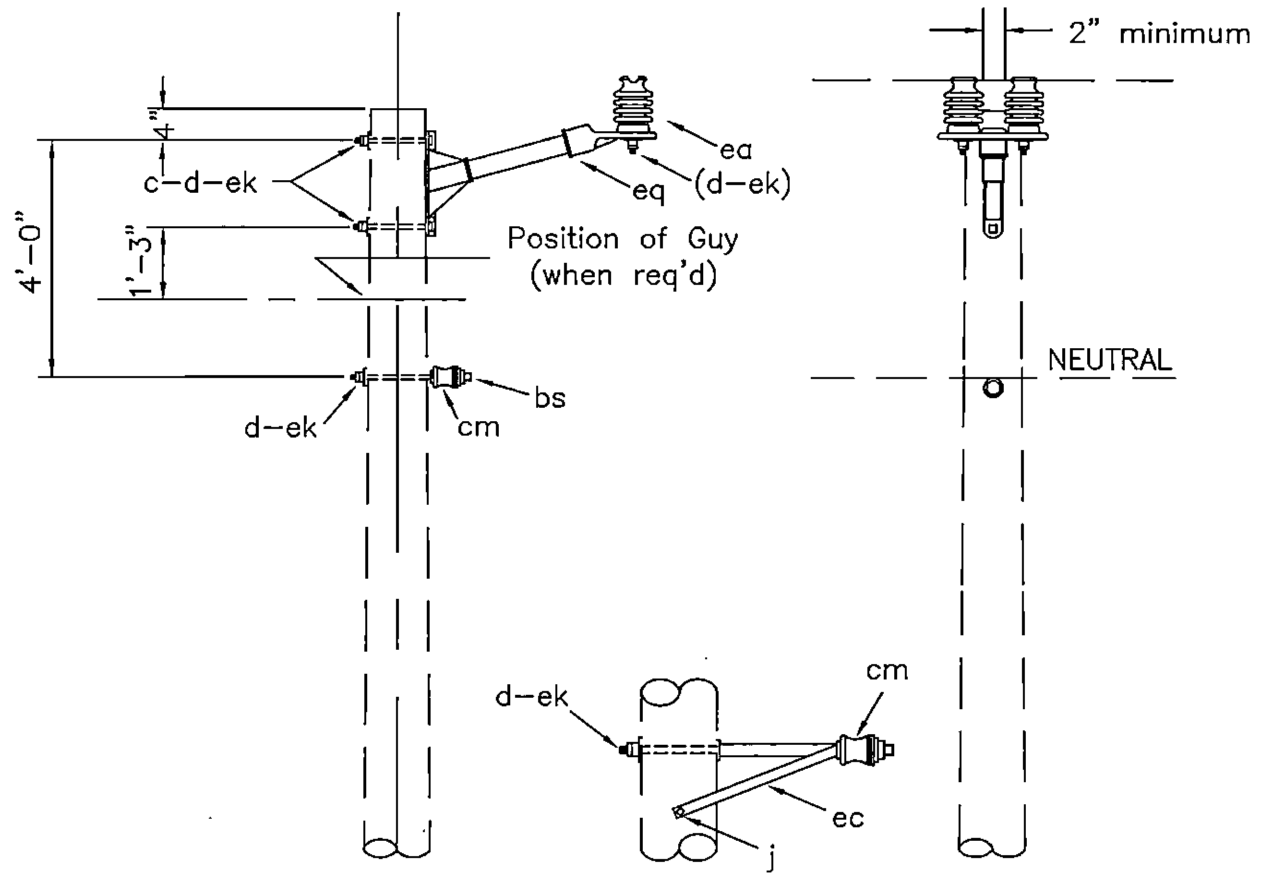
Specify A2.5N for offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

	Assembly: A2.	4N	5N
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	2	2
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	3	3
f	Pin, crossarm, 5/8" x 6 1/2"	2	2
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	3	3
eq	Bracket, insulator/equipment	1	1

Design Parameters:
Maximum Line Angles
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE (TANGENT)		
APRIL 2005	1 – PHASE PRIMARY	A2.4N
RUS	12.47/7.2 kV	A2.5N



Specify A2.5NP for offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

	Assembly: A2.	4NP	5NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	3	3
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	2	2
ec	Bracket, offset neutral		1
ek	Locknuts	3	3
eq	Bracket, insulator/equipment	1	1

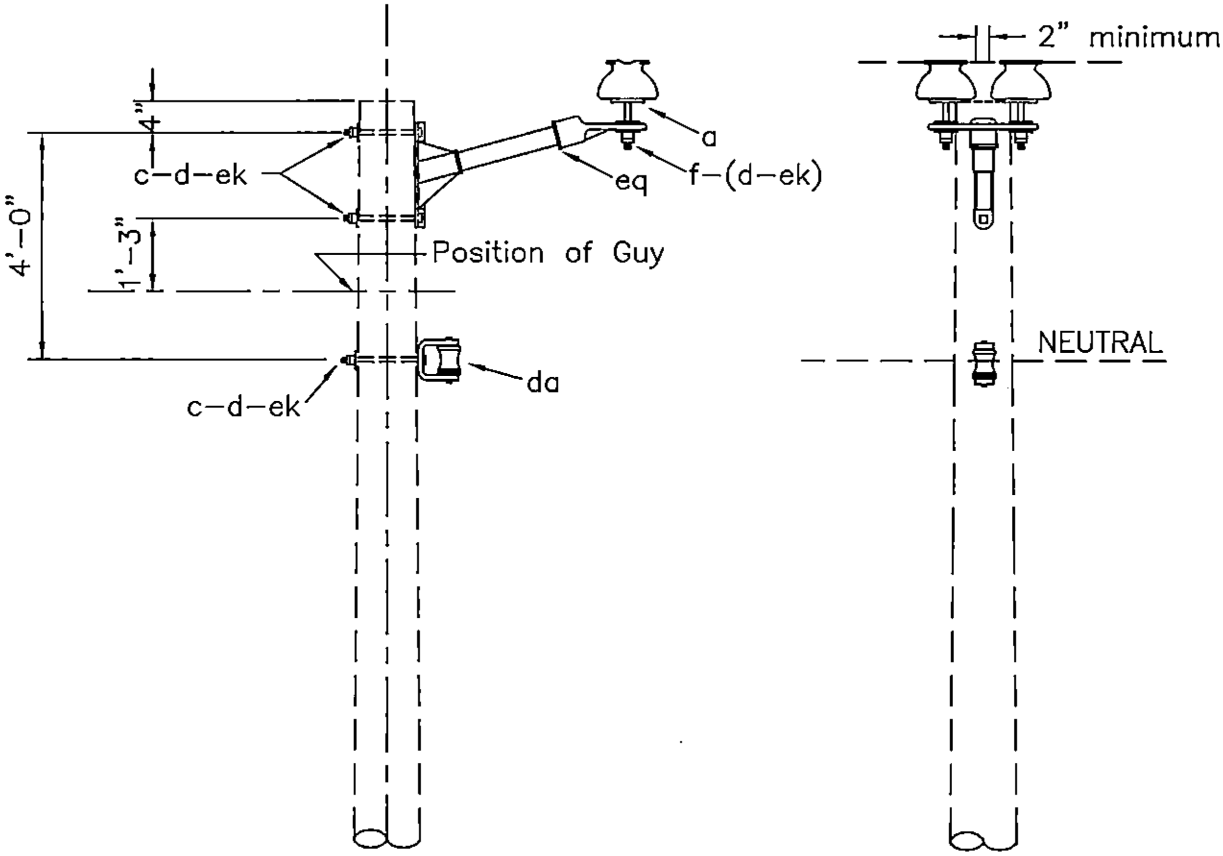
Design Parameters:
Maximum Line Angles
5° – Small conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005
RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A2.4NP
A2.5NP



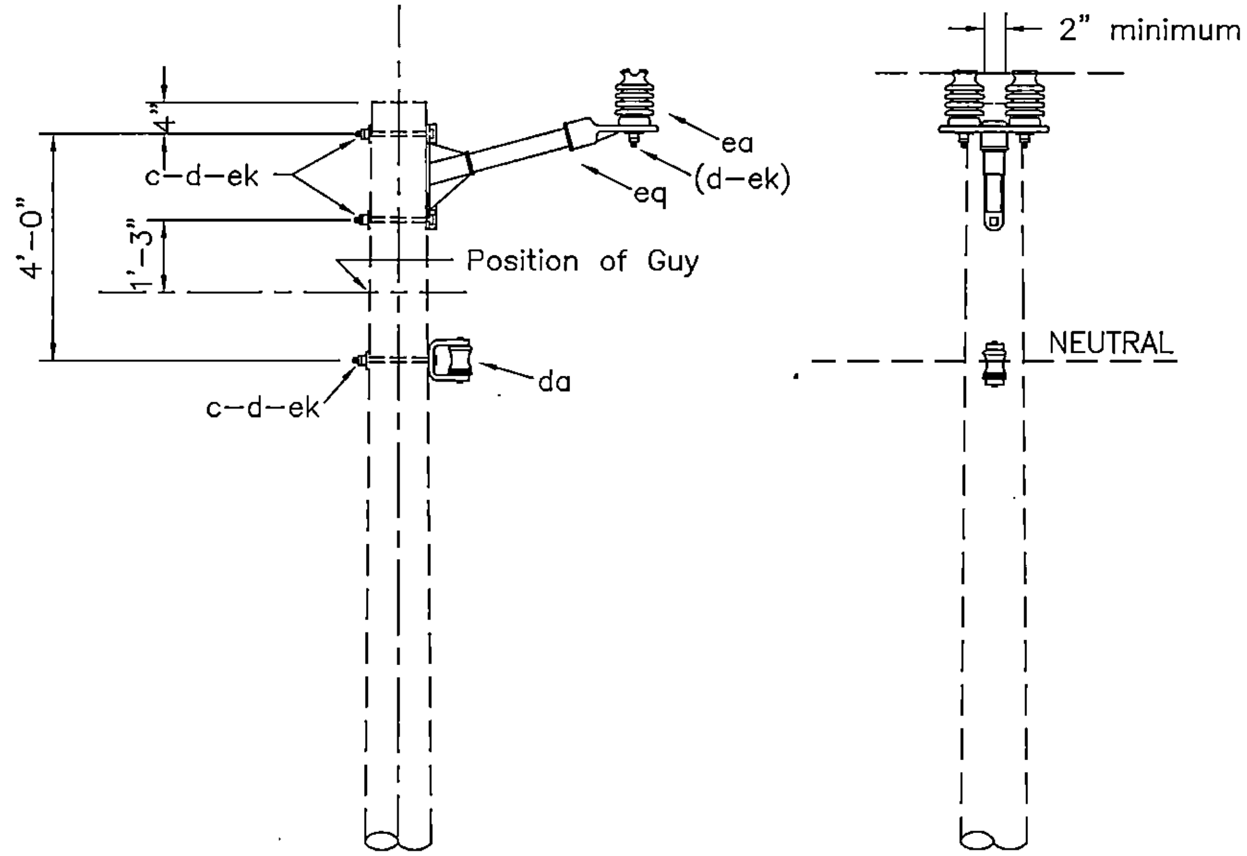
Assembly: A2.6N

ITEM	MATERIAL	QTY
a	Insulator, pin type (12.47/7.2 kV)	2
c	Bolt, machine, 5/8" x req'd length	3
d	Washer, square 2 1/4"	3
f	Pin, crossarm, 5/8" x 6 1/2"	2
da	Bracket, insulated	1
ek	Locknuts	3
eq	Bracket, insulator/equipment	1

Design Parameters:
Maximum Line Angles
See TABLE IV

DOUBLE SUPPORT–NARROW PROFILE

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	A2.6N



Assembly: A2. 6NP

ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	3
d	Washer, square 2 1/4"	3
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2kV)	2
ek	Locknuts	3
eq	Bracket, insulator/equipment	1

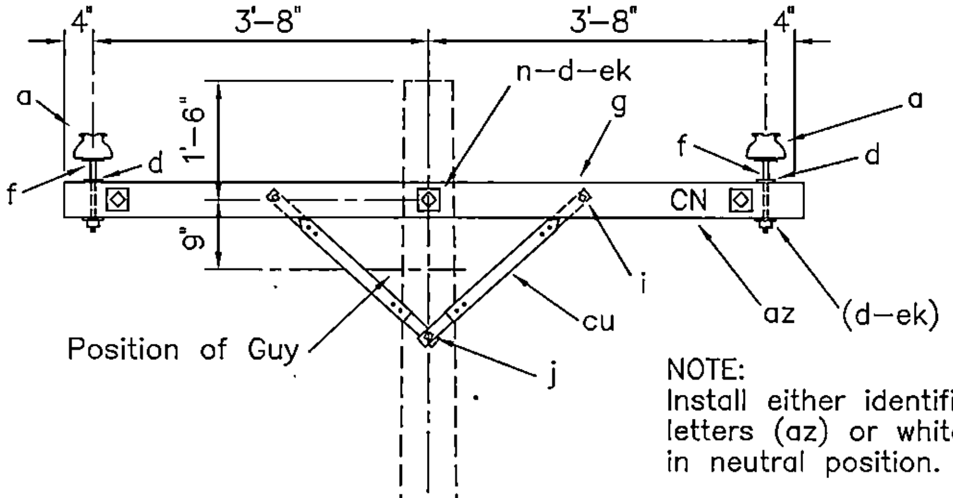
Design Parameters:
Maximum Line Angles
See TABLE IV

DOUBLE SUPPORT-NARROW PROFILE
(POST INSULATORS)

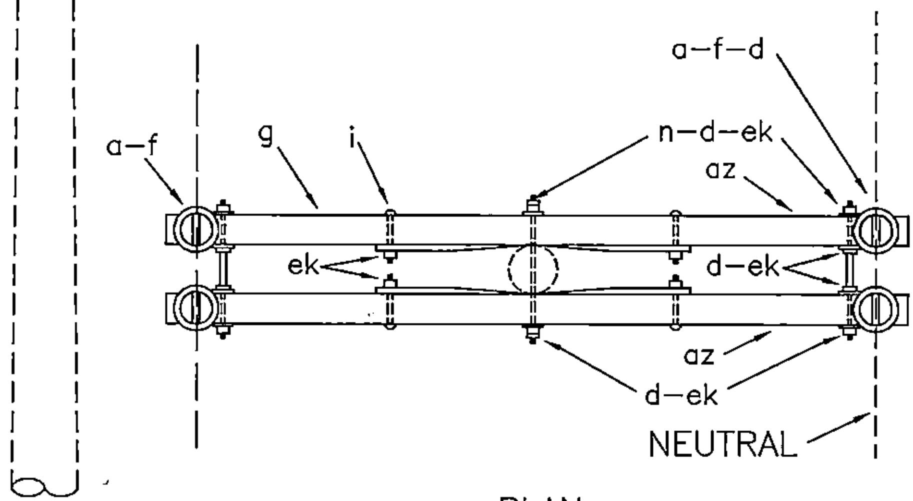
APRIL 2005
RUS

1 - PHASE PRIMARY
12.47/7.2 kV

A2.6NP



NOTE:
Install either identification letters (az) or white insulators in neutral position.



PLAN

ITEM	QTY	MATERIAL
a	2	Insulator, pin type 15 kV white
a	2	Insulator, pin type (12.47/7.2 kV)
d	14	Washer, square, 2 1/4"
f	4	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
n	3	Bolt, double arm, 5/8" x req'd length
az	4	Letters, 2" C, 2" N, with 1" nails
cu	4	Brace, 28"
ek	14	Locknuts

DESIGN PARAMETERS:

See TABLE IV

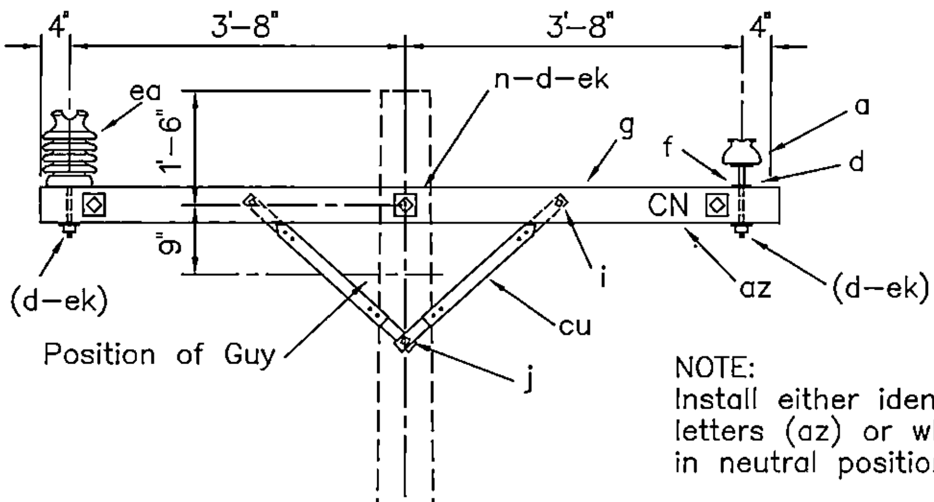
DOUBLE SUPPORT ON CROSSARMS

APRIL 2005

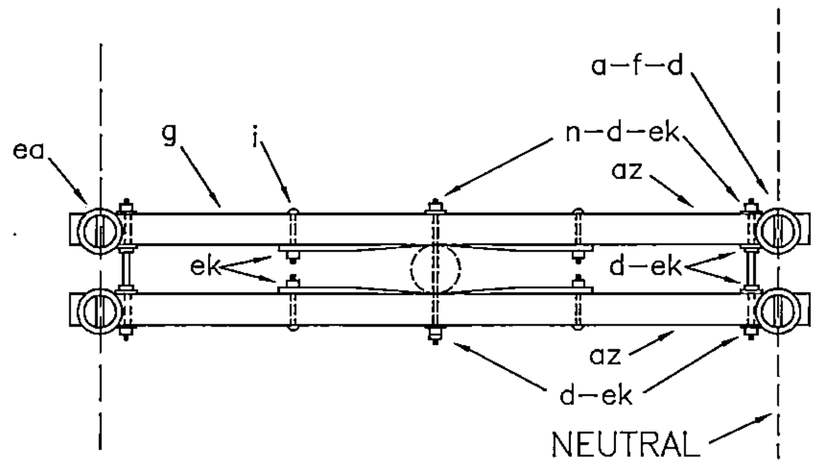
RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A2.21 (A9)



NOTE:
Install either identification letters (az) or white insulator in neutral position.



PLAN

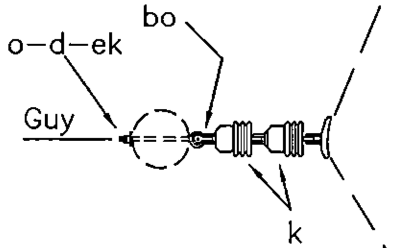
ITEM	QTY	MATERIAL
a	2	Insulator, pin type, 15 kV, white
d	12	Washer, square, 2 1/4"
f	2	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
n	3	Bolt, double arm, 5/8" x req'd length
az	4	Letters, 2" C, 2" N, with 1" nails
cu	4	Brace, 28"
ea	2	Insulator, post type (12.47/7.2 kV)
ek	14	Locknuts

DESIGN PARAMETERS:

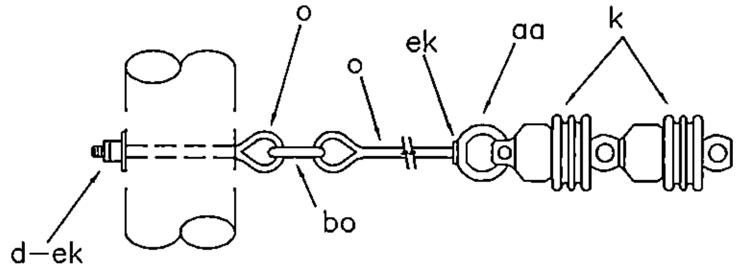
See TABLE IV

DOUBLE SUPPORT ON CROSSARMS
(POST INSULATORS)

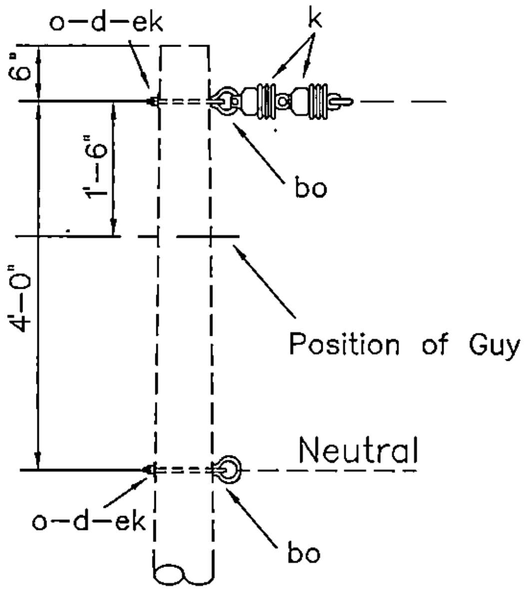
APRIL 2005	1 - PHASE PRIMARY 12.47/7.2 kV	A2.21P (A9P)
RUS		



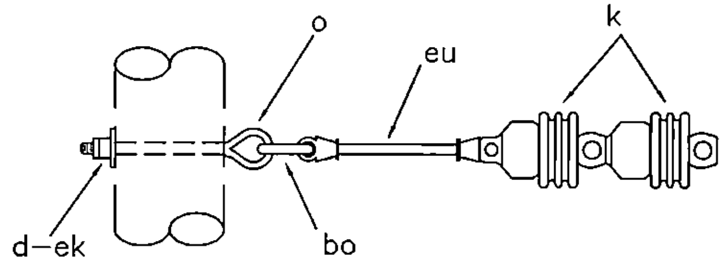
PLAN



A3.2



A3.1



A3.3

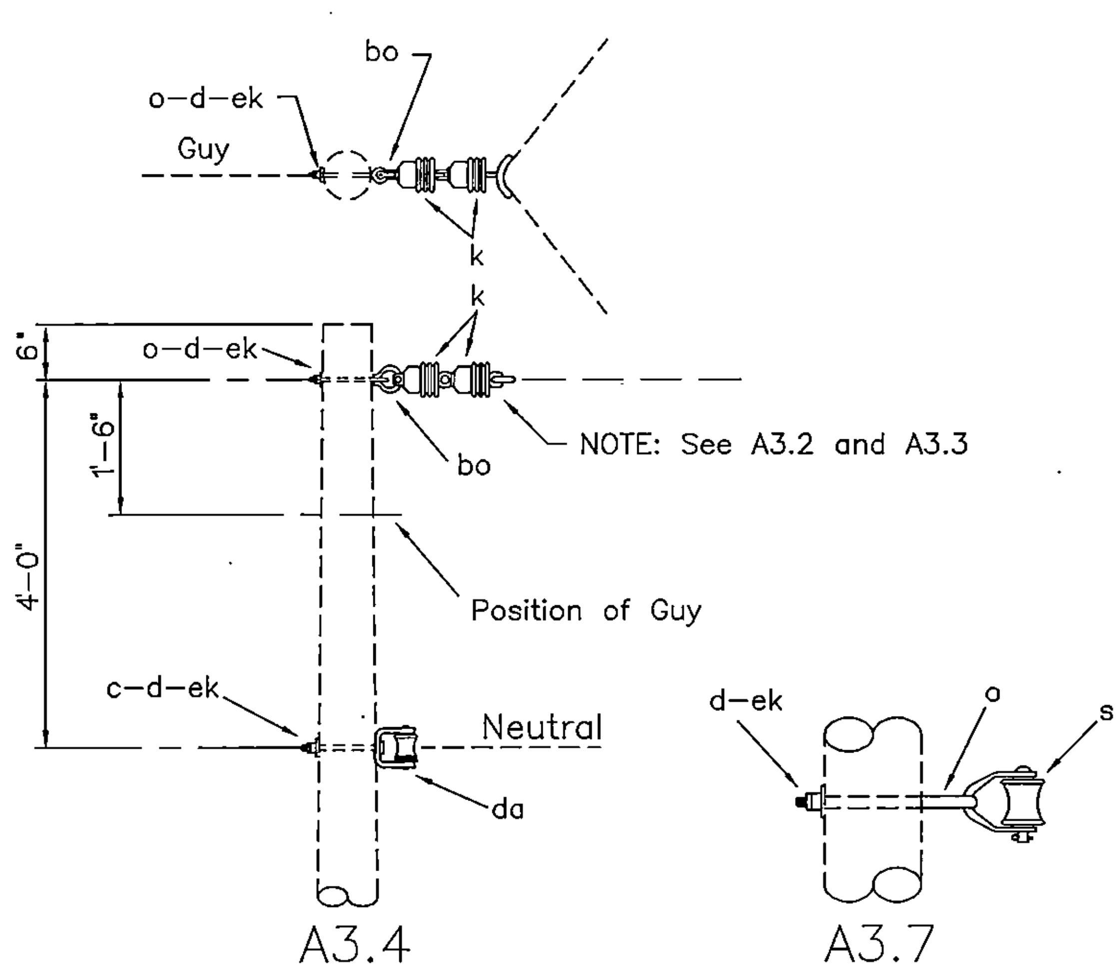
	ASSEMBLY: A3	.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 3", curved	2	2	2
k	Insulator, suspension, 4 1/4"	2	2	2
o	Bolt, eye, 5/8"x req'd length	2	3	2
aa	Nut, eye		1	
bo	Shackle, anchor	2	2	2
ek	Locknuts	2	3	2
eu	Link, extension, insulated			1
(du)	(Link, extension) – (optional)			(1)

DESIGN PARAMETERS:

PERMITTED TRANSVERSE
LOAD= 5000 lbs./Conductor
20° – 60°: #1/0 ACSR & Larger
30° – 60°: Smaller Conductors

SUSPENSION ANGLE

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	A3.1,A3.2,A3.3 (A3)



A3.5 = A3.4 neutral subassembly + A3.2 primary subassembly
A3.6 = A3.4 neutral subassembly + A3.3 primary subassembly
A3.8 = A3.7 neutral subassembly + A3.2 primary subassembly
A3.9 = A3.7 neutral subassembly + A3.3 primary subassembly

	ASSEMBLY: A3	.4	.5	.6	.7	.8	.9
ITEM	MATERIAL	QTY	QTY	QTY	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	1	1	1			
d	Washer, square, 3", curved	2	2	2	2	2	2
k	Insulator, suspension, 4 1/4"	2	2	2	2	2	2
o	Bolt, eye, 5/8"x req'd length	1	2	1	2	3	2
s	Clevis, secondary, swinging, insulated				1	1	1
aa	Nut, eye		1			1	
bo	Shackle, anchor	1	1	1	1	1	1
da	Braket, insulated	1	1	1			
ek	Locknuts	2	3	2	2	3	2
eu (du)	Link, extension, insulated (Link, extension) – (optional)			1 (1)			1 (1)

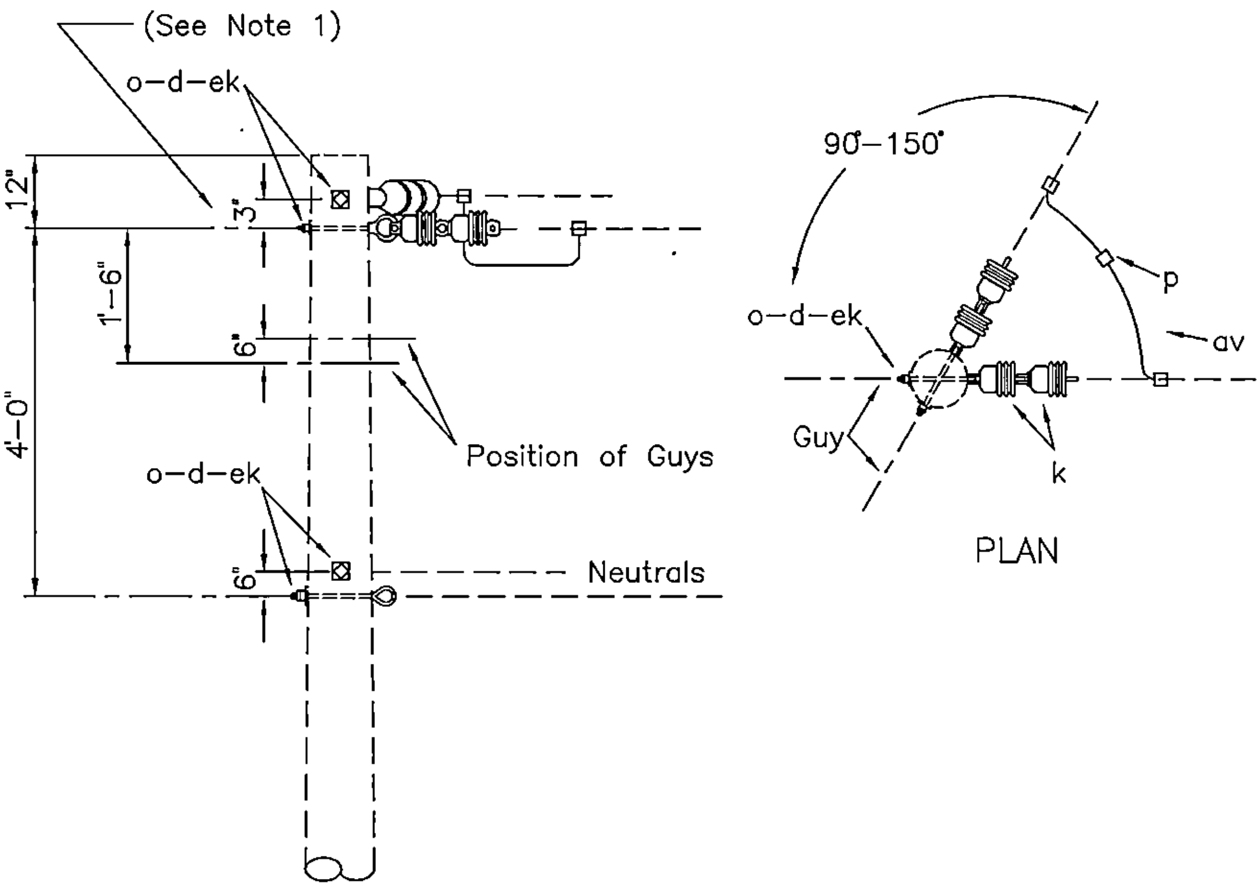
DESIGN PARAMETERS:

For ANSI Class 53–2 Spool Insulator (1 3/4") See Table VI

For ANSI Class 53–4 Spool Insulator (3") See Table VII

SUSPENSION ANGLE

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	A3.4 – A3.9



NOTES:

1, Separate 6" (top position only) when angle equals 90°.
2. Other combinations of deadend assemblies (A5.1 through A5.9) may be used, (e.g., two A5.3's; or one A5.1 plus one A5.7). Record alternative assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

ITEM	QTY	MATERIAL
d	4	Washer, square, 3", curved
k	4	Insulator, suspension, 4 1/4"
o	4	Bolt, eye, 5/8" x req'd length
p		Connectors, as req'd
av		Jumpers, as req'd
ek	4	Locknuts

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL
LOAD = 5000 lbs./Conductor

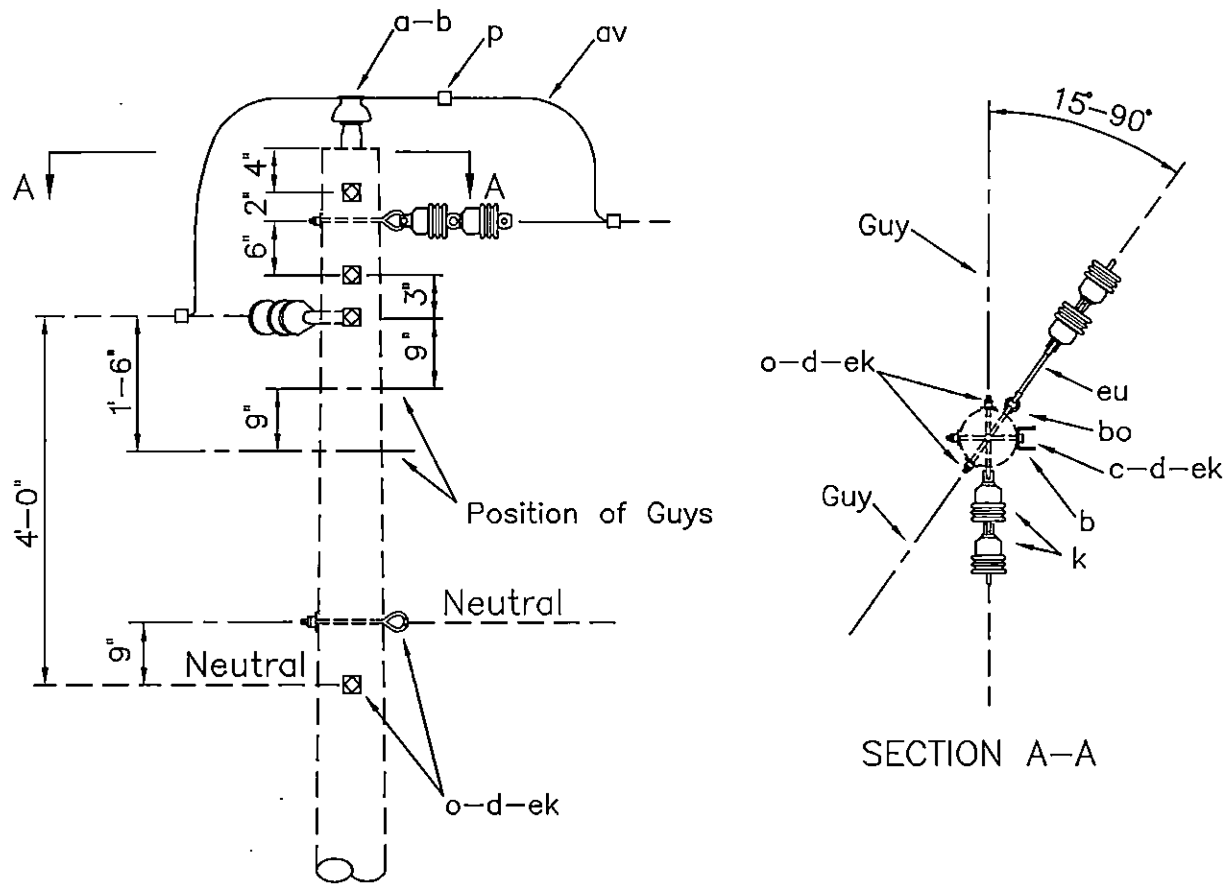
DEADEND ANGLE (90°–150°)

APRIL 2005

RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A4.1 (A4)



NOTES:

1. Use 3" curved washers, "d", on eyebolts, "o".
2. Other combinations of deadend assemblies (A5.1 through A5.9) may be used, (e.g., one A1.01 plus two A5.3's; or one A1.01 plus one A5.1 plus one A5.7). Record alternative assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

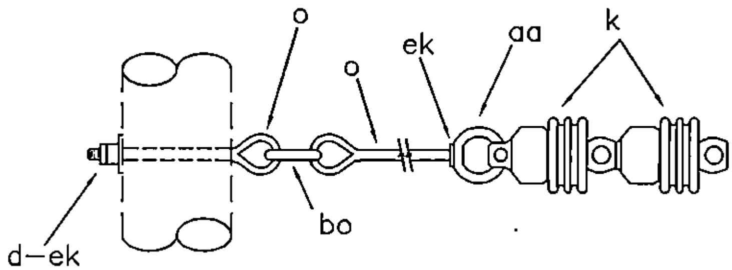
ITEM	QTY	MATERIAL
a	1	Insulator, pin type (12.47/7.2 kV)
b	1	Pin, pole top, 20"
c	2	Bolt, machine, 5/8 x req'd length
d	2	Washer, square, 2 1/4"
d	4	Washer, square, 3, curved
k	4	Insulator, suspension, 4 1/4
o	4	Bolt, eye, 5/8 x req'd length
p		Connectors, as req'd
av		Jumpers, as req'd
bo	1	Shackle, anchor
ek	6	Locknuts
eu (du)	1 (1)	Link, extension, insulated (Link, Extension)(Optional)

DESIGN PARAMETERS:

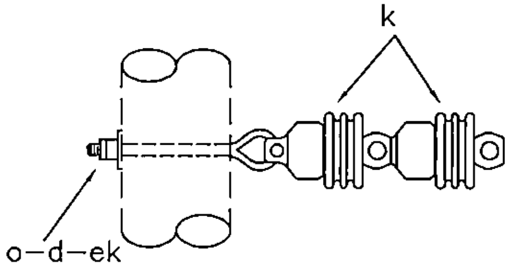
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE (15°-90°)

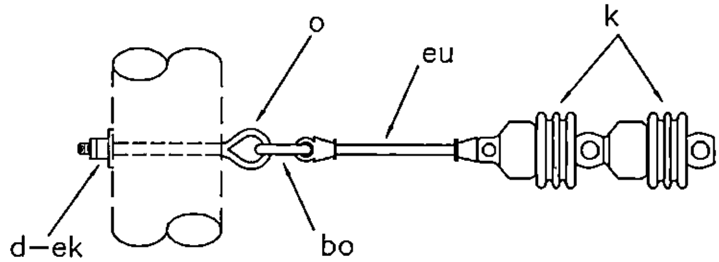
APRIL 2005	1 - PHASE PRIMARY	
RUS	12.47/7.2 kV	A4.2



A5.02



A5.01



A5.03

NOTE: When connecting to existing bolt end, use eyenut "aa" and locknut "ek" instead of eyebolt subassembly "o−d−ek".

	ASSEMBLY: A5	.01	.02	.03
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 3", curved	1	1	1
k	Insulator, suspension, 4 1/4"	2	2	2
o	Bolt, eye, 5/8"x req'd length	1	2	1
aa	Nut, eye		1	
bo	Shackle, anchor		1	1
ek	Locknuts	1	2	1
eu	Link, extension, insulated			1
(du)	(Link, extension) − (optional)			(1)

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

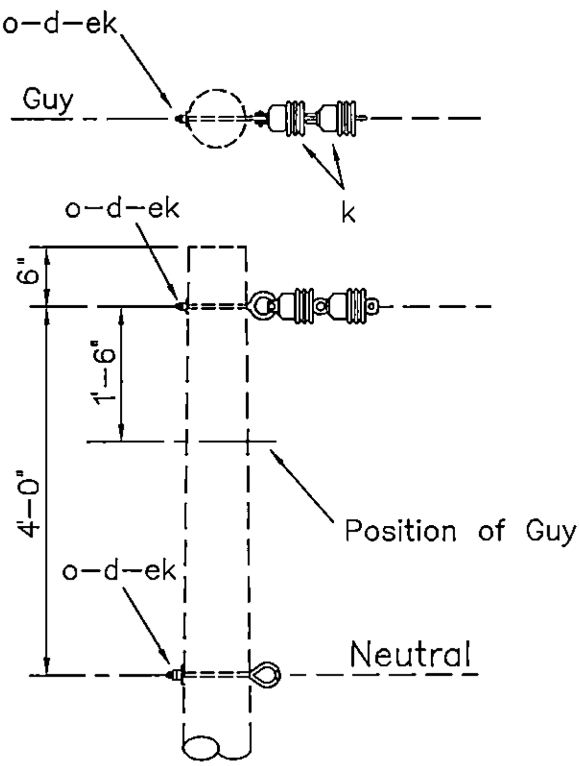
SINGLE DEADENDS

APRIL 2005

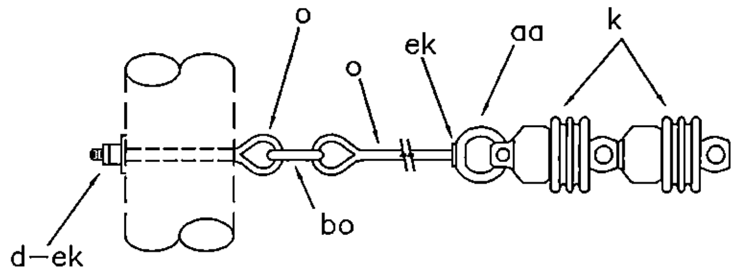
RUS

1 − PHASE PRIMARY
12.47/7.2 kV

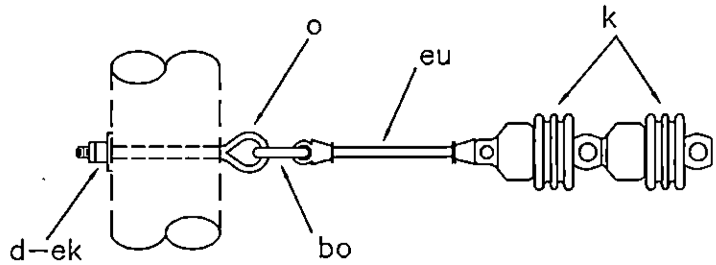
A5.01,A5.02,A5.03
(M5−24),(M5−8)



A5.1



A5.2



A5.3

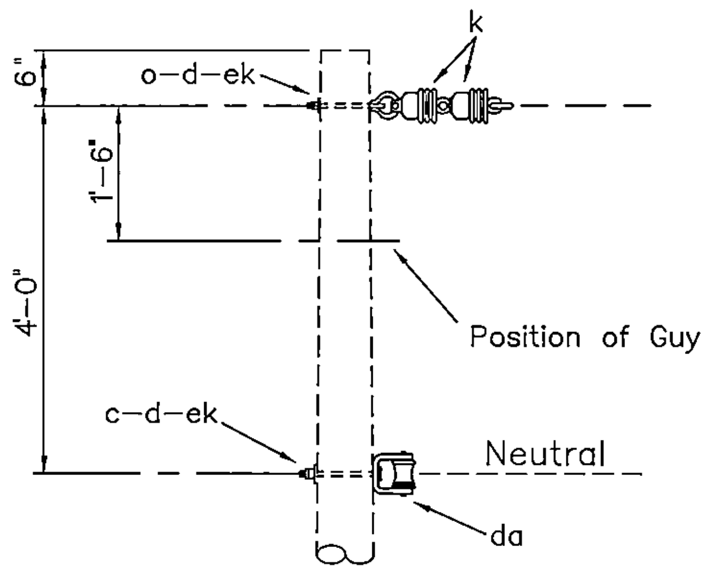
NOTE: When connecting to existing bolt end, use eyenut "aa" and locknut "ek" instead of eyebolt subassembly "o-d-ek".

	ASSEMBLY: A5	.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 3", curved	2	2	2
k	Insulator, suspension, 4 1/4"	2	2	2
o	Bolt, eye, 5/8"x req'd length	2	3	2
p	Connectors, as req'd			
aa	Nut, eye		1	
av	Jumper's, as req'd			
bo	Shackle, anchor		1	1
ek	Locknuts	2	3	2
eu	Link, extension, insulated			1
(du)	(Link, extension) – (optional)			(1)

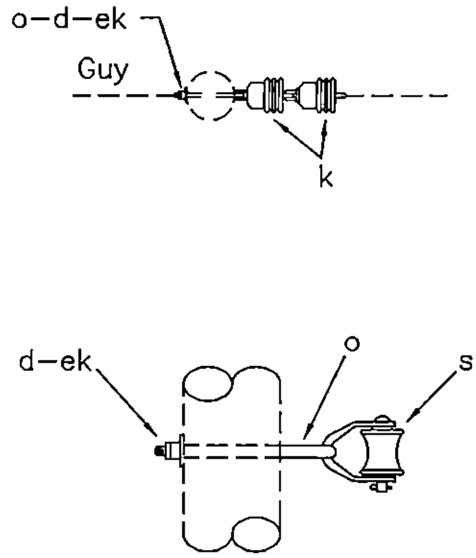
DESIGN PARAMETERS:
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

SINGLE DEADENDS

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	A5.1,A5.2,A5.3 (A5),(A5-2)



A5.4



A5.7

A5.5 = A5.4 neutral assembly + A5.2 primary subassembly
A5.6 = A5.4 neutral assembly + A5.3 primary subassembly
A5.8 = A5.7 neutral assembly + A5.2 primary subassembly
A5.9 = A5.7 neutral assembly + A5.3 primary subassembly

NOTE: When connecting to existing bolt end, use eyenut "aa" and locknut "ek" instead of eyebolt subassembly "o–d–ek".

	ASSEMBLY: A5	.4	.5	.6	.7	.8	.9
ITEM	MATERIAL	QTY	QTY	QTY	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	1	1	1			
d	Washer, square, 3", curved	2	2	2	2	2	2
k	Insulator, suspension, 4 1/4"	2	2	2	2	2	2
o	Bolt, eye, 5/8"x req'd length	1	2	1	2	3	2
p	Connectors, as req'd						
s	Clevis, secondary, swinging, insulated				1	1	1
aa	Nut, eye		1			1	
av	Jumpers, as req'd						
bo	Shackle, anchor		1	1		1	1
da	Bracket, insulated	1	1	1			
ek	Locknuts	2	3	2	2	3	2
eu	Link, extension, insulated			1			1
(du)	(Link, extension) – (optional)			(1)			(1)

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD
For ANSI Class 53–2 Spool Insulator (1 3/4"): 1,500 lbs

For ANSI Class 53–4 Spool Insulator (3"): 2,250 lbs

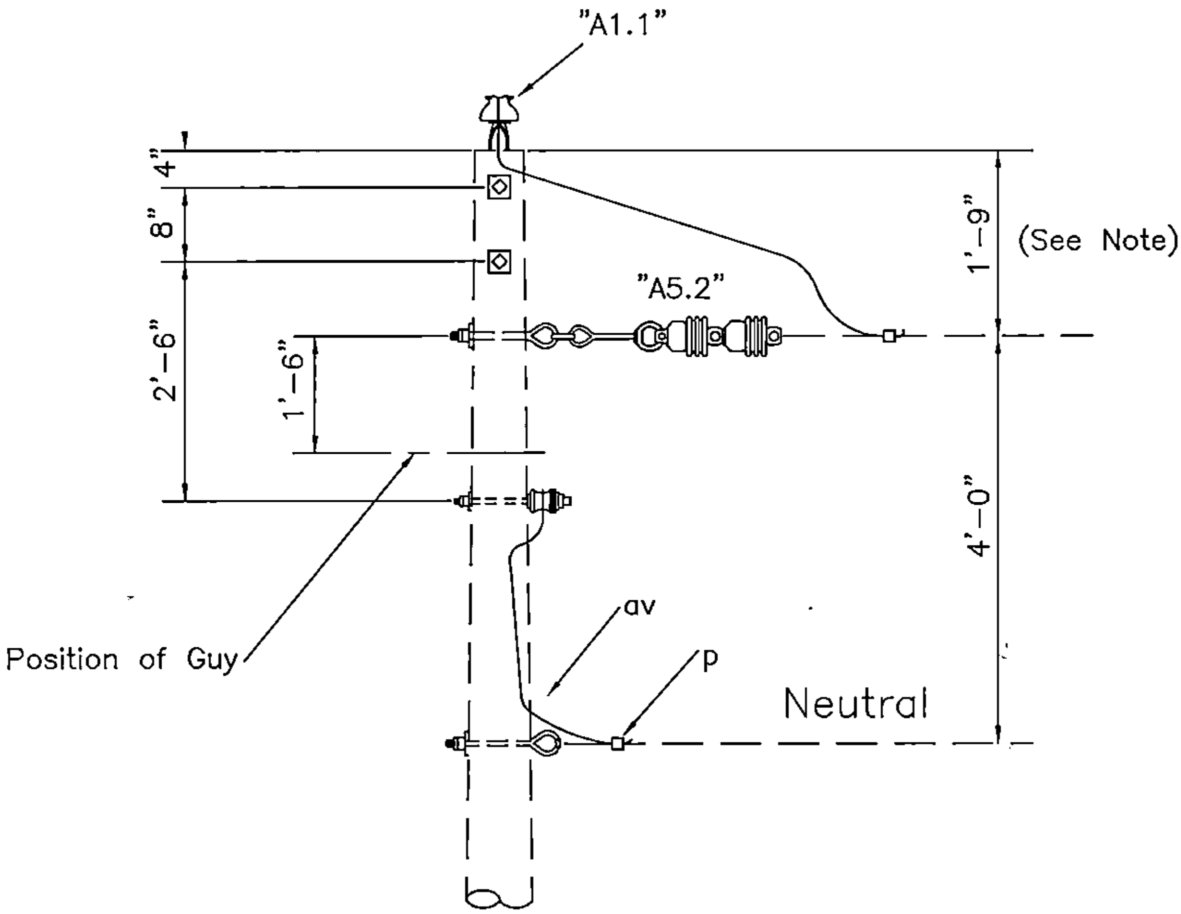
SINGLE DEADENDS

APRIL 2005

RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A5.4 – A5.9



NOTES:

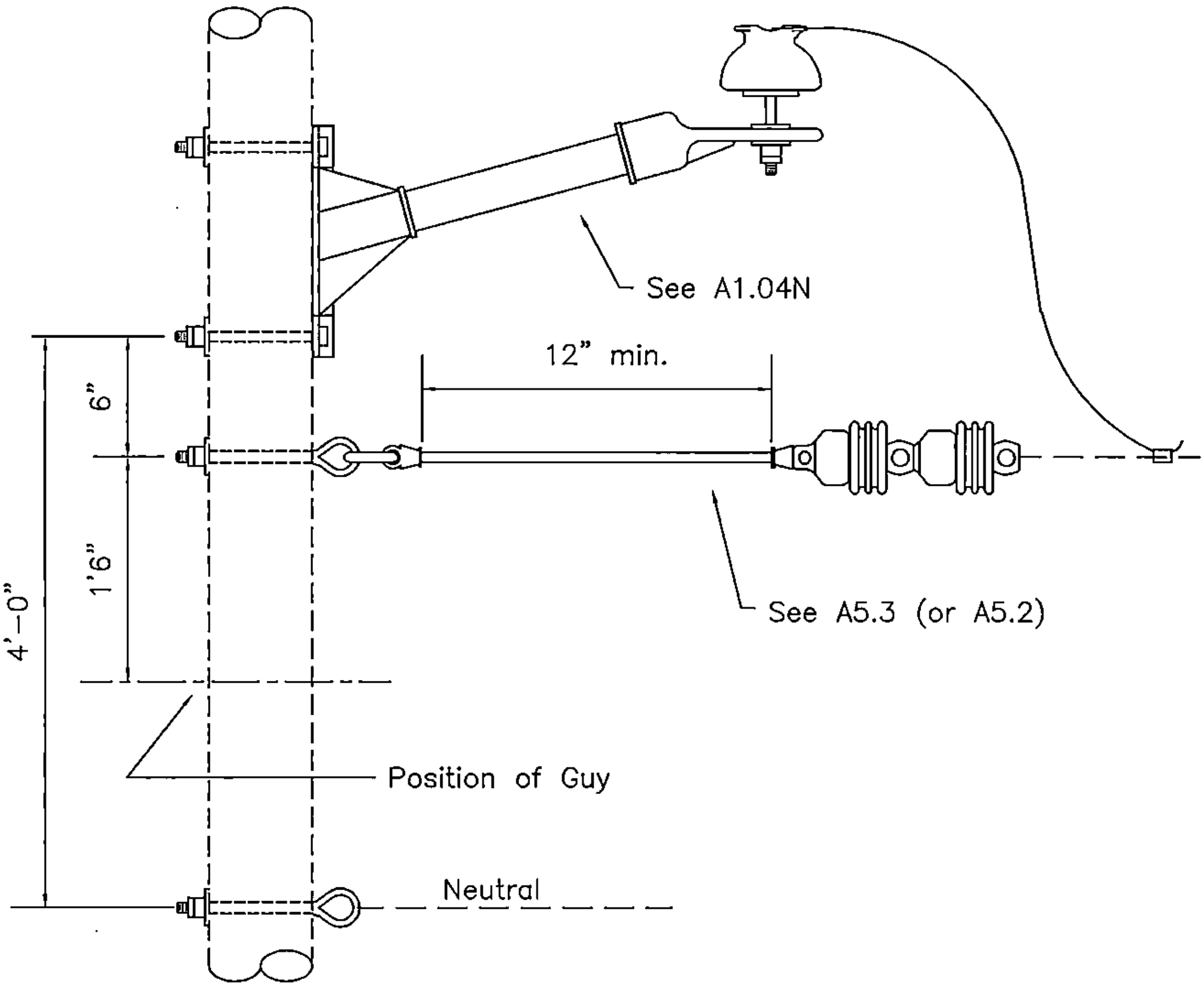
1. Tap assembly may be installed 6" from top of pole when perpendicular to line. Raise neutral and guy attachemnt 15" also.
2. Any deadend assembly, A5.1 through A5.9, may be used.

ITEM	QTY	MATERIAL
	(1)	(A1.1 Primary Assembly)
	1	A5.2 Primary Assembly
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:
PERMITTED LONGITUDINAL
LOAD = 5000 lbs./Conductor

SINGLE PHASE TAP GUIDE

APRIL 2005	1 – PHASE PRIMARY	
RUS	12.47/7.2 kV	A5.2G



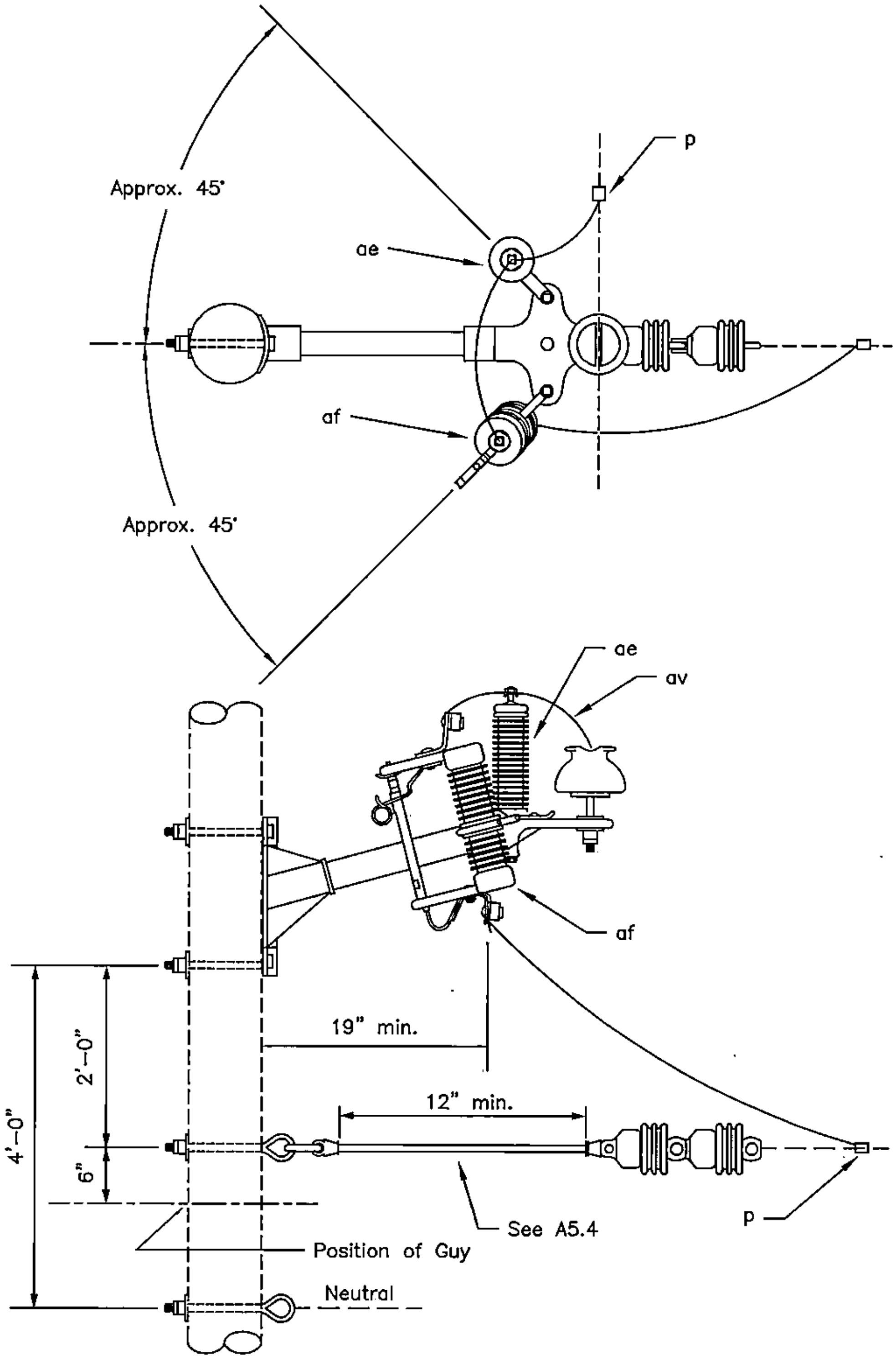
ITEM	MATERIAL	QTY
	A1.04N Primary Assembly (Narrow Profile)	1
	A5.3 Primary Assembly	1
p	Connectors, as req'd	
av	Jumpers, as req'd	

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL
LOAD = 5000 lbs./Conductor

SINGLE PHASE TAP GUIDE

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	A5.3NG



ITEM	MATERIAL	QTY
	A1.04N Primary Assembly (Narrow Profile)	1
	A5.4 Primary Assembly	1
p	Connectors, as req'd	
ae	Arrester, surge (9kV)	1
af	Cutout, dist. open (15kV)	1
av	Jumpers, as req'd	

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

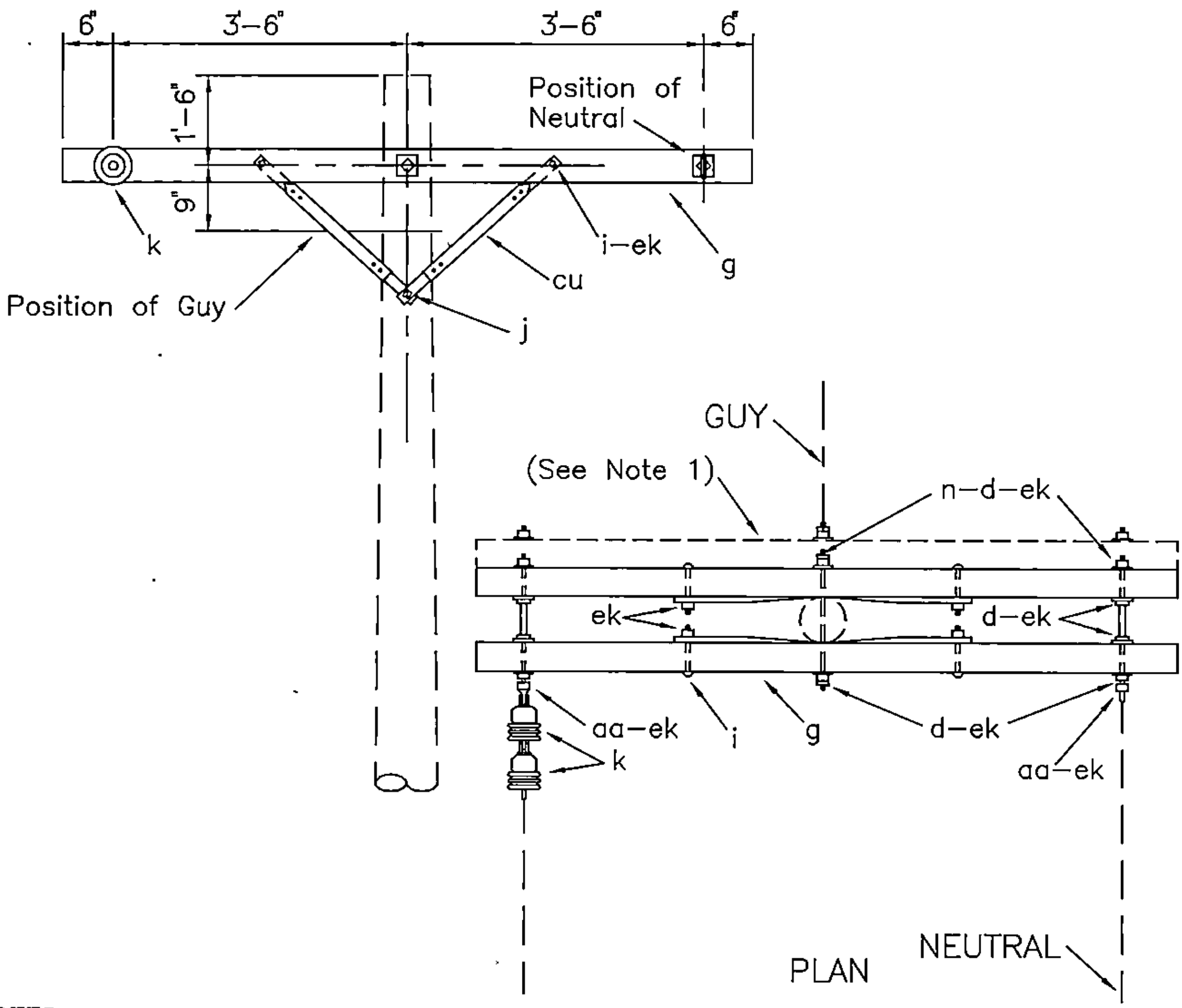
SINGLE PHASE TAP GUIDE – NARROW PROFILE (WITH CUTOUT AND ARRESTER)

APRIL 2005

RUS

1 – PHASE PRIMARY 12.47/7.2 kV

A5.4NG

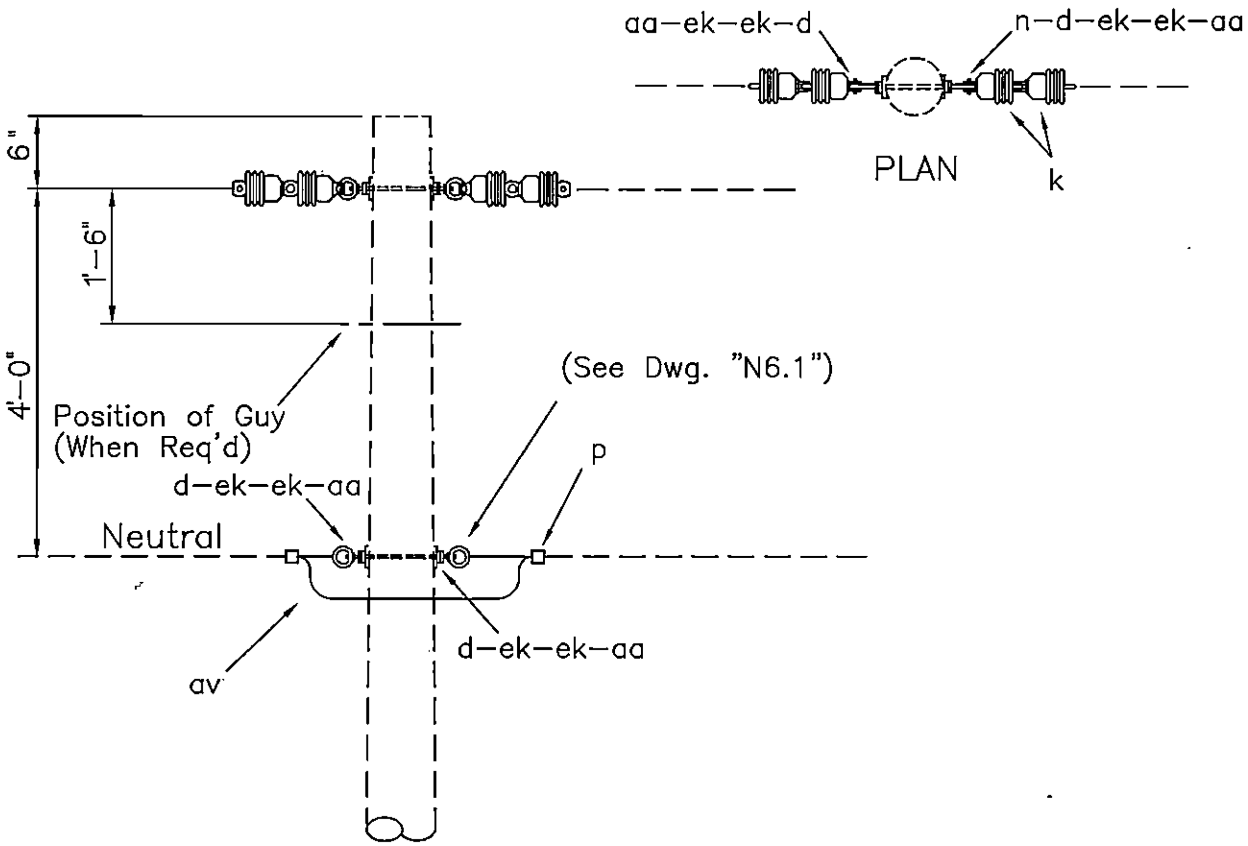


NOTES:

1. Designate as A5.31 for assembly with three crossarms.
2. Double arming eye bolt, item "dy," may be used instead of double arming bolt, item "n," and eyenut, item "aa."

ITEM	QTY	MATERIAL
d	10	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
k	2	Insulator, suspension, 4 1/4"
n	3	Bolt,double arming,5/8" x req'd length
aa	2	Nut, eye, 5/8"
cu	4	Brace, 28"
ek	16	Locknuts

DESIGN PARAMETERS:	SINGLE DEADEND ON CROSSARMS		
PERMITTED UNBALANCED CONDUCTOR TENSION: See Table A (Exhibit 2)	APRIL 2005 RUS	1 - PHASE PRIMARY 12.47/7.2 kV	A5.21 (A7) A5.31 (A7-1)



NOTES:

1. Single deadend assemblies A5.02 or A5.03 may optionally be installed
2. Maximum line angle may be increased to 15° by installing anchor shakles, item "bo", to (horizontal) eyenuts and installing side guy as req'd.

ITEM	QTY	MATERIAL
o	*	Bolt, eye, 5/8" x req'd length
bo	*	Shackle, anchor
eu	*	Link, extension, insulated
d	4	Washer, square, 3", curved
k	4	Insulator, suspension, 4 1/4"
n	2	Bolt,double arming,5/8" x req'd length
p		Connectors, as req'd
aa	4	Nut, eye, 5/8" (or as req'd)
av		Jumpers, as req'd
ek	8	Locknuts (or as req'd)

* Optional – Quantity as req'd

DESIGN PARAMETERS:

PERMITTED
LONGITUDINAL LOAD=
5000 lbs./Conductor

MAXIMUM LINE
ANGLE = 5° (See Note)

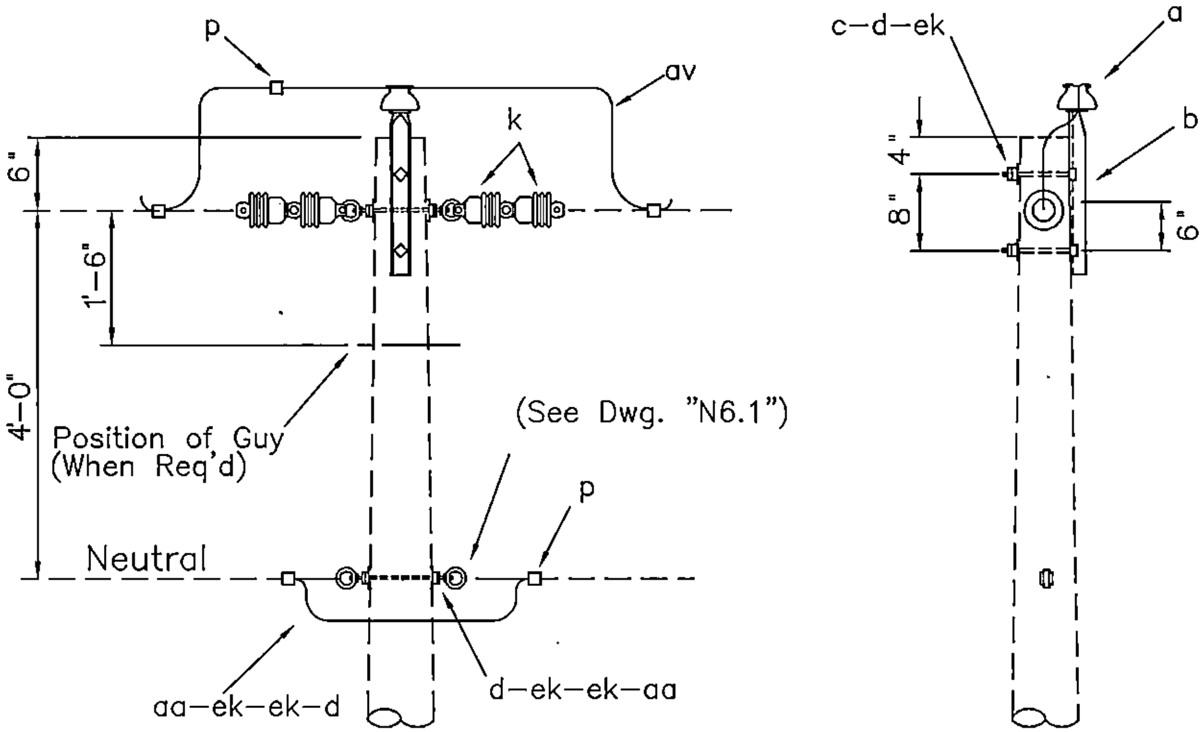
DOUBLE DEADEND (STRAIGHT)

APRIL 2005

RUS

1 – PHASE PRIMARY
12.47/7.2 kV

A6.1 (A6)



NOTES:
1. Single deadend assemblies A5.02 or A5.03 may optionally be installed.
2. Maximum line angle may be increased to 15° by installing anchor shakles, item "bo", to (horizontal) eyenuts and installing side guy as req'd.

ITEM	QTY	MATERIAL
o	*	Bolt, eye, 5/8" x req'd length
bo	*	Shackle, anchor
eu	*	Link, extension, insulated
a	1	Insulator, pin type (12.47/7.2 kV)
b	1	Pin, pole top, 20"
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
d	4	Washer, square, 3," curved
k	4	Insulator, suspension, 4 1/4"
n	2	Bolt,double arming,5/8" x req'd length
p		Connectors, as req'd
aa	4	Nut, eye, 5/8"
av		Jumpers, as req'd
ek	10	Locknuts

* Optional — Quantity as req'd

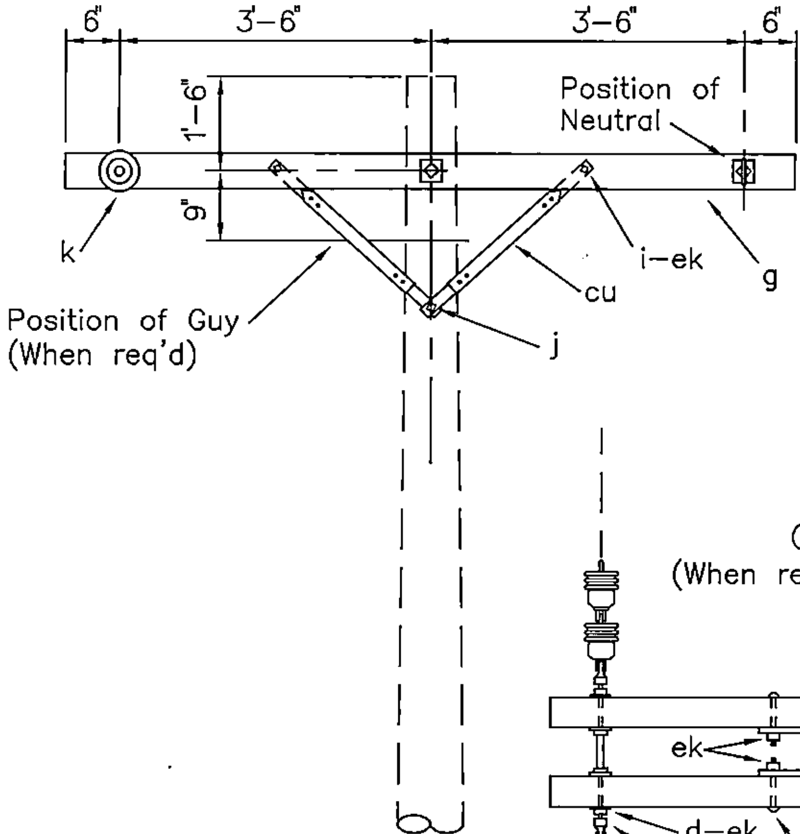
DESIGN PARAMETERS:

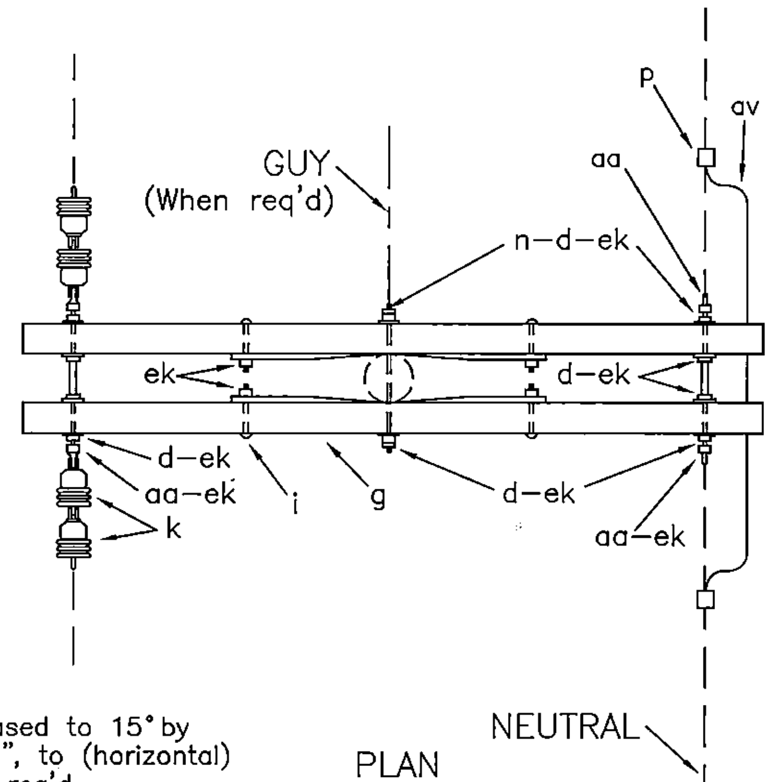
PERMITTED
LONGITUDINAL LOAD=
5000 lbs./Conductor

MAXIMUM LINE
ANGLE = 5° (See Note)

DOUBLE DEADEND
(FEED THROUGH)

APRIL 2005	1 – PHASE PRIMARY	
RUS	12.47/7.2 kV	A6.2





NOTES:

1. See drawing "N6.21" for additional details.
2. Maximum line angle may be increased to 15° by installing anchor shackles Item "bo", to (horizontal) eyenuts and installing side guy as req'd.

ITEM	QTY	MATERIAL
d	10	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
k	4	Insulator, suspension, 4 1/4"
n	3	Bolt,double arming,5/8" x req'd length
p		Connectors, as req'd
aa	4	Nut, eye, 5/8"
av		Jumpers, as req'd
cu	4	Brace, wood, 28"
ek	18	Locknuts

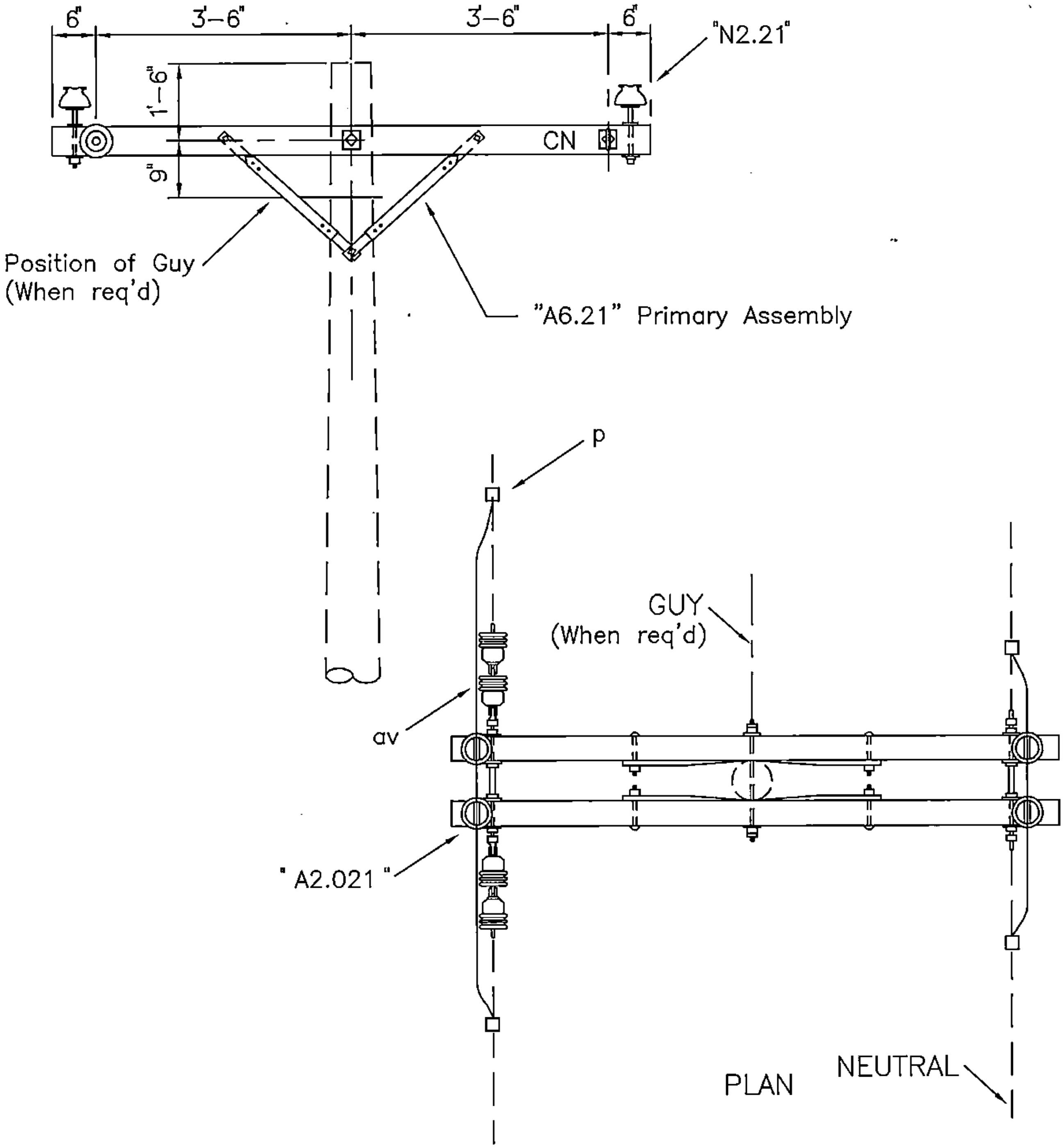
DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table A (Exhibit 2)

MAXIMUM ALLOWABLE LINE ANGLE = 5° (See Note 2)

DOUBLE DEADEND ON CROSSARMS

APRIL 2005	1 - PHASE PRIMARY 12.47/7.2 kV	A6.21 (A8)
RUS		



ITEM	QTY	MATERIAL
	1	A6.21 Primary Assembly
	1	A2.021 Primary Assembly
	1	N2.21 Neutral Assembly
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:

See Table A (Exhibit 2)

MAXIMUM LINE ANGLE = 5° (See Dwg. A6-21)

DOUBLE DEADEND GUIDE
(FEED THROUGH ON CROSSARMS)

APRIL 2005	1 – PHASE PRIMARY	
RUS	12.47/7.2 kV	A6.22G

TWO-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

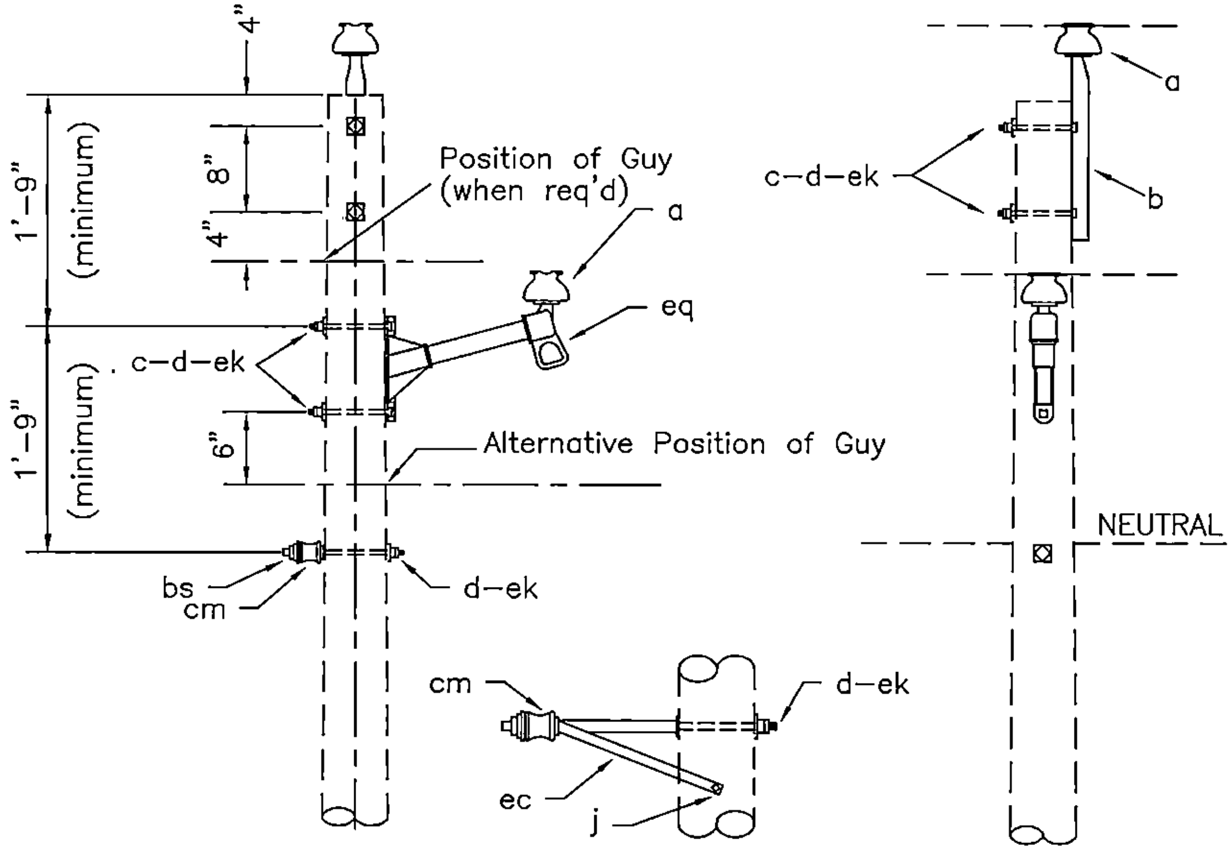
DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
B1.1N B1.2N		SINGLE SUPPORT – NARROW PROFILE (TANGENT)
B1.1NP B1.2NP		SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B1.3N		SINGLE SUPPORT – NARROW PROFILE
B1.3NP		SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
B1.4N B1.5N		SINGLE SUPPORT – NARROW PROFILE (TANGENT)
B1.4NP B1.5NP		SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B1.6N		SINGLE SUPPORT – NARROW PROFILE
B1.6NP		SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
B1.7N B1.8N		SINGLE SUPPORT – NARROW PROFILE (TANGENT)
B1.7NP B1.8NP		SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B1.9N		SINGLE SUPPORT – NARROW PROFILE
B1.9NP		SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
B1.11 B1.12	(B1) (B1A)	SINGLE SUPPORT ON CROSSARM (TANGENT)
B1.11P B1.12P	(B1P) (B1AP)	SINGLE SUPPORT ON CROSSARM (TANGENT) (POST INSULATORS)
B1.13		SINGLE SUPPORT ON CROSSARM
B1.13P		SINGLE SUPPORT ON CROSSARM (POST INSULATORS)

TWO-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
B1.14	(B9-1)	SINGLE SUPPORT, NEUTRAL ON CROSSARM
B1.14P	(B9-1P)	SINGLE SUPPORT, NEUTRAL ON CROSSARM (POST INSULATORS)
B2.1N B2.2N		DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
B2.1NP B2.2NP		DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B2.3N		DOUBLE SUPPORT – NARROW PROFILE
B2.3NP		DOUBLE SUPPORT – NARROW PROFILE (POST INSULATORS)
B2.4N B2.5N		DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
B2.4NP B2.5NP		DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B2.6N		DOUBLE SUPPORT – NARROW PROFILE
B2.6NP		DOUBLE SUPPORT – NARROW PROFILE (POST INSULATORS)
B2.7N B2.8N		DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
B2.7NP B2.8NP		DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B2.9N		DOUBLE SUPPORT – NARROW PROFILE
B2.9NP		DOUBLE SUPPORT – NARROW PROFILE (POST INSULATORS)
B2.21	(B2)	DOUBLE SUPPORT ON CROSSARMS
B2.21P	(B2P)	DOUBLE SUPPORT ON CROSSARMS (POST INSULATORS)
B2.22	(B9)	DOUBLE SUPPORT, NEUTRAL ON CROSSARMS
B2.22P	(B9P)	DOUBLE SUPPORT, NEUTRAL ON CROSSARMS (POST INSULATORS)

TWO-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS **1728F-804** (New)	 **Bulletin 50-3** (Old)	DRAWING TITLE (DESCRIPTION)
B2.24 B2.25	(B1-1) (B1-1A)	DOUBLE SUPPORT ON CROSSARMS - TANGENT
B2.24P B2.25P	(B1-1P) (B1-1AP)	DOUBLE SUPPORT ON CROSSARMS - TANGENT (POST INSULATORS)
B3.1 B3.2 B3.3	(B3)	SUSPENSION ANGLE
B3.4 B3.5 B3.6 B3.7 B3.8 B3.9		SUSPENSION ANGLE
B4.1G	((B4-1))	DEADEND ANGLE GUIDE (90° – 150°)
B4.2G		DEADEND ANGLE GUIDE (15° – 90°)
B5.1 B5.2 B5.3	(B5-1)	SINGLE DEADENDS
B5.4 B5.5 B5.6 B5.7 B5.8 B5.9		SINGLE DEADENDS
B5.21 B5.31	(B7) (B7-1)	SINGLE DEADEND ON CROSSARMS
B6.21	(B8)	DOUBLE DEADEND CROSSARMS



Specify B1.2N for offset neutral assembly

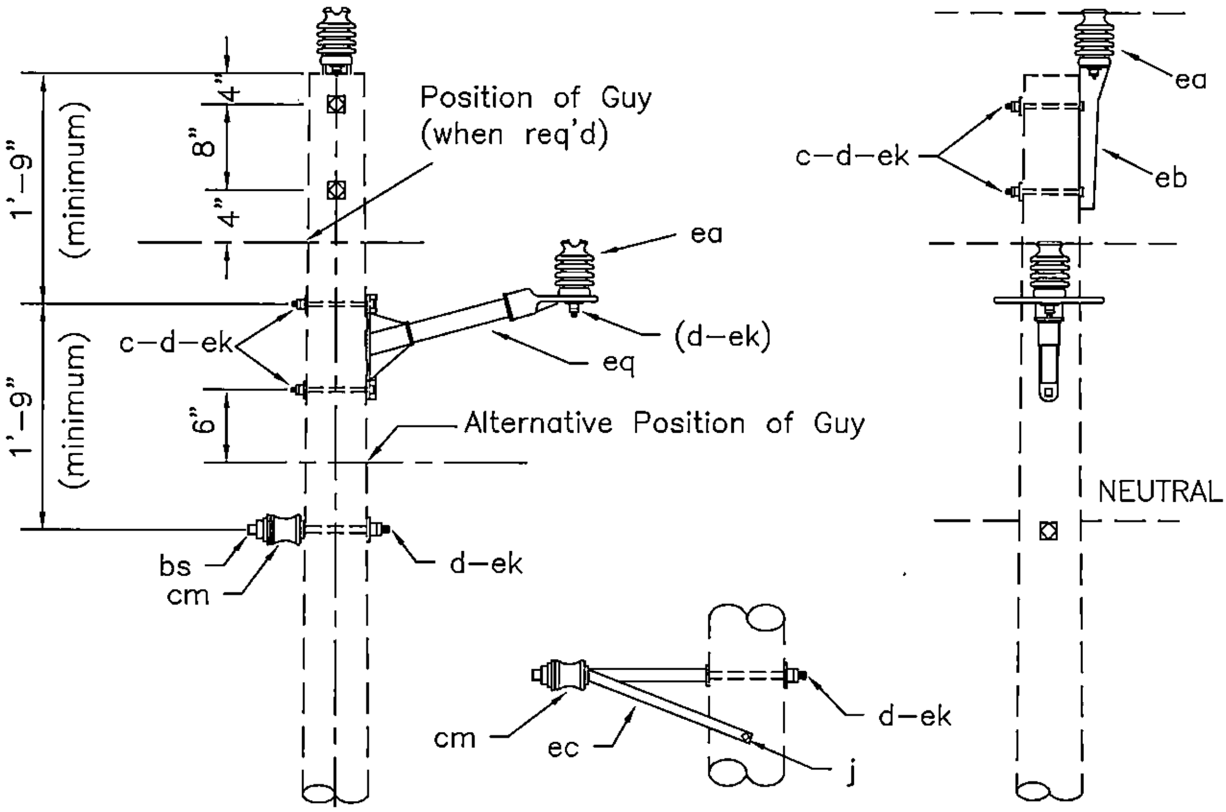
ITEM	MATERIAL ASSEMBLY: B1.	1N QTY	2N QTY	
a	Insulator, pin type (12.47/7.2 kV)	2	2	
b	Pin, pole top, 20"	1	1	
c	Bolt, machine, 5/8" x req'd length	4	4	
d	Washer, square 2 1/4"	5	5	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(1)	(1)	(If req'd)
j	Screw, lag, 1/2" x 4"		2	
bs	Bolt, single, upset	1		
cm	Insulator, spool, 3"	1	1	
ec	Bracket, offset neutral		1	
ek	Locknuts	5	5	
eq	Bracket, insulator/equipment	1	1	

Design Parameters:

MAXIMUM LINE ANGLES:
5°–Small Conductors
2°–Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT)

APRIL 2005	2 – PHASE PRIMARY	B1.1N
RUS	12.47/7.2 kV	B1.2N



Specify B1.2NP for
offset neutral assembly

		ASSEMBLY: B1. 1NP	2NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	5	5
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	2	2
eb	Bracket, pole top	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	1	1

Design Parameters:

MAXIMUM LINE ANGLES:
5°-Small Conductors
2°-Larger than #1/0

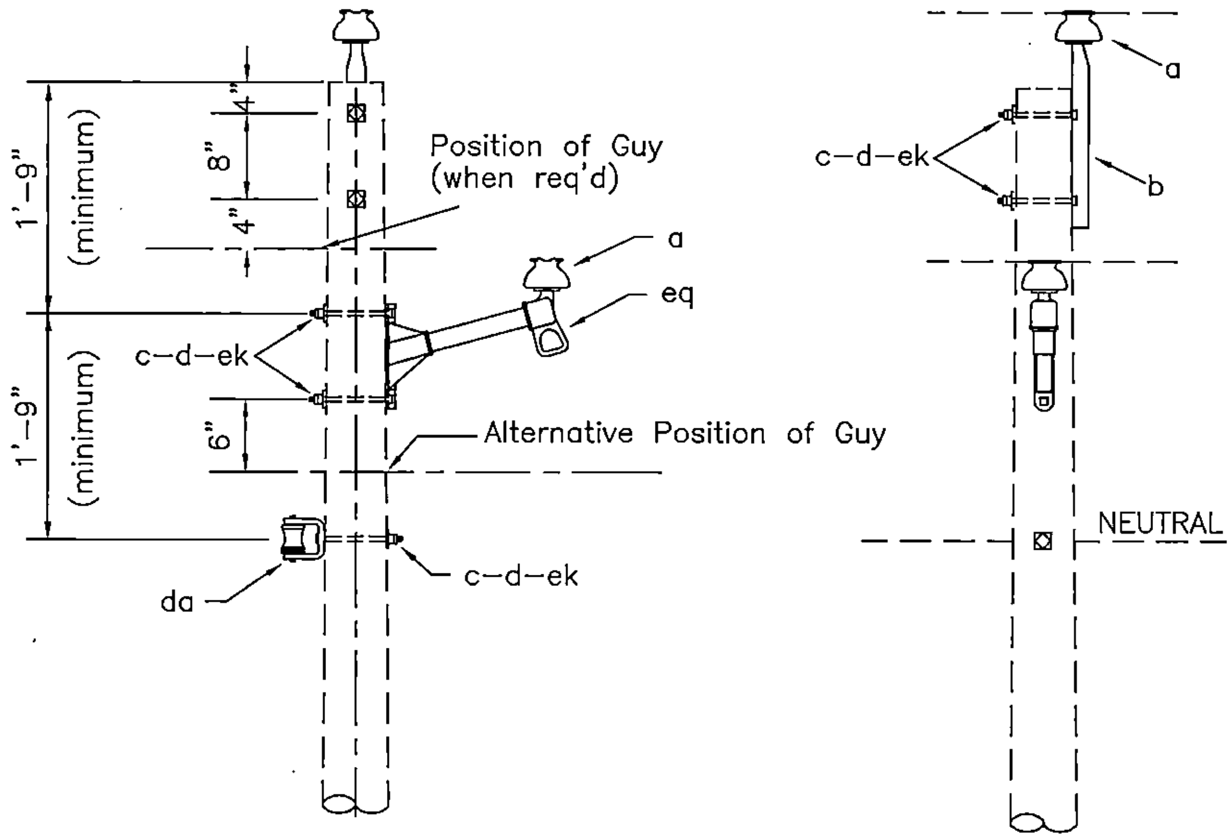
SINGLE SUPPORT-NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005

RUS

2 - PHASE PRIMARY
12.47/7.2 kV

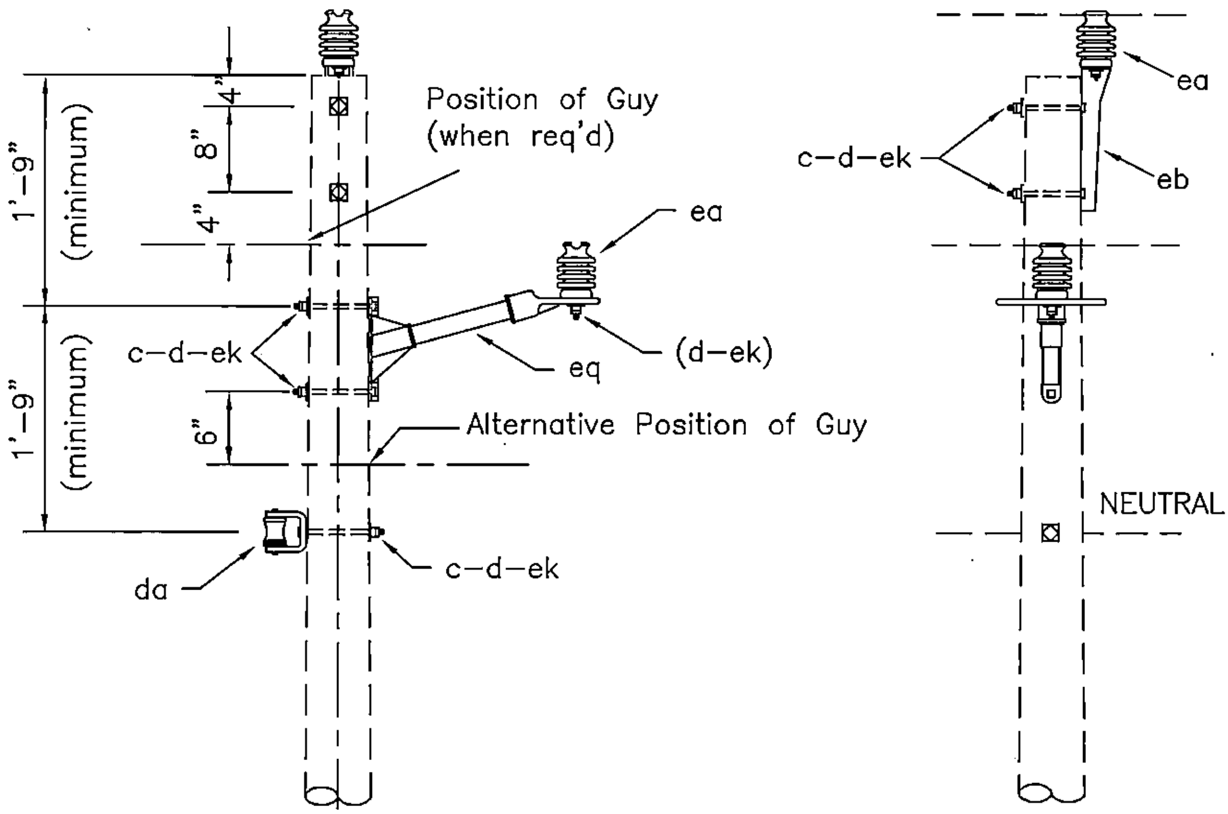
B1.1NP
B1.2NP



ASSEMBLY: B1. 3N

ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	2	
b	Pin, pole top, 20"	1	
c	Bolt, machine, 5/8" x req'd length	5	
d	Washer, square 2 1/4"	5	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(1)	(If req'd)
da	Bracket, insulated	1	
ek	Locknuts	5	
eq	Bracket, insulator/equipment	1	

Design Parameters: MAXIMUM LINE ANGLES: See TABLE I	SINGLE SUPPORT–NARROW PROFILE		
	APRIL 2005 RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B1.3N



ASSEMBLY: B1.3NP

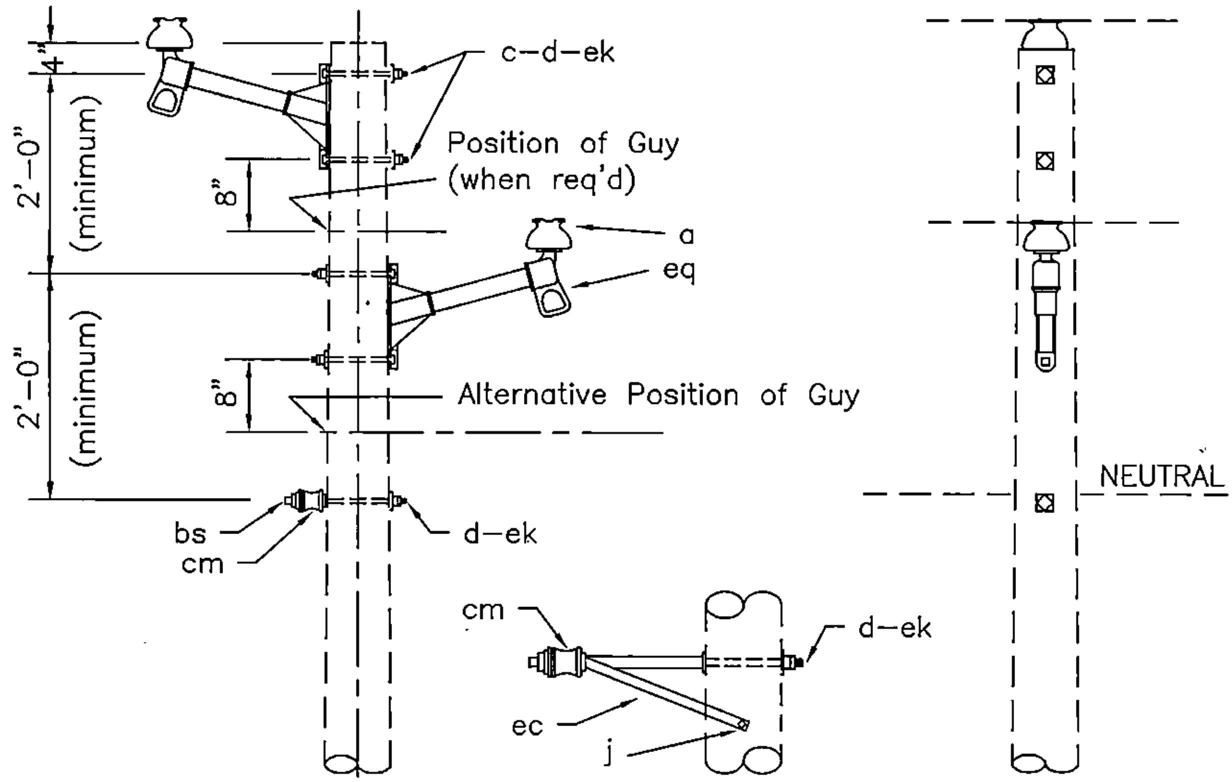
ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	5
d	Washer, square 2 1/4"	5
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	2
eb	Bracket, pole top	1
ek	Locknuts	5
eq	Bracket, insulator/equipment	1

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE II

SINGLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B1.3NP
RUS	12.47/7.2 kV	



Specify B1.5N for offset neutral assembly

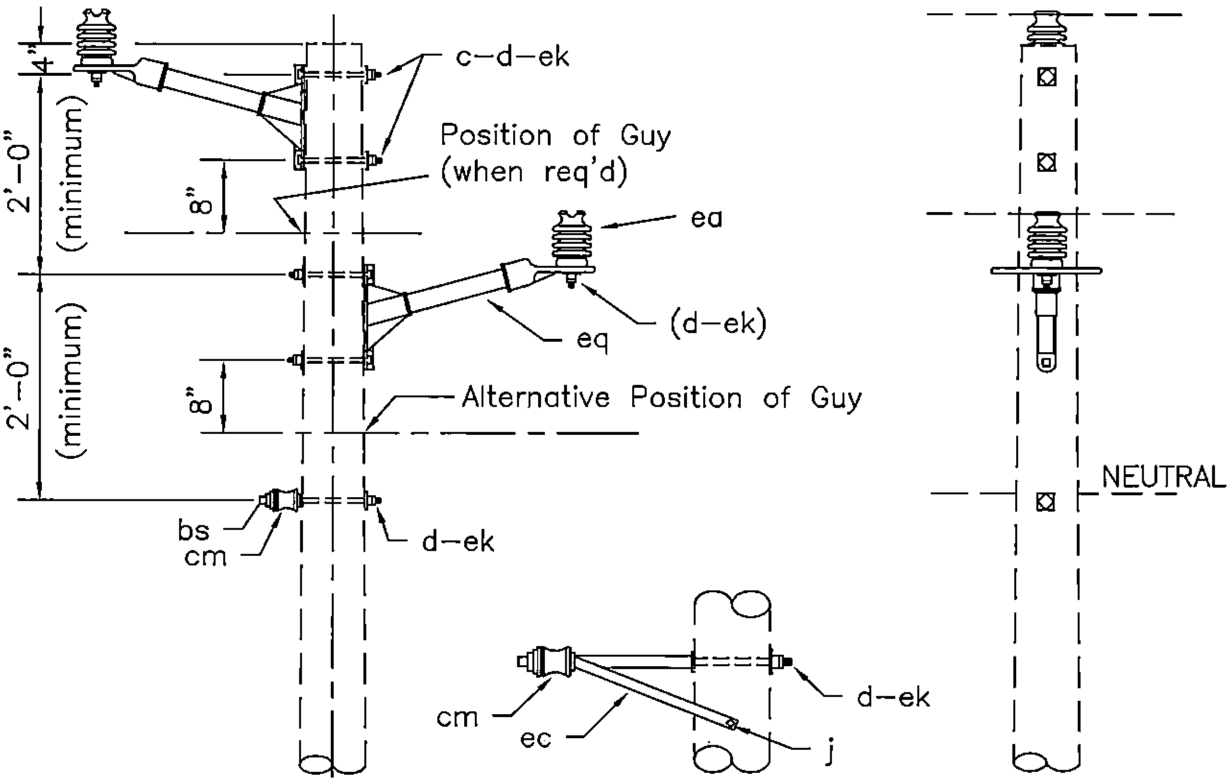
ITEM	MATERIAL (ASSEMBLY: B1.)	4N QTY	5N QTY	
a	Insulator, pin type (12.47/7.2 kV)	2	2	
c	Bolt, machine, 5/8" x req'd length	4	4	
d	Washer, square 2 1/4"	5	5	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(2)	(2)	(If req'd)
j	Screw, lag, 1/2" x 4"		2	
bs	Bolt, single, upset	1		
cm	Insulator, spool, 3"	1	1	
ec	Bracket, offset neutral		1	
ek	Locknuts	5	5	
eq	Bracket, insulator/equipment	2	2	

Design Parameters:

MAXIMUM LINE ANGLES:
5°–Small Conductors
2°–Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT)

APRIL 2005	2 – PHASE PRIMARY	B1.4N
RUS	12.47/7.2 kV	B1.5N



Specify B1.5NP for offset neutral assembly

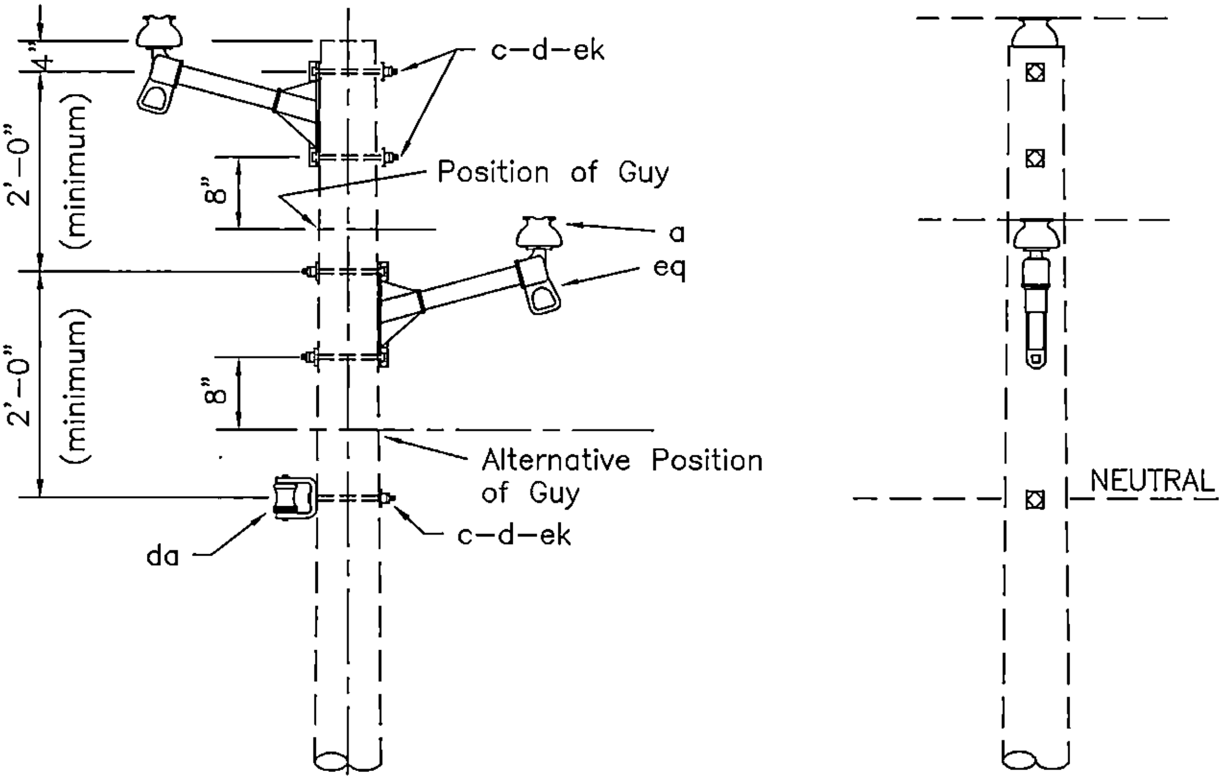
ITEM	MATERIAL (ASSEMBLY: B1.)	4NP QTY	5NP QTY
c	Bolt, machine 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	5	5
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	2	2
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	2	2

Design Parameters:

MAXIMUM LINE ANGLES:
5°–Small Conductors
2°–Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE (TANGENT) (POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B1.4NP
RUS	12.47/7.2 kV	B1.5NP



ASSEMBLY: B1. 6N

ITEM	MATERIAL	QTY	
a	Insulator, pin type (12.47/7.2 kV)	2	
c	Bolt, machine, 5/8" x req'd length	5	
d	Washer, square 2 1/4"	5	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(2)	(If req'd)
da	Bracket, insulated	1	
ek	Locknuts	5	
eq	Bracket, insulator/equipment	2	

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE II

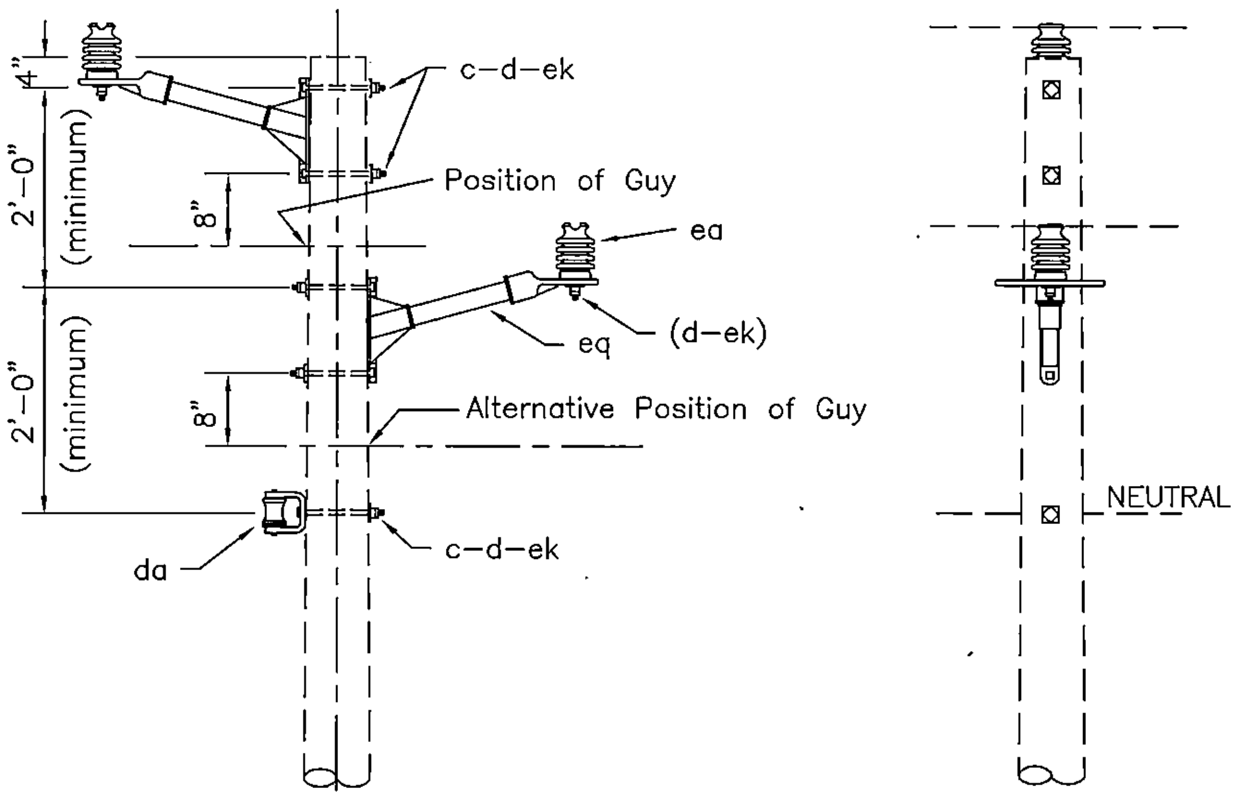
SINGLE SUPPORT–NARROW PROFILE

APRIL 2005

RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B1.6N



ASSEMBLY: B1.6NP

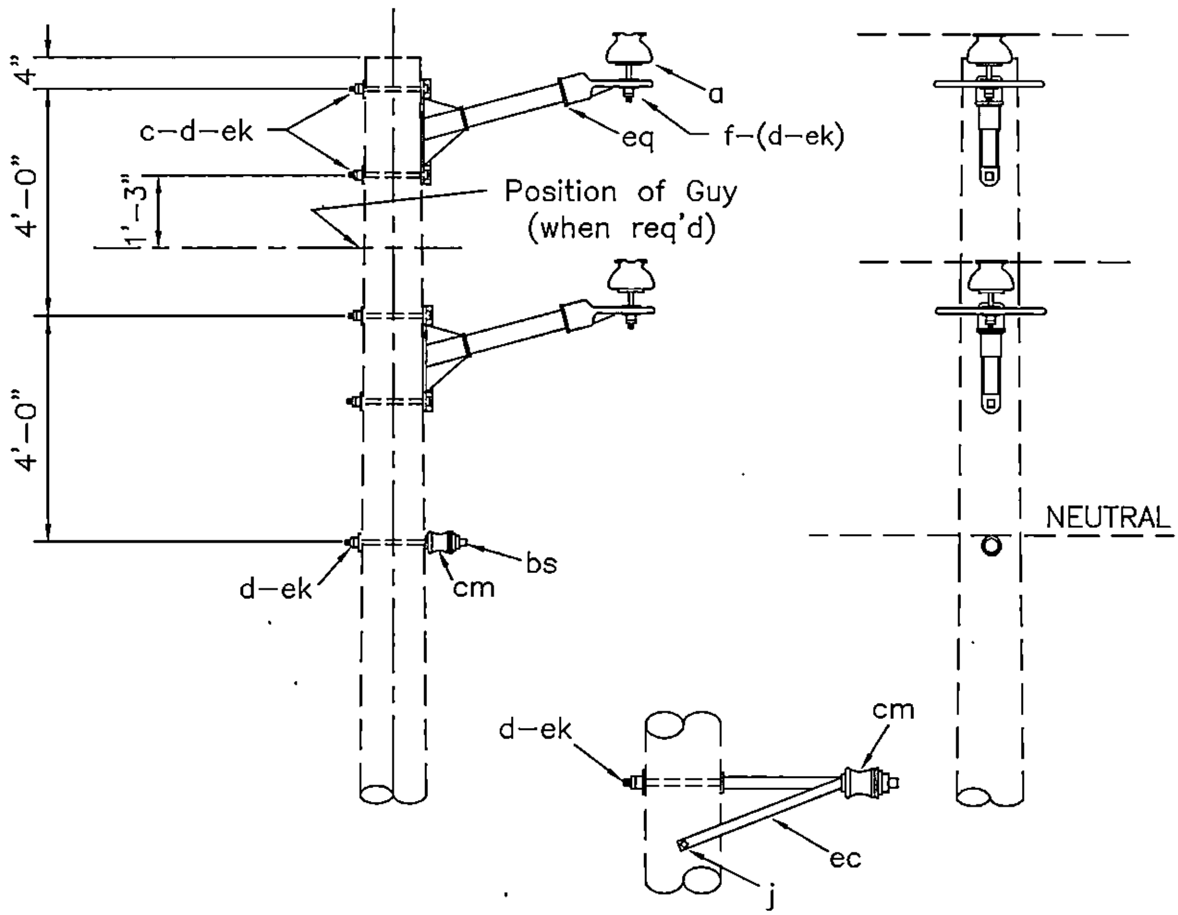
ITEM	MATERIAL	QTY
c	Bolt, machine 5/8" x req'd length	5
d	Washer, square 2 1/4"	5
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	2
ek	Locknuts	5
eq	Bracket, insulator/equipment	2

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE II

SINGLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B1.6NP
RUS	12.47/7.2 kV	



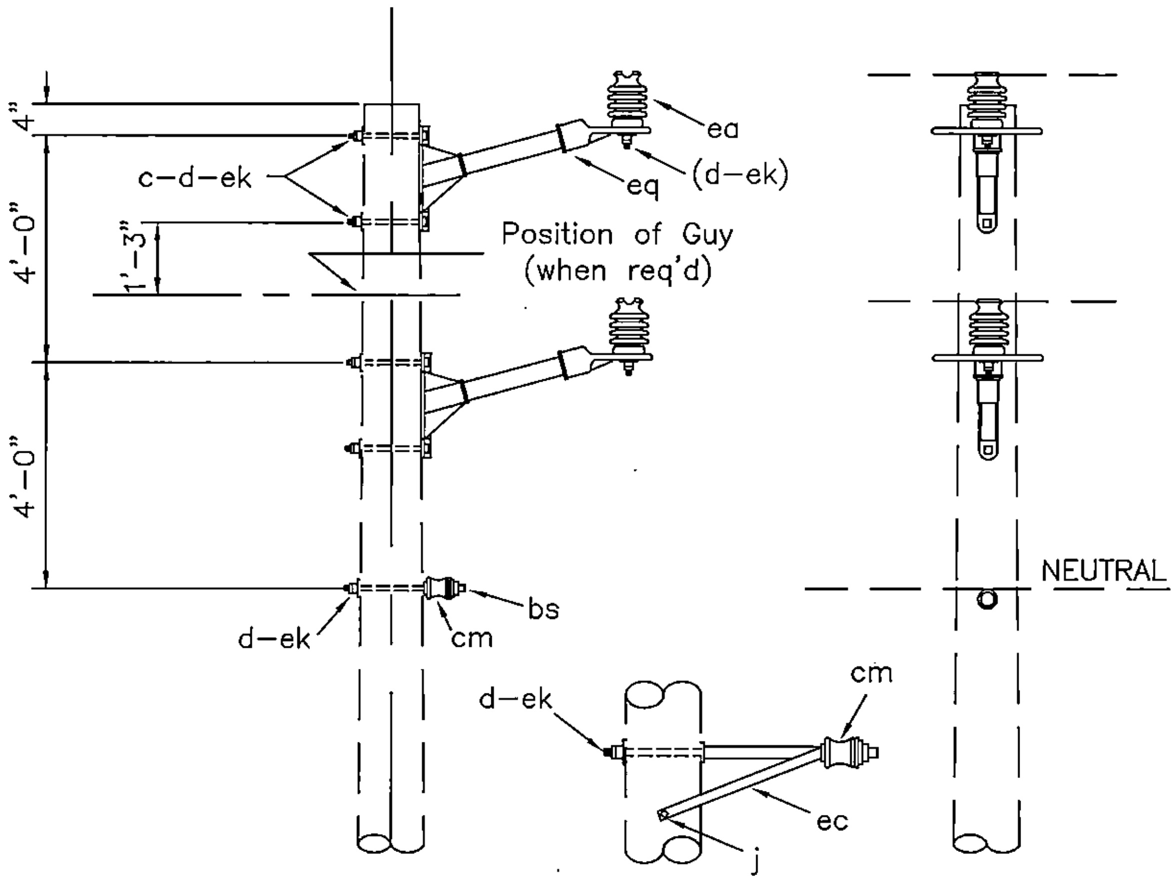
Specify B1.8N for
offset neutral assembly

	Assembly: B1.	7N	8N	
ITEM	MATERIAL	QTY	QTY	
a	Insulator, pin type (12.47/7.2 kV)	2	2	
c	Bolt, machine, 5/8" x req'd length	4	4	
d	Washer, square 2 1/4"	5	5	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(2)	(2)	(If req'd)
j	Screw, lag, 1/2" x 4"		2	
bs	Bolt, single, upset	1		
cm	Insulator, spool, 3"	1	1	
ec	Bracket, offset neutral		1	
ek	Locknuts	5	5	
eq	Bracket, insulator/equipment	2	2	

Design Parameters:
Maximum Line Angles
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT)

APRIL 2005	2 – PHASE PRIMARY	B1.7N
RUS	12.47/7.2 kV	B1.8N



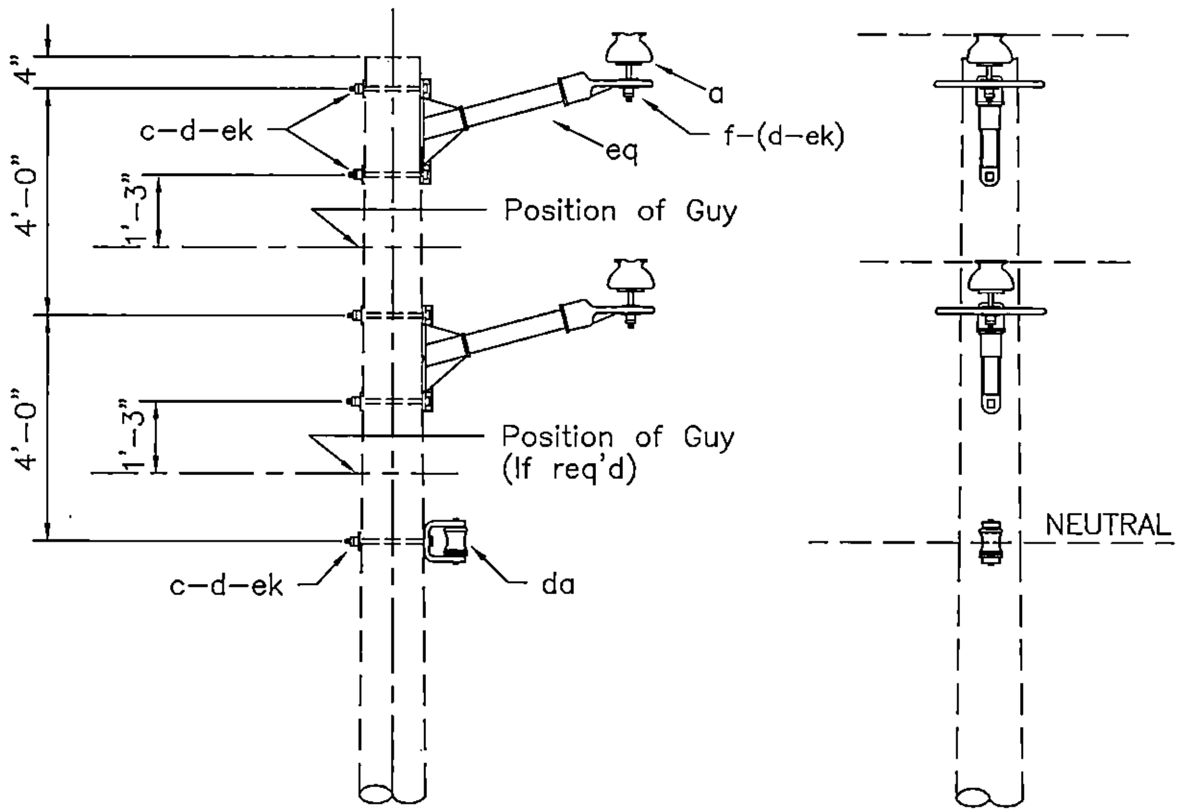
Specify B1.8NP for offset neutral assembly

	Assembly: B1.	7NP	8NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	5	5
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.5 kV)	2	2
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	2	2

Design Parameters:
Maximum Line Angles
5° – Small conductors
2° – Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE (TANGENT) (POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B1.7NP
RUS	12.47/7.2 kV	B1.8NP



Assembly: B1. 9N

ITEM	MATERIAL	QTY
a	Insulator, pin type (12.47/7.2 kV)	2
c	Bolt, machine, 5/8" x req'd length	5
d	Washer, square 2 1/4"	5
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(2) (If req'd)
da	Bracket, insulated	1
ek	Locknuts	5
eq	Bracket, insulator/equipment	2

Design Parameters:
Maximum Line Angles
See TABLE II

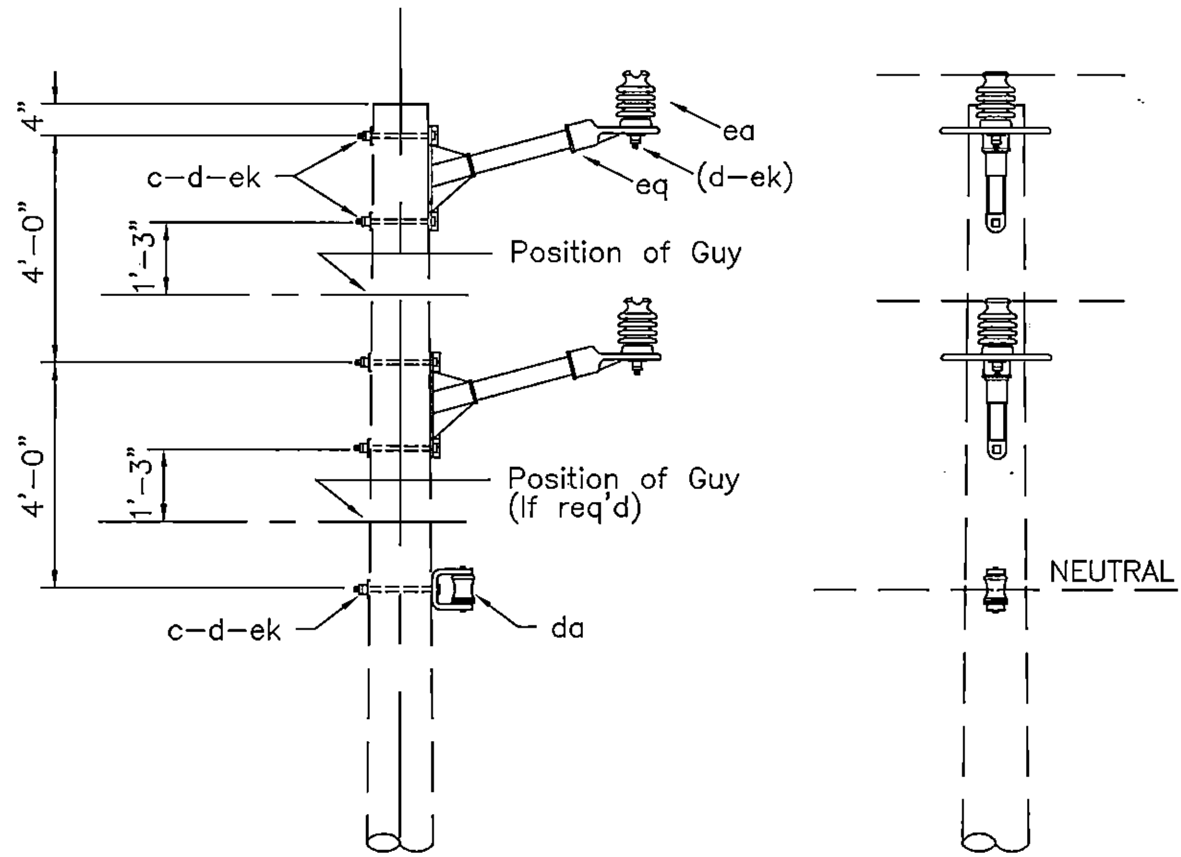
SINGLE SUPPORT–NARROW PROFILE

APRIL 2005

RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B1.9N



Assembly: B1. 9NP

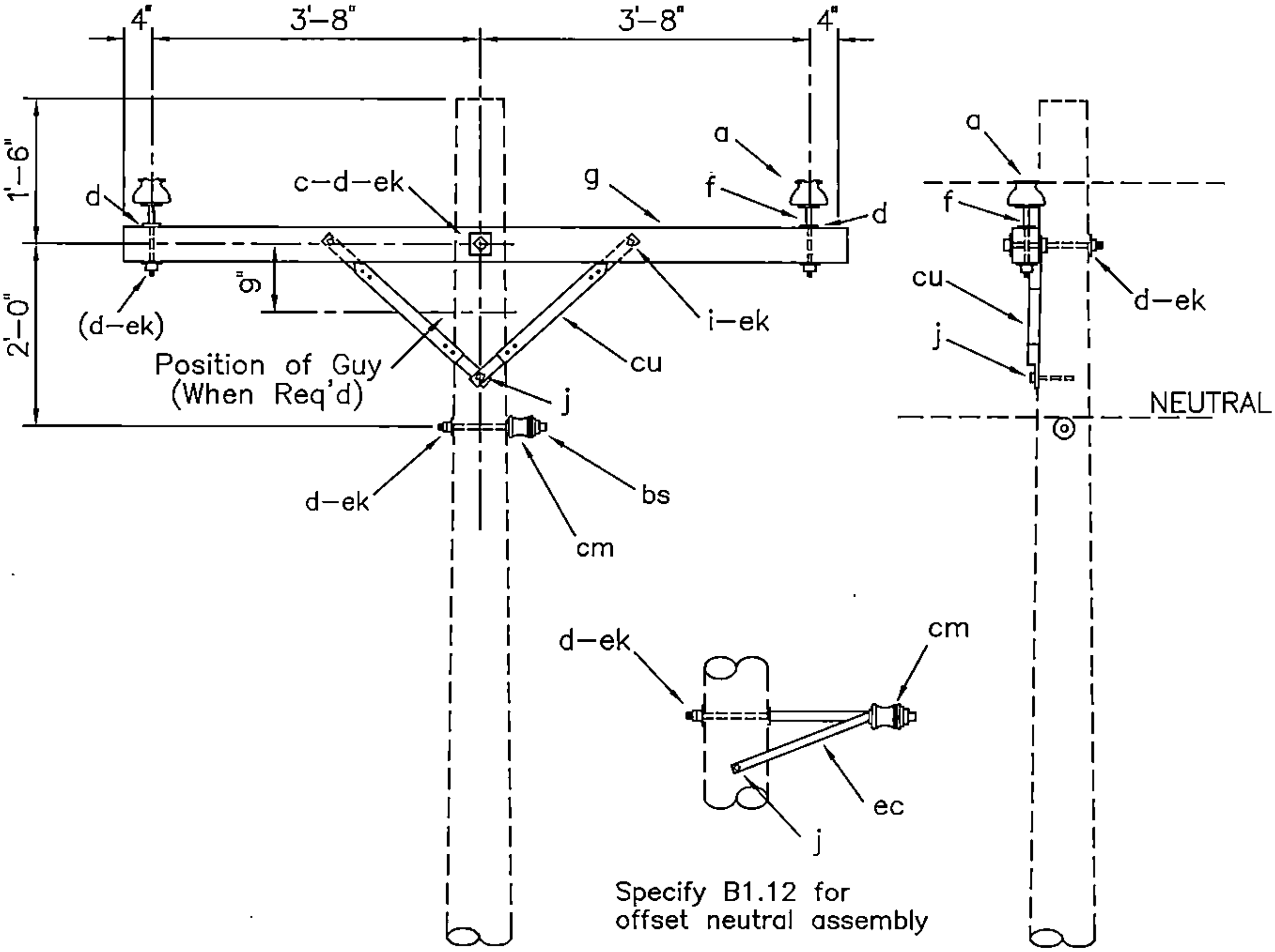
ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	5
d	Washer, square 2 1/4"	5
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.5 kV)	2
ek	Locknuts	5
eq	Bracket, insulator/equipment	2

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE II

SINGLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B1.9NP
RUS	12.47/7.2 kV	



		ASSEMBLY: B1.	11	12
ITEM	MATERIAL		QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)		2	2
c	Bolt, machine, 5/8" x req'd length		1	1
d	Washer, square, 2 1/4"		5	5
f	Pin, crossarm steel, 5/8" x 10 3/4"		2	2
g	Crossarm, 3 5/8" x 4 5/8" x 8'-0"		1	1
i	Bolt, carriage, 3/8" x 4 1/2"		2	2
j	Screw, lag, 1/2" x 4"		1	3
bs	Bolt, single, upset		1	
cm	Insulator, spool, 3"		1	1
cu	Brace, 28"		2	2
ec	Bracket, offset, neutral			1
ek	Locknuts		4	4

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

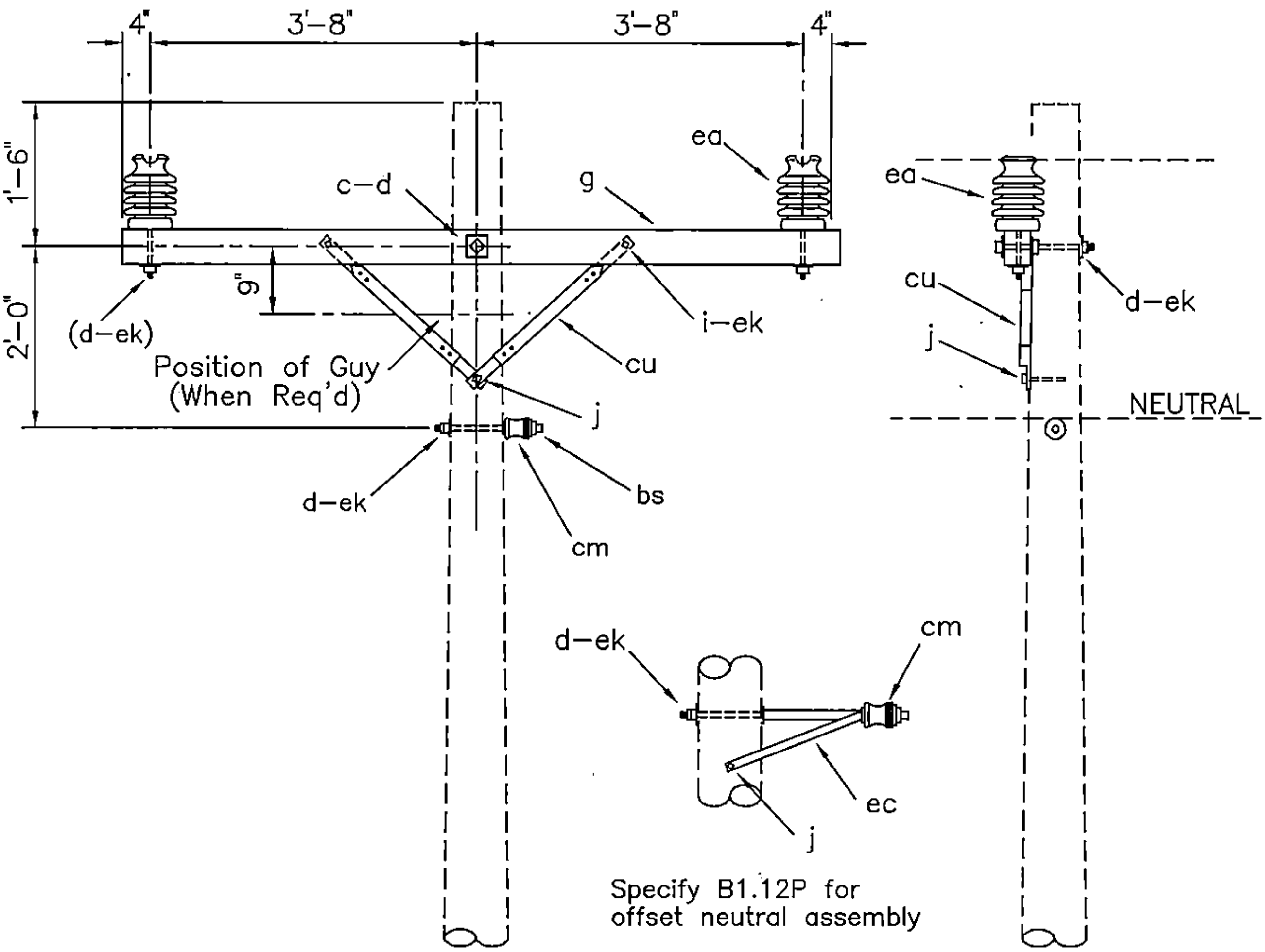
SINGLE SUPPORT ON CROSSARM (TANGENT)

APRIL 2005

RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B1.11 (B1)
B1.12 (B1A)



Specify B1.12P for
offset neutral assembly

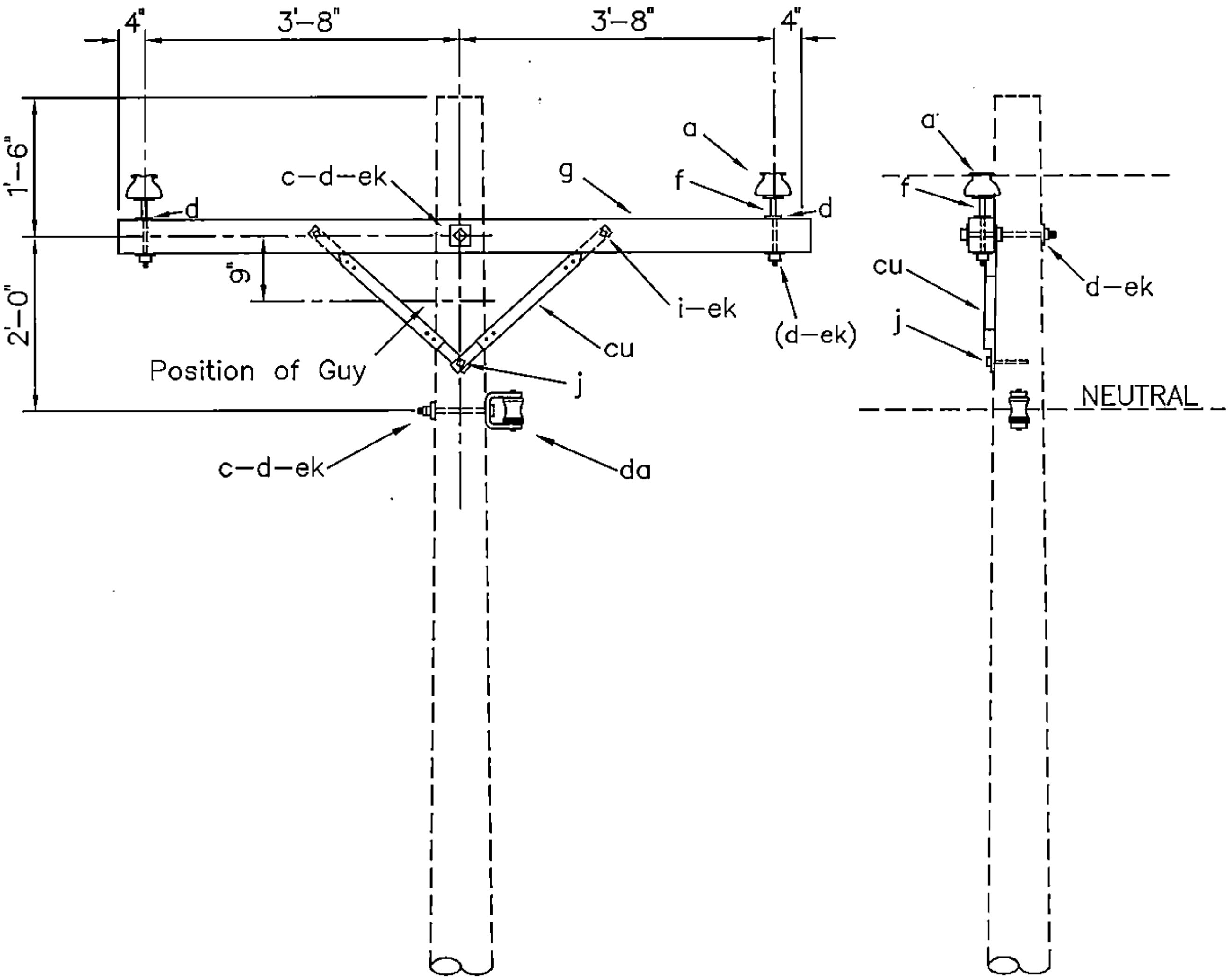
		ASSEMBLY: B1.	11P	12P
ITEM	MATERIAL		QTY	QTY
c	Bolt, machine, 5/8" x req'd length		1	1
d	Washer, square, 2 1/4"		3	3
g	Crossarm, 3 5/8" x 4 5/8" x 8'-0"		1	1
i	Bolt, carriage, 3/8" x 4 1/2"		2	2
j	Screw, lag, 1/2" x 4"		1	3
bs	Bolt, single, upset		1	
cm	Insulator, spool, 3"		1	1
cu	Brace, 28"		2	2
ea	Insulator, post type, (12.47/7.2 kV)		2	2
ec	Bracket, offset, neutral			1
ek	Locknuts		4	4

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT ON CROSSARM
(TANGENT) (POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B1.11P (B1P)
RUS	12.47/7.2 kV	B1.12P (B1AP)



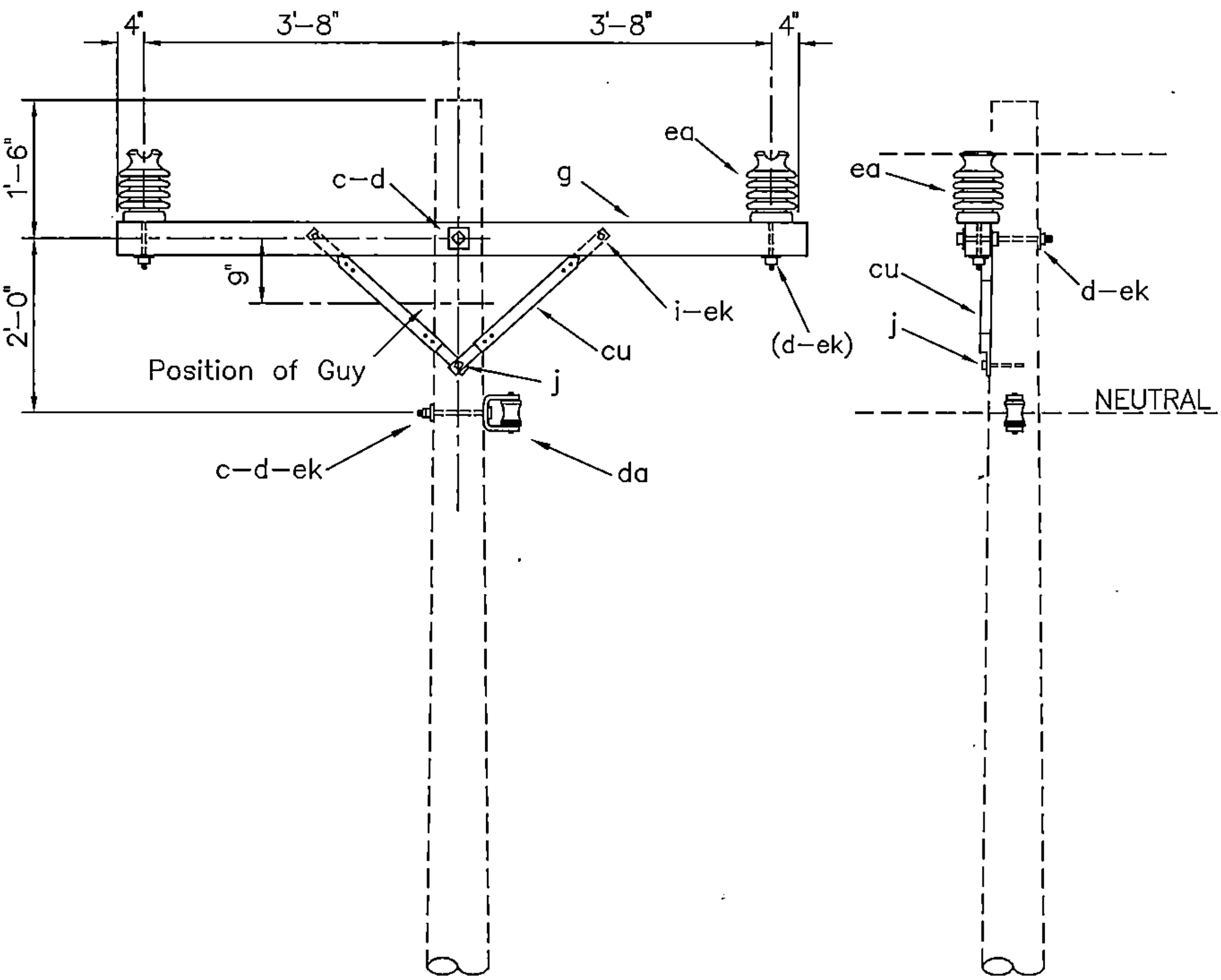
ITEM	QTY	MATERIAL
a	2	Insulator, pin type (12.47/7.2 kV)
c	2	Bolt, machine, 5/8" x req'd length
d	5	Washer, square, 2 1/4"
f	2	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
cu	2	Brace, 28"
da	1	Bracket, insulated
ek	4	Locknuts

DESIGN PARAMETERS:

See TABLE II

SINGLE SUPPORT ON CROSSARM

APRIL 2005	2 – PHASE PRIMARY	
RUS	12.47/7.2 kV	B1.13



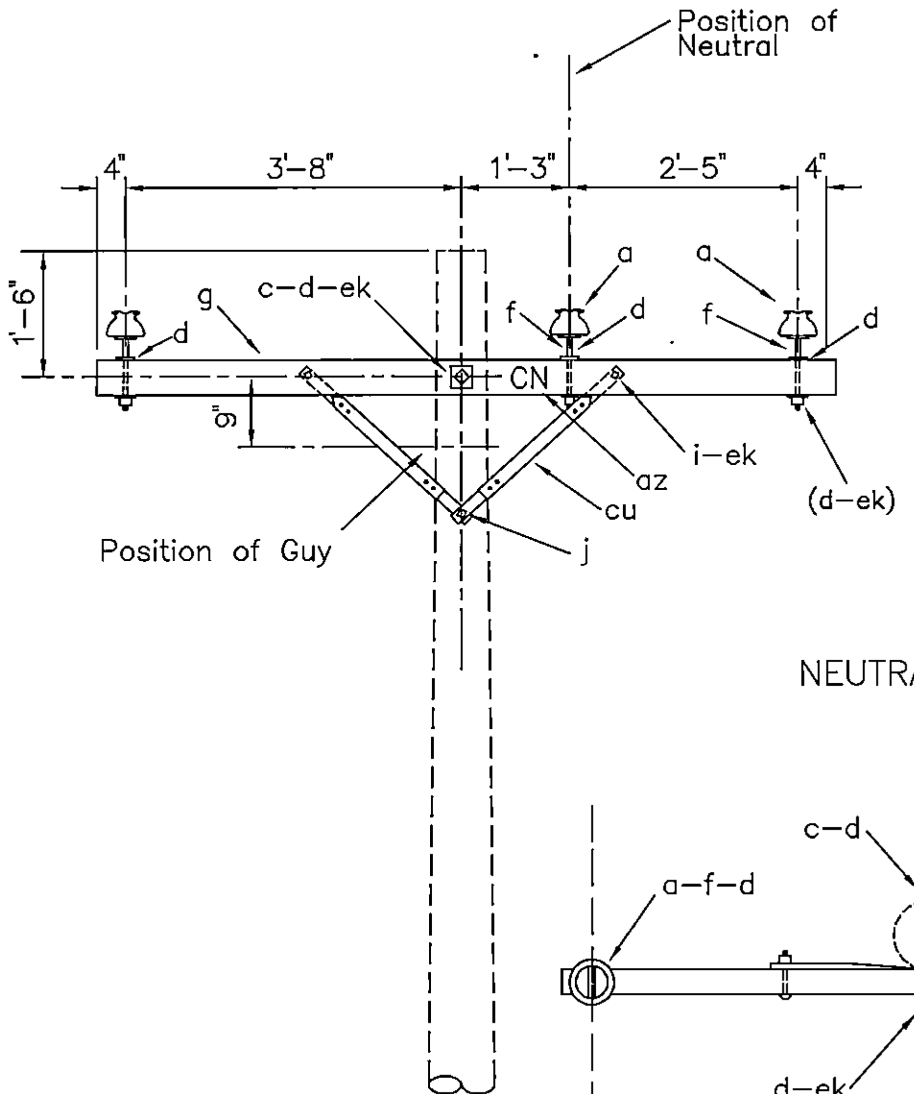
ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
cu	2	Brace, 28"
da	1	Bracket, insulated
ea	2	Insulator, post type (12.47/7.2 kV)
ek	4	Locknuts

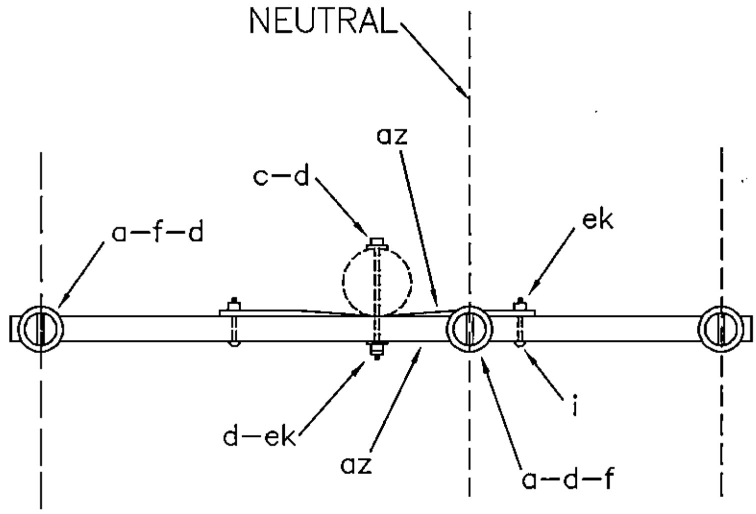
DESIGN PARAMETERS:

See TABLE II

SINGLE SUPPORT ON CROSSARM
(POST INSULATORS)

APRIL 2005 RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B1.13P





PLAN

ITEM	QTY	MATERIAL
a	1	Insulator, pin type, 15 kV, white
a	2	Insulator, pin type (12.47/7.2 kV)
c	1	Bolt, machine, 5/8" x req'd length
d	5	Washer, square, 2 1/4"
f	3	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
az	4	Letters, 2" C, 2" N, with nails
cu	2	Brace, 28"
ek	3	Locknuts

NOTE:

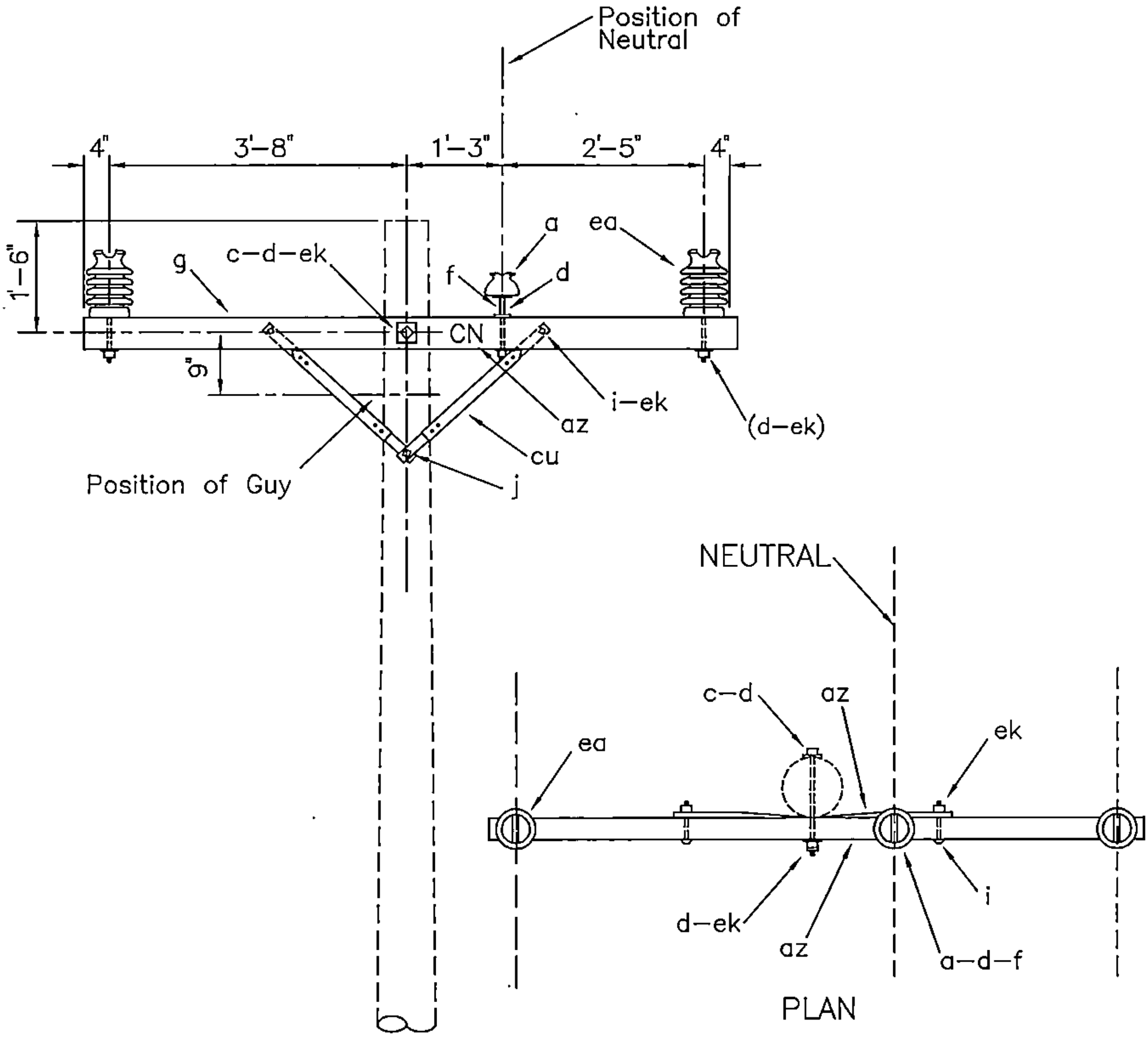
Install either identification letters (az) or white insulator in neutral position.

DESIGN PARAMETERS:

See TABLE II

SINGLE SUPPORT, NEUTRAL ON CROSSARM

APRIL 2005 RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B1.14 (B9–1)



ITEM	QTY	MATERIAL
a	1	Insulator, pin type, 15 kV, white
c	1	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
f	1	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
az	4	Letters, 2" C, 2" N, with nails
cu	2	Brace, 28"
ea	2	Insulator, post type (12.47/7.2 kV)
ek	3	Locknuts

NOTE:

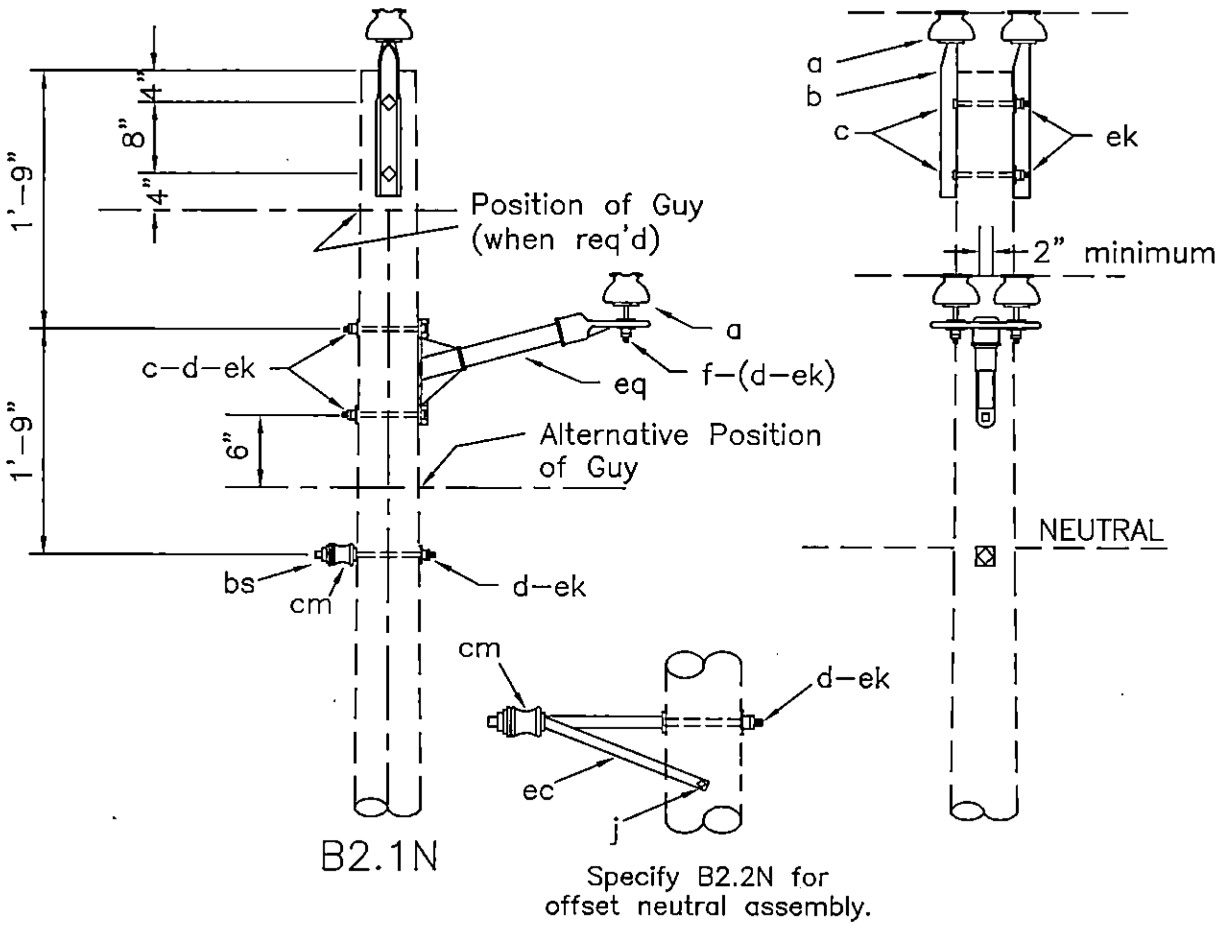
Install either identification letters (az) or white insulator in neutral position.

DESIGN PARAMETERS:

See TABLE II

SINGLE SUPPORT, NEUTRAL ON CROSSARM (POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B1.14P
RUS	12.47/7.2 kV	(B9–1P)



NOTE: These assemblies used for NESC Grade B construction.

ITEM	MATERIAL (ASSEMBLY: B2.)	1N QTY	2N QTY
a	Insulator, pin type (12.47/7.2 kV)	4	4
b	Pin, pole top, 20"	2	2
c	Bolt, machine, 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	3	3
f	Pin, crossarm, 5/8" x 6 1/2"	2	2
j	Screw, lag 1/2" x 4"		2
bs	Bolt, single upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	1	1

Design Parameters:

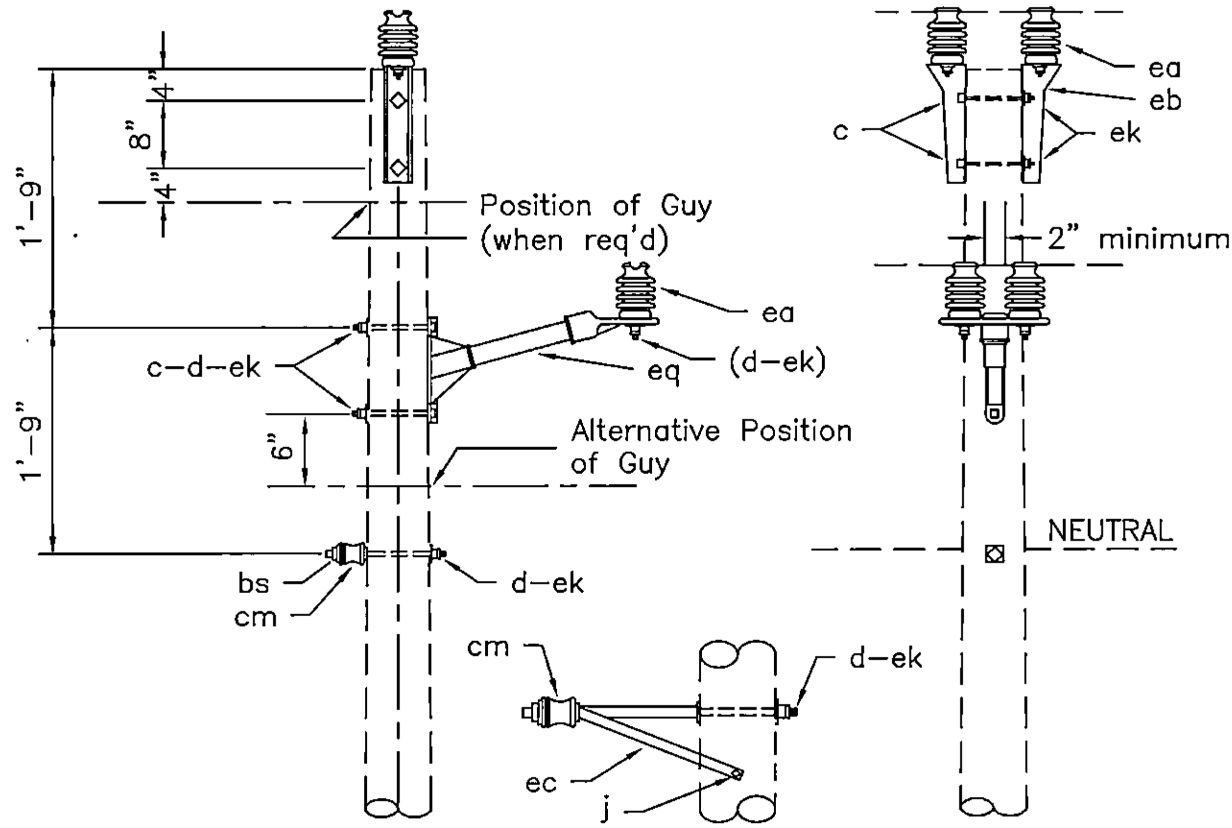
MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE
(TANGENT)

APRIL 2005
RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B2.1N
B2.2N



B2.1NP

Specify B2.2NP for offset neutral assembly

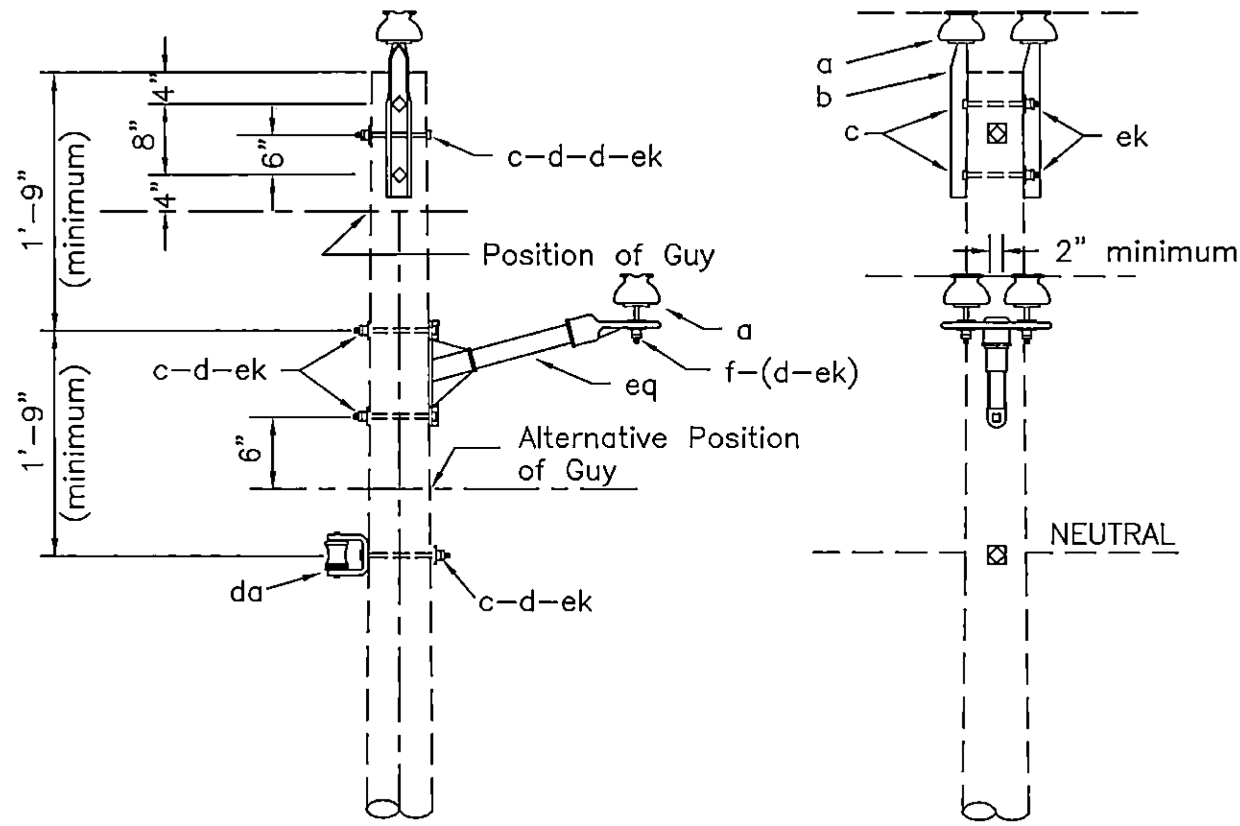
NOTE: These assemblies used for NESC Grade B construction.

ITEM	MATERIAL (ASSEMBLY: B2.)	1NP QTY	2NP QTY
c	Bolt, machine, 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	3	3
j	Screw, lag 1/2" x 4"		2
bs	Bolt, single upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.5 kV)	4	4
eb	Bracket, pole top	2	2
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	1	1

Design Parameters:
Maximum Line Angles:
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE (TANGENT) (POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B2.1NP
RUS	12.47/7.2 kV	B2.2NP



ITEM	MATERIAL ASSEMBLY: B2.	3N QTY
a	Insulator, pin type (12.47/7.2 kV)	4
b	Pin, pole top, 20"	2
c	Bolt, machine, 5/8" x req'd length	6
d	Washer, square 2 1/4"	5
f	Pin, crossarm, 5/8" x 6 1/2"	2
da	Bracket, insulated	1
ek	Locknuts	6
eq	Bracket, insulator/equipment	1

Design Parameters:

MAXIMUM LINE ANGLES:
See Table III

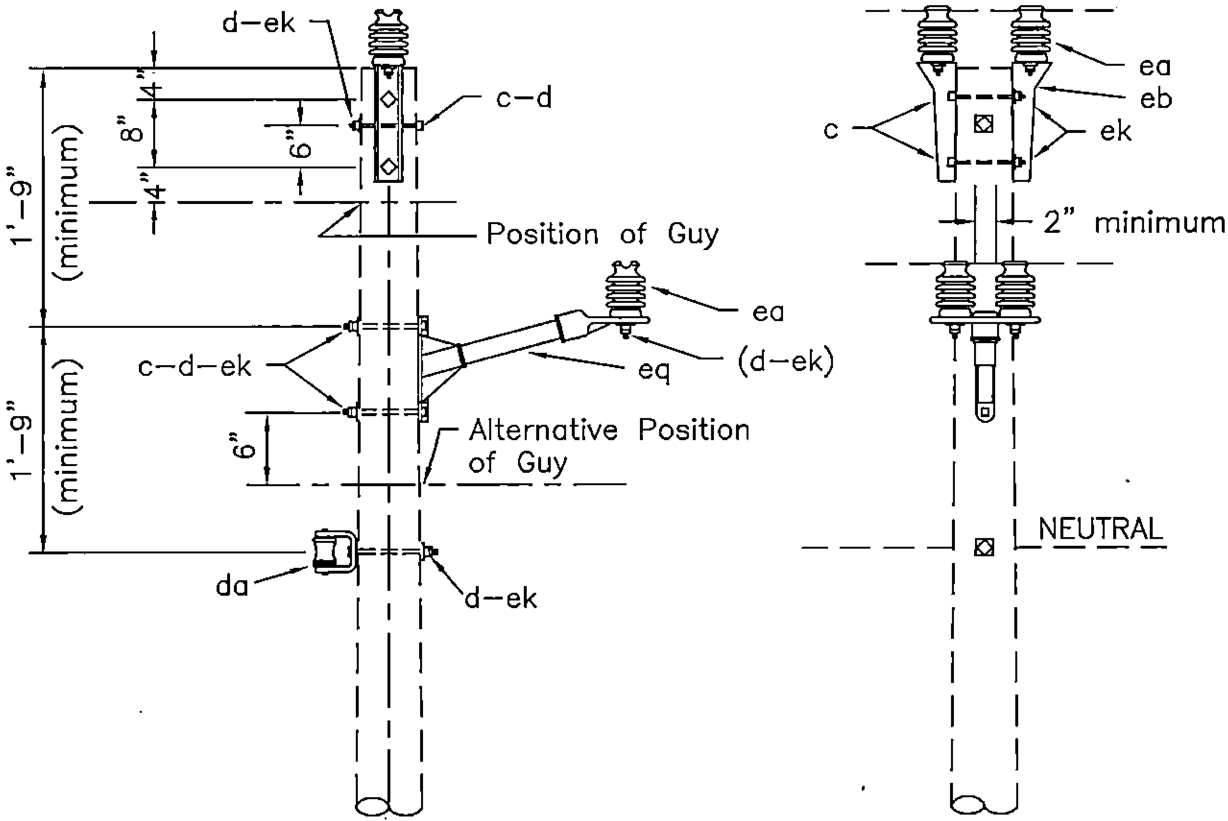
DOUBLE SUPPORT–NARROW PROFILE

APRIL 2005

RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B2.3N



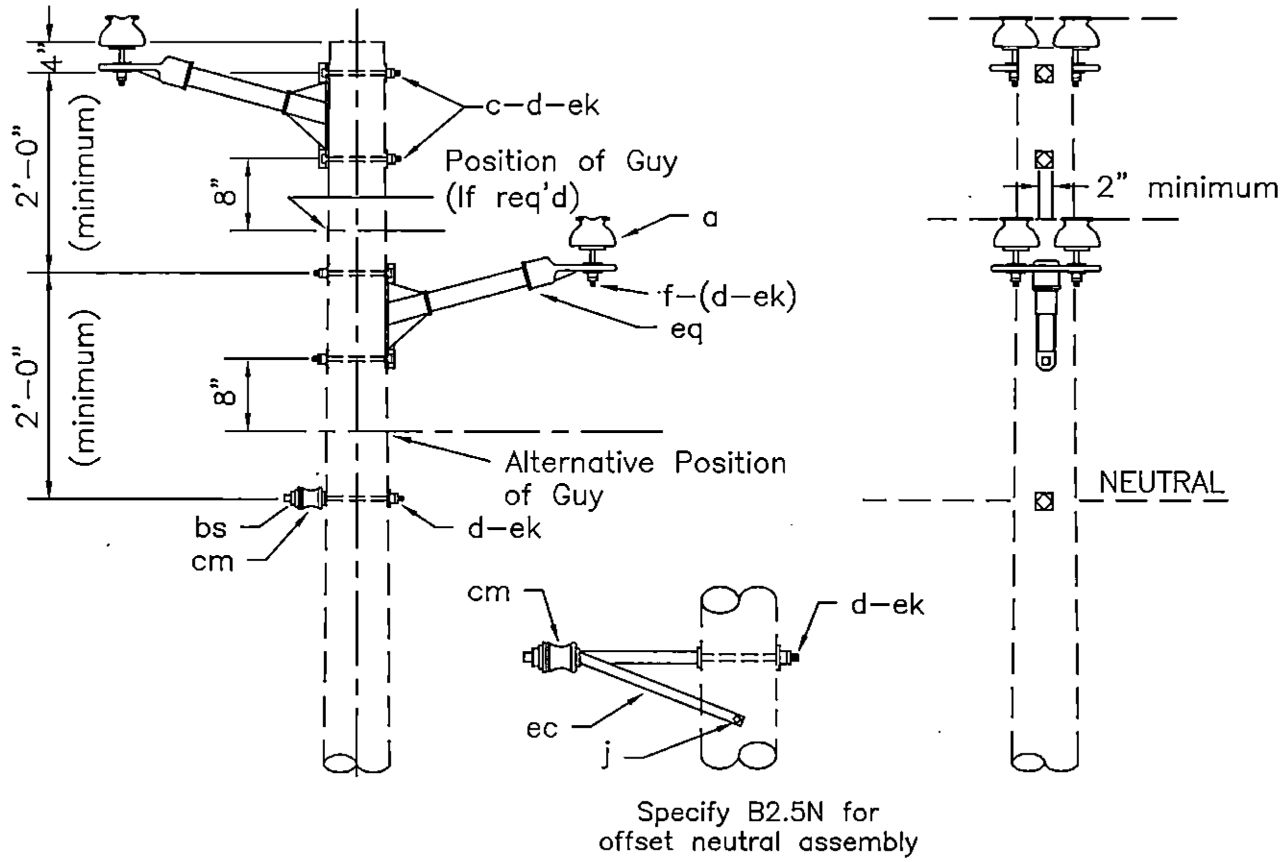
ASSEMBLY: B2. 3NP

ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	6
d	Washer, square 2 1/4".	5
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	4
eb	Bracket, pole top	2
ek	Locknuts	6
eq	Bracket, insulator/equipment	1

Design Parameters:
Maximum Line Angles:
See TABLE IV

DOUBLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B2.3NP
RUS	12.47/7.2 kV	



NOTE: Use these assemblies for NESC Grade B construction.

	ASSEMBLY: B2.	4N	5N
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	4	4
c	Bolt, machine, 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	5	5
f	Pin, crossarm, 5/8" x 6 1/2"	4	4
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	2	2

Design Parameters:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

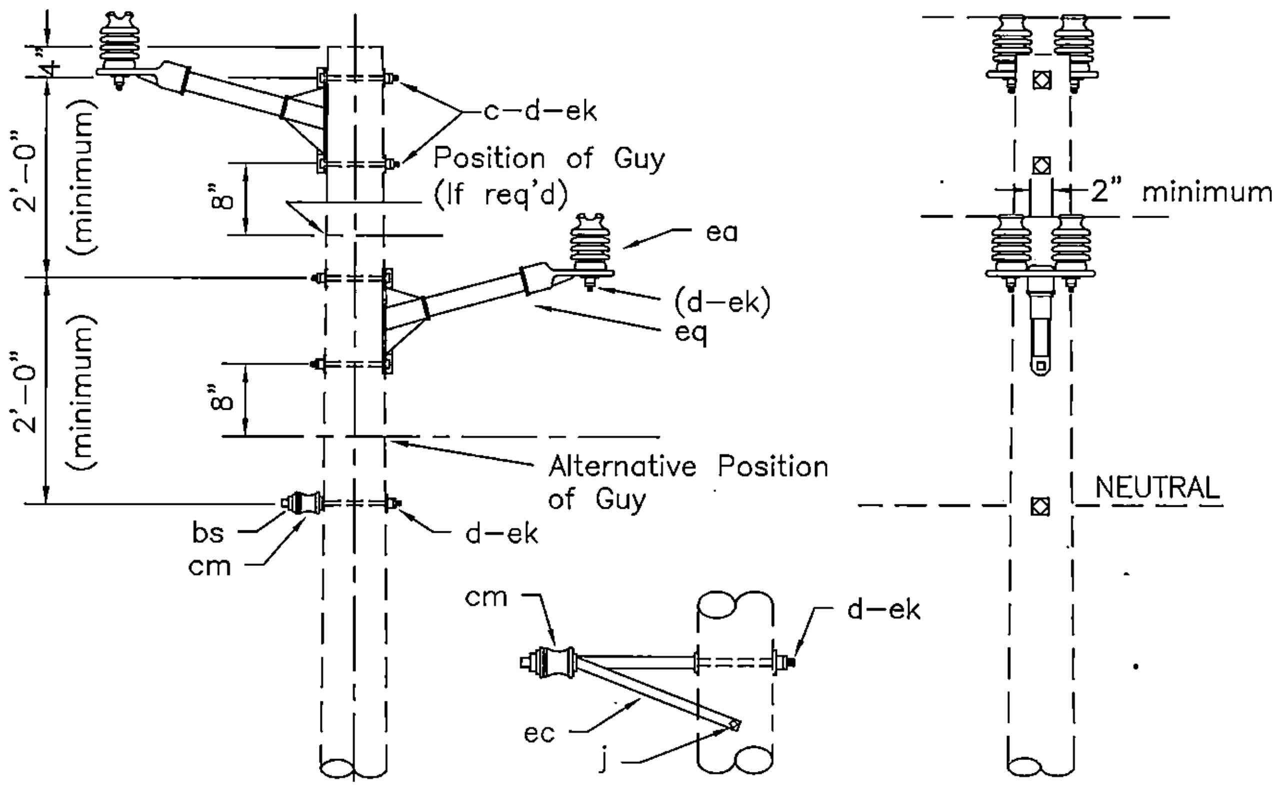
DOUBLE SUPPORT–NARROW PROFILE (TANGENT)

APRIL 2005

RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B2.4N
B2.5N



Specify B2.5NP for offset neutral assembly

NOTE: Use these assemblies for NESC Grade B construction.

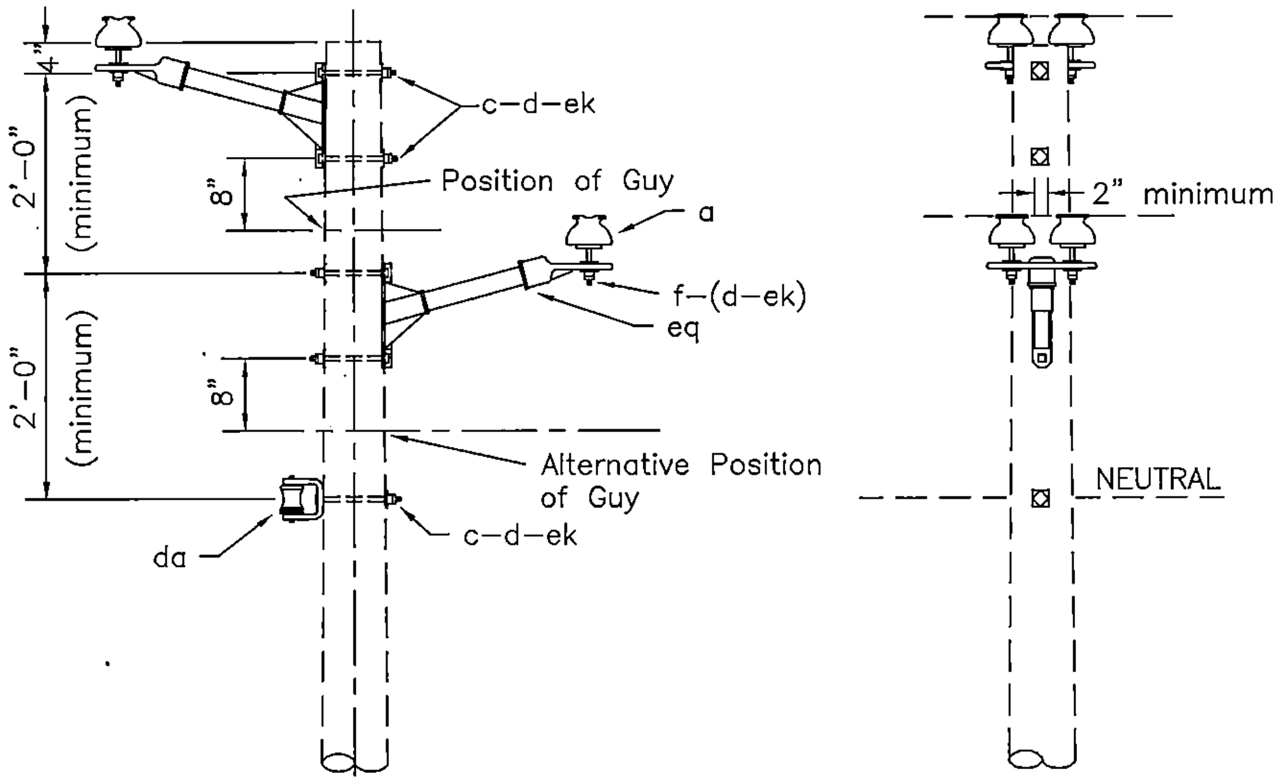
	ASSEMBLY: B2.	4NP	5NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	5	5
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kv)	4	4
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	2	2

Design Parameters:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE (TANGENT)(POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B2.4NP
RUS	12.47/7.2 kV	B2.5NP



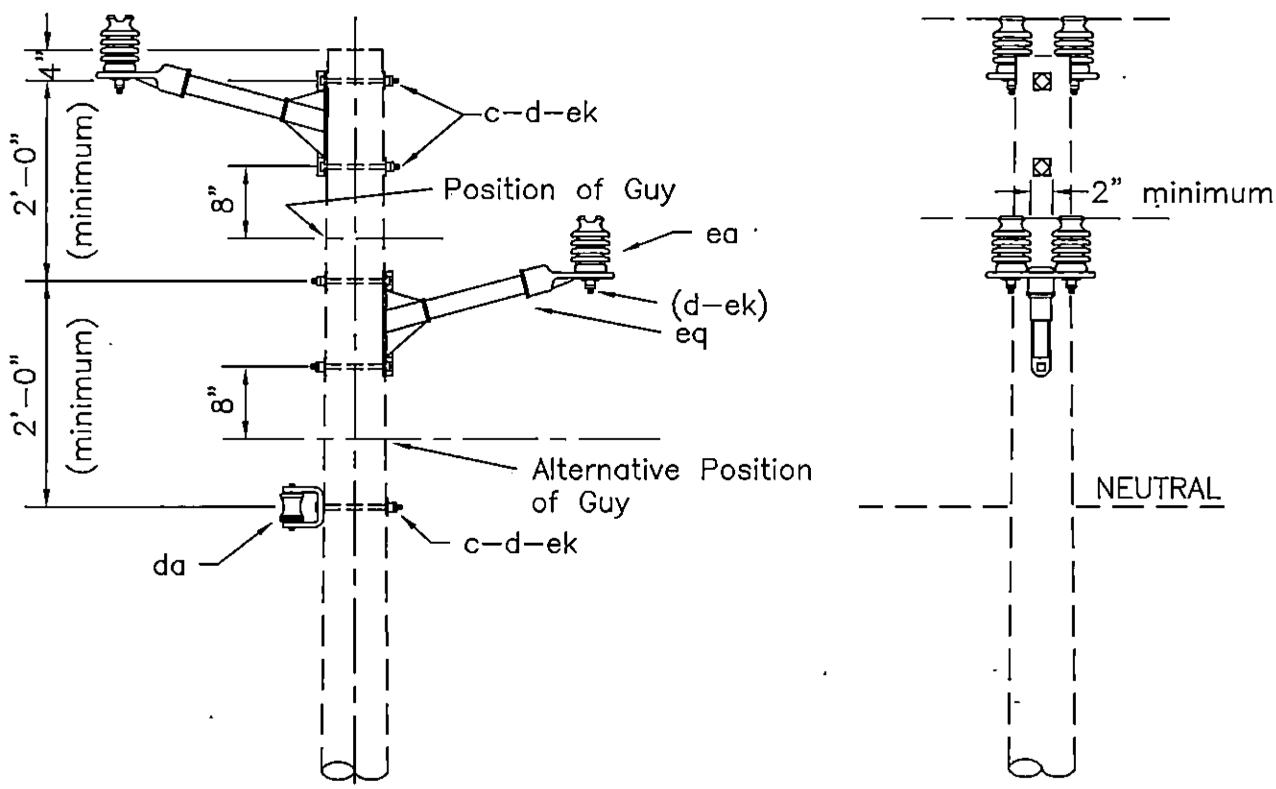
ASSEMBLY:	B2.	6N
ITEM	MATERIAL	QTY
a	Insulator, pin type (12.47/7.2 kV)	4
c	Bolt, machine, 5/8" x req'd length	5
d	Washer, square 2 1/4"	5
f	Pin, crossarm, 5/8" x 6 1/2"	4
da	Bracket, insulated	1
ek	Locknuts	5
eq	Bracket, insulator/equipment	2

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE IV

DOUBLE SUPPORT—NARROW PROFILE

APRIL 2005	2 – PHASE PRIMARY	B2.6N
RUS	12.47/7.2 kV	



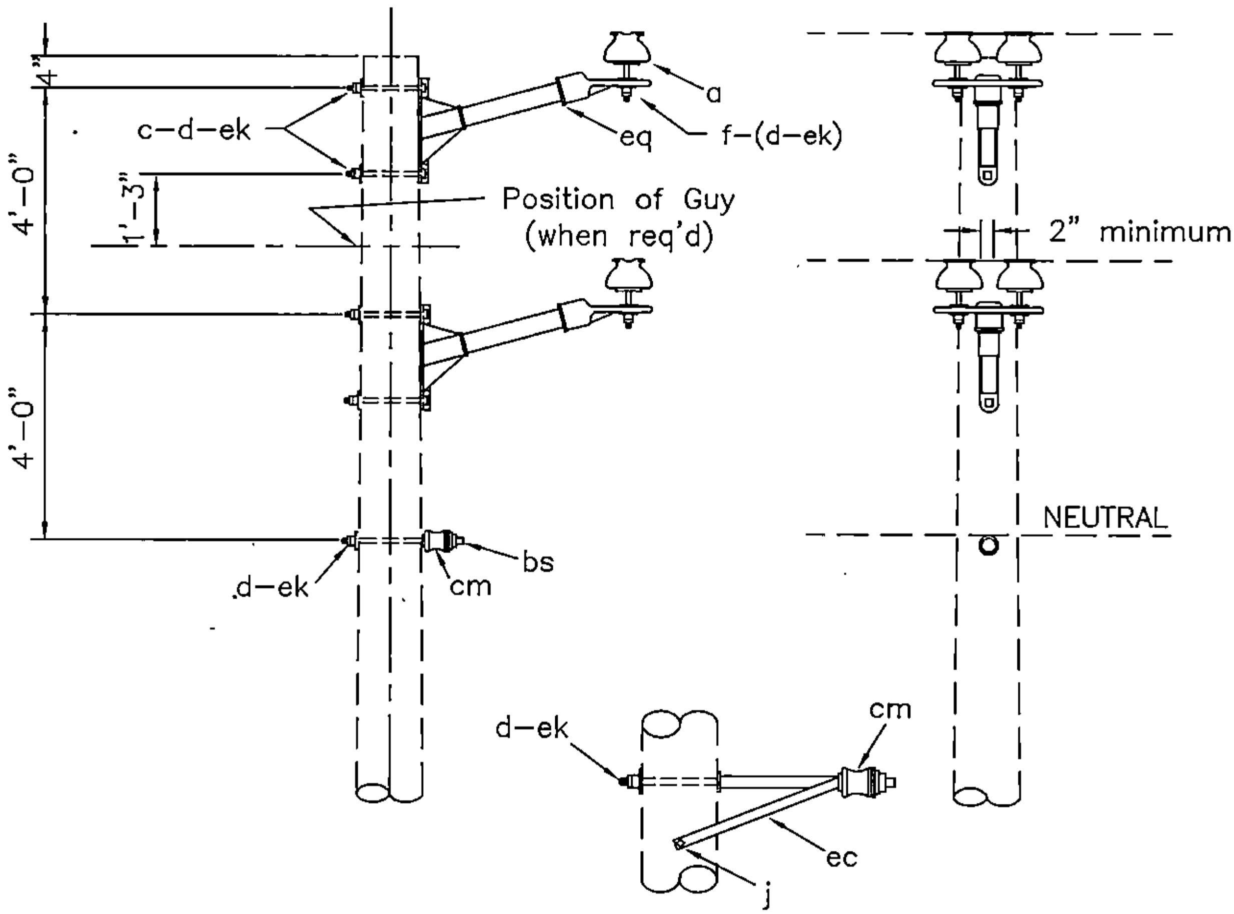
ASSEMBLY:	B2.	6NP
ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	5
d	Washer, square 2 1/4"	5
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2kV)	4
ek	Locknuts	5
eq	Bracket, insulator/equipment	2

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE IV

DOUBLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B2.6NP
RUS	12.47/7.2 kV	



Specify B2.8N for
offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

	Assembly: B2.	7N	8N
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	4	4
c	Bolt, machine, 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	5	5
f	Pin, crossarm, 5/8" x 6 1/2"	4	4
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	2	2

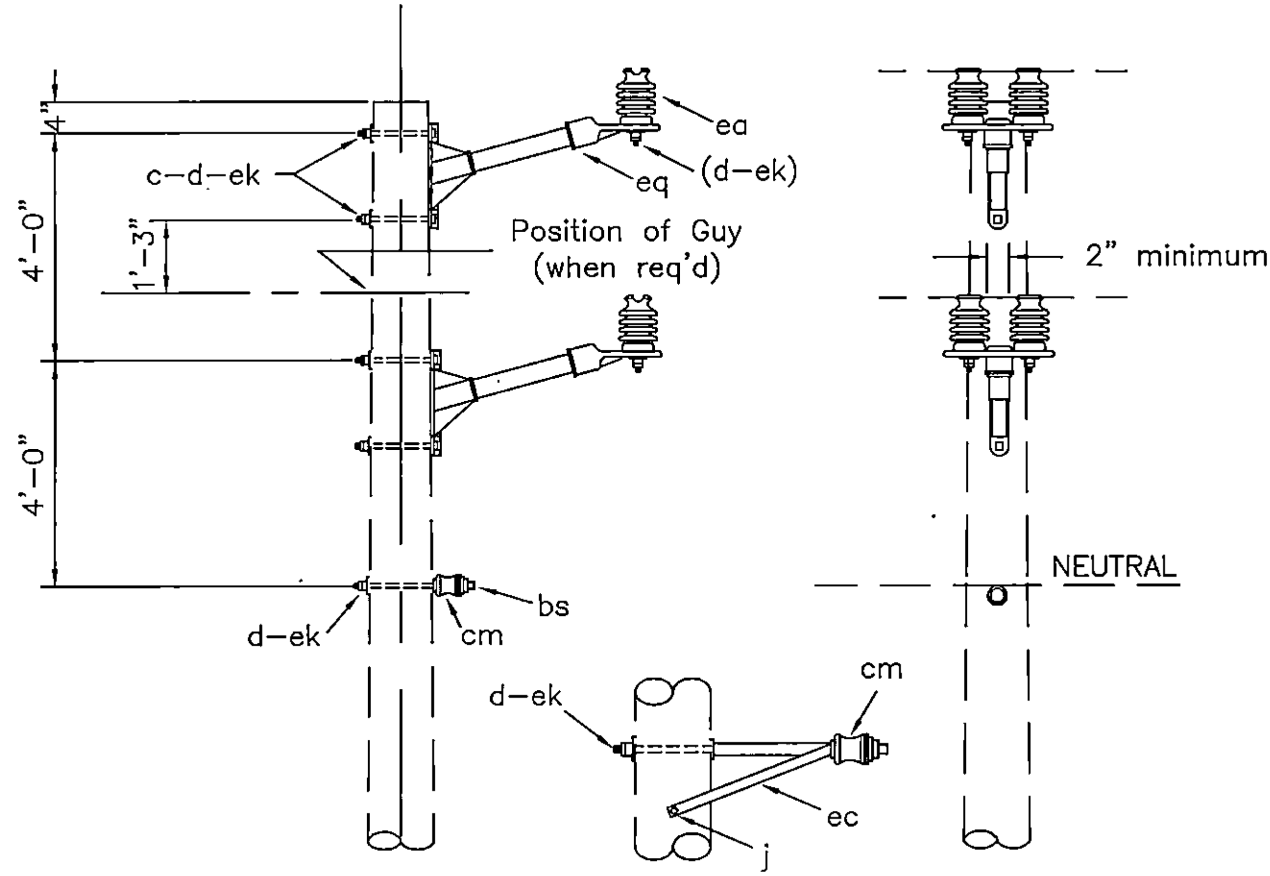
Design Parameters:
Maximum Line Angles
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE
(TANGENT)

APRIL 2005
RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B2.7N
B2.8N



Specify B2.8NP for offset neutral assembly

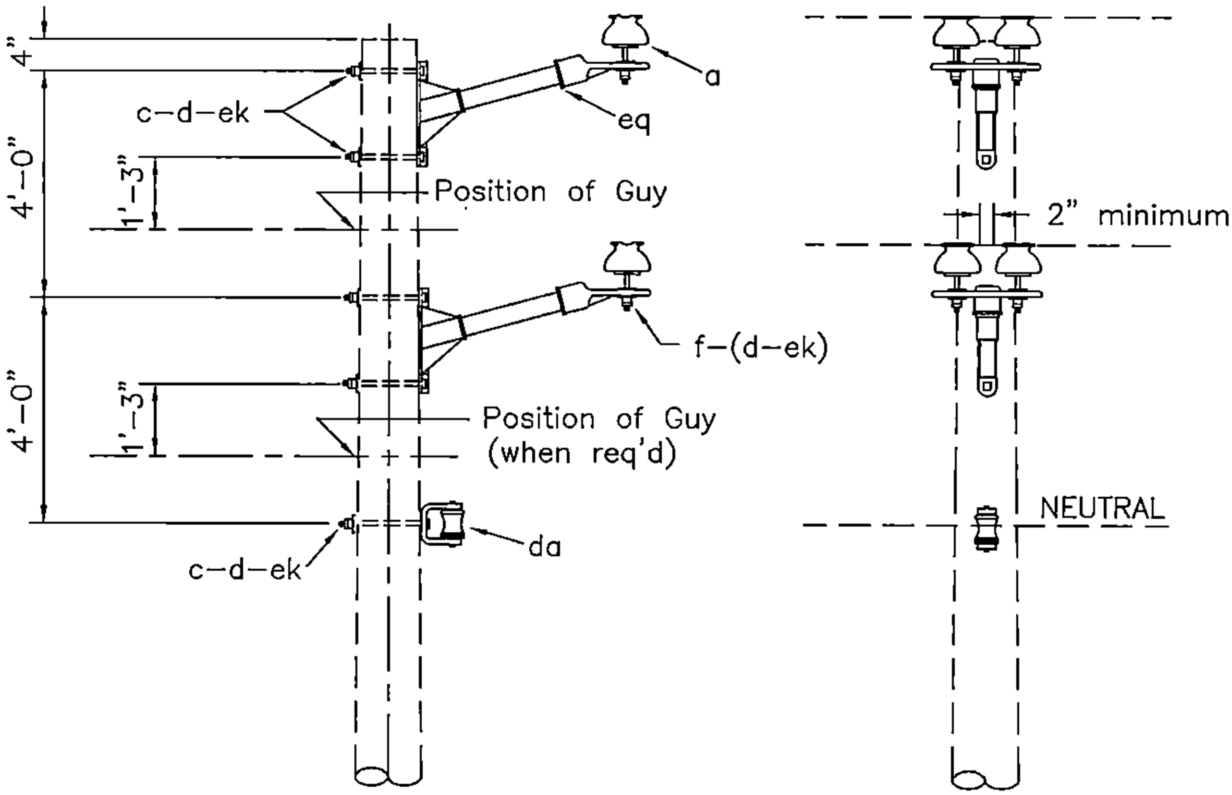
NOTE: These assemblies used for NESC Grade B construction.

	Assembly: B2.	7NP	8NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	4	4
d	Washer, square 2 1/4"	5	5
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	4	4
ec	Bracket, offset neutral		1
ek	Locknuts	5	5
eq	Bracket, insulator/equipment	2	2

Design Parameters:
Maximum Line Angles
5° – Small conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005	2 – PHASE PRIMARY	B2.7NP
RUS	12.47/7.2 kV	B2.8NP



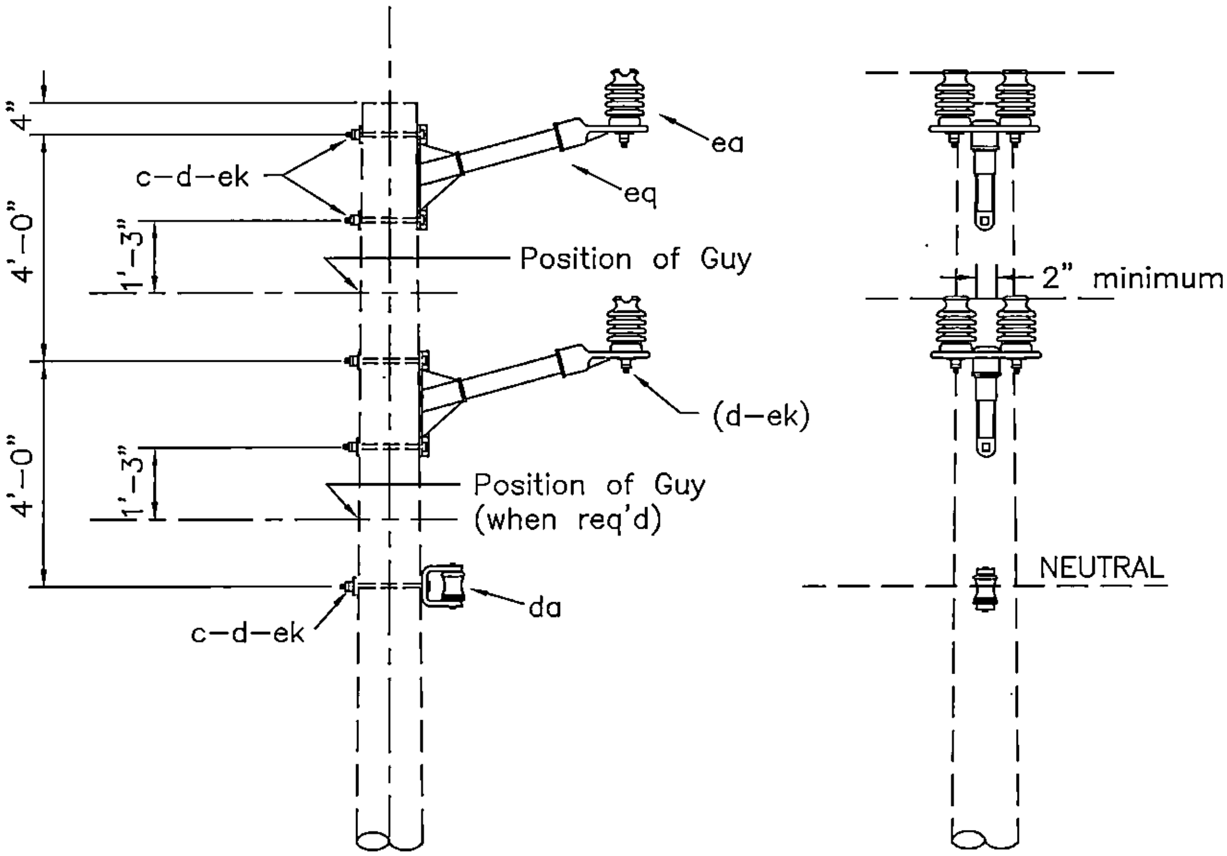
Assembly: B2.9N

ITEM	MATERIAL	QTY
a	Insulator, pin type (12.47/7.2 kV)	4
c	Bolt, machine, 5/8" x req'd length	5
d	Washer, square 2 1/4"	5
f	Pin, crossarm, 5/8" x 6 1/2"	4
da	Bracket, insulated	1
ek	Locknuts	5
eq	Bracket, insulator/equipment	2

Design Parameters:
Maximum Line Angles
See TABLE IV

DOUBLE SUPPORT–NARROW PROFILE

APRIL 2005	2 – PHASE PRIMARY 12.47/7.2 kV	B2.9N
RUS		



Assembly: B2.9NP

ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	5
d	Washer, square 2 1/4"	5
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	4
ek	Locknuts	5
eq	Bracket, insulator/equipment	2

Design Parameters:
Maximum Line Angles
See TABLE IV

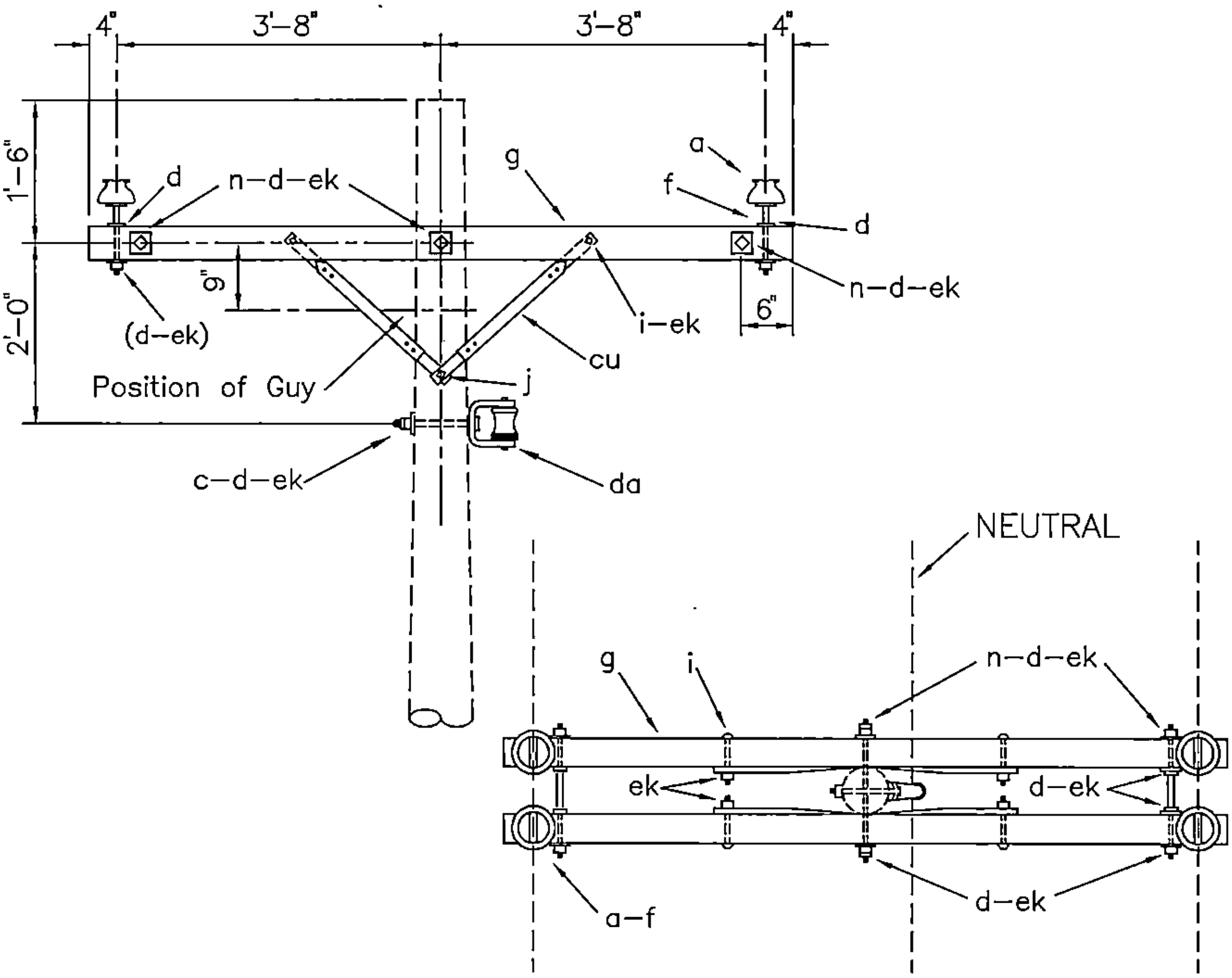
DOUBLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005

RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B2.9NP



PLAN

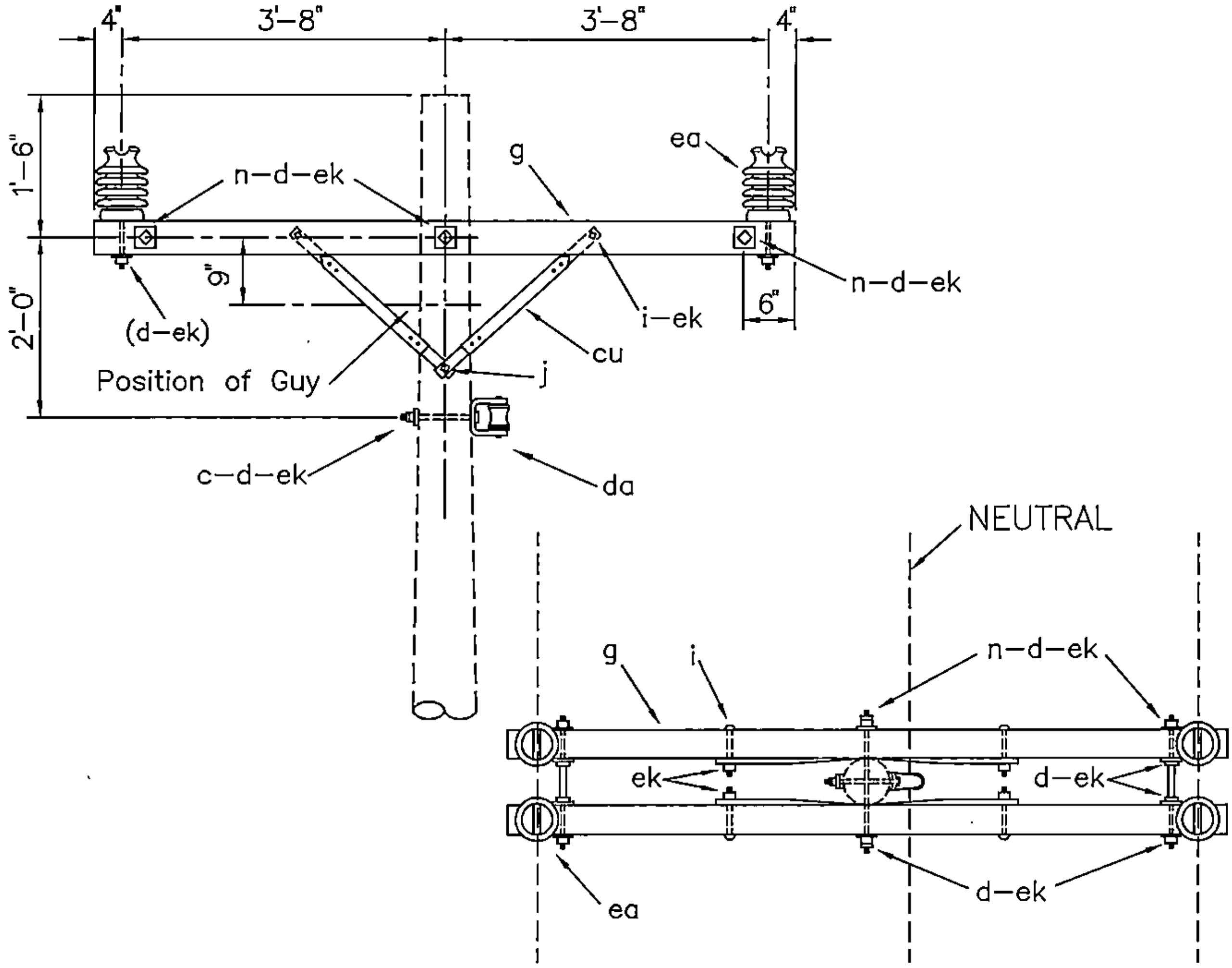
ITEM	QTY	MATERIAL
a	4	Insulator, pin type (12.47/7.2 kV)
c	1	Bolt, machine, 5/8" x req'd length
d	15	Washer, square, 2 1/4"
f	4	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
n	3	Bolt, double arm, 5/8" x req'd length
cu	4	Brace, 28"
da	1	Bracket, insulated
ek	15	Locknuts

DESIGN PARAMETERS:

See TABLE IV

DOUBLE SUPPORT ON CROSSARMS

APRIL 2005 RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B2.21 (B2)



PLAN

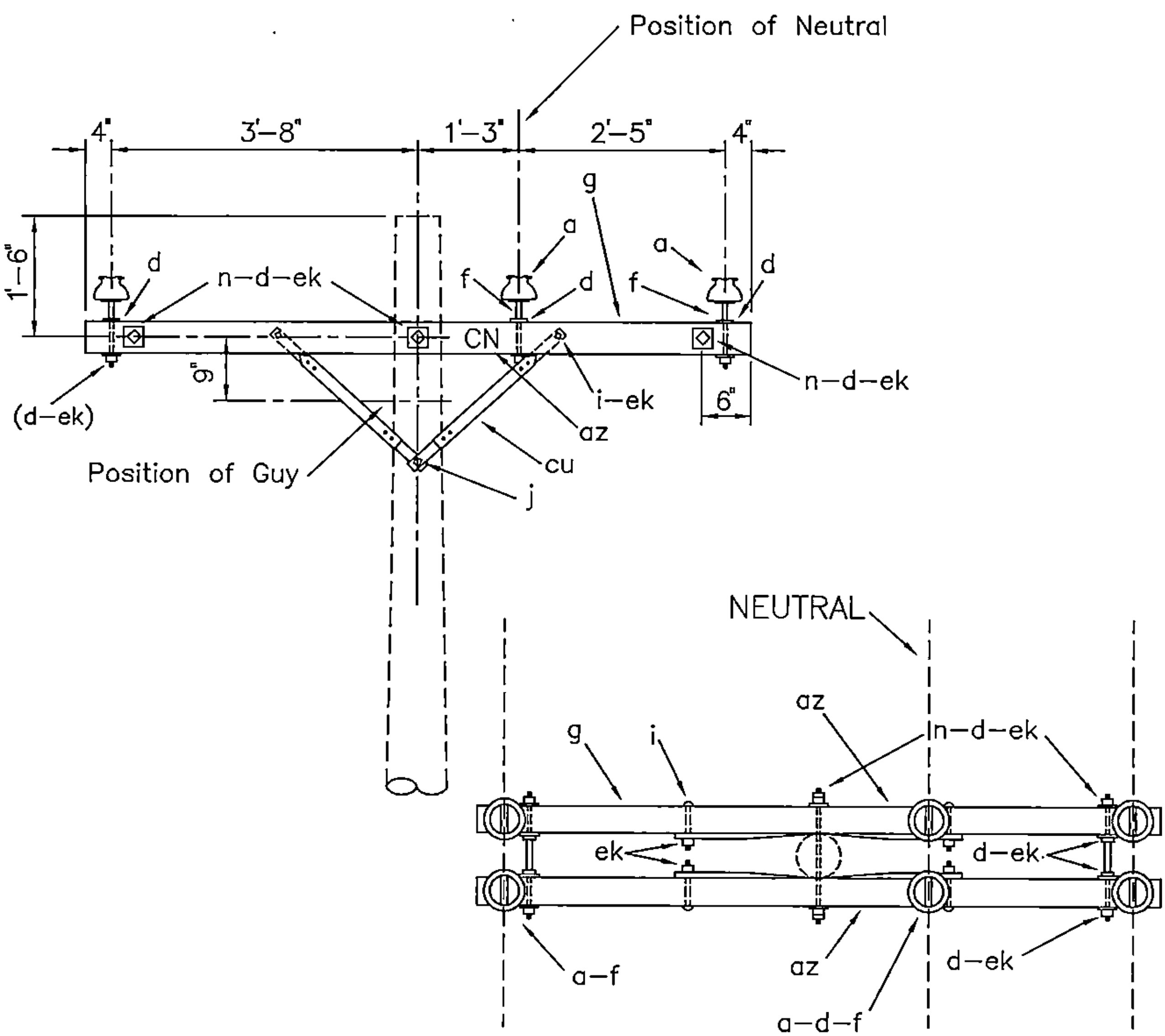
ITEM	QTY	MATERIAL
c	1	Bolt, machine, 5/8" x req'd length
d	11	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
n	3	Bolt, double arm, 5/8" x req'd length
cu	4	Brace, 28"
da	1	Bracket, insulated
ea	4	Insulator, post type (12.47/7.2 kV)
ek	15	Locknuts

DESIGN PARAMETERS:

See TABLE IV

DOUBLE SUPPORT ON CROSSARMS
(POST INSULATORS)

APRIL 2005 RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B2.21P (B2P)



PLAN

ITEM	QTY	MATERIAL
a	2	Insulator, pin type, white, (15 kV)
a	4	Insulator, pin type (12.47/7.2 kV)
d	16	Washer, square, 2 1/4"
f	6	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
n	3	Bolt, double arm, 5/8" x req'd length
az	4	Letters, 2" C, 2" N, with nails
cu	4	Brace, 28"
ek	14	Locknuts

NOTE:

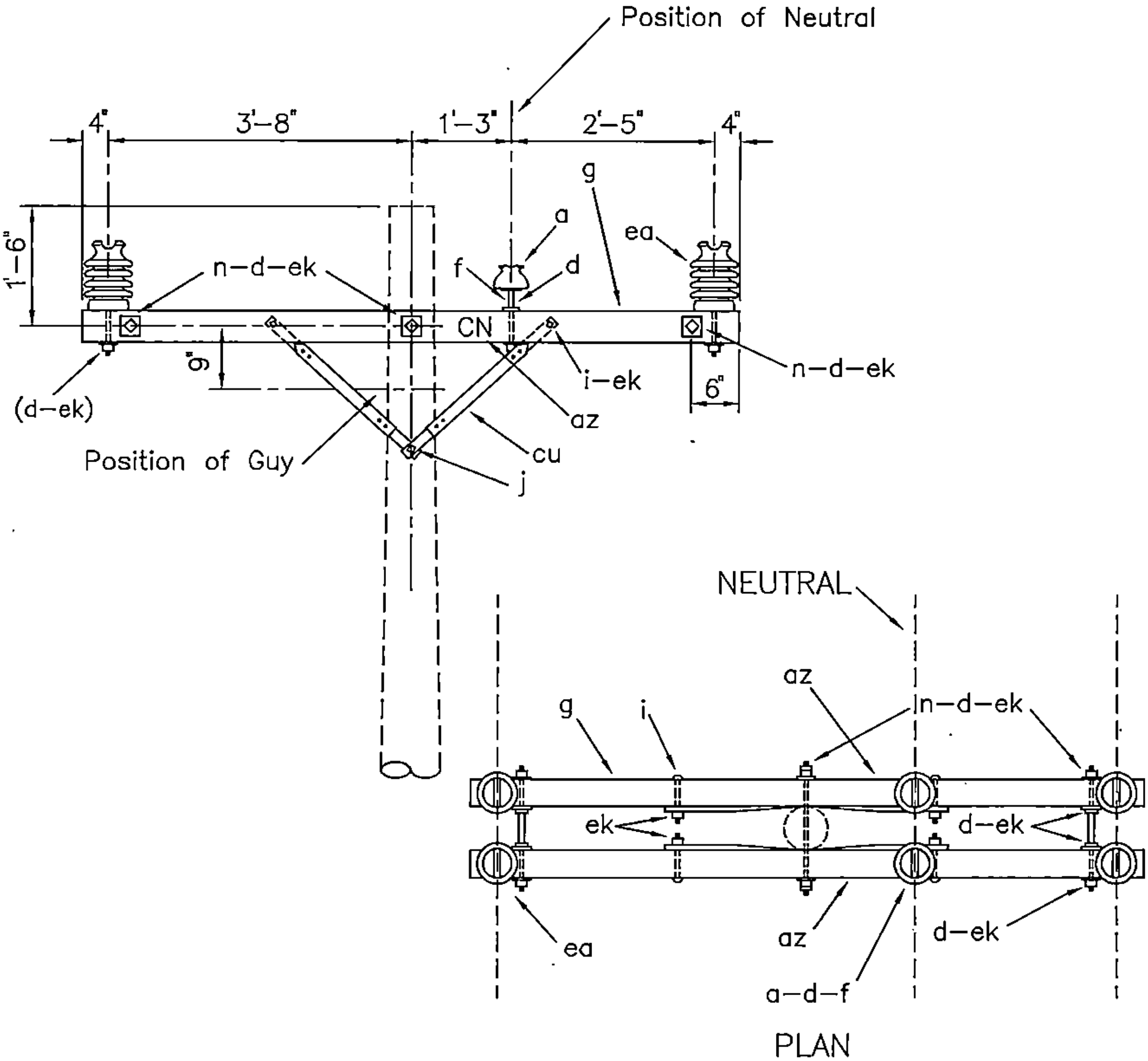
Install either identification letters (az) or white insulators in neutral position.

DESIGN PARAMETERS:

See TABLE IV

DOUBLE SUPPORT, NEUTRAL ON CROSSARMS

APRIL 2005 / RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B2.22 (B9)



ITEM	QTY	MATERIAL
a	2	Insulator, pin type, white, (15 kV)
d	12	Washer, square, 2 1/4"
f	2	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
n	3	Bolt, double arm, 5/8" x req'd length
az	4	Letters, 2" C, 2" N, with nails
cu	4	Brace, 28"
ea	4	Insulator, post type (12.47/7.2 kV)
ek	14	Locknuts

NOTE:

Install either identification letters (az) or white insulators in neutral position.

DESIGN PARAMETERS:

See TABLE IV

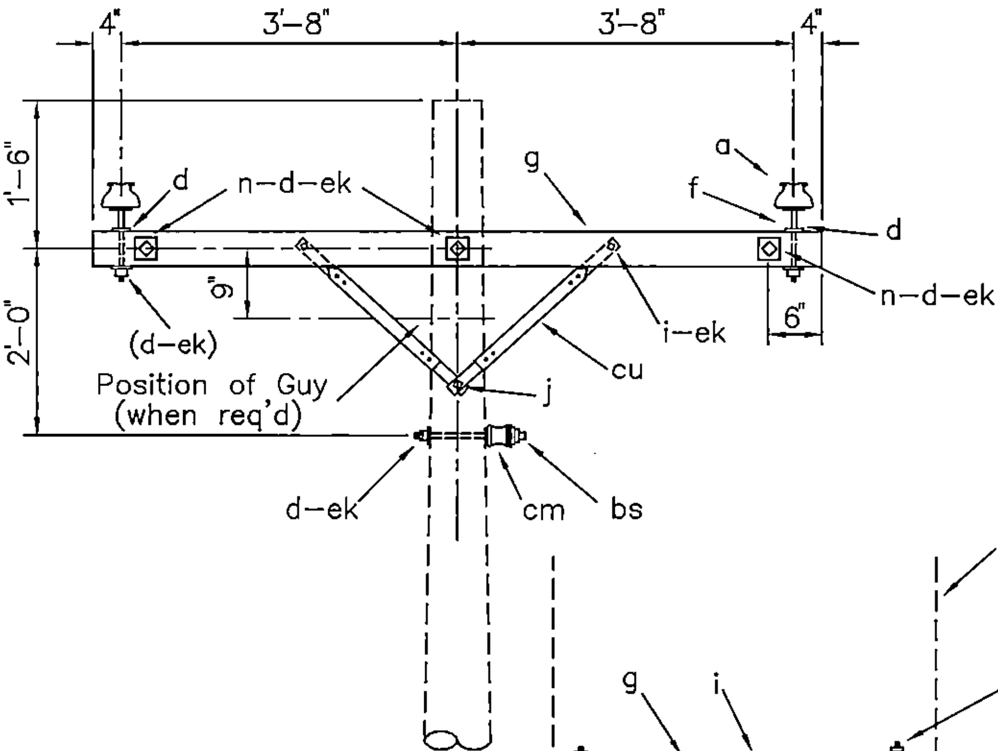
DOUBLE SUPPORT, NEUTRAL ON CROSSARMS (POST INSULATORS)

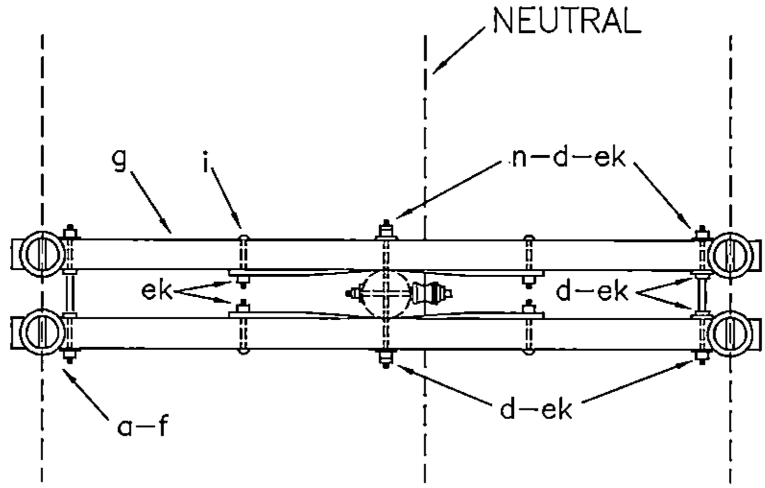
APRIL 2005

RUS

2 – PHASE PRIMARY 12.47/7.2 kV

B2.22P (B9P)

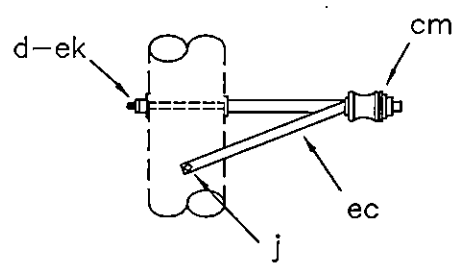




PLAN

NOTE: These assemblies used for NESC Grade B construction.

	ASSEMBLY: B2.	24	25
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2kV)	4	4
d	Washer, square 2 1/4"	15	15
f	Pin, crossarm, steel, 5/8" x 10 3/4"	4	4
g	Crossarm, 3 5/8" x 4 5/8" x 8'-0"	2	2
i	Bolt, carriage, 3/8" x 4 1/2"	4	4
j	Screw, lag, 1/2" x 4"	2	4
n	Bolt, double arm, 5/8" x req'd length	3	3
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	Brace, 28"	4	4
ec	Bracket, offset neutral		1
ek	Locknuts	15	15



Specify B2.25 for offset neutral assembly

DESIGN PARAMETERS:

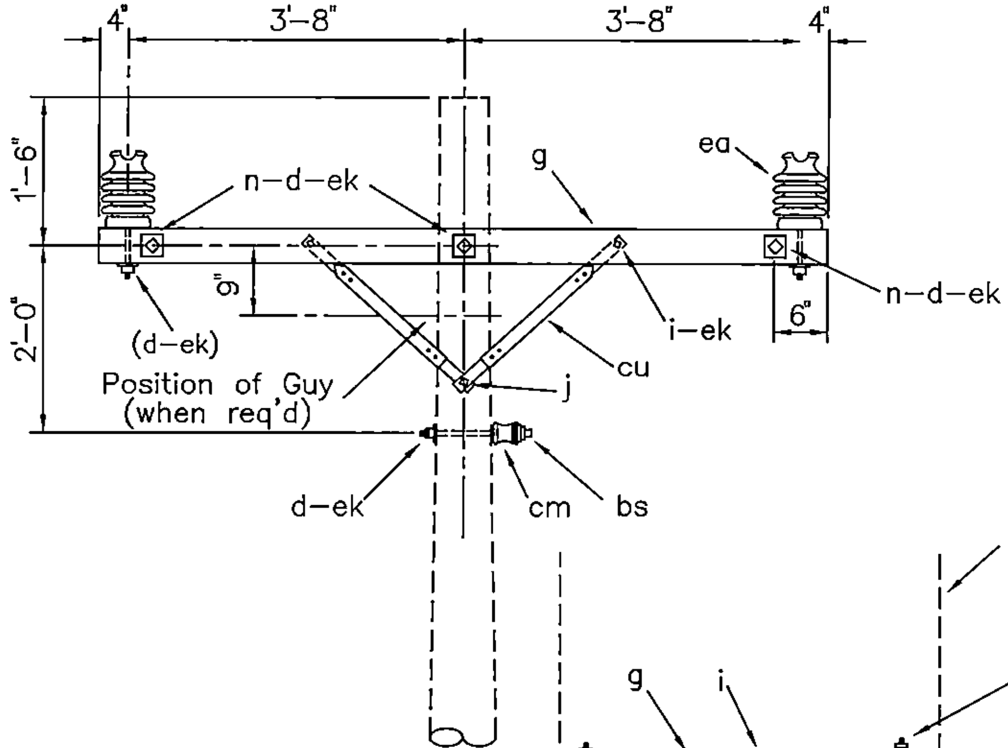
MAXIMUM LINE ANGLES:
5°-Small Conductors
2°-Larger than #1/0

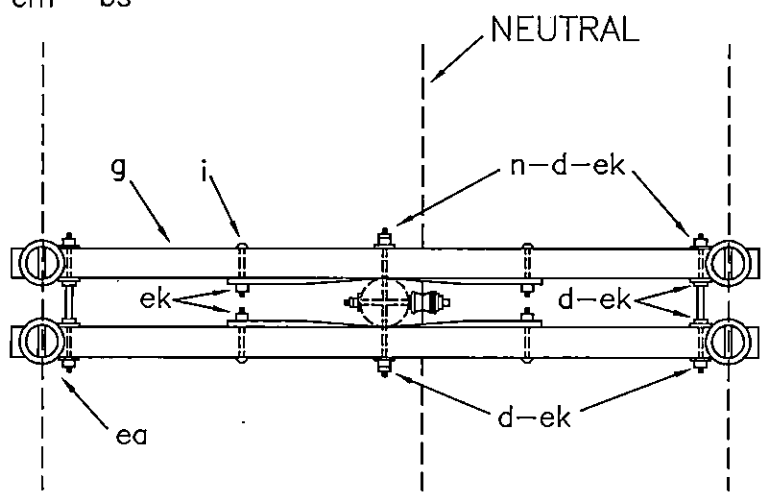
DOUBLE SUPPORT ON CROSSARMS-TANGENT

APRIL 2005
RUS

2 - PHASE PRIMARY
12.47/7.2 kV

B2.24,B2.25
(B1-1,B1-1A)

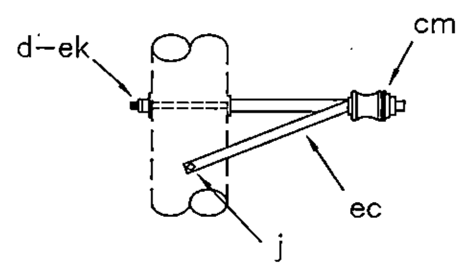




NOTE: These assemblies used for NESC Grade B construction.

PLAN

ITEM	MATERIAL (ASSEMBLY: B2.)	24P QTY	25P QTY
d	Washer, square 2 1/4"	11	11
g	Crossarm, 3 5/8" x 4 5/8" x 8'-0"	2	2
i	Bolt, carriage, 3/8" x 4 1/2"	4	4
j	Screw, lag, 1/2" x 4"	2	4
n	Bolt, double arm, 5/8" x req'd length	3	3
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	Brace, 28"	4	4
ea	Insulator, post type (12.47/7.2kV)	4	4
ec	Bracket, offset neutral		1
ek	Locknuts	11	11



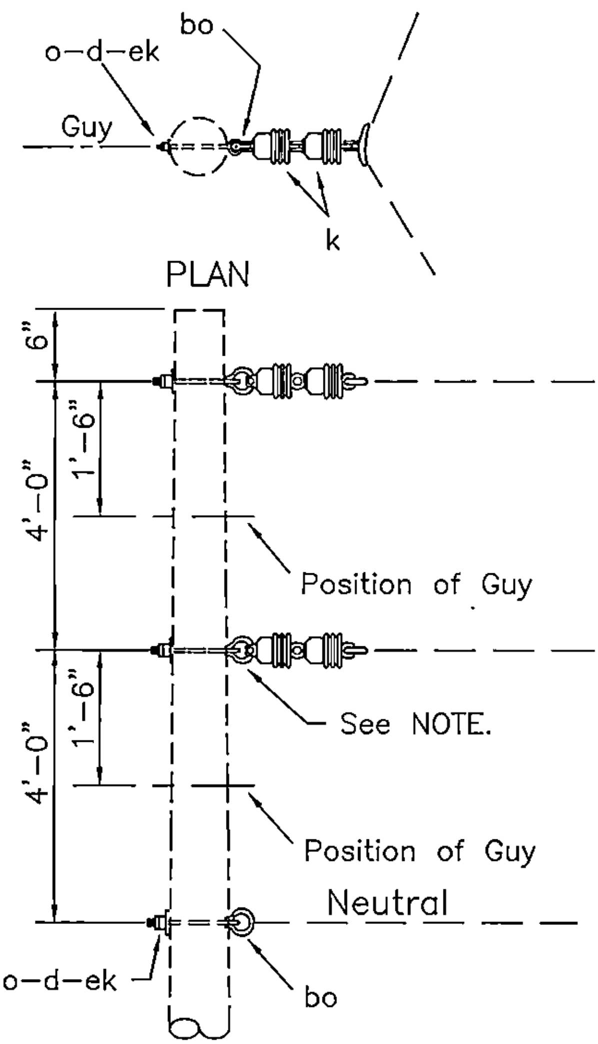
Specify B2.25P for offset neutral assembly

DESIGN PARAMETERS:

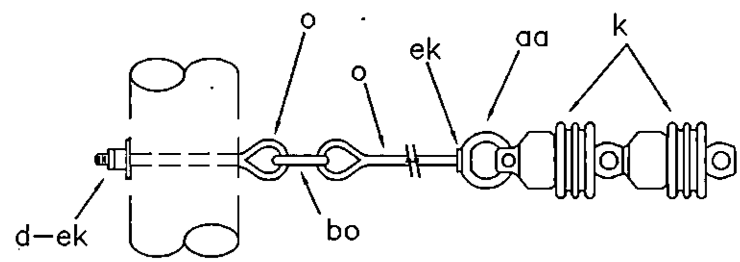
MAXIMUM LINE ANGLES:
5°-Small Conductors
2°-Larger than #1/0

DOUBLE SUPPORT ON CROSSARMS-TANGENT (POST INSULATORS)

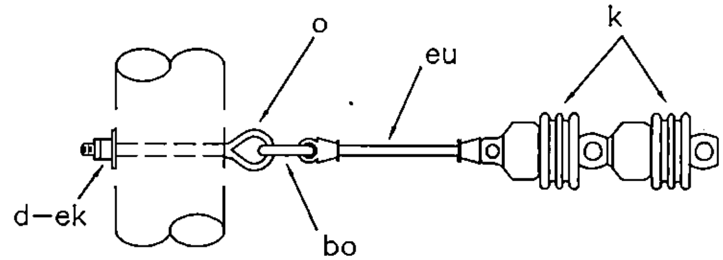
APRIL 2005 RUS	2 - PHASE PRIMARY 12.47/7.2 kV	B2.24P,B2.25P (B1-1P,B1-1AP)



B3.1



B3.2



B3.3

NOTE: Extension link (item "eu" or "du") or eye bolt (item "o"), eye nut (item "aa") and locknut (item "ek") may be installed in lower primary position. Adjust material as required.

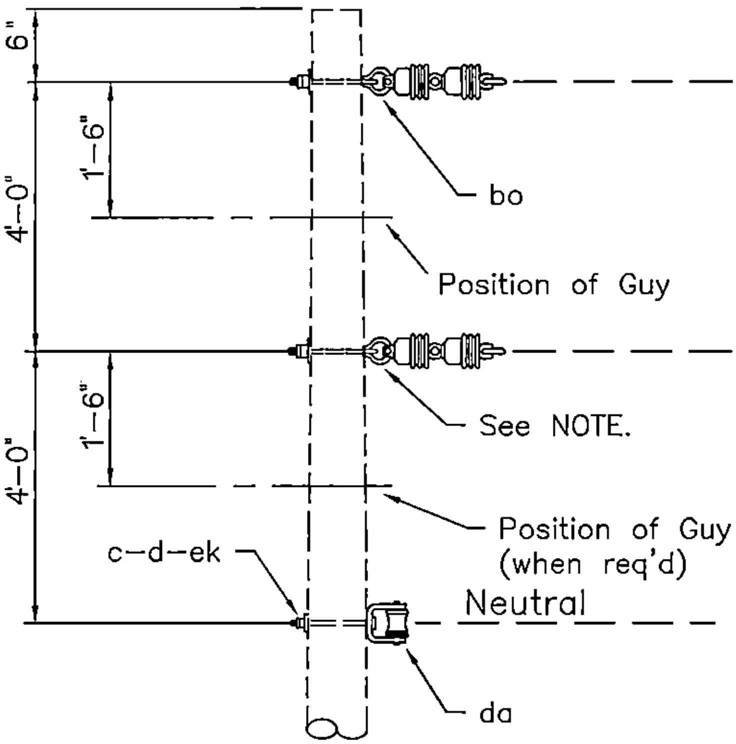
	ASSEMBLY: B3	.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 3", curved	3	3	3
k	Insulator, suspension, 4 1/4"	4	4	4
o	Bolt, eye, 5/8"x req'd length	3	5	3
aa	Nut, eye		2	
bo	Shackle, anchor	3	3	3
ek	Locknuts	3	5	3
eu	Link, extension, insulated			2
(du)	(Link, extension) – (optional)			(2)

DESIGN PARAMETERS:

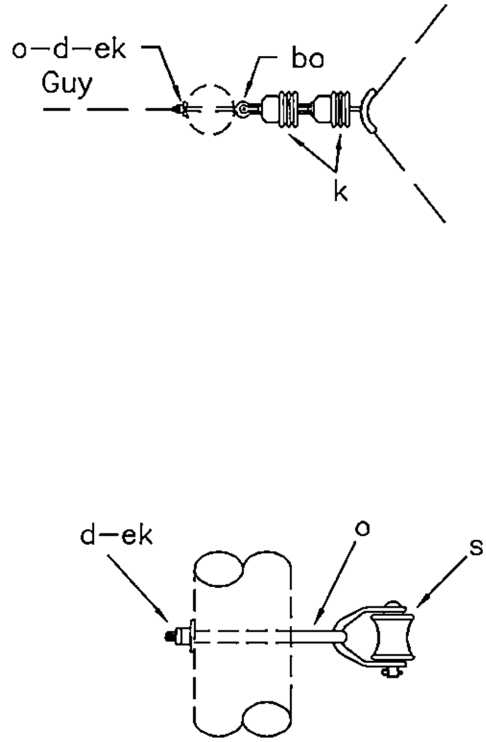
PERMITTED TRANSVERSE
LOAD= 5000 lbs./Conductor
20° – 60°: #1/0 ACSR & Larger
30° – 60°: Smaller Conductors

SUSPENSION ANGLE

APRIL 2005 RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B3.1,B3.2,B3.3 (B3)



B3.4



B3.7

B3.5 = B3.4 neutral assembly + B3.2 primary subassembly
B3.6 = B3.4 neutral assembly + B3.3 primary subassembly
B3.8 = B3.7 neutral assembly + B3.2 primary subassembly
B3.9 = B3.7 neutral assembly + B3.3 primary subassembly

NOTE: Extension link (item "eu" or "du") or eye bolt (item "o"), eye nut (item "aa") and locknut (item "ek") may be installed in lower primary position. Adjust material as required.

	ASSEMBLY: B3	.4	.5	.6	.7	.8	.9
ITEM	MATERIAL	QTY	QTY	QTY	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	1	1	1			
d	Washer, square, 3", curved	3	3	3	3	3	3
k	Insulator, suspension, 4 1/4"	4	4	4	4	4	4
o	Bolt, eye, 5/8"x req'd length	1	2	1	2	3	2
s	Clevis, secondary, swinging, insulated				1	1	1
aa	Nut, eye		2			2	
bo	Shackle, anchor	2	2	2	2	2	2
da	Bracket, insulated	1	1	1			
ek	Locknuts	3	5	3	3	5	3
eu (du)	Link, extension, insulated (Link, extension) – (optional)			2 (2)			2 (2)

DESIGN PARAMETERS:

For ANSI Class 53-2 Spool Insulator (1 3/4") See Table VI

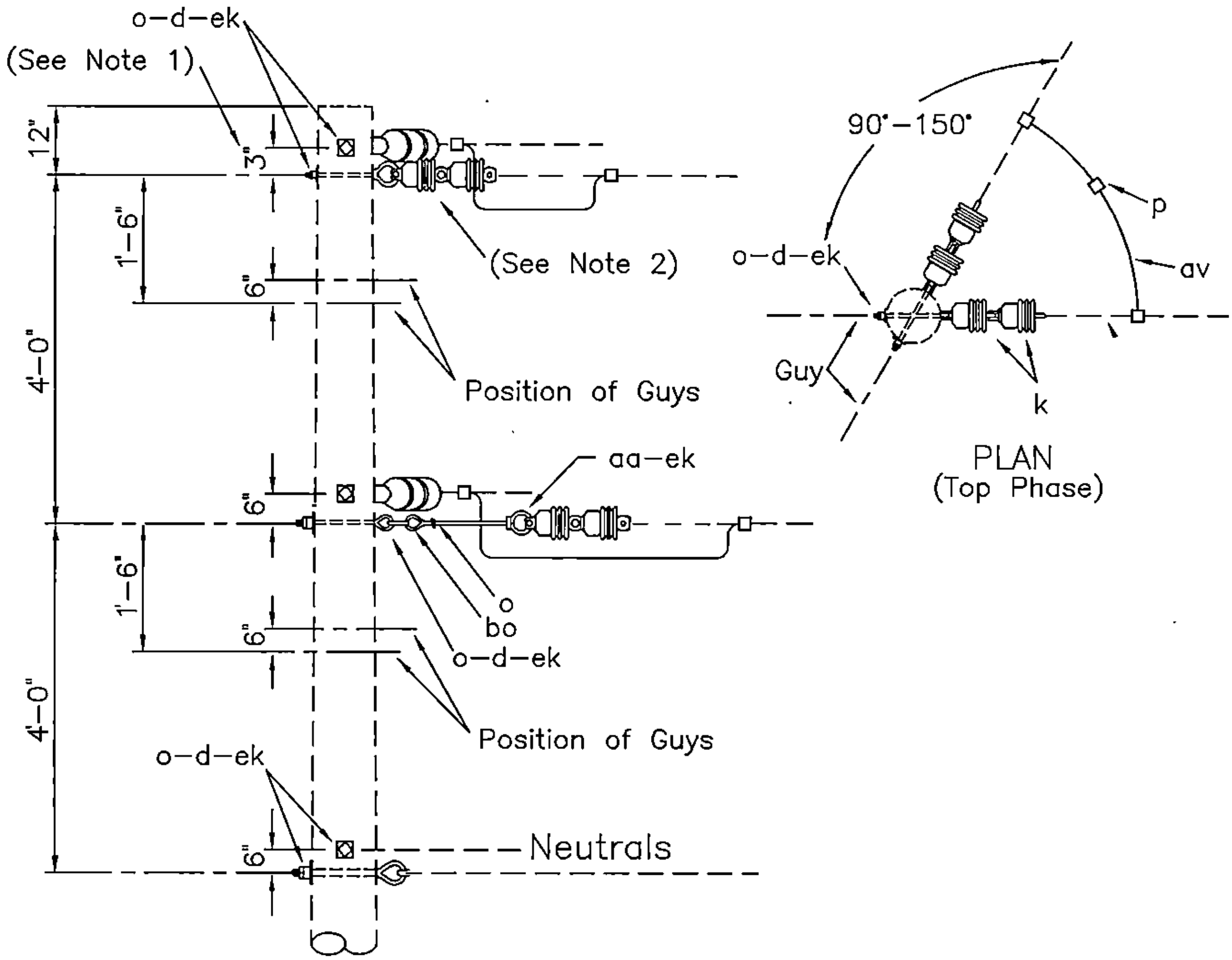
For ANSI Class 53-4 Spool Insulator (3") See Table VII

SUSPENSION ANGLE

APRIL 2005
RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B3.4 – B3.9



NOTES:

1. Separate 6" (top position only) when angle equals 90°.
2. This drawing shows two A5.1 plus two A5.02 assemblies and their material as an example. Any combination of B5.1 – B5.9, A4.1 – A5.9 and A5.03 assemblies may be installed. Record assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

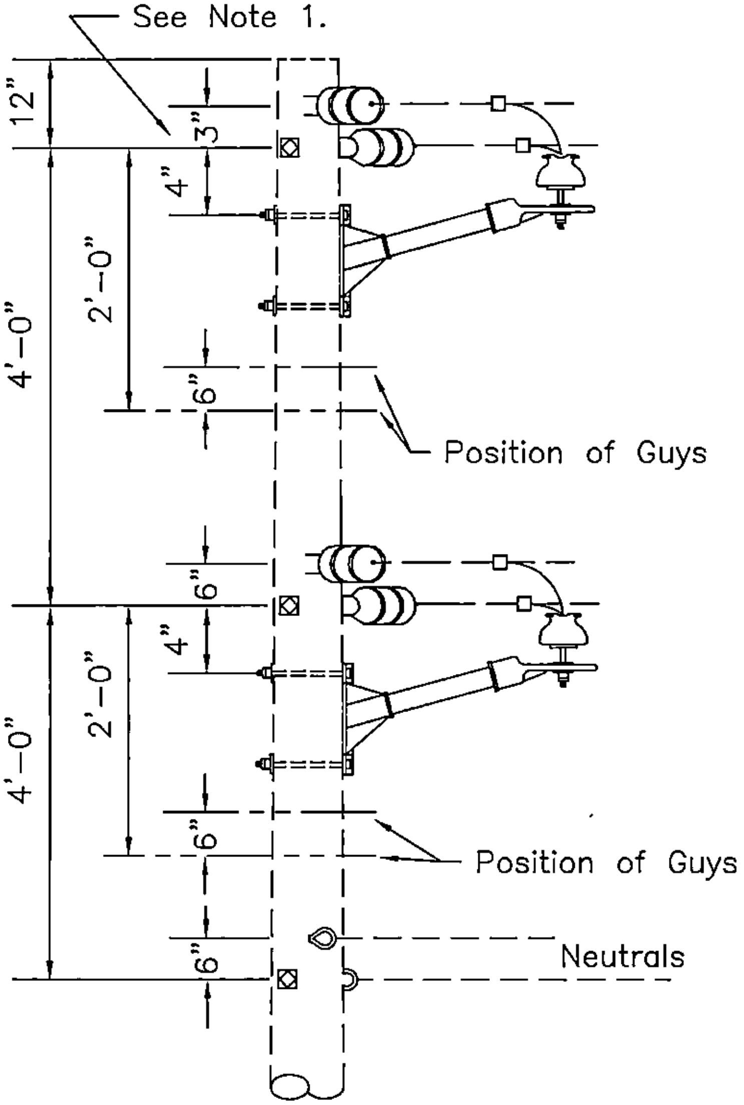
ITEM	QTY	MATERIAL
		Primary Assemblies, as req'd (See Note 2)
p		Connectors, as req'd
av		Jumpers, as req'd

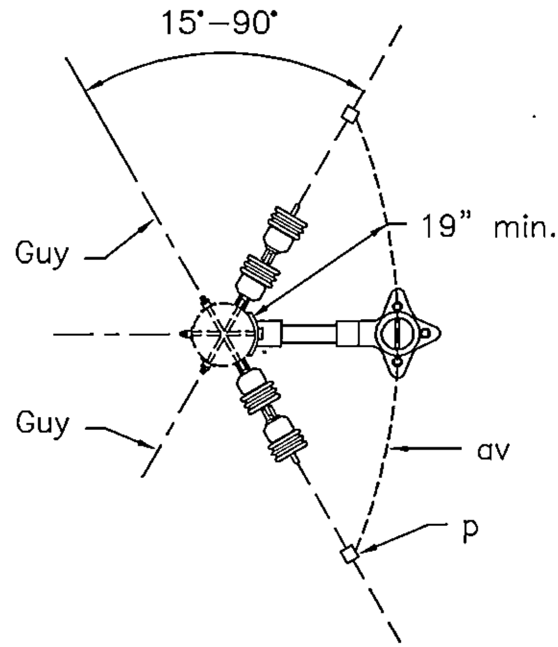
DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE GUIDE (90°–150°)

APRIL 2005	2 – PHASE PRIMARY	B4.1G
RUS	12.47/7.2 kV	(B4-1)





PLAN
(Top Phase)

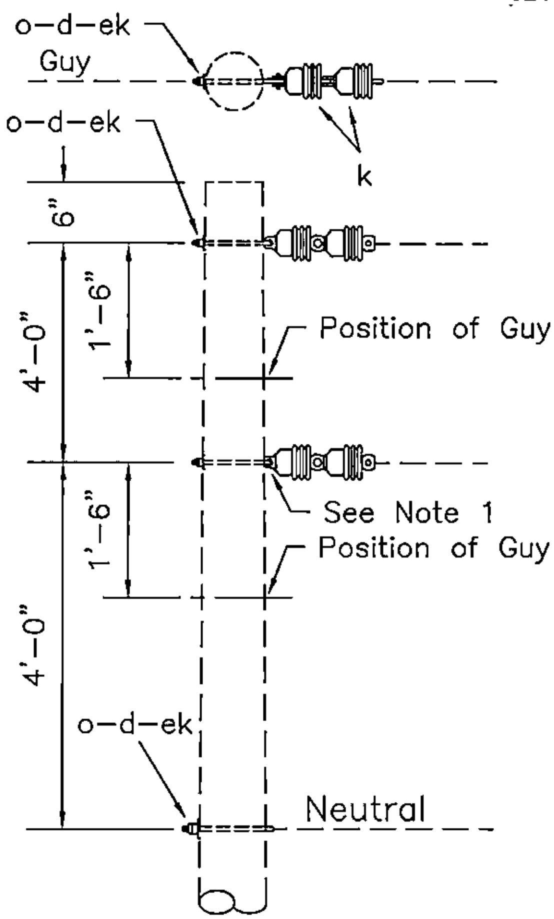
NOTES:
1. Separate 6" (top position only) when angle equals 90°.
2. This drawing shows two B5.1 and two A1.04N assemblies as an example. Any combination of two A1.04N plus B5.1 – B5.9, A5.1 – A5.9 and A5.01 – A5.03 assemblies may be installed. Record assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

ITEM	QTY	MATERIAL
		Primary Assemblies, as req'd (See Note 2)
	2	A1.04N primary assemblies
p		Connectors, as req'd
av		Jumpers, as req'd

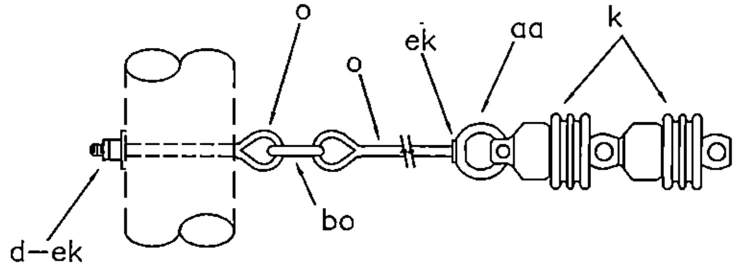
DESIGN PARAMETERS:
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE GUIDE (15°–90°)

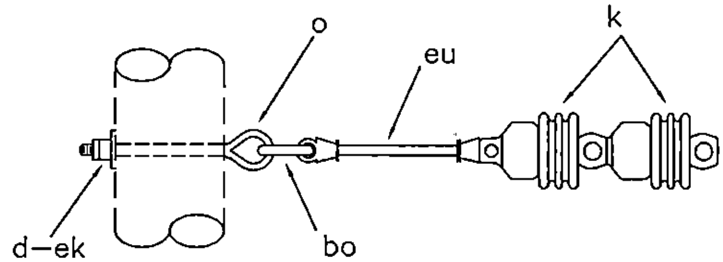
APRIL 2005 RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B4.2G



B5.1



B5.2



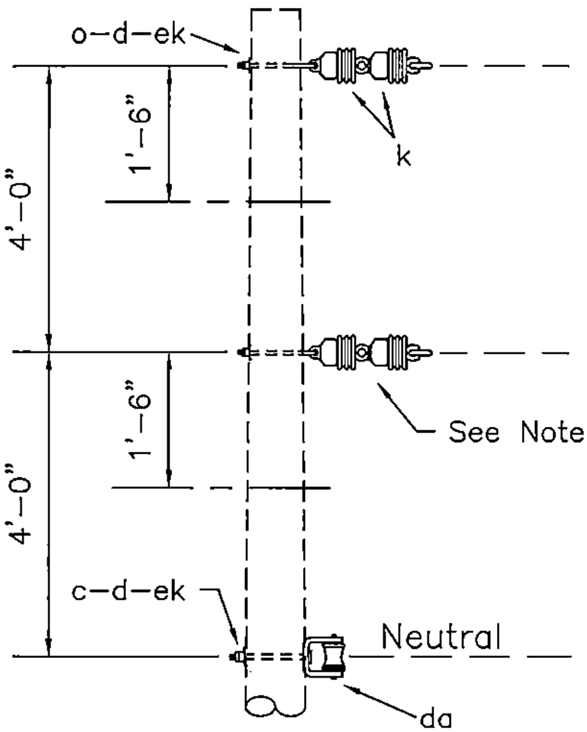
B5.3

NOTES: 1. Extension link (item "eu" or "du") or eye bolt (item "o"), eye nut (item "aa") and locknut (item "ek") may be installed in lower primary position. Adjust material as required.

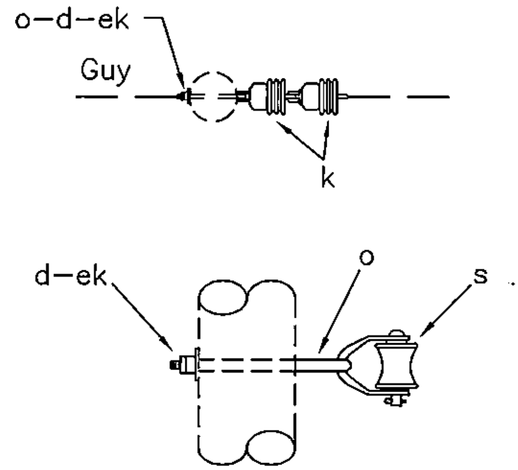
2. When connecting to existing bolt end, use eye nut "aa" and lock nut "ek" instead of eye bolt subassembly "o–d–ek".

	ASSEMBLY: B5	.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 3", curved	3	3	3
k	Insulator, suspension, 4 1/4"	4	4	4
o	Bolt, eye, 5/8"x req'd length	3	4	3
p	Connectors, as req'd			
aa	Nut, eye		1	
av	Jumper's, as req'd			
bo	Shackle, anchor		1	1
ek	Locknuts	3	4	3
eu (du)	Link, extension, insulated (Link, extension) – (optional)			2 (2)

DESIGN PARAMETERS: PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor	SINGLE DEADENDS		
	APRIL 2005 RUS	2 – PHASE PRIMARY 12.47/7.2 kV	B5.1,B5.2,B5.3 (B5–1)



B5.4



B5.7

B5.5 = B5.4 neutral assembly + B5.2 primary subassembly
B5.6 = B5.4 neutral assembly + B5.3 primary subassembly
B5.8 = B5.7 neutral assembly + B5.2 primary subassembly
B5.9 = B5.7 neutral assembly + B5.3 primary subassembly

NOTES:
1. Extension link (item "eu" or "du") or eyebolt (item "o"), eyenut (item "aa") and locknut (item "ek") may be installed in lower primary position. Adjust material as required.
2. When connecting to existing bolt end, use eyenut "aa" and locknut "ek" instead of eyebolt subassembly "o–d–ek".

	ASSEMBLY: B5	.4	.5	.6	.7	.8	.9
ITEM	MATERIAL	QTY	QTY	QTY	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	1	1	1			
d	Washer, square, 3", curved	3	3	3	3	3	3
k	Insulator, suspension, 4 1/4"	4	4	4	4	4	4
o	Bolt, eye, 5/8"x req'd length	2	3	2	3	4	3
p	Connectors, as req'd						
s	Clevis, secondary, swinging, insulated				1	1	1
aa	Nut, eye		1			1	
av	Jumpers, as req'd						
bo	Shackle, anchor		2	2		2	2
da	Bracket, insulated	1	1	1			
ek	Locknuts	3	4	3	3	4	3
eu (du)	Link, extension, insulated (Link, extension) – (optional)			2 (2)			2 (2)

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD
For ANSI Class 53–2 Spool Insulator (1 3/4"): 1,500 lbs

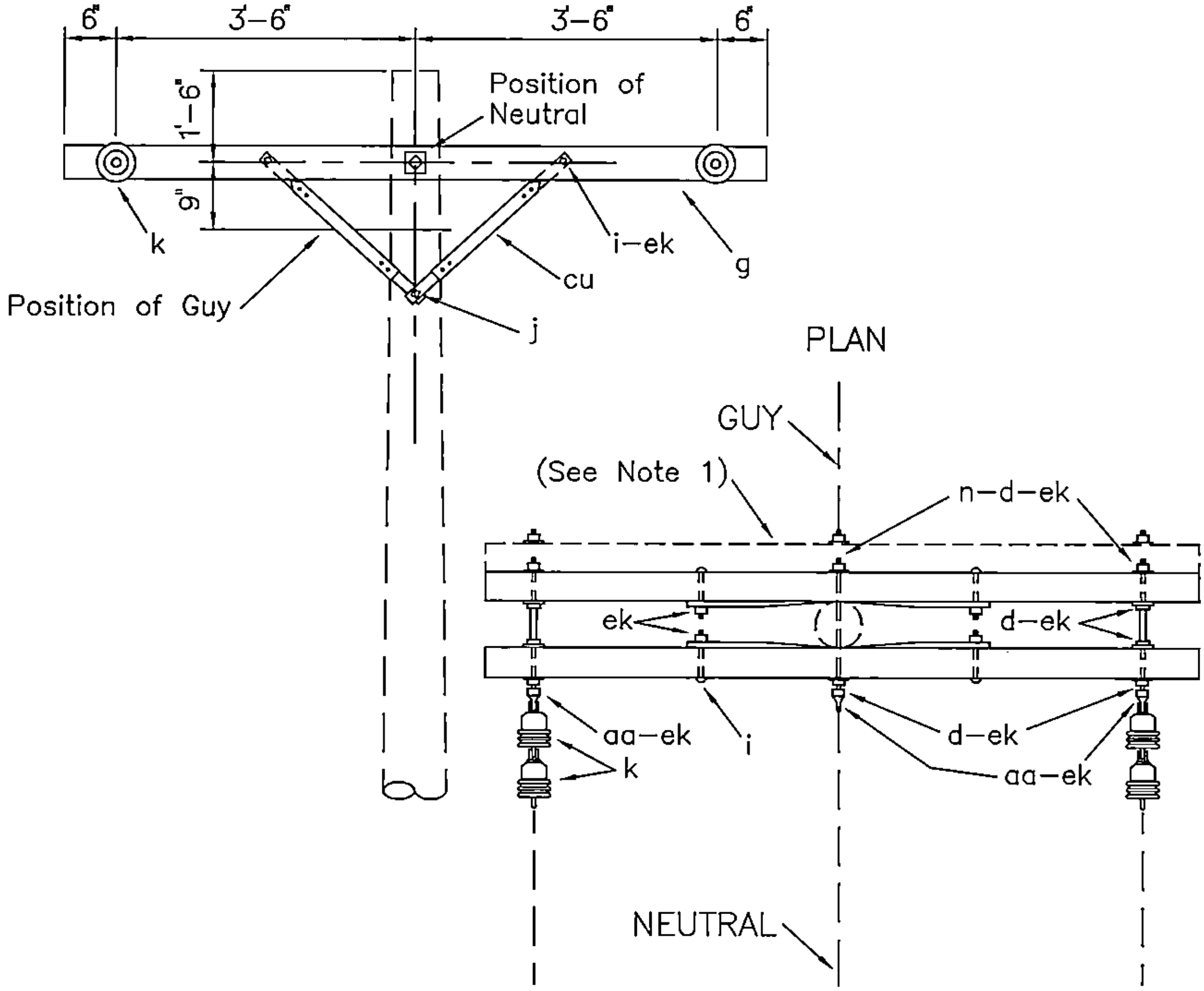
For ANSI Class 53–4 Spool Insulator (3"): 2,250 lbs

SINGLE DEADENDS

APRIL 2005
RUS

2 – PHASE PRIMARY
12.47/7.2 kV

B5.4 – B5.9



NOTES:

1. Designate as B5.31 for assembly with three crossarms.
2. Double arming eye bolt, item "dy", may be used instead of double arming bolt, item "n", and eyenut, item "aa".
3. See assembly B6.21 for alternative neutral position and materials.

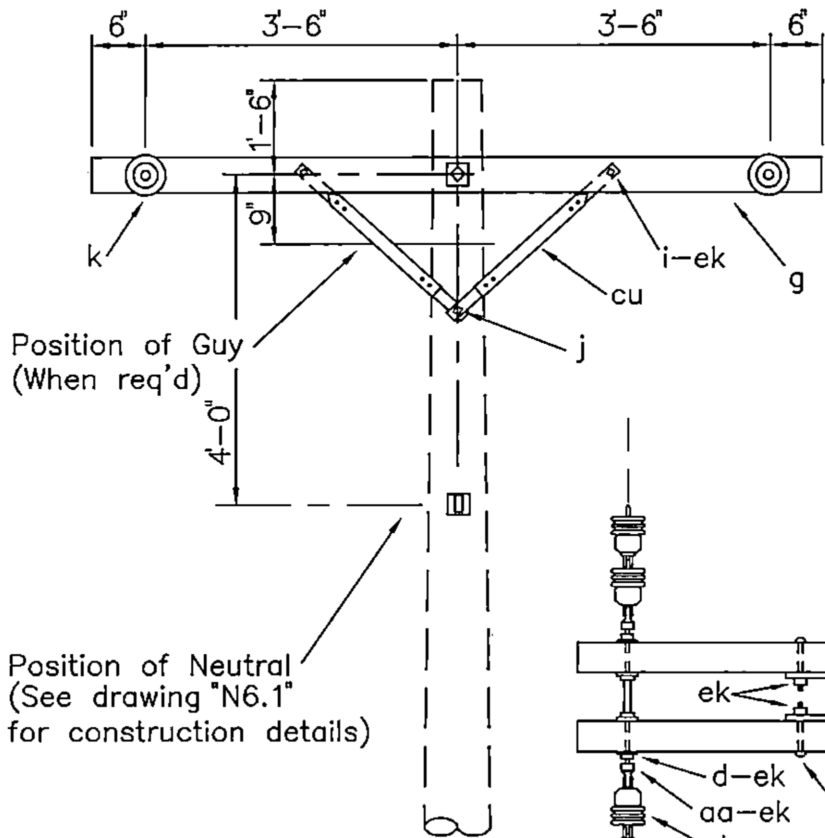
ITEM	QTY	MATERIAL
d	10	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
k	4	Insulator, suspension, 4 1/4"
n	3	Bolt,double arming,5/8" x req'd length
aa	3	Nut, eye, 5/8"
cu	4	Brace, 28"
ek	17	Locknuts

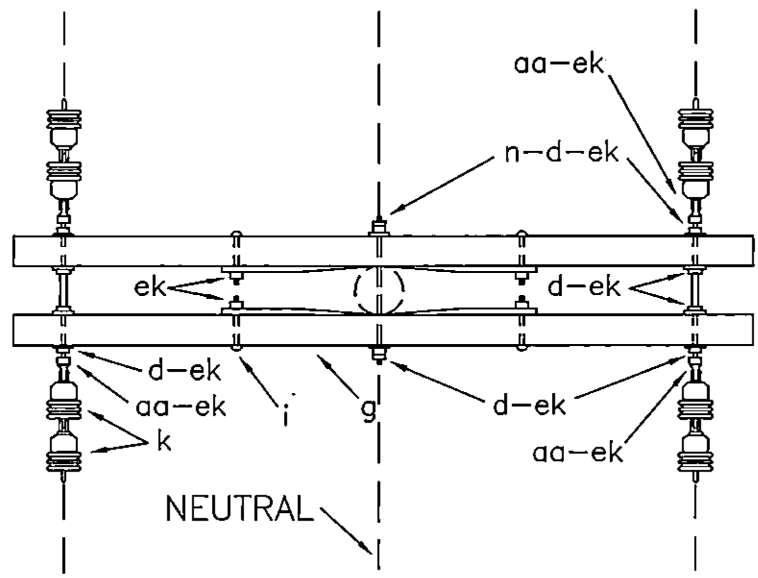
DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table A (Exhibit 2)

SINGLE DEADEND ON CROSSARMS

APRIL 2005 RUS	2 - PHASE PRIMARY 12.47/7.2 kV	B5.21 (B7) B5.31 (B7-1)





PLAN

NOTES:

1. Double arming bolt, item "n", and eye nut, item "aa" may be replaced with double arming eye bolt, item "dy".
2. Maximum line angle may be increased to 15° by installing anchor shackles, item "bo", to (horizontal) eyenuts and installing side guy as req'd.
3. See assembly B5.21 for alternative neutral position and materials.

ITEM	QTY	MATERIAL
d	10	Washer, square, 2 1/4"
d	2	Washer, square, 3", curved
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
k	8	Insulator, suspension, 4 1/4"
n	4	Bolt,double arming,5/8" x req'd length
aa	6	Nut, eye, 5/8"
cu	4	Brace, 28"
ek	22	Locknuts

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table A (Exhibit 2)

DOUBLE DEADEND ON CROSSARMS

APRIL 2005	2 – PHASE PRIMARY	
RUS	12.47/7.2 kV	B6.21 (B8)

THREE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
C1.1N C1.2N		SINGLE SUPPORT – NARROW PROFILE (TANGENT)
C1.1NP C1.2NP		SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
C1.3N		SINGLE SUPPORT – NARROW PROFILE
C1.3NP		SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
C1.4N C1.5N		SINGLE SUPPORT – NARROW PROFILE (TANGENT)
C1.4NP C1.5NP		SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
C1.6N		SINGLE SUPPORT – NARROW PROFILE
C1.6NP		SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
C1.7N C1.8N		SINGLE SUPPORT – NARROW PROFILE (TANGENT)
C1.7NP C1.8NP		SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
C1.9N		SINGLE SUPPORT – NARROW PROFILE
C1.9NP		SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
C1.11 C1.12	(C1) (C1A)	SINGLE SUPPORT ON CROSSARM (TANGENT)
C1.11L C1.12L	(C1-2)	SINGLE SUPPORT ON CROSSARM (TANGENT) (LARGE CONDUCTORS)
C1.11P C1.12P	(C1P) (C1AP)	SINGLE SUPPORT ON CROSSARM (TANGENT) (POST INSULATORS)
C1.13		SINGLE SUPPORT ON CROSSARM
C1.13L	(C1-4)	SINGLE SUPPORT ON CROSSARM (LARGE CONDUCTORS)
C1.13P		SINGLE SUPPORT ON CROSSARM (POST INSULATORS)

THREE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

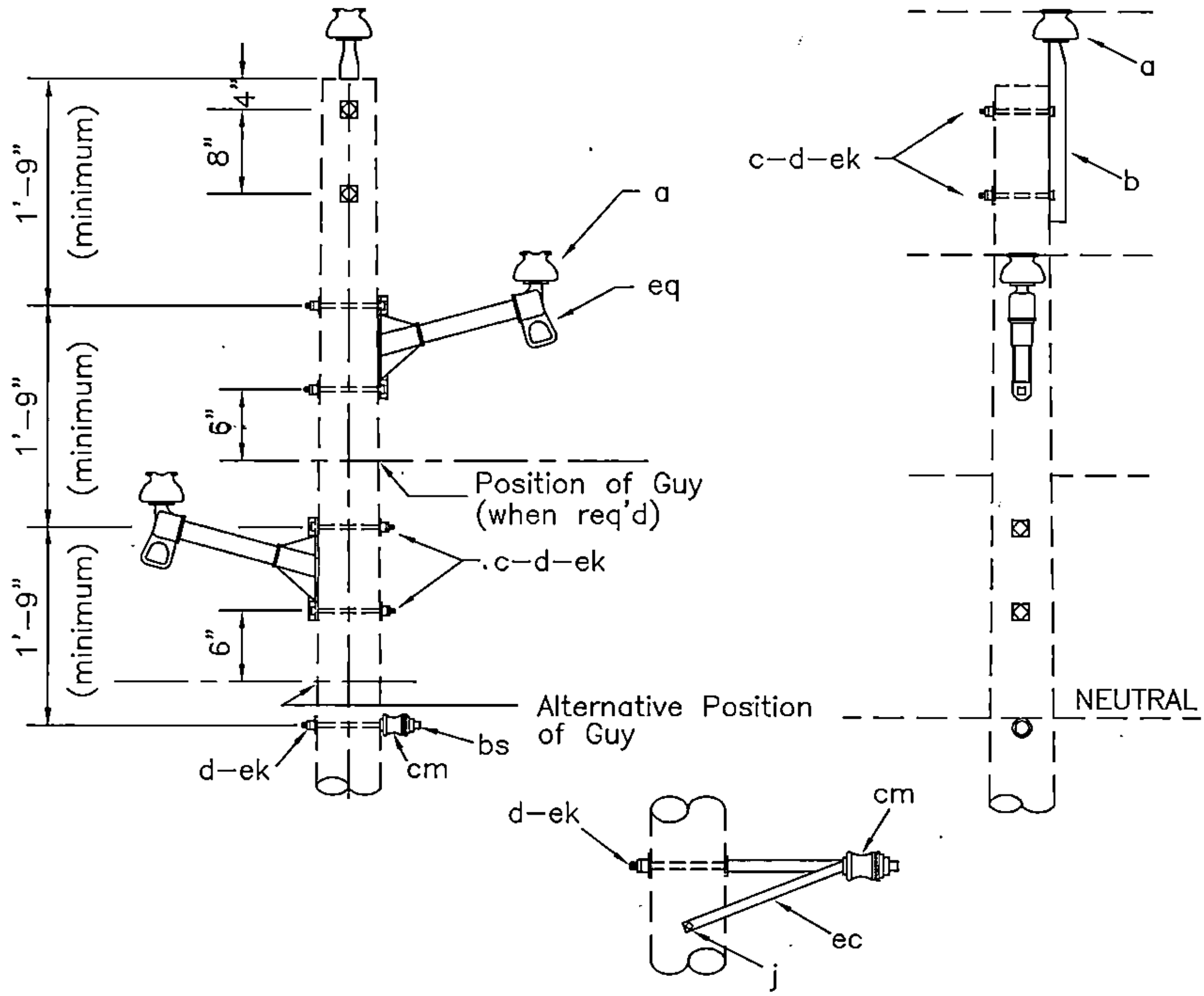
DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
C1.41	(C9-1)	SINGLE SUPPORT, NEUTRAL ON CROSSARM
C1.41L	(C9-3)	SINGLE SUPPORT, NEUTRAL ON CROSSARM (LARGE CONDUCTORS)
C1.41P	(C9-1P)	SINGLE SUPPORT, NEUTRAL ON CROSSARM (POST INSULATORS)
C1.81G		THREE-PHASE JUNCTION GUIDE
C2.1N C2.2N		DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
C2.1NP C2.2NP		DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
C2.3N		DOUBLE SUPPORT – NARROW PROFILE
C2.3NG		DOUBLE SUPPORT – NARROW PROFILE (ALTERNATIVE GUYING GUIDE)
C2.3NP		DOUBLE SUPPORT – NARROW PROFILE (POST INSULATORS)
C2.4N C2.5N		DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
C2.4NP C2.5NP		DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
C2.6N		DOUBLE SUPPORT – NARROW PROFILE
C2.6NP		DOUBLE SUPPORT – NARROW PROFILE (POST INSULATORS)
C2.7N C2.8N		DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
C2.7NP C2.8NP		DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
C2.9N		DOUBLE SUPPORT – NARROW PROFILE
C2.9NP		DOUBLE SUPPORT – NARROW PROFILE (POST INSULATORS)

THREE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
C2.21	(C2)	DOUBLE SUPPORT ON CROSSARMS
C2.21L	(C1-3)	DOUBLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)
C2.21P	(C1-3P)	DOUBLE SUPPORT ON CROSSARMS (POST INSULATORS)
C2.24 C2.25	(C1-1) (C1-1A)	DOUBLE SUPPORT ON CROSSARMS - TANGENT
C2.24P C2.25P	(C1-1P) (C1-1AP)	DOUBLE SUPPORT ON CROSSARMS - TANGENT (POST INSULATORS)
C2.51	(C9)	DOUBLE SUPPORT, NEUTRAL ON CROSSARMS
C2.51L	(C9-2)	DOUBLE SUPPORT, NEUTRAL ON CROSSARMS (LARGE CONDUCTORS)
C2.51P	(C9-2PL)	DOUBLE SUPPORT, NEUTRAL ON CROSSARMS (POST INSULATORS)
C2.52	(C2-1)	DOUBLE SUPPORT ON 10-FOOT CROSSARMS
C2.52L	(C2-2)	DOUBLE SUPPORT ON 10-FOOT CROSSARMS (LARGE CONDUCTORS)
C2.52P	(C2-2PL)	DOUBLE SUPPORT ON 10-FOOT CROSSARMS (POST INSULATORS)
C3.1 C3.2 C3.3	(C3)	SUSPENSION ANGLE
C3.4 C3.5 C3.6 C3.7 C3.8 C3.9		SUSPENSION ANGLE
C3.1L	(C3-1)	SUSPENSION ANGLE (LARGE CONDUCTORS)

THREE-PHASE PRIMARY POLE TOP ASSEMBLY UNITS

DRAWING NUMBERS **1728F-804** (New)	 **Bulletin 50-3** (Old)	DRAWING TITLE (DESCRIPTION)
C4.1G	((C4-1))	DEADEND GUIDE $(90^{o} - 150^{o})$
C4.2G		DEADEND GUIDE $(15^{o} - 90^{o})$
C5.1 C5.2 C5.3	 (C5-1)	SINGLE DEADENDS - VERTICAL
C5.4 C5.5 C5.6 C5.7 C5.8 C5.9		SINGLE DEADENDS - VERTICAL
C5.11G		SINGLE PHASE TAP GUIDE
C5.21 C5.31	(C7) (C7-1)	SINGLE DEADEND ON CROSSARMS
C5.21L C5.32L		SINGLE DEADEND ON CROSSARMS (LARGE CONDUCTORS)
C5.22 C5.32	(C7-2)	SINGLE DEADEND ON CROSSARMS - ALTERNATIVE
C5.71L	(C7A)	SINGLE DEADEND ON CROSSARM ASSEMBLY
C5.82G		THREE PHASE HORIZONTAL TAP GUIDE
C6.21 C6.31	(C8)	DOUBLE DEADEND ON CROSSARMS
C6.21L C6.31l	 (C8-3)	DOUBLE DEADEND ON CROSSARMS (LARGE CONDUCTORS)
C6.52 C6.53		DOUBLE DEADEND ON 10-FOOT CROSSARMS
C6.52G		DOUBLE DEADEND ON 10-FOOT CROSSARMS (FEEDTHROUGH GUIDE)
C6.91G		DOUBLE DEADENDS (BUCKARMS) GUIDE



Specify C1.2N for offset neutral assembly

ITEM	MATERIAL (ASSEMBLY: C1.)	1N QTY	2N QTY	
a	Insulator, pin type (12.47/7.2 kV)	3	3	
b	Pin, pole top, 20"	1	1	
c	Bolt, machine, 5/8" x req'd length	6	6	
d	Washer, square 2 1/4"	7	7	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(2)	(2)	(If req'd)
j	Screw, lag, 1/2" x 4"		2	
bs	Bolt, single, upset	1		
cm	Insulator, spool, 3"	1	1	
ec	Bracket, offset neutral		1	
ek	Locknuts	7	7	
eq	Bracket, insulator/equipment	2	2	

Design Parameters:

MAXIMUM LINE ANGLES:
5°–Small Conductors
2°–Larger than #1/0

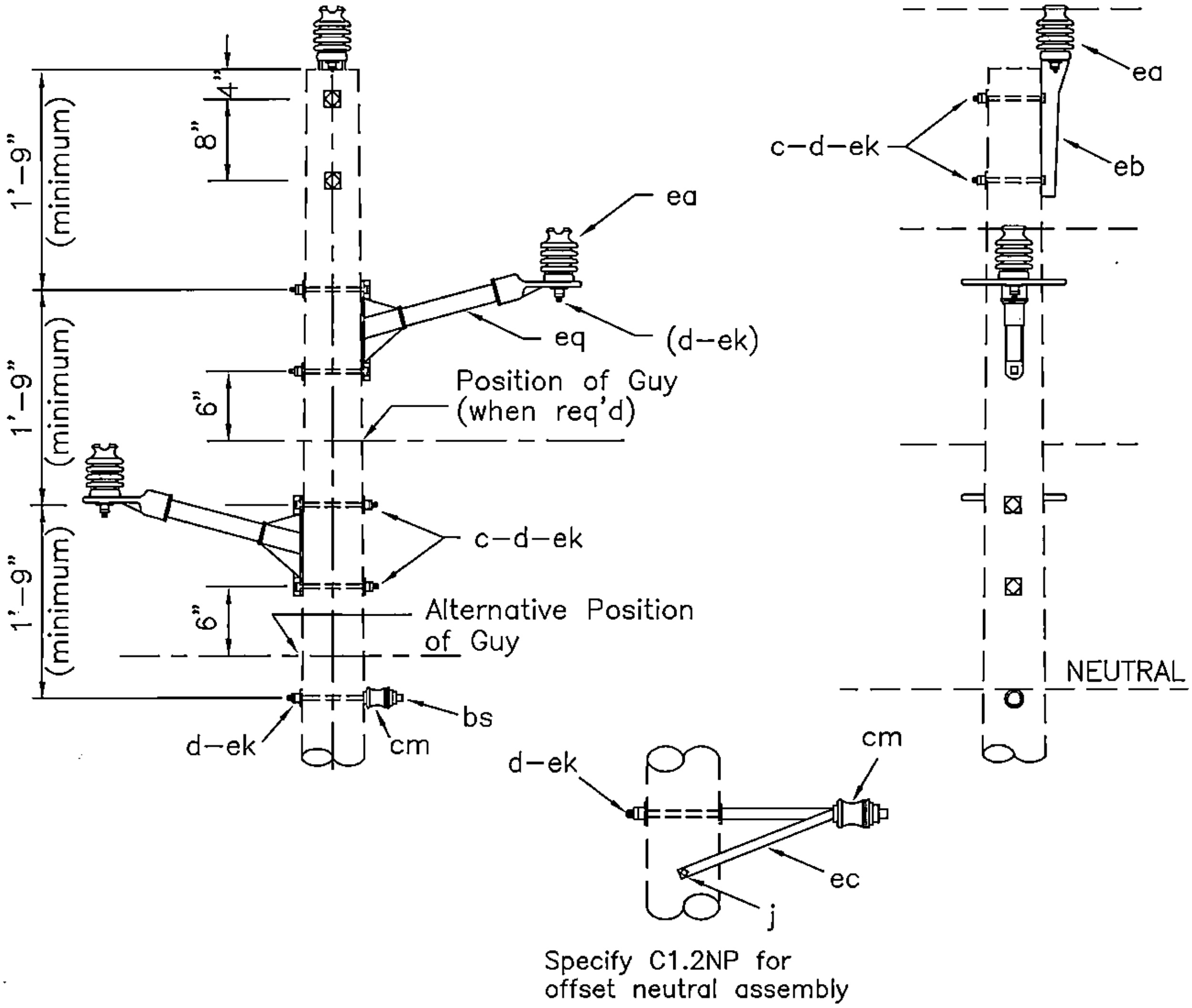
SINGLE SUPPORT–NARROW PROFILE (TANGENT)

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C1.1N
C1.2N



	ASSEMBLY: C1.	1NP	2NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	7	7
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	3	3
eb	Bracket, pole top	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	2	2

Design Parameters:

MAXIMUM LINE ANGLES:
5°–Small Conductors
2°–Larger than #1/0

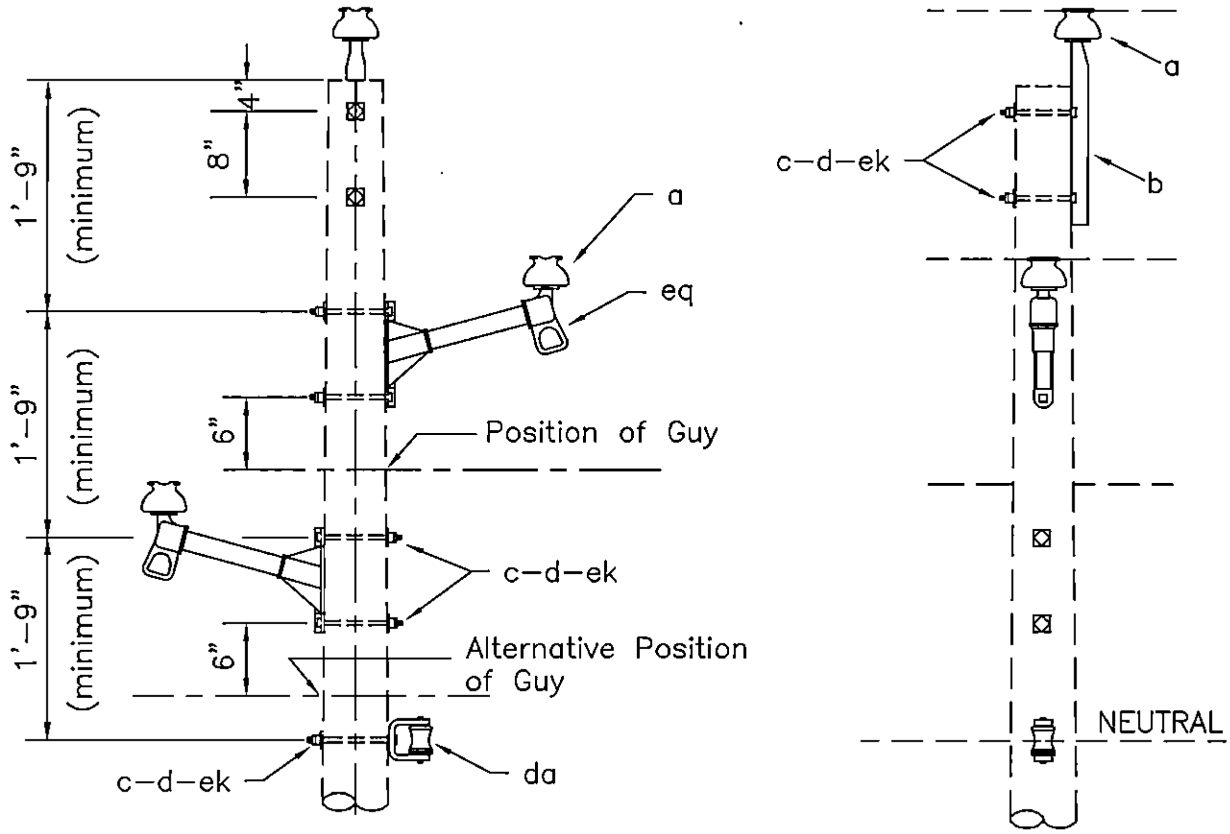
SINGLE SUPPORT–NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C1.1NP
C1.2NP



NOTE: If additional or alternative guying is required, frame pole according to C2.3NG.

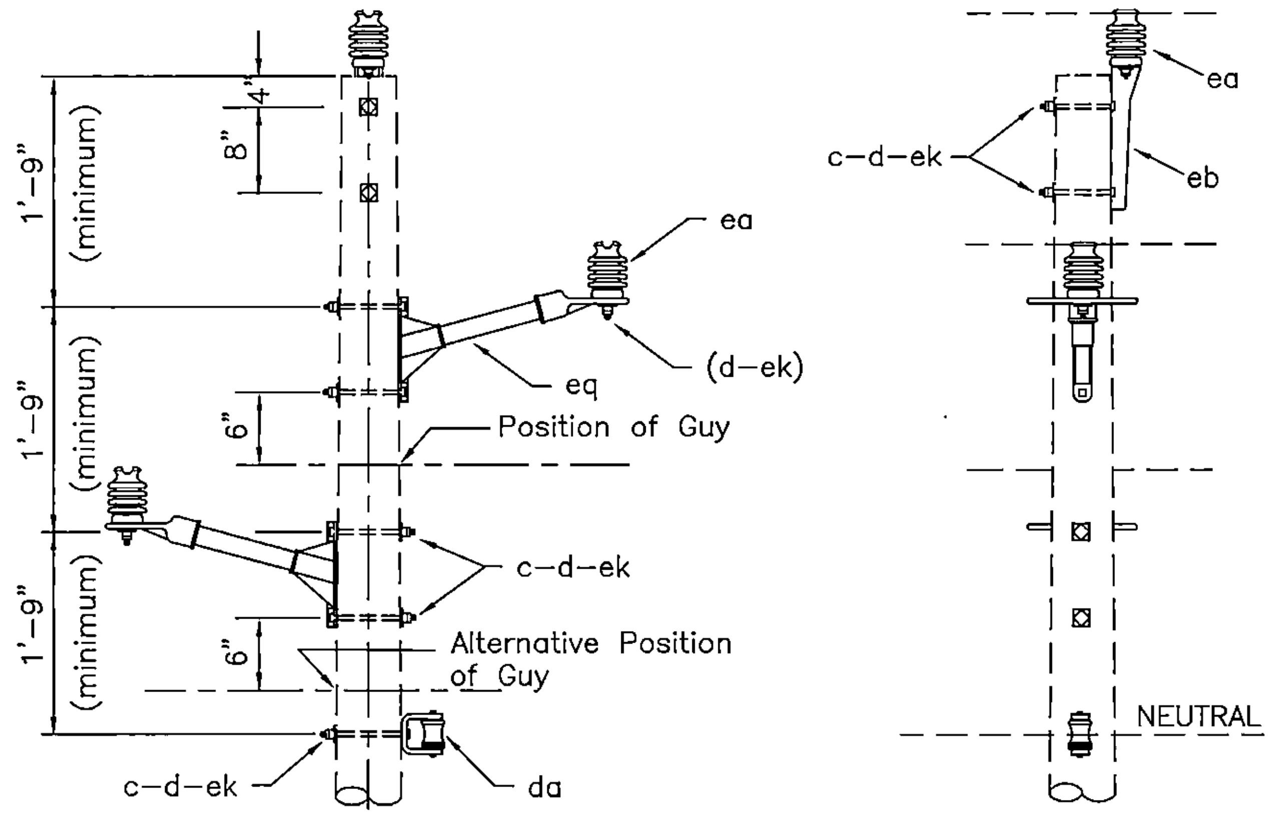
ITEM	MATERIAL — ASSEMBLY: C1.	3N QTY	
a	Insulator, pin type (12.47/7.2 kV)	3	
b	Pin, pole top, 20"	1	
c	Bolt, machine, 5/8" x req'd length	7	
d	Washer, square 2 1/4"	7	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(2)	(If req'd)
da	Bracket, insulated	1	
ek	Locknuts	7	
eq	Bracket, insulator/equipment	2	

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE I

SINGLE SUPPORT—NARROW PROFILE

APRIL 2005	3 – PHASE PRIMARY	C1.3N
RUS	12.47/7.2 kV	



ASSEMBLY: C1.3NP

ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	3
eb	Bracket, pole top	1
ek	Locknuts	7
eq	Bracket, insulator/equipment	2

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE II

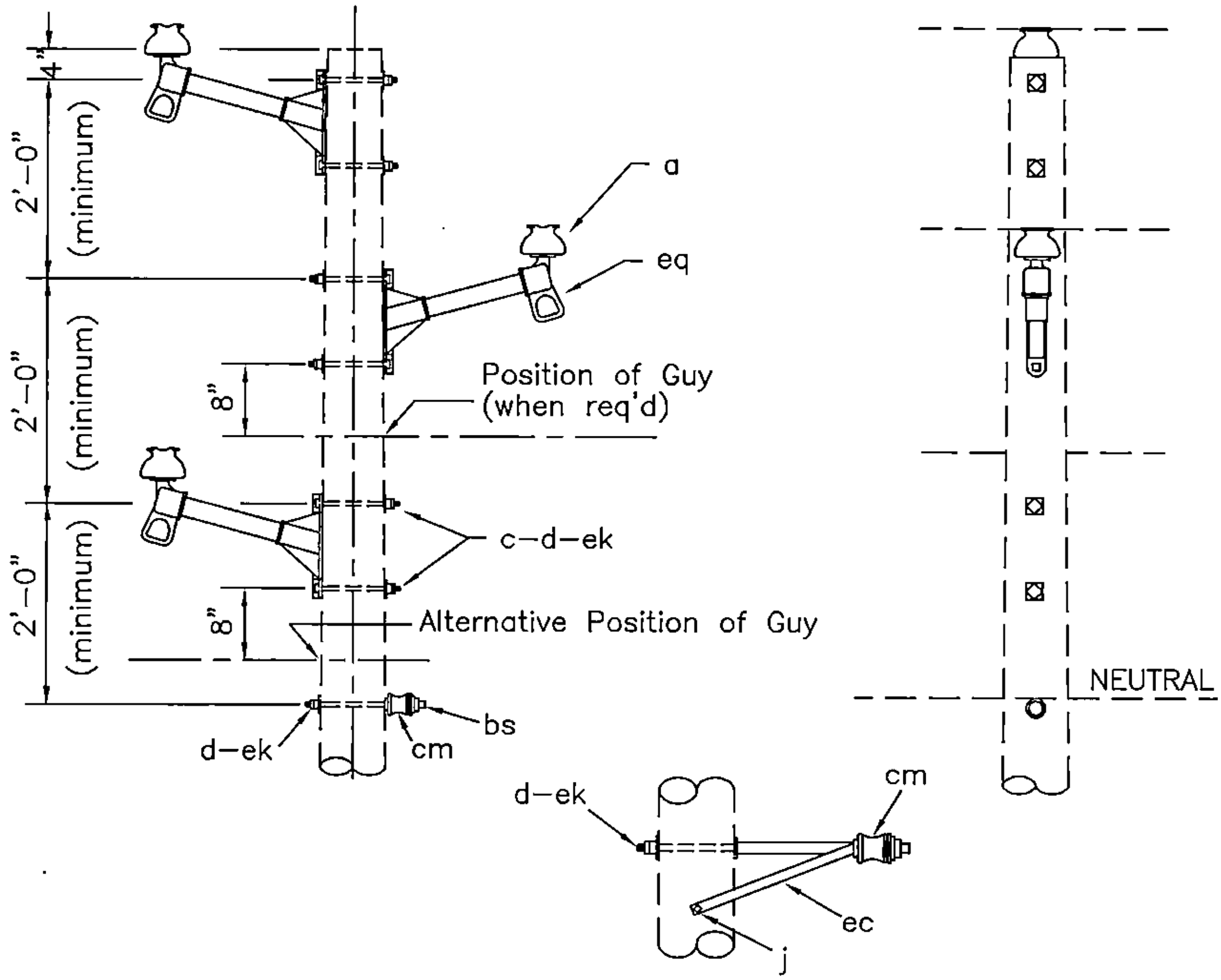
SINGLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C1.3NP



Specify C1.5N for offset neutral assembly

ITEM	MATERIAL (ASSEMBLY: C1.)	4N QTY	5N QTY	
a	Insulator, pin type (12.47/7.2 kV)	3	3	
c	Bolt, machine, 5/8" x req'd length	6	6	
d	Washer, square 2 1/4"	7	7	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(3)	(3)	(If req'd)
j	Screw, lag, 1/2" x 4"		2	
bs	Bolt, single, upset	1		
cm	Insulator, spool, 3"	1	1	
ec	Bracket, offset neutral		1	
ek	Locknuts	7	7	
eq	Bracket,insulator/equipment	3	3	

Design Parameters:

MAXIMUM LINE ANGLES:
5°-Small Conductors
2°-Larger than #1/0

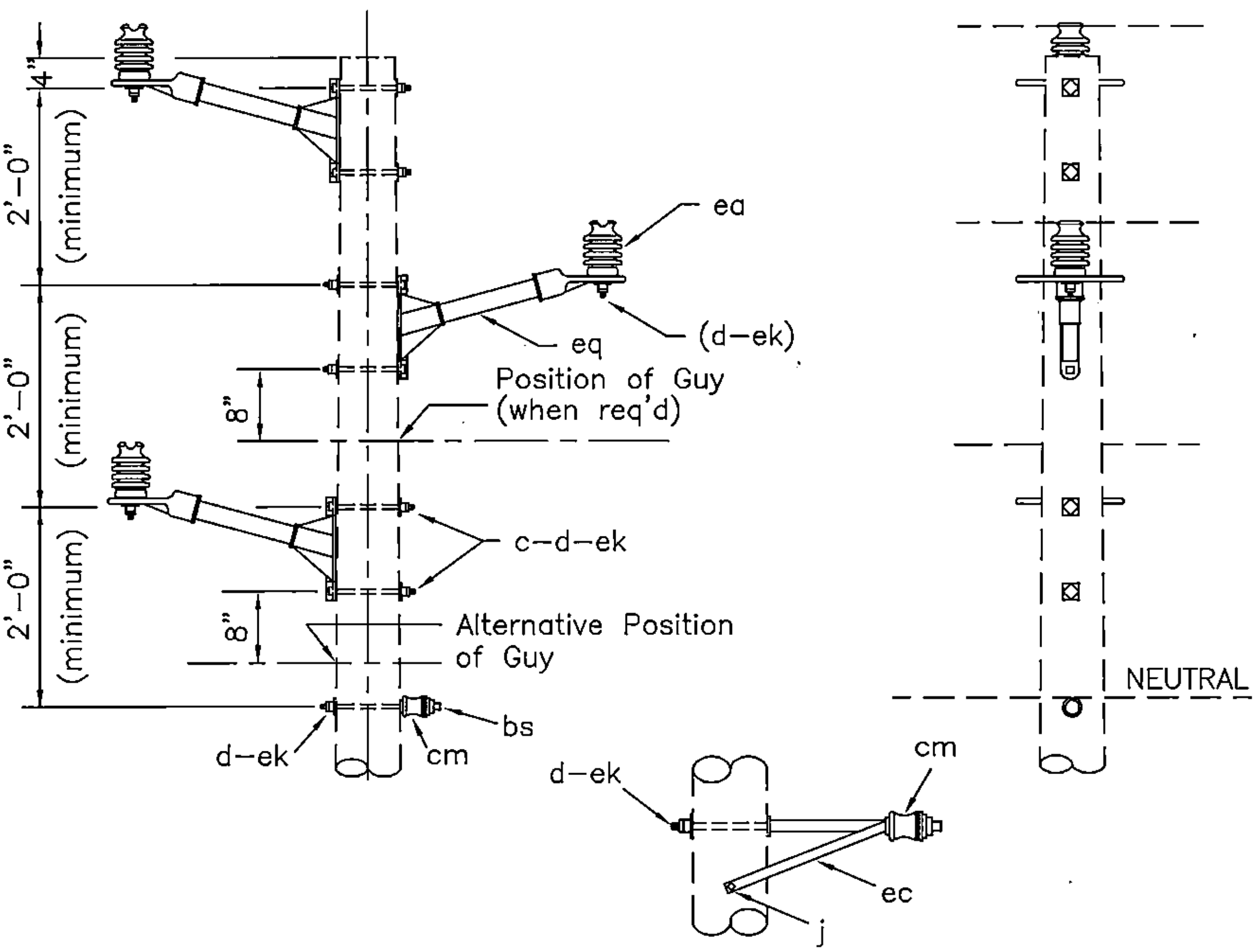
SINGLE SUPPORT-NARROW PROFILE (TANGENT)

APRIL 2005

RUS

3 - PHASE PRIMARY 12.47/7.2 kV

C1.4N
C1.5N



Specify C1.5NP for offset neutral assembly

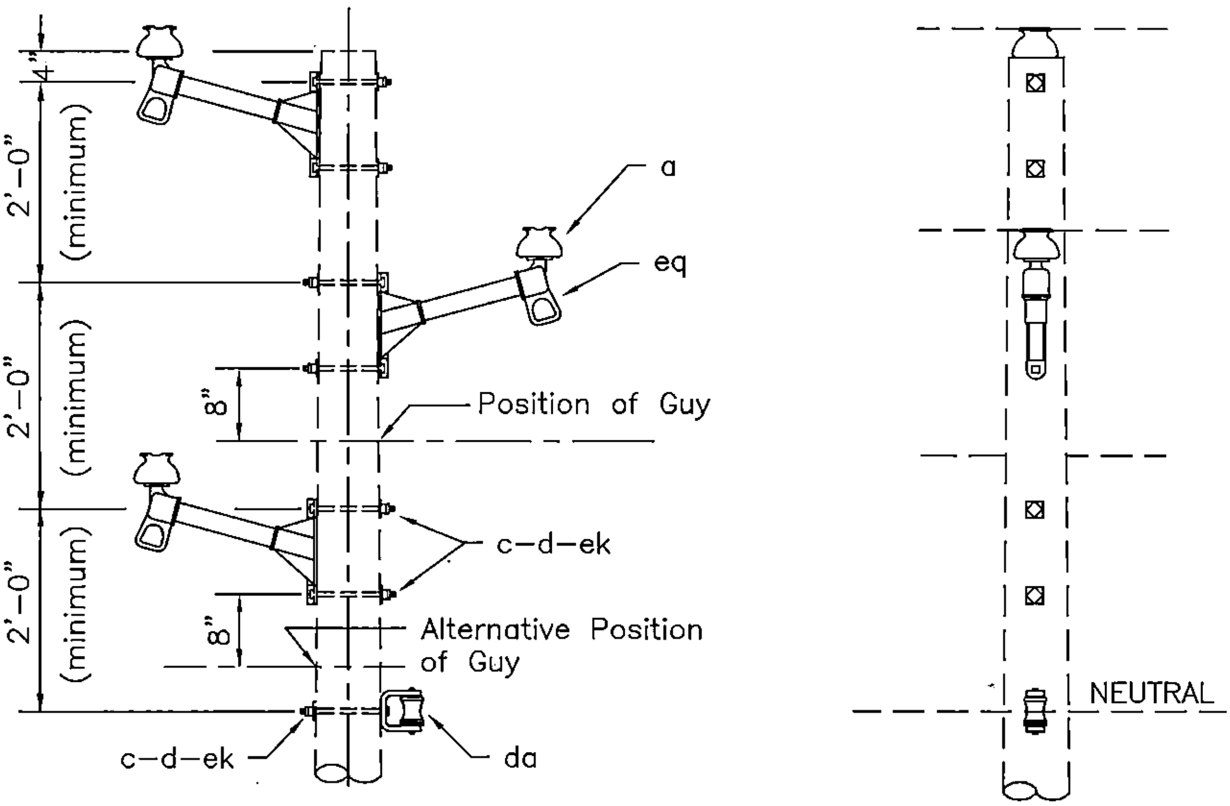
ITEM	ASSEMBLY: C1. MATERIAL	4NP QTY	5NP QTY
c	Bolt, machine 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	7	7
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	3	3
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	3	3

Design Parameters:

MAXIMUM LINE ANGLES:
5°–Small Conductors
2°–Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005	3 – PHASE PRIMARY	C1.4NP
RUS	12.47/7.2 kV	C1.5NP



ITEM	MATERIAL ASSEMBLY: C1.	6N QTY
a	Insulator, pin type (12.47/7.2 kV)	3
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(3) (If req'd)
da	Bracket, insulated	1
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

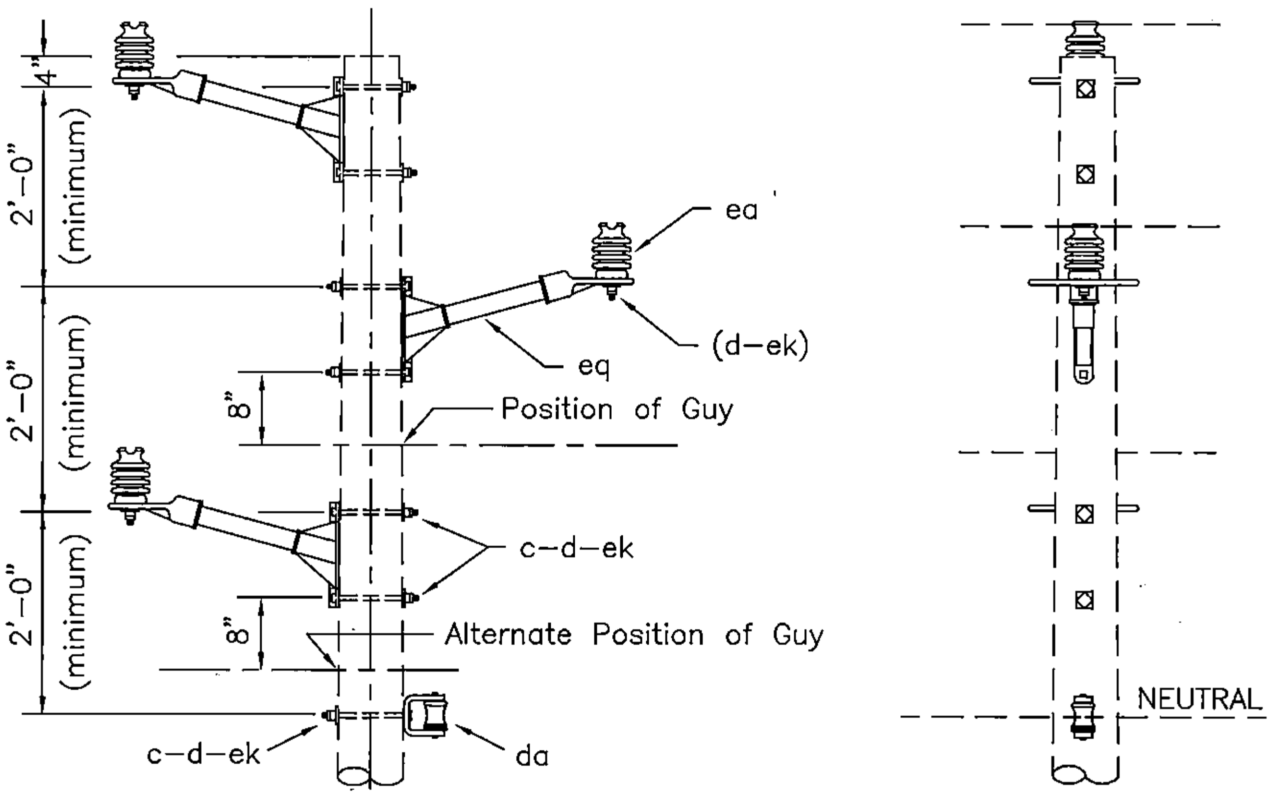
Design Parameters:
Maximum Line Angles
See TABLE II

SINGLE SUPPORT–NARROW PROFILE

APRIL 2005
RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C1.6N



ASSEMBLY: C1. 6NP

ITEM	MATERIAL	QTY
c	Bolt, machine 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	3
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE II

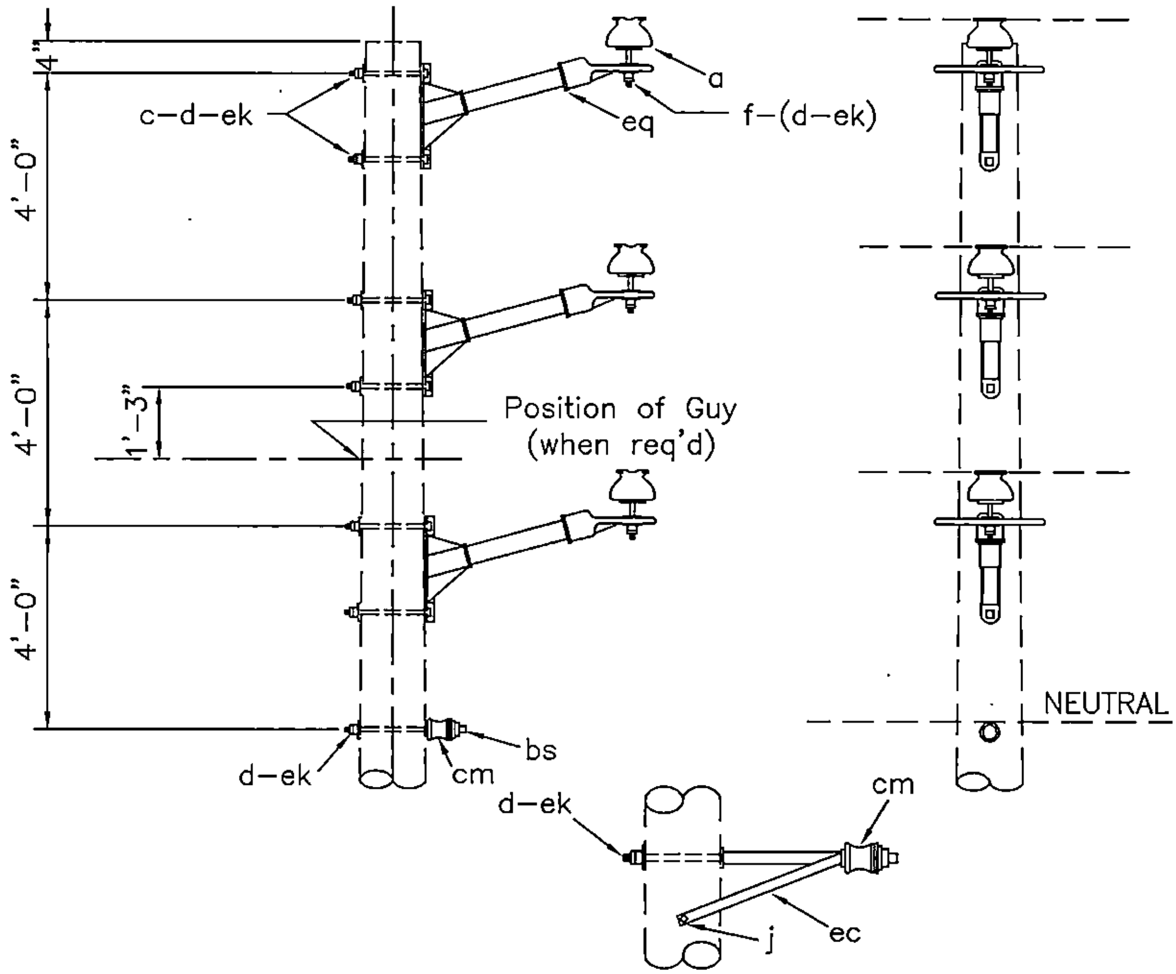
SINGLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C1.6NP



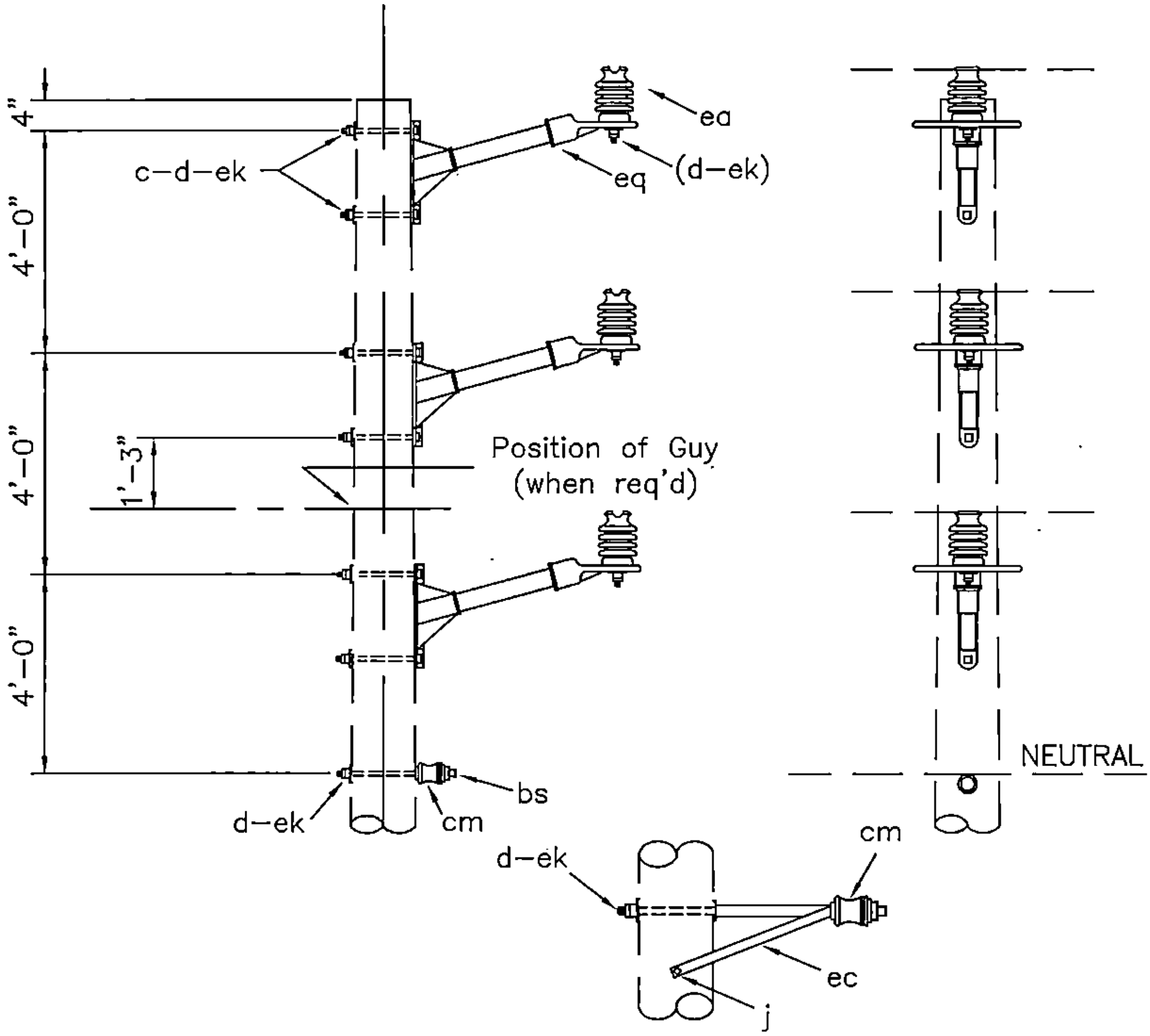
Specify C1.8N for offset neutral assembly

ITEM	MATERIAL	Assembly: C1. 7N QTY	8N QTY	
a	Insulator, pin type (12.47/7.2 kV)	3	3	
c	Bolt, machine, 5/8" x req'd length	6	6	
d	Washer, square 2 1/4"	7	7	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(3)	(3)	(If req'd)
j	Screw, lag, 1/2" x 4"		2	
bs	Bolt, single, upset	1		
cm	Insulator, spool, 3"	1	1	
ec	Bracket, offset neutral		1	
ek	Locknuts	7	7	
eq	Bracket, insulator/equipment	3	3	

Design Parameters:
Maximum Line Angles
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT)

APRIL 2005	3 – PHASE PRIMARY 12.47/7.2 kV	C1.7N C1.8N
RUS		



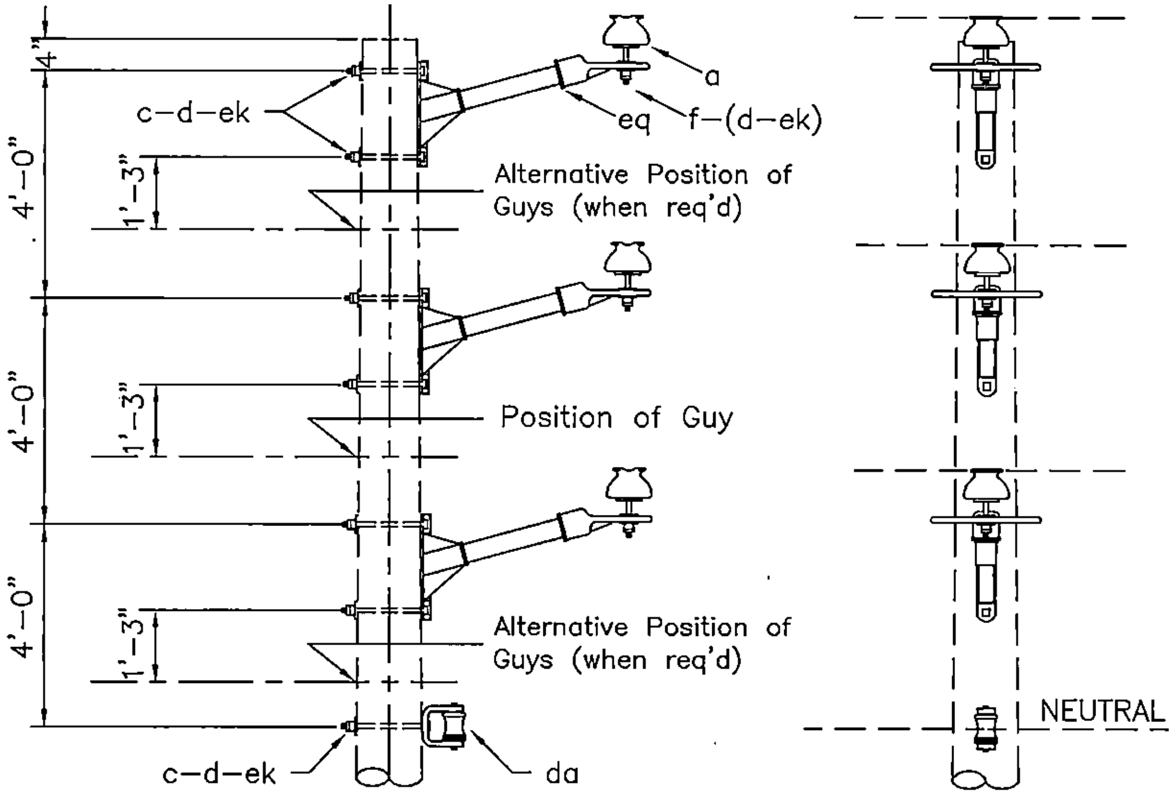
Specify C1.8NP for
offset neutral assembly

	Assembly: C1.	7NP	8NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	7	7
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.5 kV)	3	3
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	3	3

Design Parameters:
Maximum Line Angles
5° – Small conductors
2° – Larger than #1/0

SINGLE SUPPORT–NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005	3 – PHASE PRIMARY	C1.7NP
RUS	12.47/7.2 kV	C1.8NP



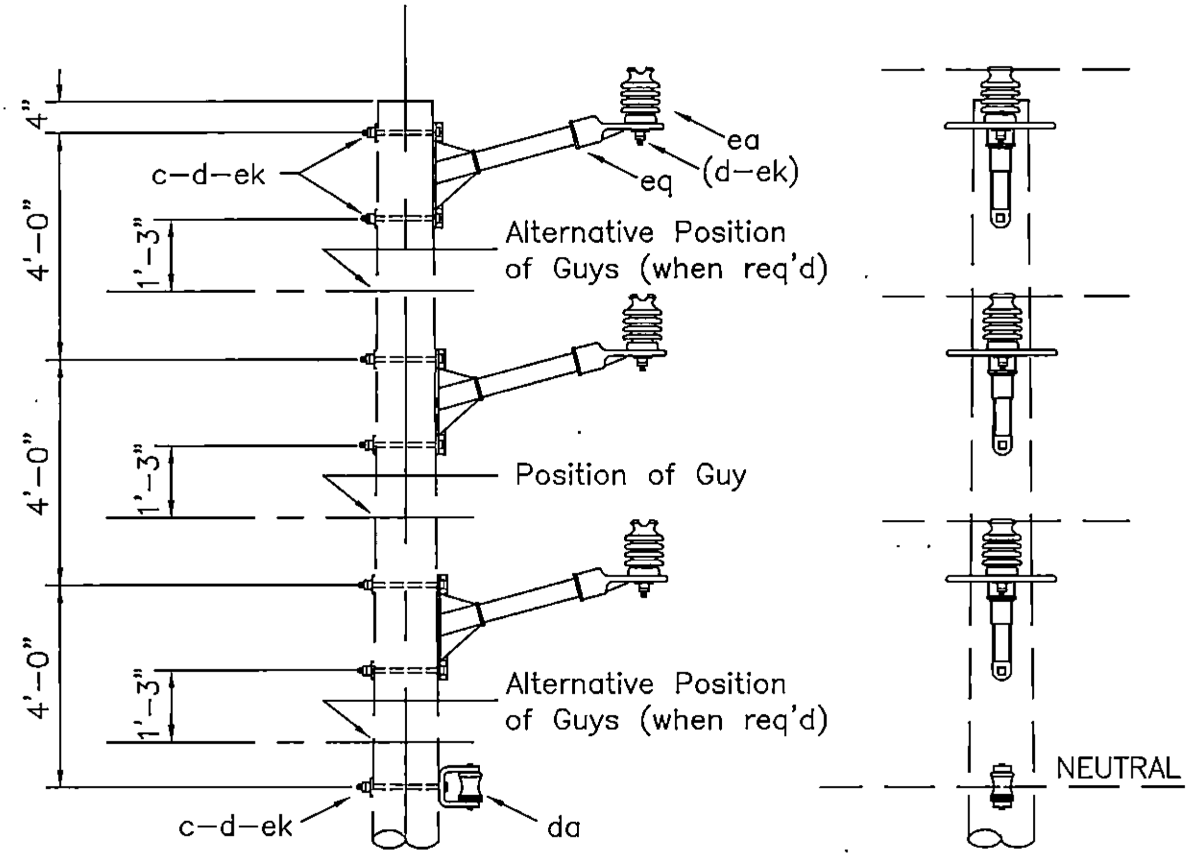
Assembly: C1.9N

ITEM	MATERIAL	QTY
a	Insulator, pin type (12.47/7.2 kV)	3
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(3) (If req'd)
da	Bracket, insulated	1
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

Design Parameters:
Maximum Line Angles
See TABLE II

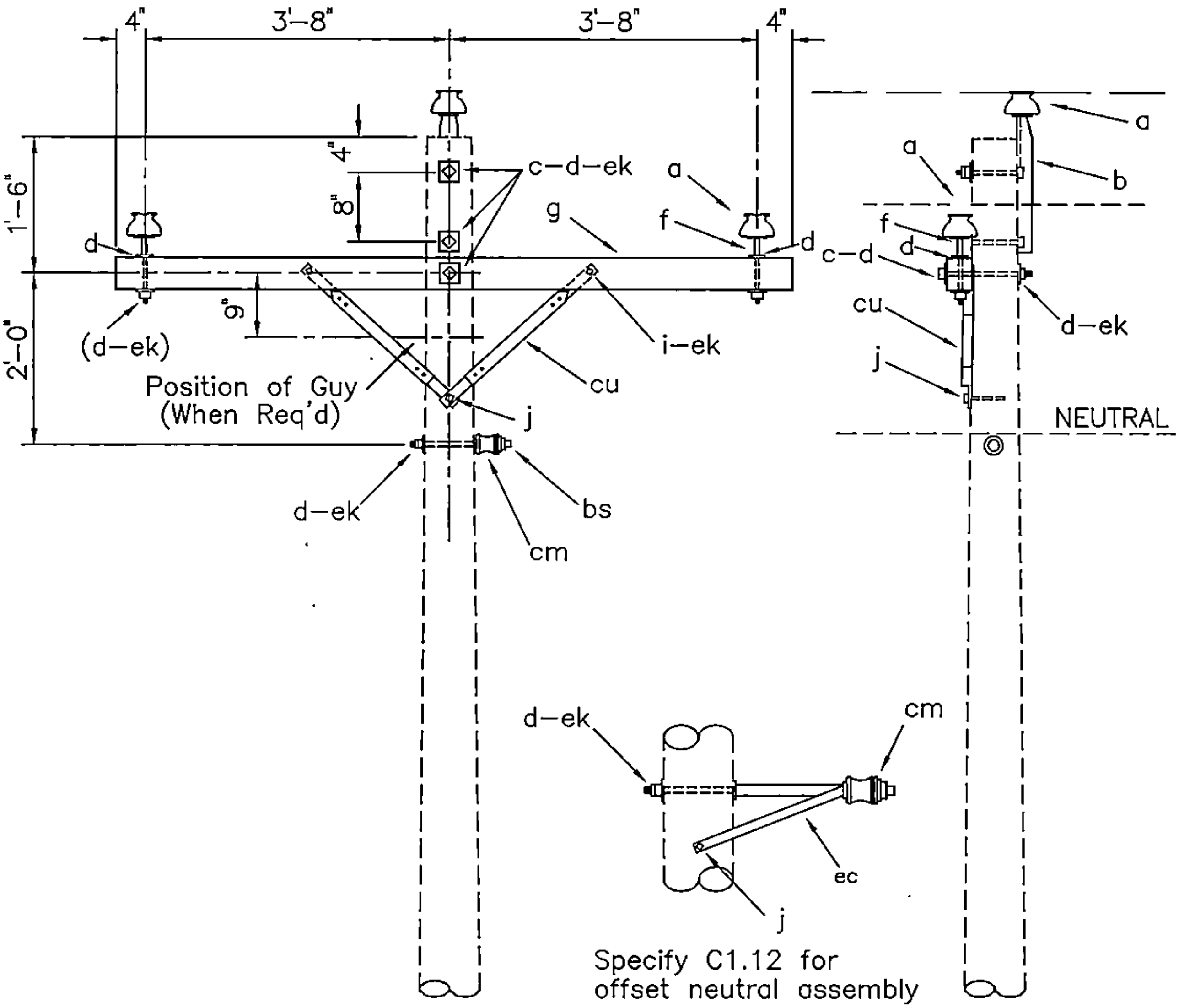
SINGLE SUPPORT–NARROW PROFILE

APRIL 2005	3 – PHASE PRIMARY 12.47/7.2 kV	C1.9N
RUS		



	Assembly: C1.	9NP
ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	3
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

Design Parameters: MAXIMUM LINE ANGLES: See TABLE II	SINGLE SUPPORT–NARROW PROFILE (POST INSULATORS)		
	APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C1.9NP



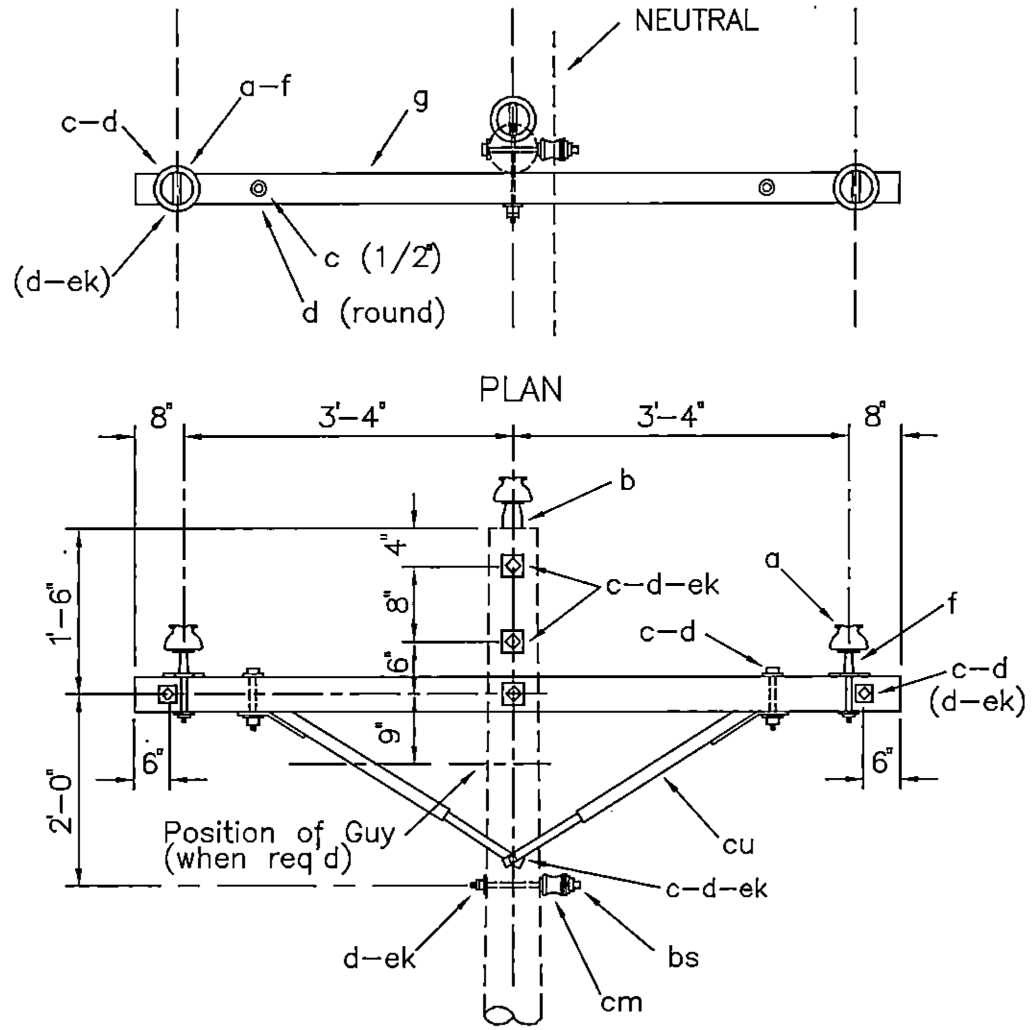
		ASSEMBLY: C1.	11	12
ITEM	MATERIAL		QTY	QTY
a	Insulator, pin type, (12.47/7.2 kV)		3	3
b	Pin, pole top, 20"		1	1
c	Bolt, machine, 5/8 x req'd length		3	3
d	Washer, square, 2 1/4"		7	7
f	Pin, crossarm, steel, 5/8" x 10 3/4"		2	2
g	Crossarm, 3 5/8" x 4 5/8" x 8'-0"		1	1
i	Bolt, carriage, 3/8" x 4"		2	2
j	Screw, lag, 1/2" x 4"		1	3
bs	Bolt, single, upset		1	
cm	Insulator, spool, 3"		1	1
cu	Brace, 28"		2	2
ec	Bracket, offset neutral			1
ek	Locknuts		6	6

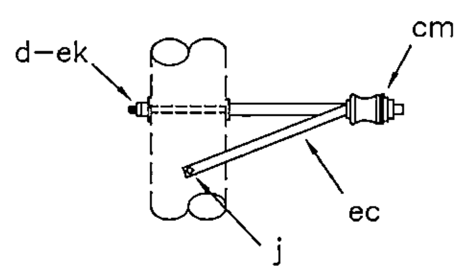
DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT ON CROSSARM (TANGENT)

APRIL 2005	3 – PHASE PRIMARY	C1.11 (C1)
RUS	12.47/7.2 kV	C1.12 (C1A)





Specify C1.12L for offset neutral assembly

	ASSEMBLY: C1.	11L	12L
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type, (12.47/7.2 kV)	3	3
b	Pin, pole top, 20"	1	1
c	Bolt, machine, 1/2" x req'd length	2	2
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, round, 1 3/8"	2	2
d	Washer, square, 2 1/4"	10	10
f	Pin, crossarm, clamp type	2	2
g	Crossarm, 3 5/8" x 4 5/8" x 8'–0"	1	1
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	Brace, wood, 60" span	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	9	9

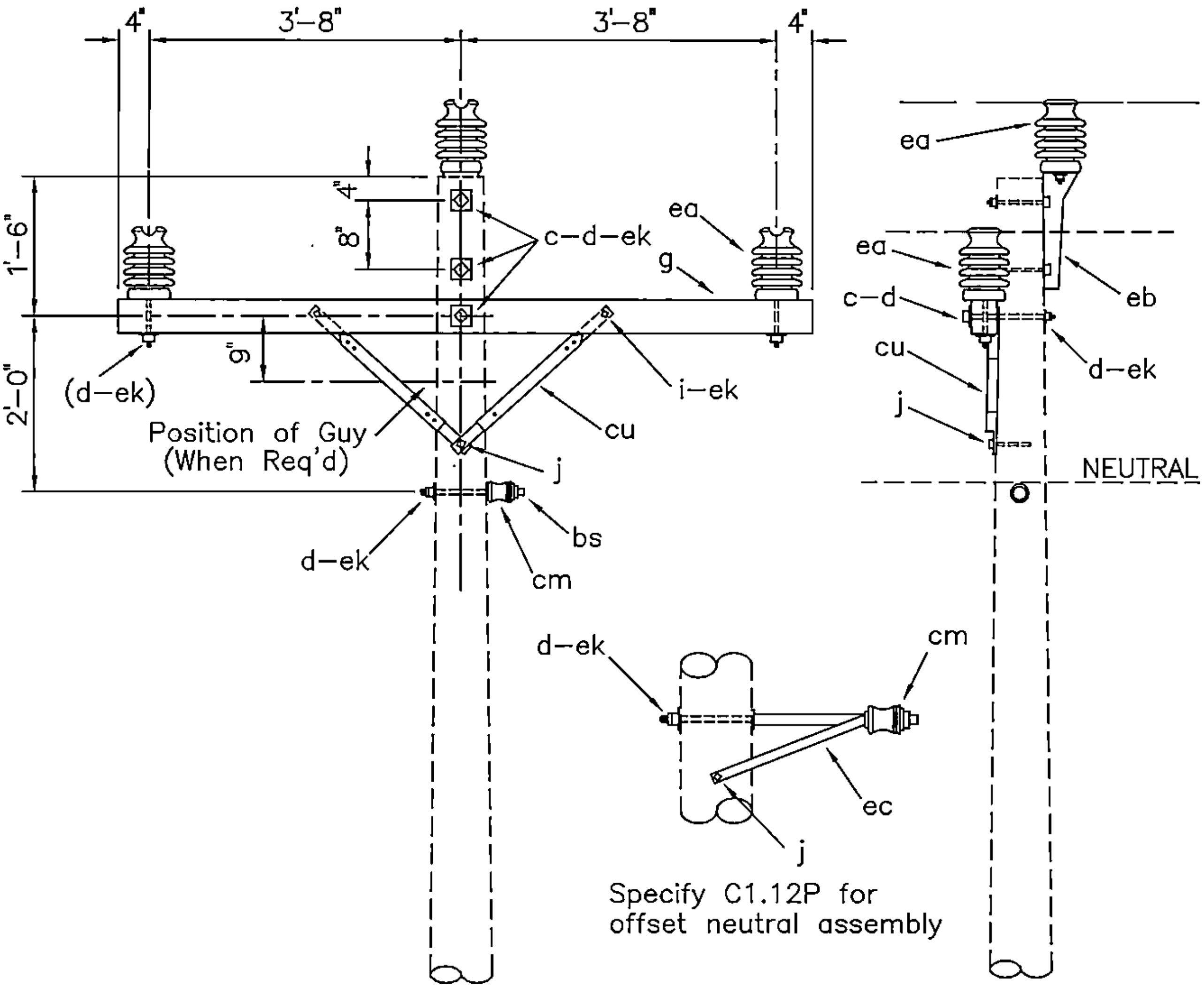
DESIGN PARAMETERS:

MAXIMUM LINE ANGLE:

2° – (Large Conductors)

SINGLE SUPPORT ON CROSSARM
(TANGENT) (LARGE CONDUCTORS)

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C1.11L (C1–2) C1.12L



	ASSEMBLY: C1.	11P	12P
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	3	3
d	Washer, square, 2 1/4"	5	5
g	Crossarm, 3 5/8" x 4 5/8" x 8'-0"	1	1
i	Bolt, carriage, 3/8" x 4"	2	2
j	Screw, lag, 1/2" x 4"	1	3
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	Brace, 28"	2	2
ea	Insulator, post type (12.47/7.2 kV)	3	3
eb	Bracket, pole top	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	6	6

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

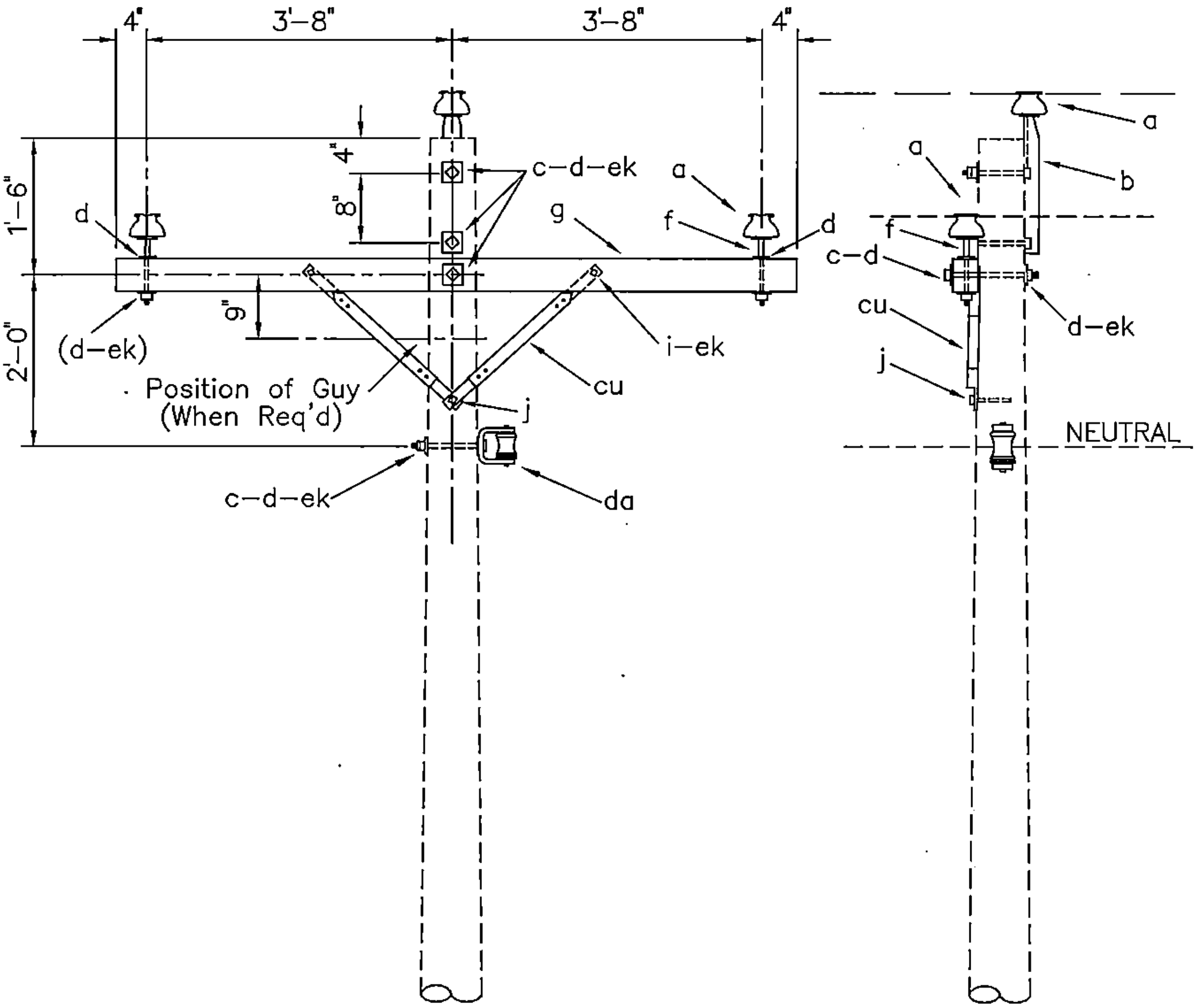
SINGLE SUPPORT ON CROSSARM
(TANGENT) (POST INSULATORS)

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C1.11P (C1P)
C1.12P (C1AP)



ITEM	QTY	MATERIAL
a	3	Insulator, pin type (12.47/7.2 kV)
b	1	Pin, pole top, 20"
c	4	Bolt, machine, 5/8" x req'd length
d	7	Washer, square, 2 1/4"
f	2	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
cu	2	Brace, 28"
da	1	Bracket, insulated
ek	6	Locknuts

DESIGN PARAMETERS:

See TABLE I

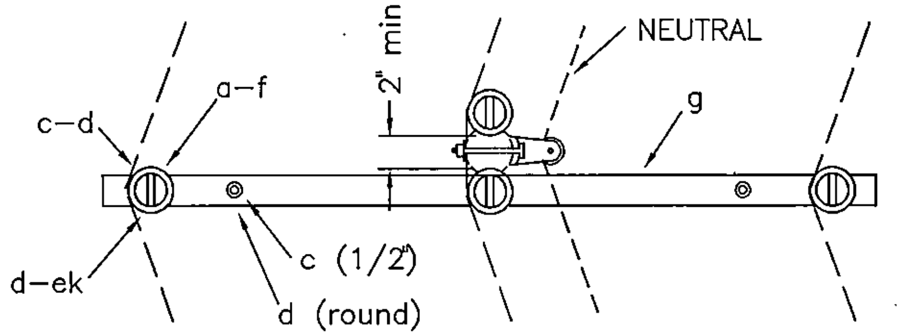
SINGLE SUPPORT ON CROSSARM

APRIL 2005

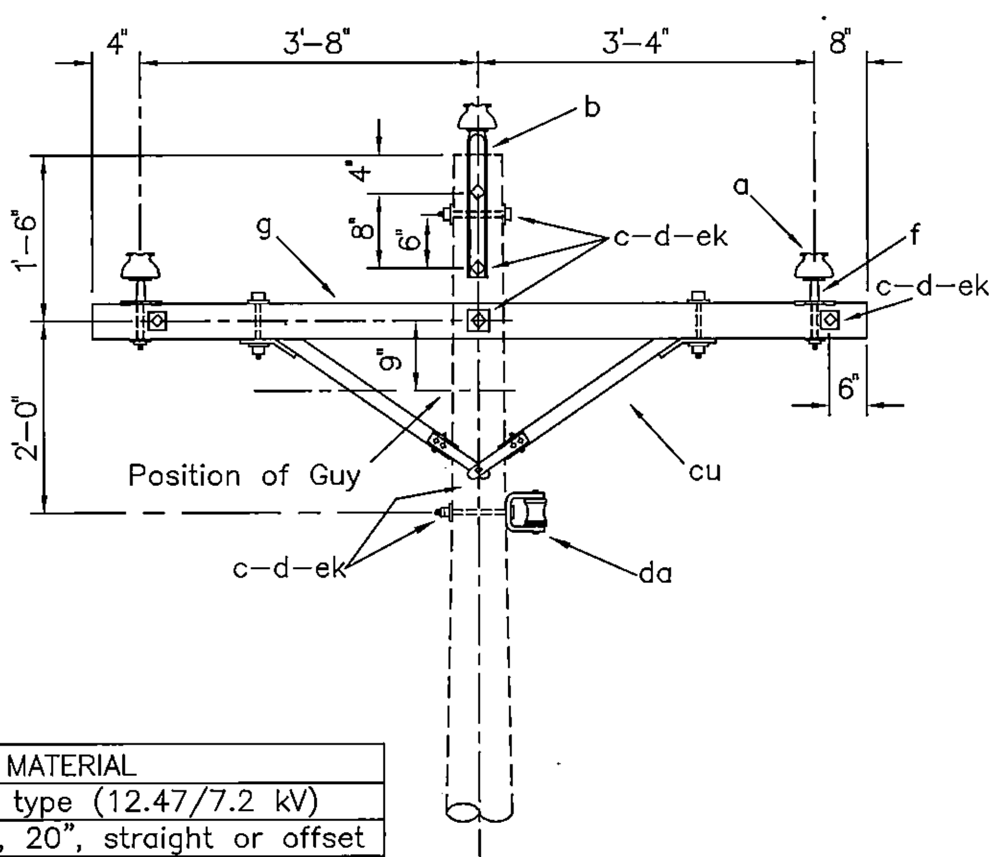
RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C1.13



PLAN



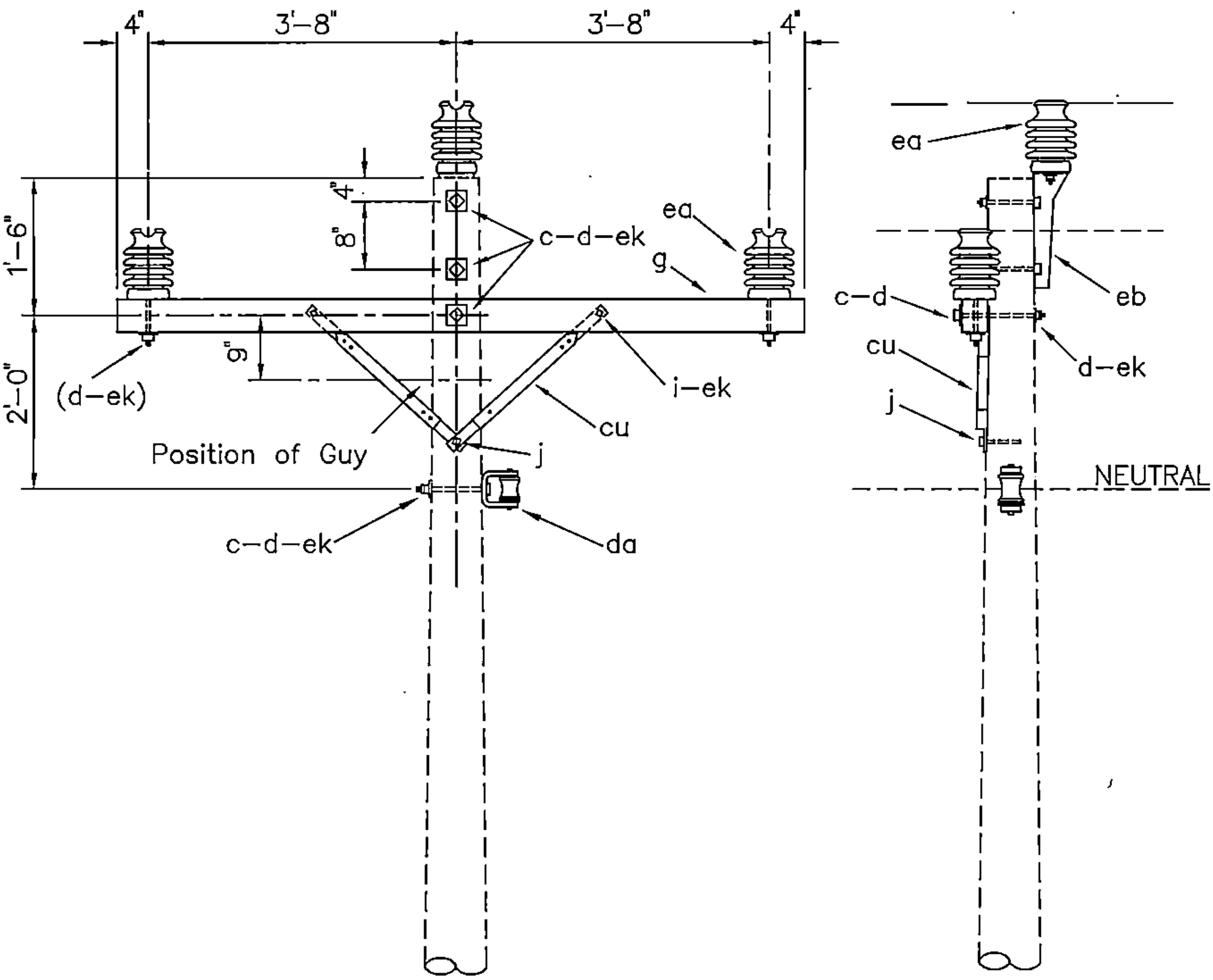
ITEM	QTY	MATERIAL
a	4	Insulator, pin type (12.47/7.2 kV)
b	2	Pin, pole top, 20", straight or offset
c	2	Bolt, machine, 1/2" x req'd length
c	8	Bolt, machine, 5/8" x req'd length
d	2	Washer, round, 1 3/8"
d	12	Washer, square, 2 1/4"
f	2	Pin, crossarm, clamp type
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
cu	1	Brace, wood, 60" span
da	1	Bracket, insulated
ek	10	Locknuts

DESIGN PARAMETERS:

See TABLE III

SINGLE SUPPORT ON CROSSARM
(LARGE CONDUCTORS)

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C1.13L (C1–4)



ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	5	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
cu	2	Brace, 28"
da	1	Bracket, insulated
ea	3	Insulator, post type (12.47/7.2 kV)
eb	1	Bracket, pole top
ek	6	Locknuts

DESIGN PARAMETERS:

See TABLE II

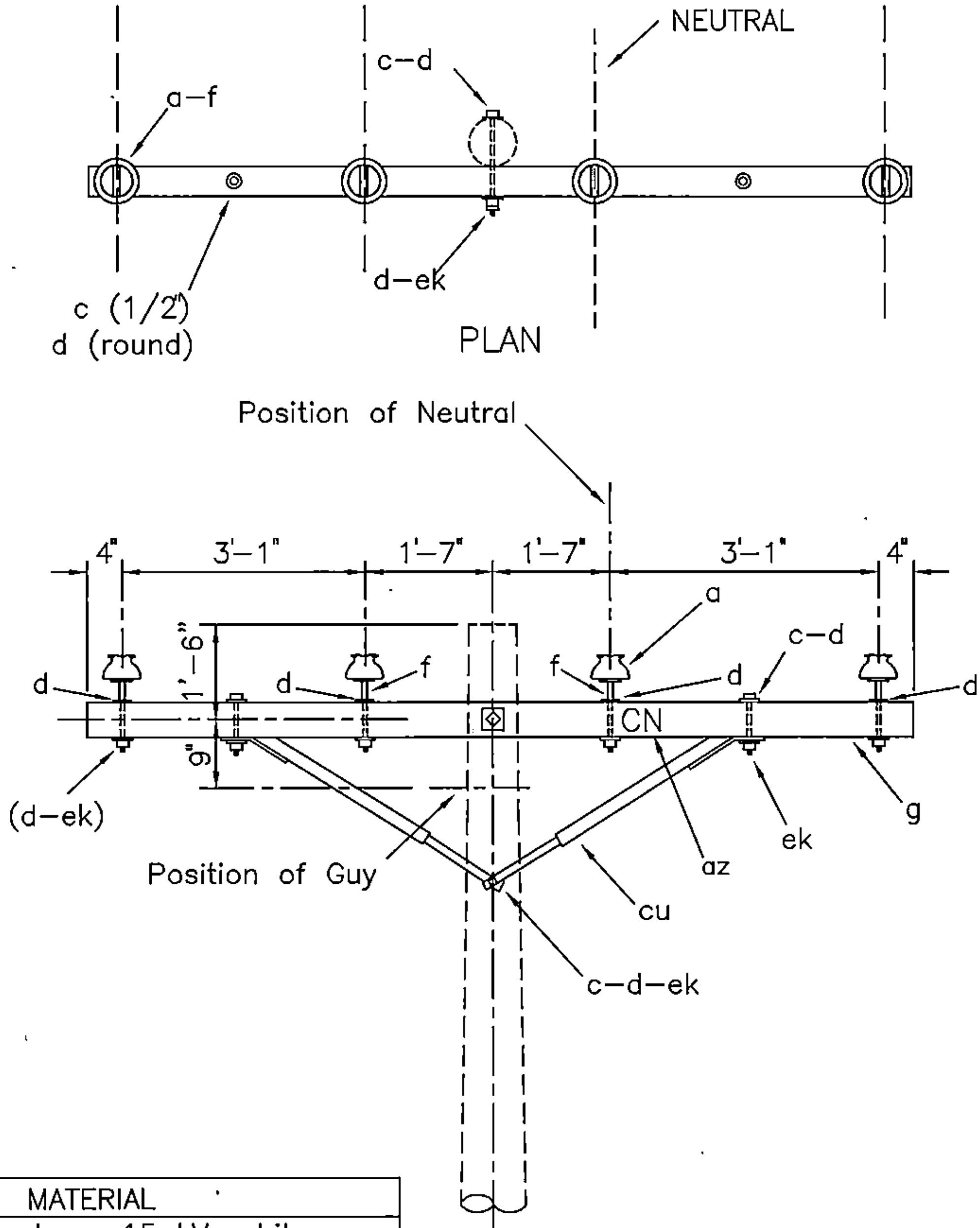
SINGLE SUPPORT ON CROSSARM
(POST INSULATORS)

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C1.13P



ITEM	QTY	MATERIAL
a	1	Insulator, pin type, 15 kV, white
a	3	Insulator, pin type (12.47/7.2 kV)
c	2	Bolt, machine, 1/2" x req'd length
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, round, 1 3/8"
d	7	Washer, square, 2 1/4"
f	4	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 10'–0"
az	4	Letters, 2" C, 2" N, with 1" nails
cu	1	Brace, wood, 60" span
ek	4	Locknuts

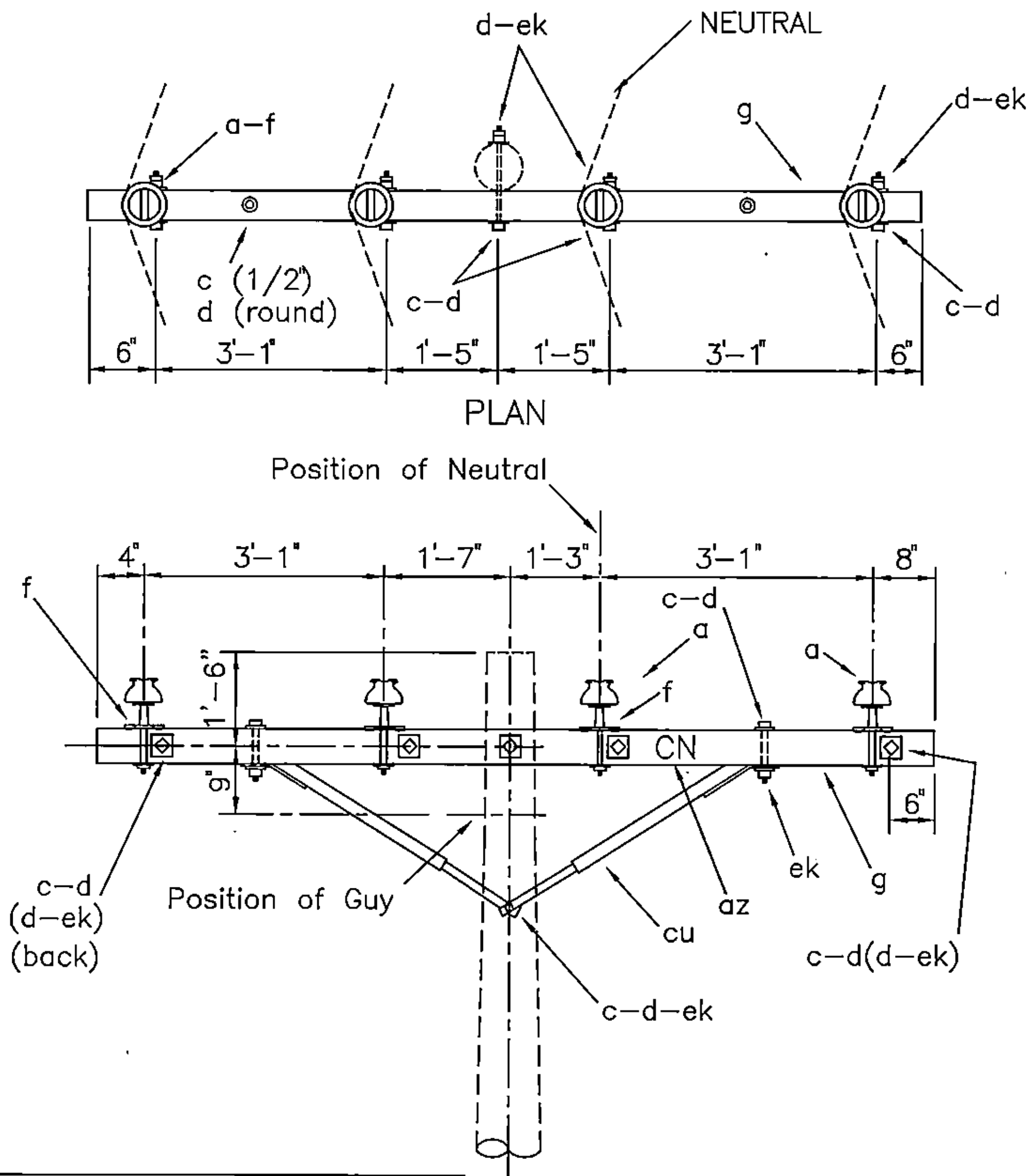
NOTE: Install either identification letters (az) or white insulator in neutral position.

DESIGN PARAMETERS:

See TABLE II

SINGLE SUPPORT, NEUTRAL ON CROSSARM

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C1.41 (C9–1)



ITEM	QTY	MATERIAL
a	1	Insulator, pin type, 15 kv, white
a	3	Insulator, pin type (12.47/7.2 kV)
c	2	Bolt, machine, 1/2" x req'd length
c	6	Bolt, machine, 5/8" x req'd length
d	2	Washer, round, 1 3/8"
d	11	Washer, square, 2 1/4"
f	4	Pin, crossarm, steel clamp type
g	1	Crossarm, 3 5/8" x 4 5/8" x 10'–0"
az	4	Letters, 2" C, 2" N, with 1" nails
cu	1	Brace, wood, 60" span
ek	8	Locknuts

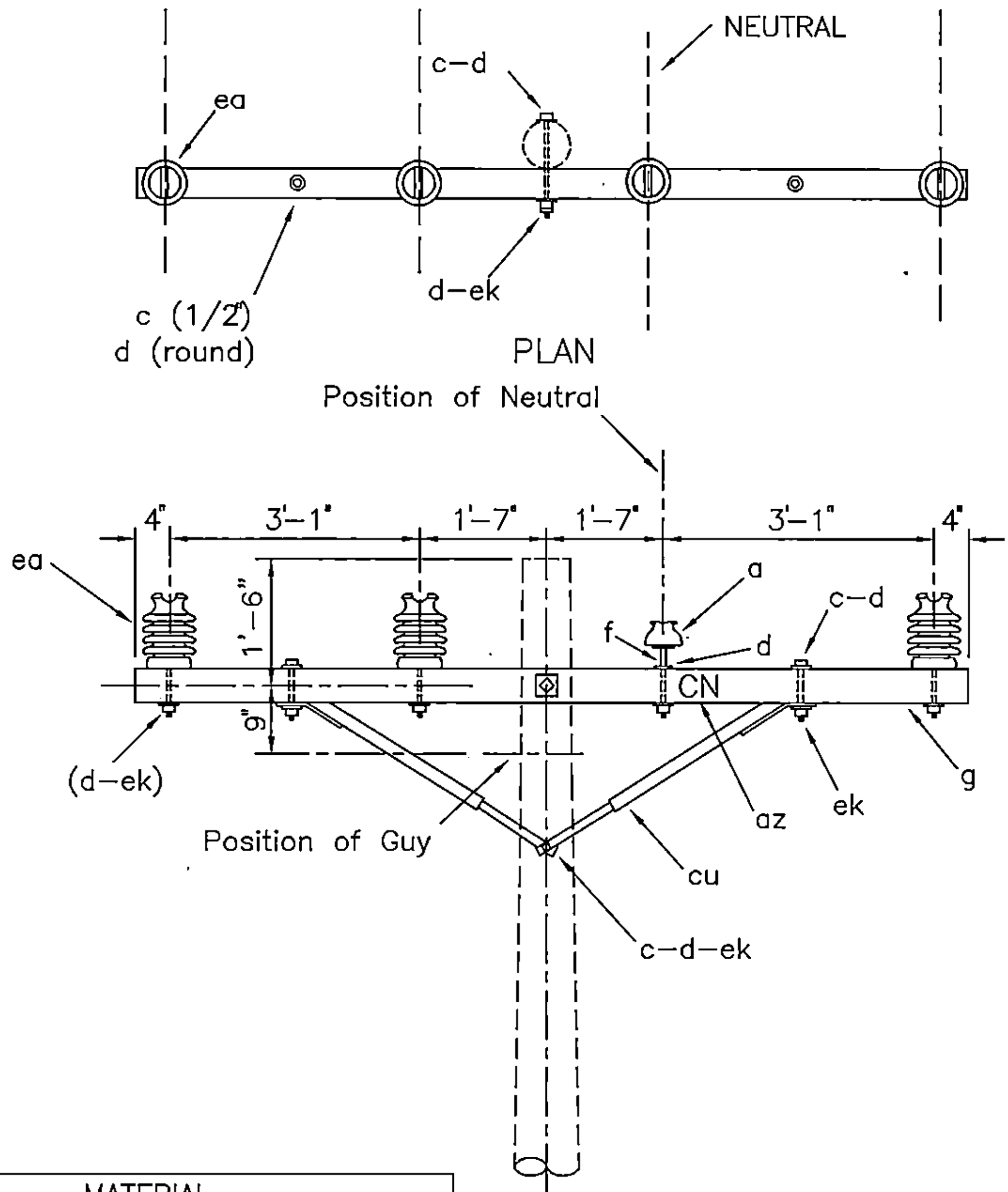
NOTE: Install either identification letters (az) or white insulator in neutral position.

DESIGN PARAMETERS:

See TABLE III

SINGLE SUPPORT, NEUTRAL ON CROSSARM
(LARGE CONDUCTORS)

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C1.41L (C9–3)



ITEM	QTY	MATERIAL
a	1	Insulator, pin type, 15 kV, white
c	2	Bolt, machine, 1/2" x req'd length
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, round, 1 3/8"
d	4	Washer, square, 2 1/4"
f	1	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 10'−0"
az	4	Letters, 2" C, 2" N, with 1" nails
cu	1	Brace, wood, 60" span
ea	3	Insulator, post type (12.47/7.2 kV)
ek	4	Locknuts

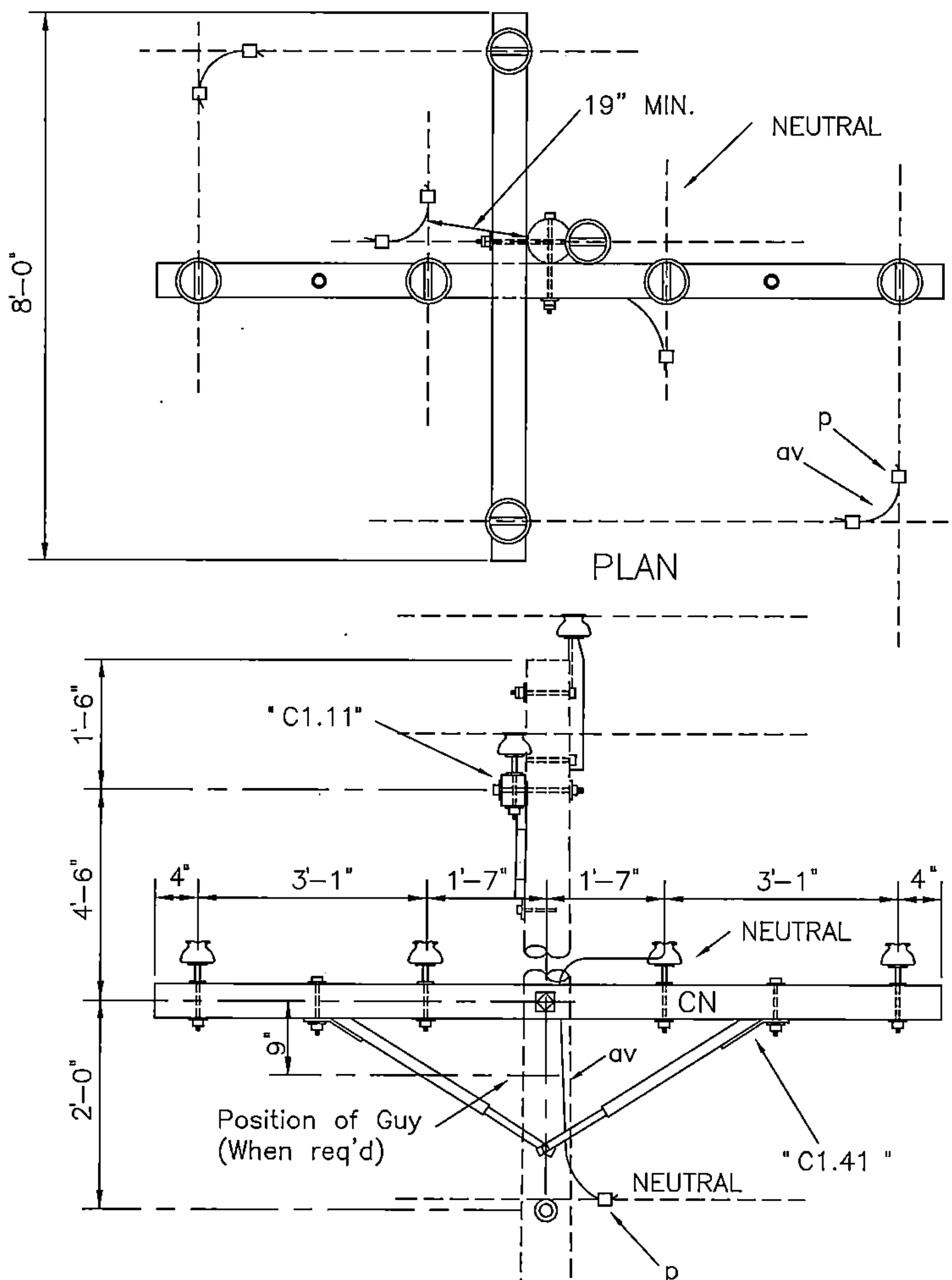
NOTE: Install identification letters (az) in neutral position. (optional)

DESIGN PARAMETERS:

See TABLE II

SINGLE SUPPORT, NEUTRAL ON CROSSARM (POST INSULATORS)

APRIL 2005 RUS	3 − PHASE PRIMARY 12.47/7.2 kV	C1.41P (C9−1P)



ITEM	QTY	MATERIAL
	1	C1.11 Primary Assembly
	1	C1.41 Primary Assembly
p		Connectors, as req'd
av		Jumpers, as req'd

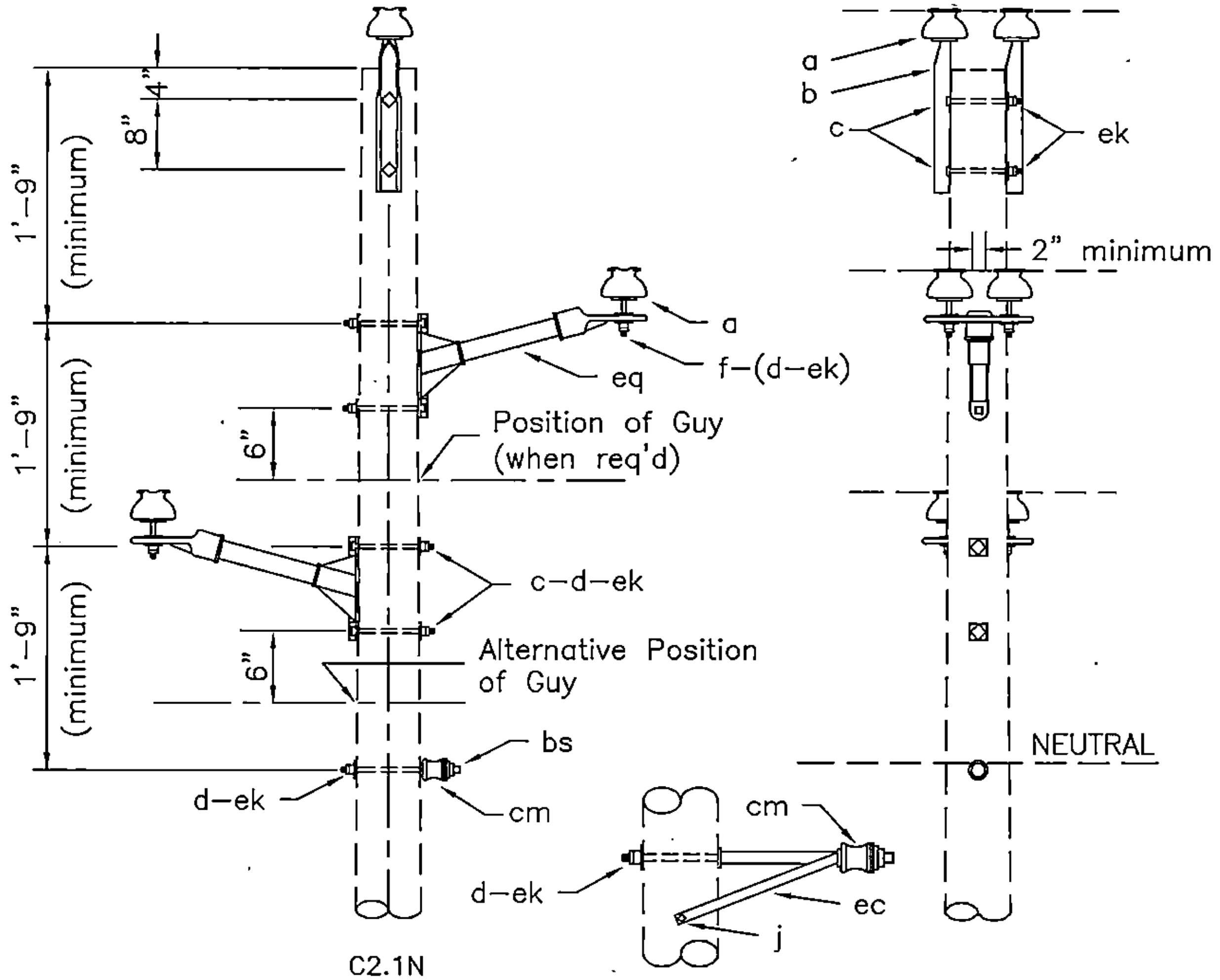
DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:

5° – Small Conductors
2° – Larger than #1/0

THREE PHASE JUNCTION GUIDE

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C1.81G



Specify C2.2N for offset neutral assembly.

NOTES: These assemblies used for NESC Grade B construction.

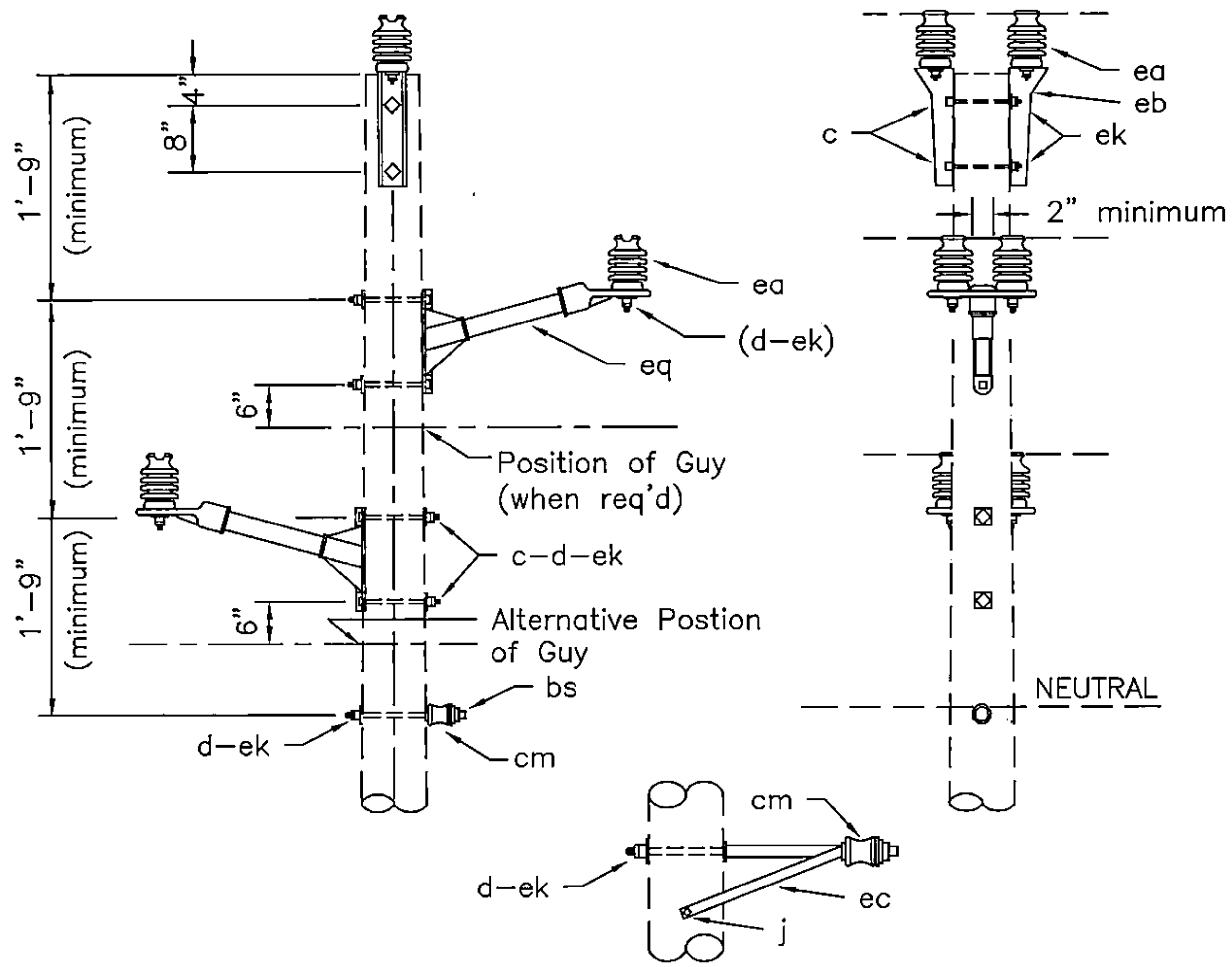
	ASSEMBLY: C2.	1N	2N
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	6	6
b	Pin, pole top, 20"	2	2
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	5	5
f	Pin, crossarm, 5/8" x 6 1/2"	4	4
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	2	2

Design Parameters:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE (TANGENT)

APRIL 2005	3 – PHASE PRIMARY 12.47/7.2 kV	C2.1N
RUS		C2.2N



Specify C2.2NP for
offset neutral assembly.

NOTES: These assemblies used for NESC Grade B construction.

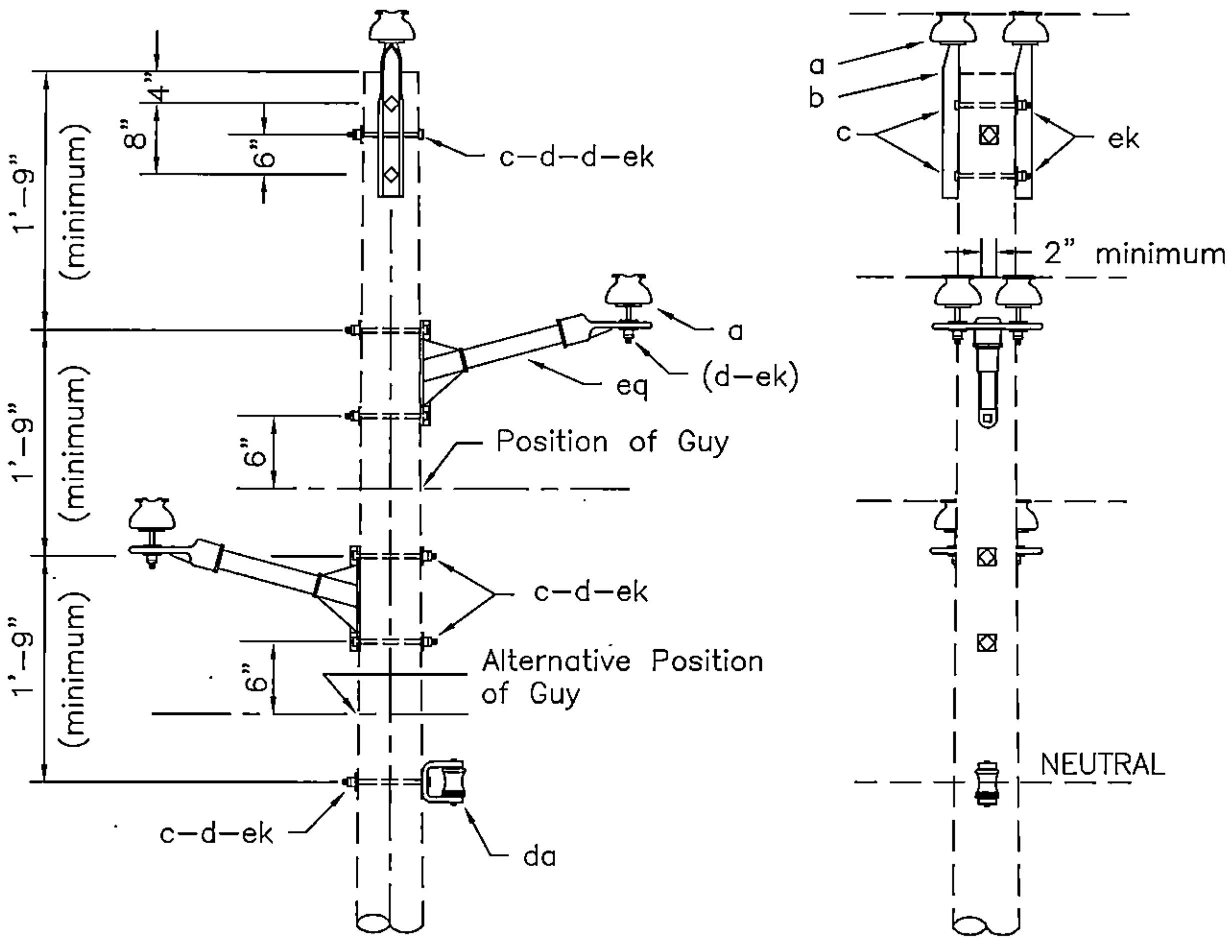
	ASSEMBLY: C2.	1NP	2NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	5	5
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.2 kV)	6	6
eb	Bracket, pole top	2	
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	2	2

Design Parameters:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005	3 – PHASE PRIMARY	C2.1NP
RUS	12.47/7.2 kV	C2.2NP



NOTES: If additional or alternative guying is required frame pole according to C2.3NG.

ITEM	MATERIAL	QTY
	ASSEMBLY: C2.	3N
a	Insulator, pin type (12.47/7.2 kV)	6
b	Pin, pole top, 20"	2
c	Bolt, machine, 5/8" x req'd length	8
d	Washer, square 2 1/4"	7
f	Pin, crossarm, 5/8" x 6 1/2"	4
da	Bracket, insulated	1
ek	Locknuts	8
eq	Bracket, insulator/equipment	2

Design Parameters:

MAXIMUM LINE ANGLES:
See Table III

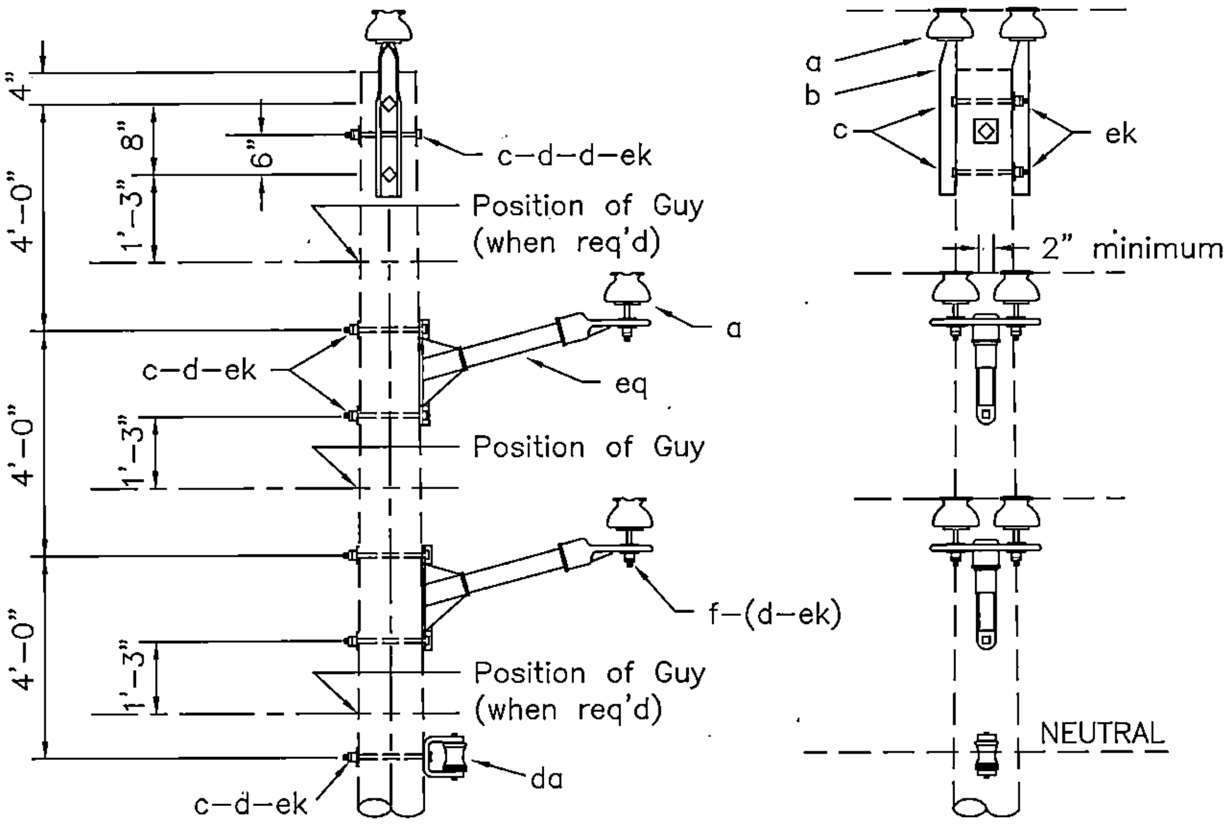
DOUBLE SUPPORT–NARROW PROFILE

APRIL 2005

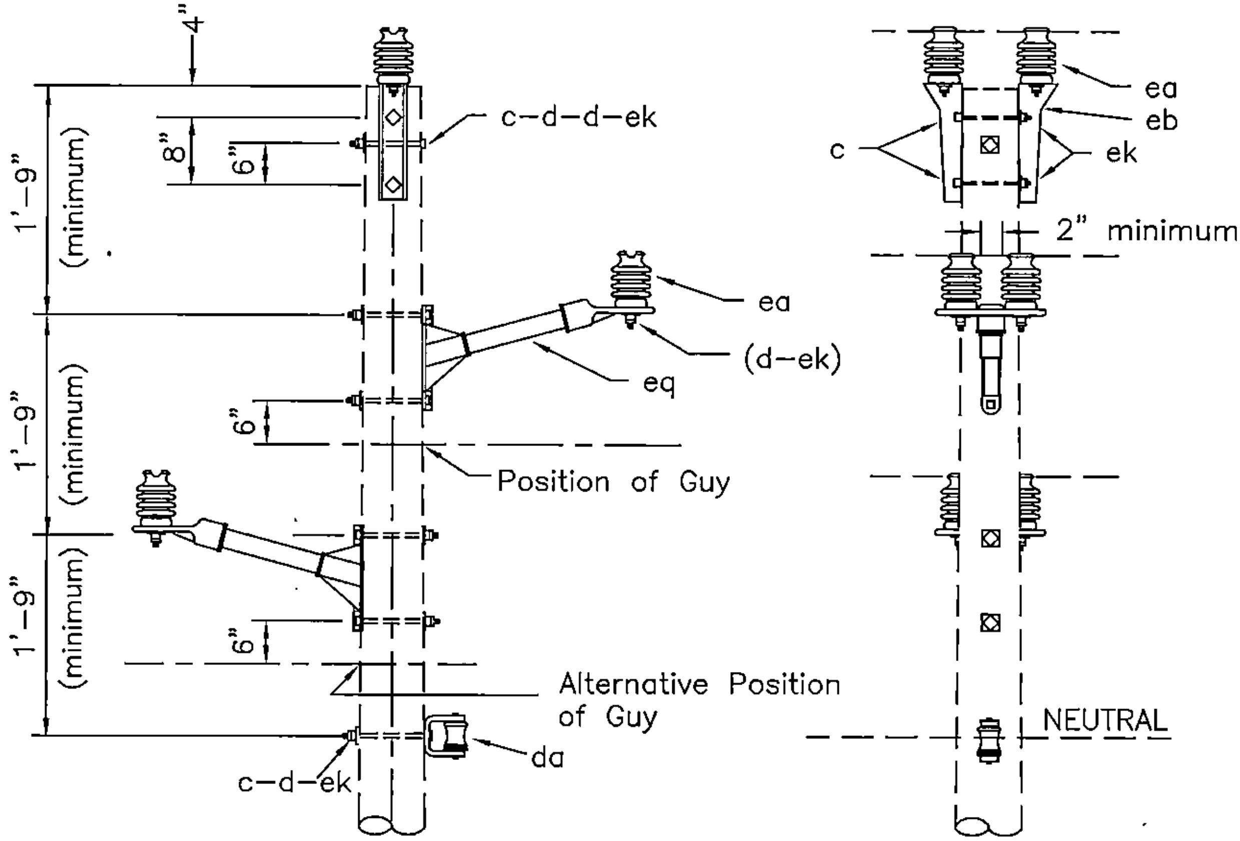
RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C2.3N



Design Parameters: MAXIMUM LINE ANGLES: See Table III	DOUBLE SUPPORT-NARROW PROFILE (ALTERNATIVE GUYING GUIDE)		
	APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	C2.3NG



NOTES: If additional or alternative guying is required, frame pole according to C2.3NG

ASSEMBLY: C2.		3NP
ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	8
d	Washer, square 2 1/4"	7
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.5 kV)	6
eb	Bracket, pole top	2
ek	Locknuts	8
eq	Bracket, insulator/equipment	2

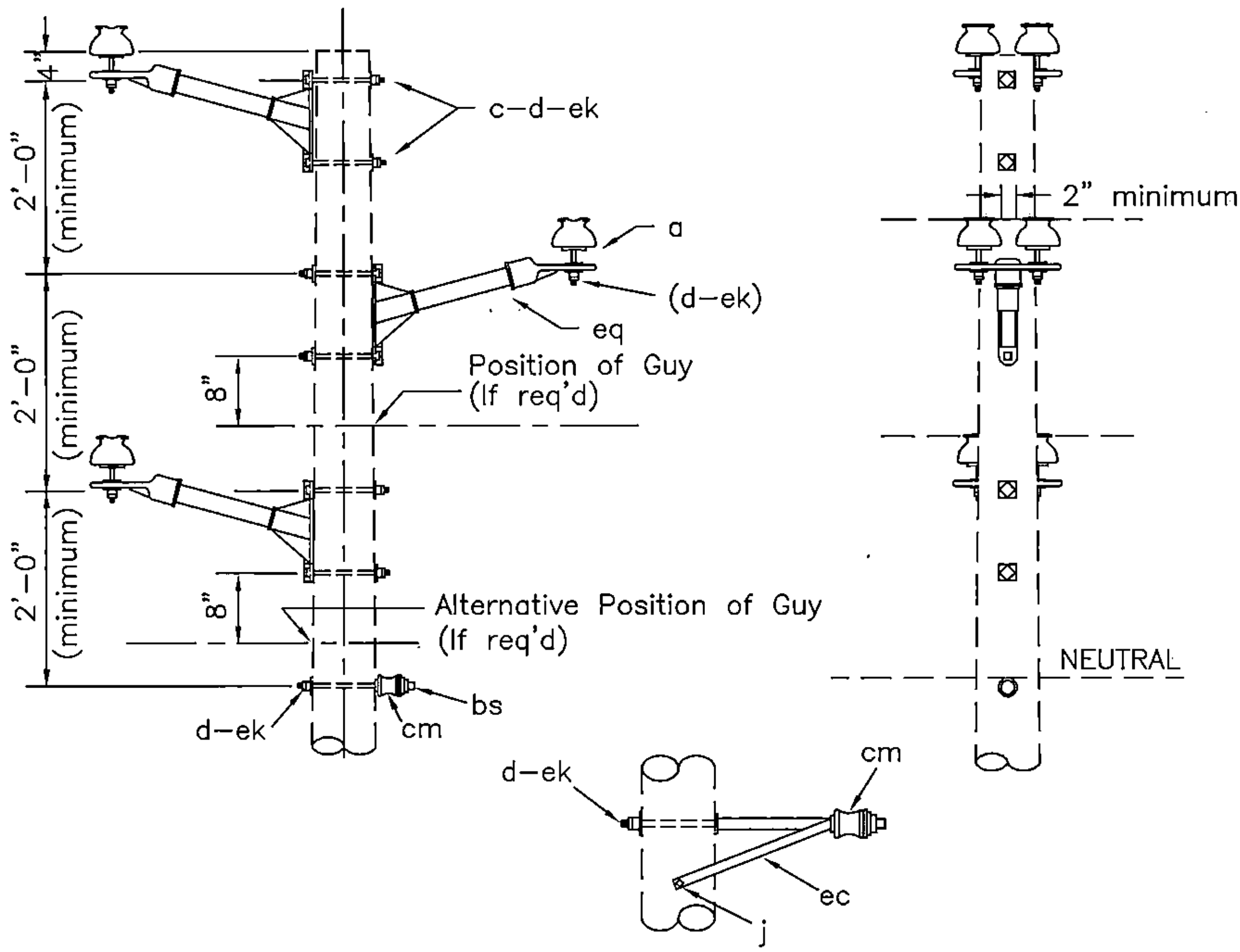
Design Parameters:
Maximum Line Angles:
See TABLE IV

DOUBLE SUPPORT–NARROW PROFILE
(POST INSULATORS)

APRIL 2005
RUS

2 – PHASE PRIMARY
12.47/7.2 kV

C2.3NP

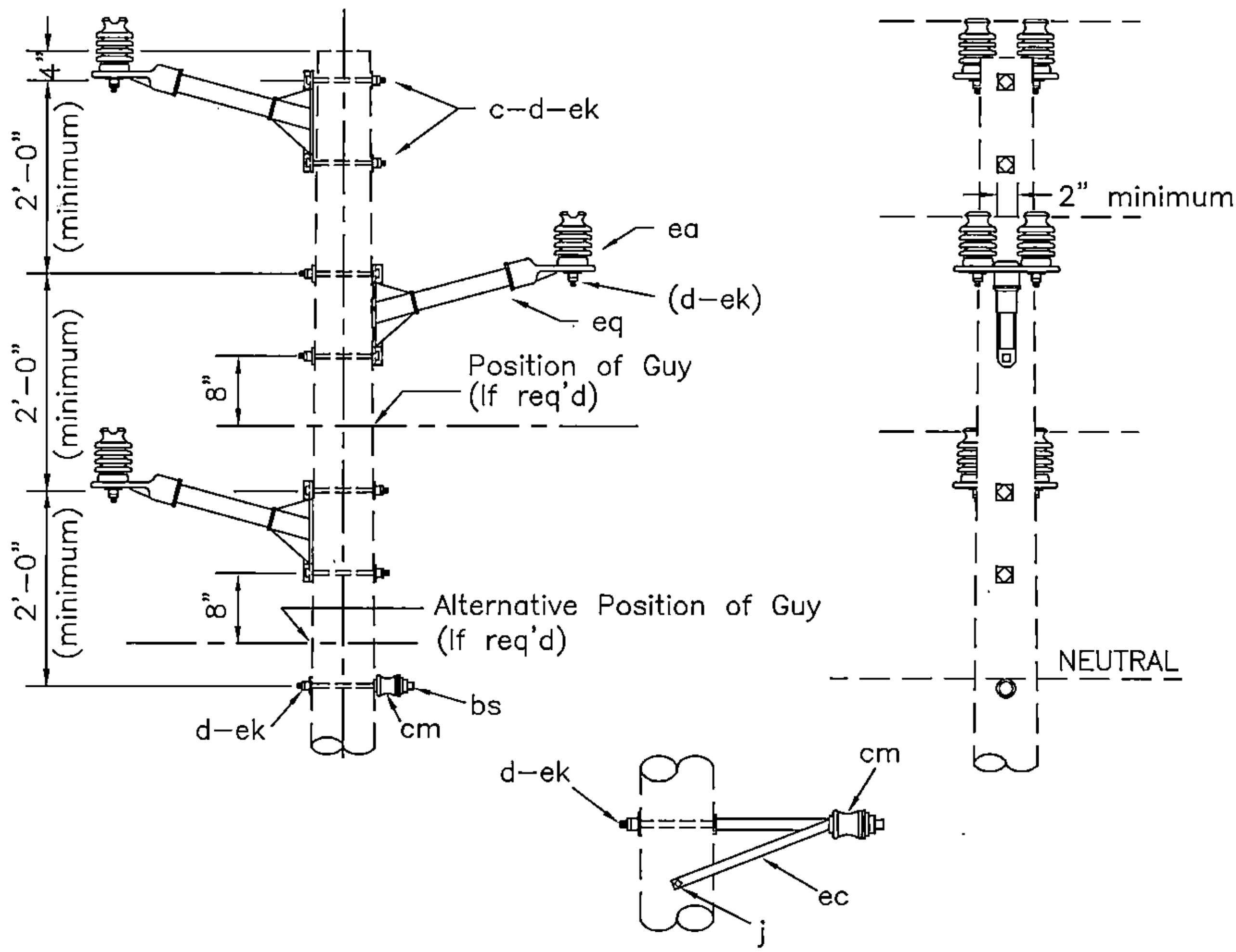


Specify C2.5N for offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

	ASSEMBLY: C2.	4N	5N
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	6	6
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	7	7
f	Pin, crossarm, 5/8" x 6 1/2"	6	6
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	3	3

Design Parameters: MAXIMUM LINE ANGLES: 5°–Small Conductors 2°–Larger than #1/0	DOUBLE SUPPORT–NARROW PROFILE (TANGENT)		
	APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C2.4N C2.5N



Specify C2.5NP for offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

	ASSEMBLY: C2.	4NP	5NP
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	7	7
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type, (12.47/7.2kV)	6	6
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	3	3

Design Parameters:

MAXIMUM LINE ANGLES:
5°-Small Conductors
2°-Larger than #1/0

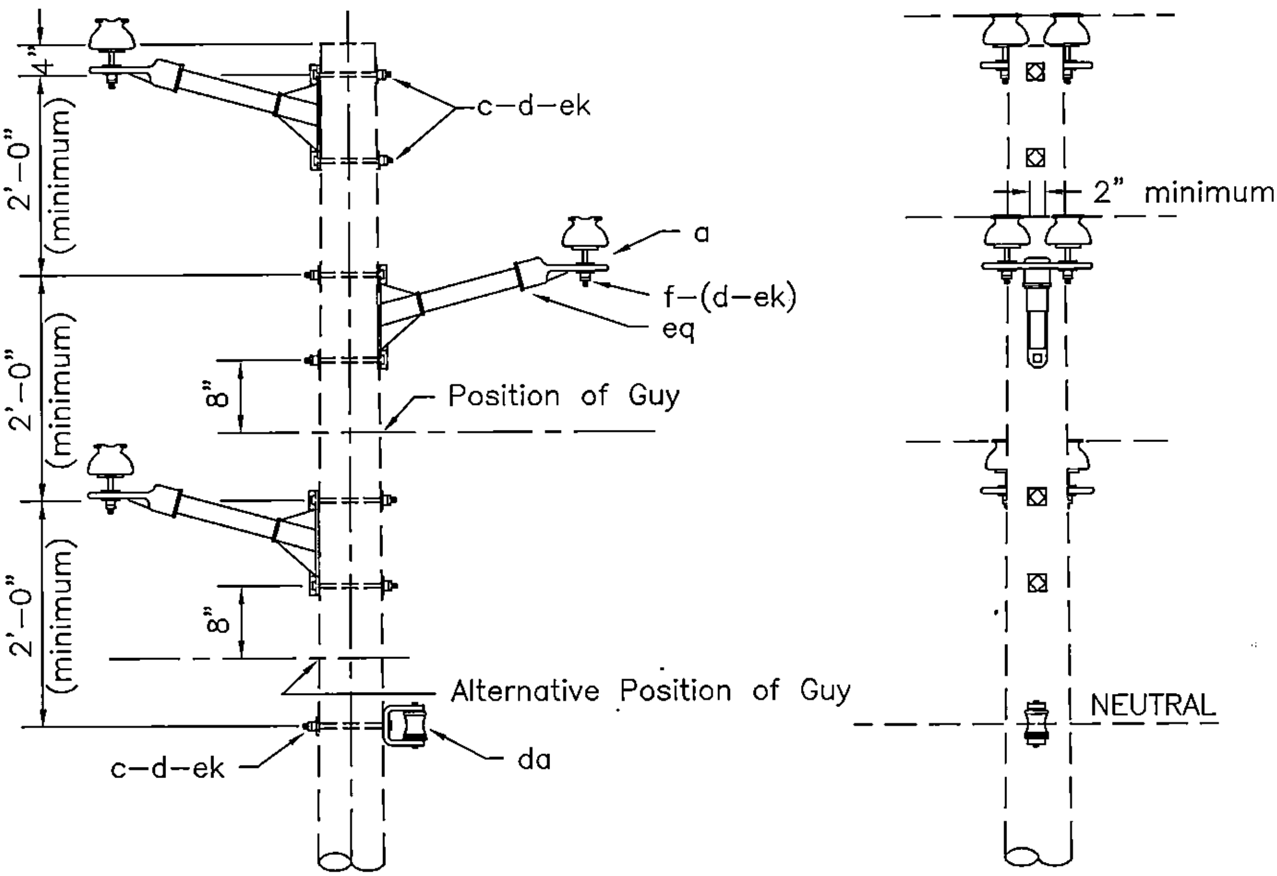
DOUBLE SUPPORT-NARROW PROFILE
(TANGENT)(POST INSULATORS)

APRIL 2005

RUS

3 - PHASE PRIMARY
12.47/7.2 kV

C2.4NP
C2.5NP



NOTE: If additional guying is required, use assembly C2.9N.

ITEM	MATERIAL (ASSEMBLY: C2.)	QTY (6N)
a	Insulator, pin type (12.47/7.2 kV)	6
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
f	Pin, crossarm, 5/8" x 6 1/2"	6
da	Bracket, insulated	1
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

Design Parameters:

MAXIMUM LINE ANGLES:
See TABLE IV

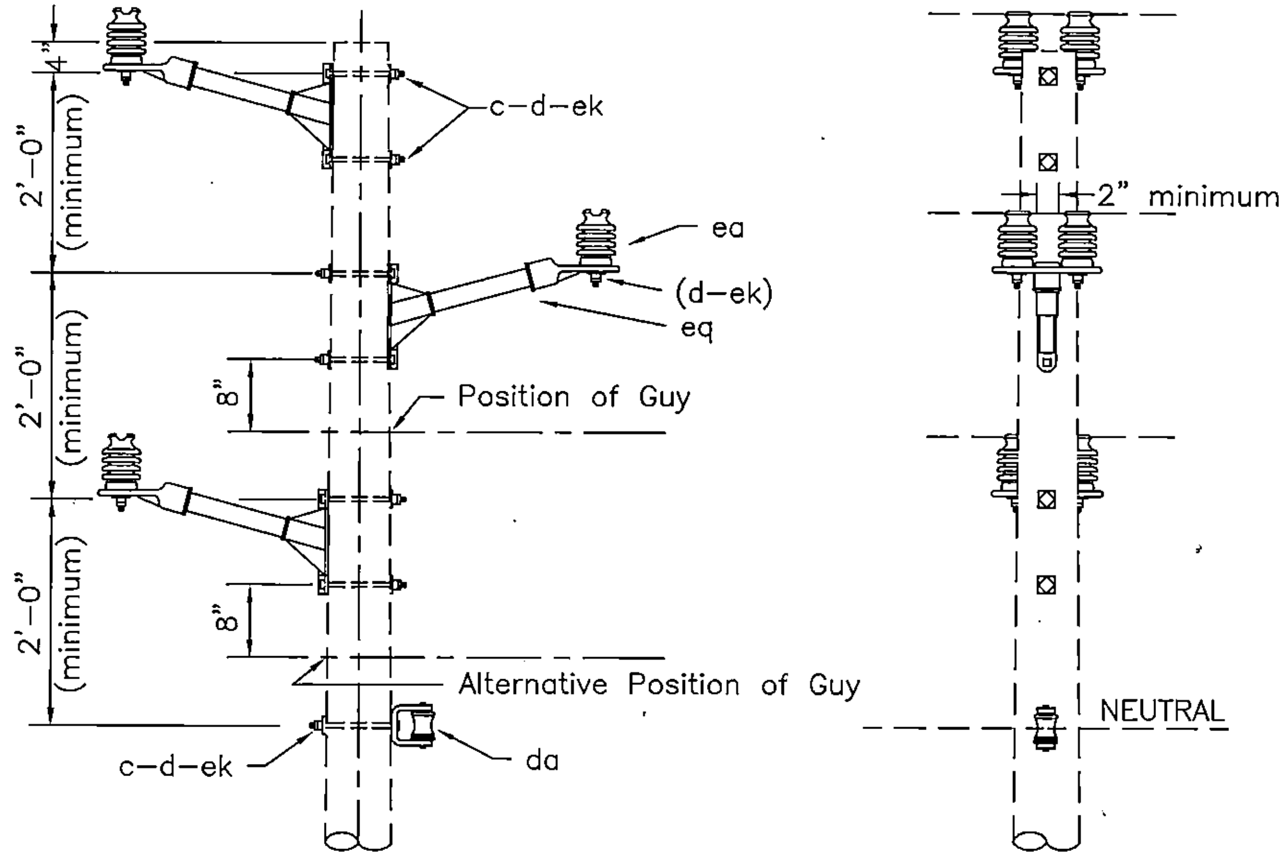
DOUBLE SUPPORT–NARROW PROFILE

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

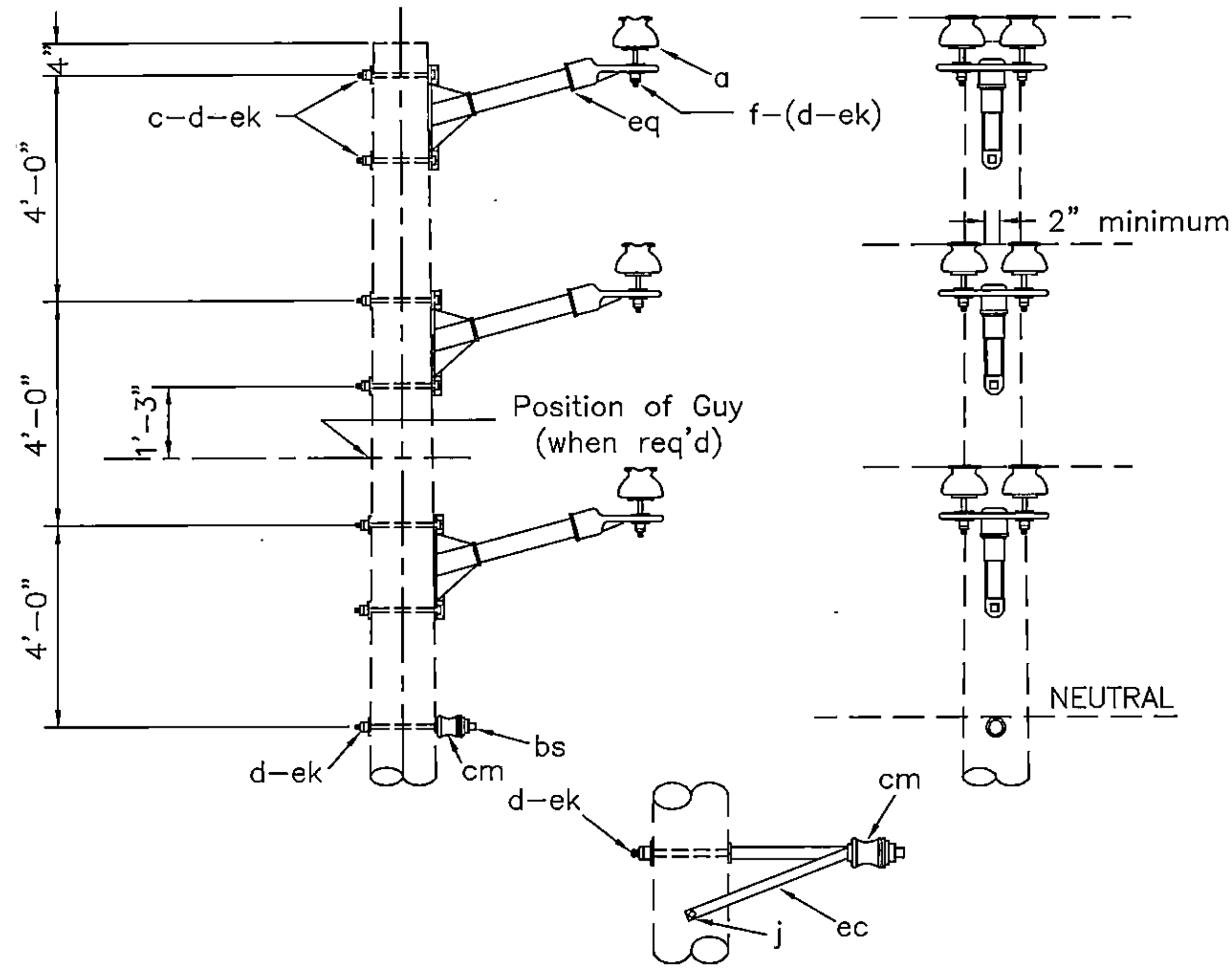
C2.6N



NOTE: If additional guying is required, use assembly C2.9NP.

	ASSEMBLY: C2.	6NP
ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2kV)	6
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

Design Parameters: MAXIMUM LINE ANGLES: See TABLE IV	DOUBLE SUPPORT-NARROW PROFILE (POST INSULATORS)		
	APRIL 2005	3 - PHASE PRIMARY 12.47/7.2 kV	C2.6NP
	RUS		



Specify C2.8N for offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

ITEM	MATERIAL Assembly: C2.	7N QTY	8N QTY
a	Insulator, pin type (12.47/7.2 kV)	6	6
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	7	7
f	Pin, crossarm, 5/8" x 6 1/2"	6	6
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	3	3

Design Parameters:
Maximum Line Angles
5° – Small Conductors
2° – Larger than #1/0

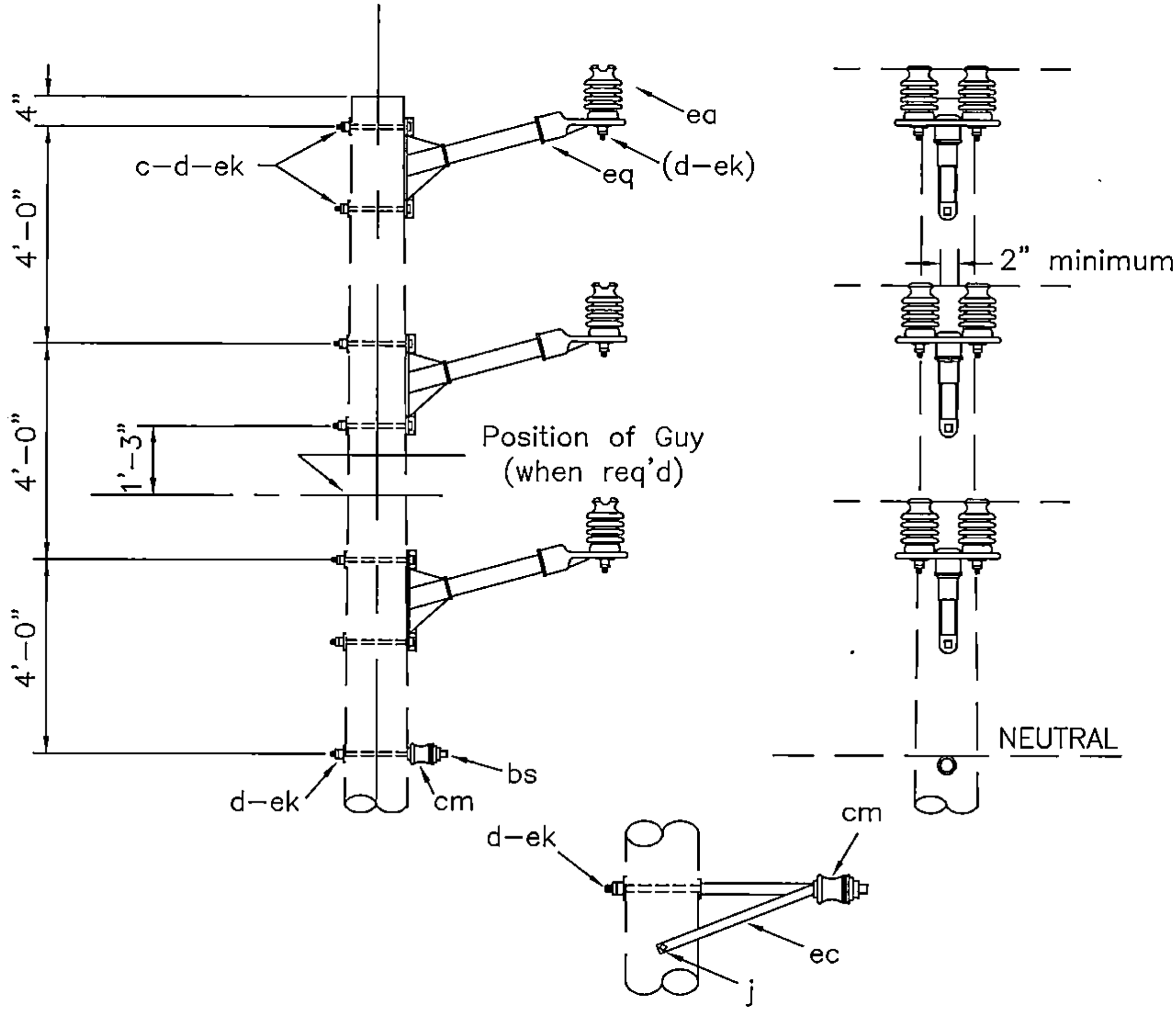
DOUBLE SUPPORT–NARROW PROFILE (TANGENT)

APRIL 2005

RUS

3 – PHASE PRIMARY 12.47/7.2 kV

C2.7N
C2.8N



Specify C2.8NP for offset neutral assembly

NOTE: These assemblies used for NESC Grade B construction.

ITEM	MATERIAL (Assembly: C2.)	7NP QTY	8NP QTY
c	Bolt, machine, 5/8" x req'd length	6	6
d	Washer, square 2 1/4"	7	7
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ea	Insulator, post type (12.47/7.5 kV)	6	6
ec	Bracket, offset neutral		1
ek	Locknuts	7	7
eq	Bracket, insulator/equipment	3	3

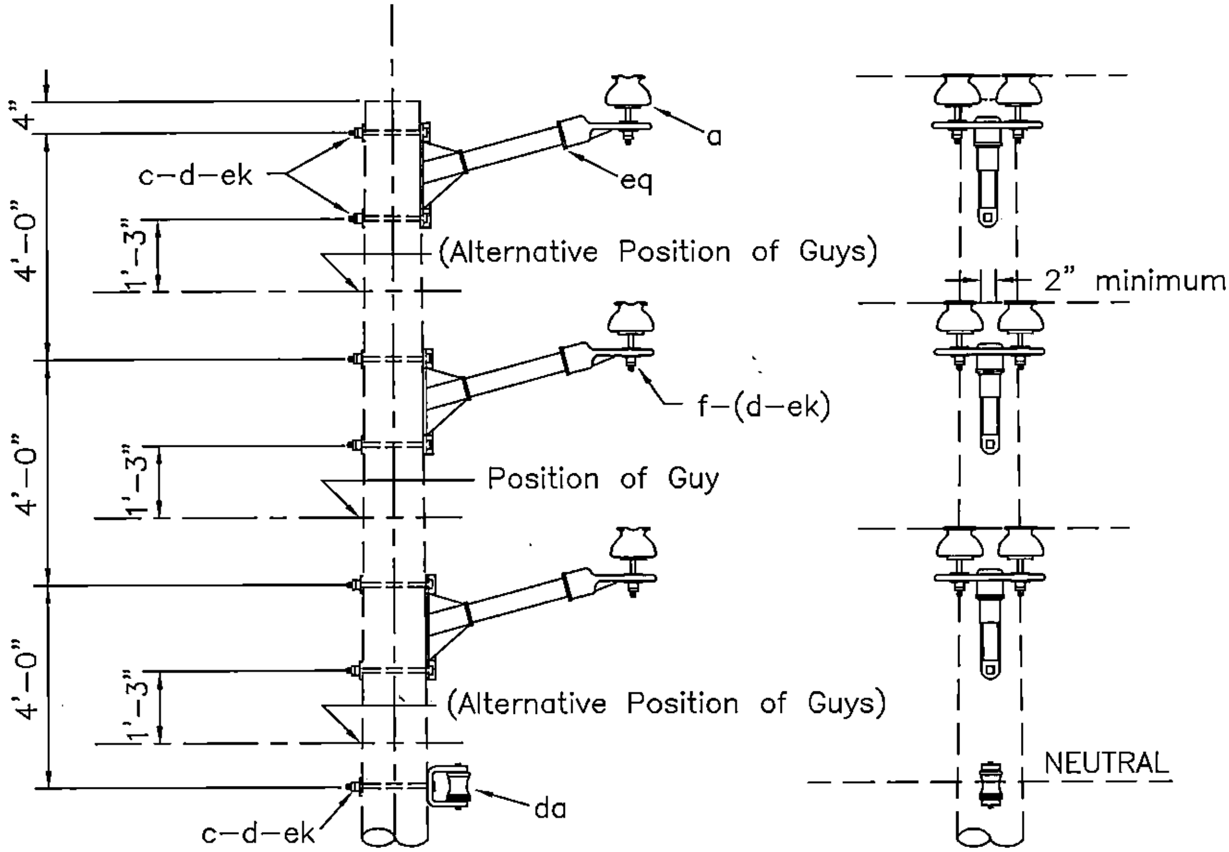
Design Parameters:
Maximum Line Angles
5° – Small conductors
2° – Larger than #1/0

DOUBLE SUPPORT–NARROW PROFILE
(TANGENT) (POST INSULATORS)

APRIL 2005
RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C2.7NP
C2.8NP



Assembly: C2.9N

ITEM	MATERIAL	QTY
a	Insulator, pin type (12.47/7.2 kV)	6
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
f	Pin, crossarm, 5/8" x 6 1/2"	6
da	Bracket, insulated	1
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

Design Parameters:
Maximum Line Angles
See TABLE IV

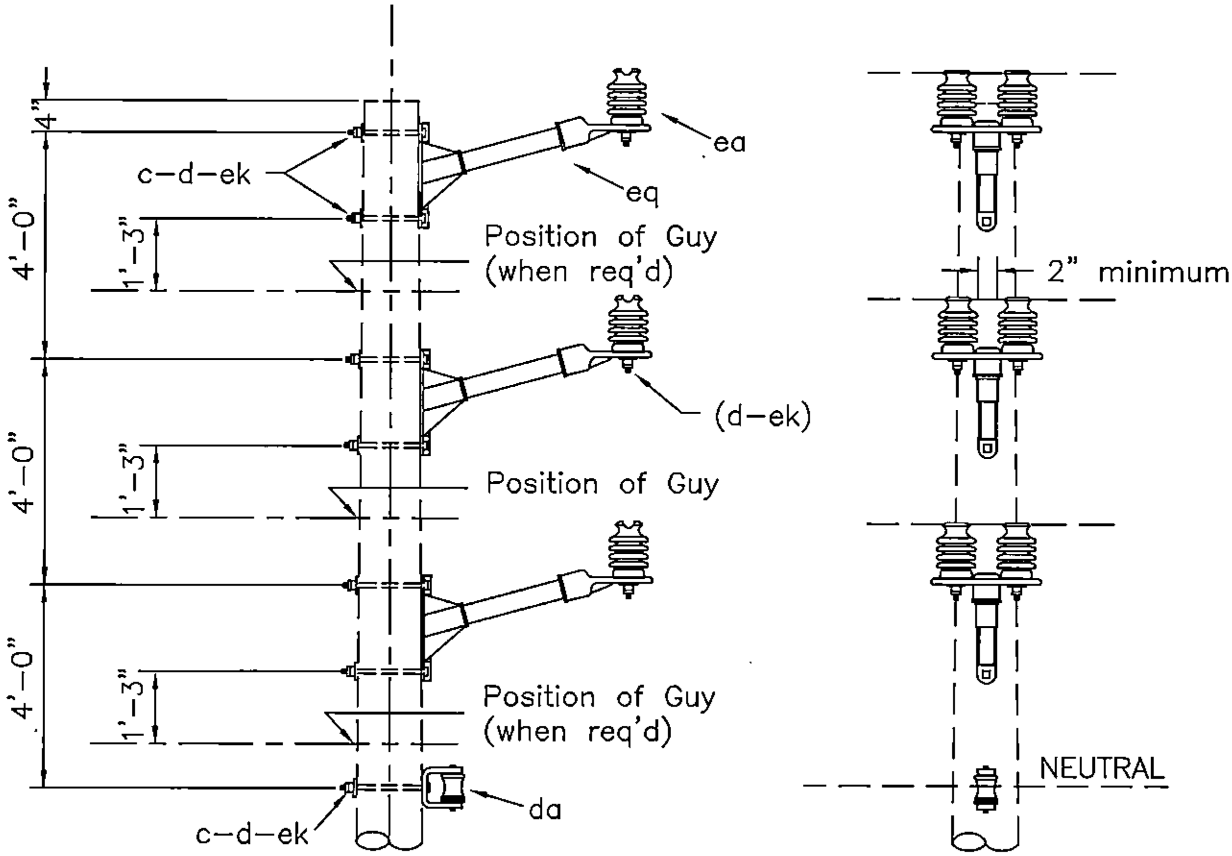
DOUBLE SUPPORT—NARROW PROFILE

APRIL 2005

RUS

3 — PHASE PRIMARY
12.47/7.2 kV

C2.9N

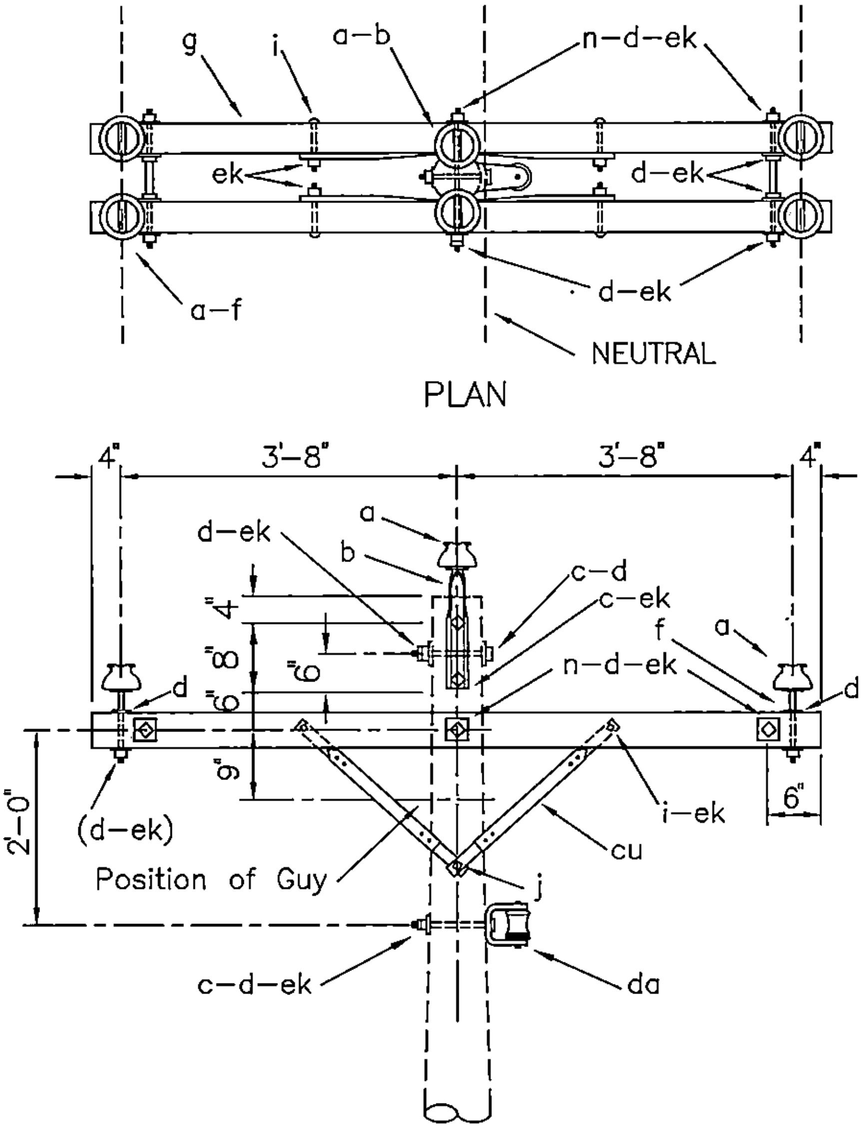


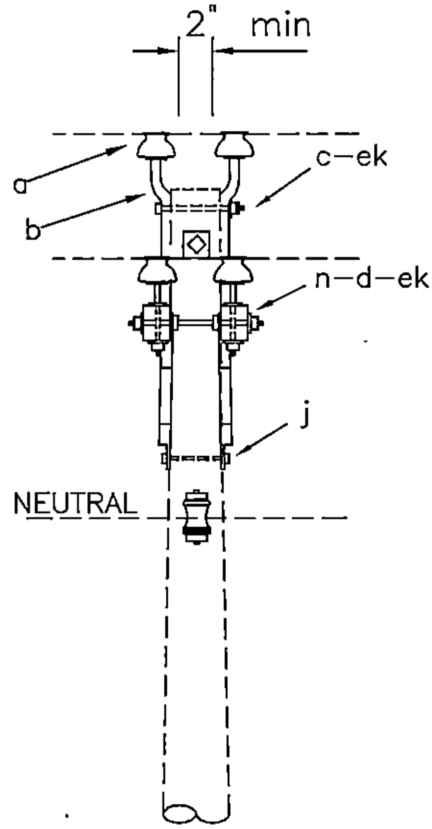
Assembly: C2. 9NP

ITEM	MATERIAL	QTY
c	Bolt, machine, 5/8" x req'd length	7
d	Washer, square 2 1/4"	7
da	Bracket, insulated	1
ea	Insulator, post type (12.47/7.2 kV)	6
ek	Locknuts	7
eq	Bracket, insulator/equipment	3

Design Parameters:
Maximum Line Angles
See TABLE IV

DOUBLE SUPPORT–NARROW PROFILE (POST INSULATORS)		
APRIL 2005	3 – PHASE PRIMARY 12.47/7.2 kV	C2.9NP
RUS		





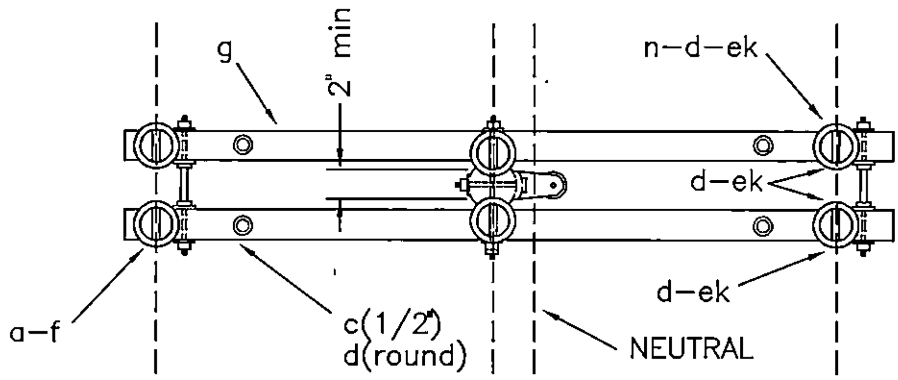
ITEM	QTY	MATERIAL
a	6	Insulator, pin type (12.47/7.2 kV)
b	2	Pin, pole top, 20", straight or offset
c	4	Bolt, machine, 5/8" x req'd length
d	17	Washer, square, 2 1/4"
f	4	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
n	3	Bolt, double arming, 5/8"xreq'd length
cu	4	Brace, 28"
da	1	Bracket, insulated
ek	18	Locknuts

DESIGN PARAMETERS:

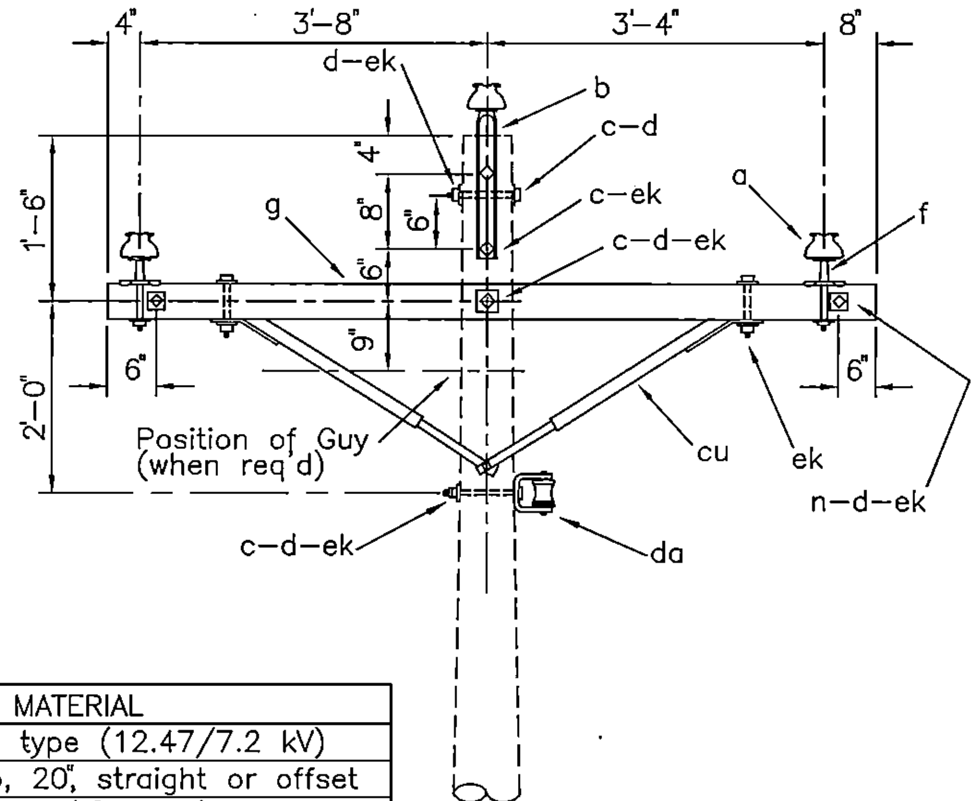
See TABLE III

DOUBLE SUPPORT ON CROSSARMS

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C2.21 (C2)



PLAN



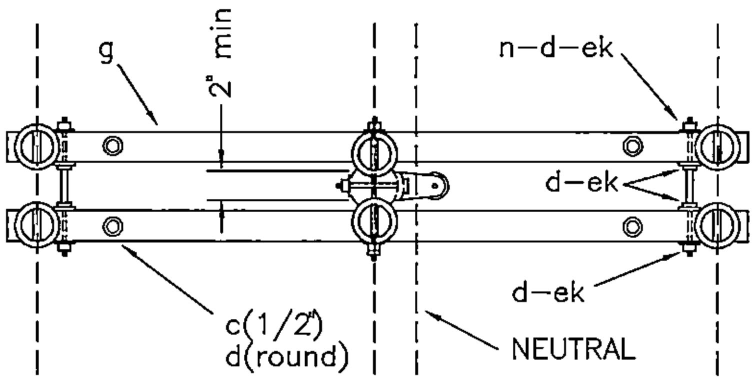
ITEM	QTY	MATERIAL
a	6	Insulator, pin type (12.47/7.2 kV)
b	2	Pin, pole top, 20", straight or offset
c	4	Bolt, machine, 1/2" x req'd length
c	5	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	14	Washer, square, 2 1/4"
f	4	Pin, crossarm, steel, clamp type
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
n	3	Bolt, double arming, 5/8" x req'd length
cu	2	Brace, wood, 60" span
da	1	Bracket, insulated
ek	19	Locknuts

DESIGN PARAMETERS:

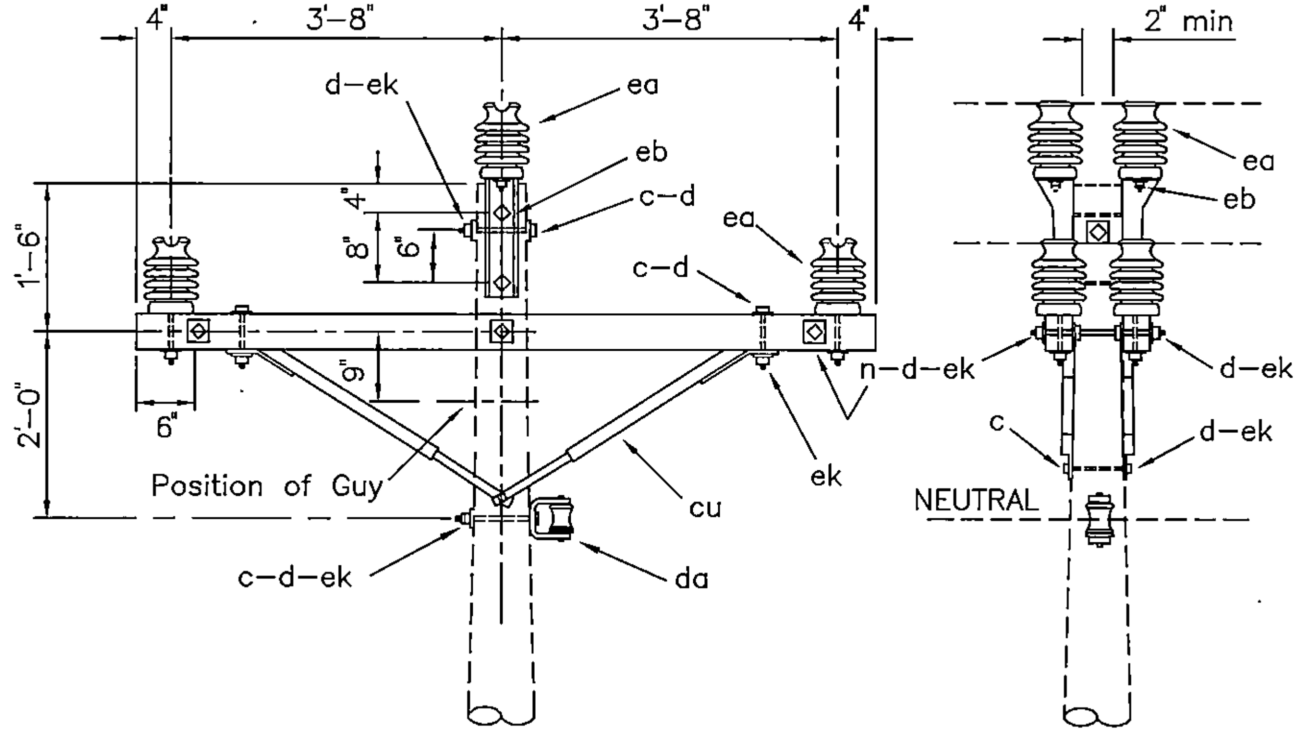
See TABLE III

DOUBLE SUPPORT ON CROSSARMS
(LARGE CONDUCTORS)

APRIL 2005	3 – PHASE PRIMARY	C2.21L
RUS	12.47/7.2 kV	(C1–3)



PLAN



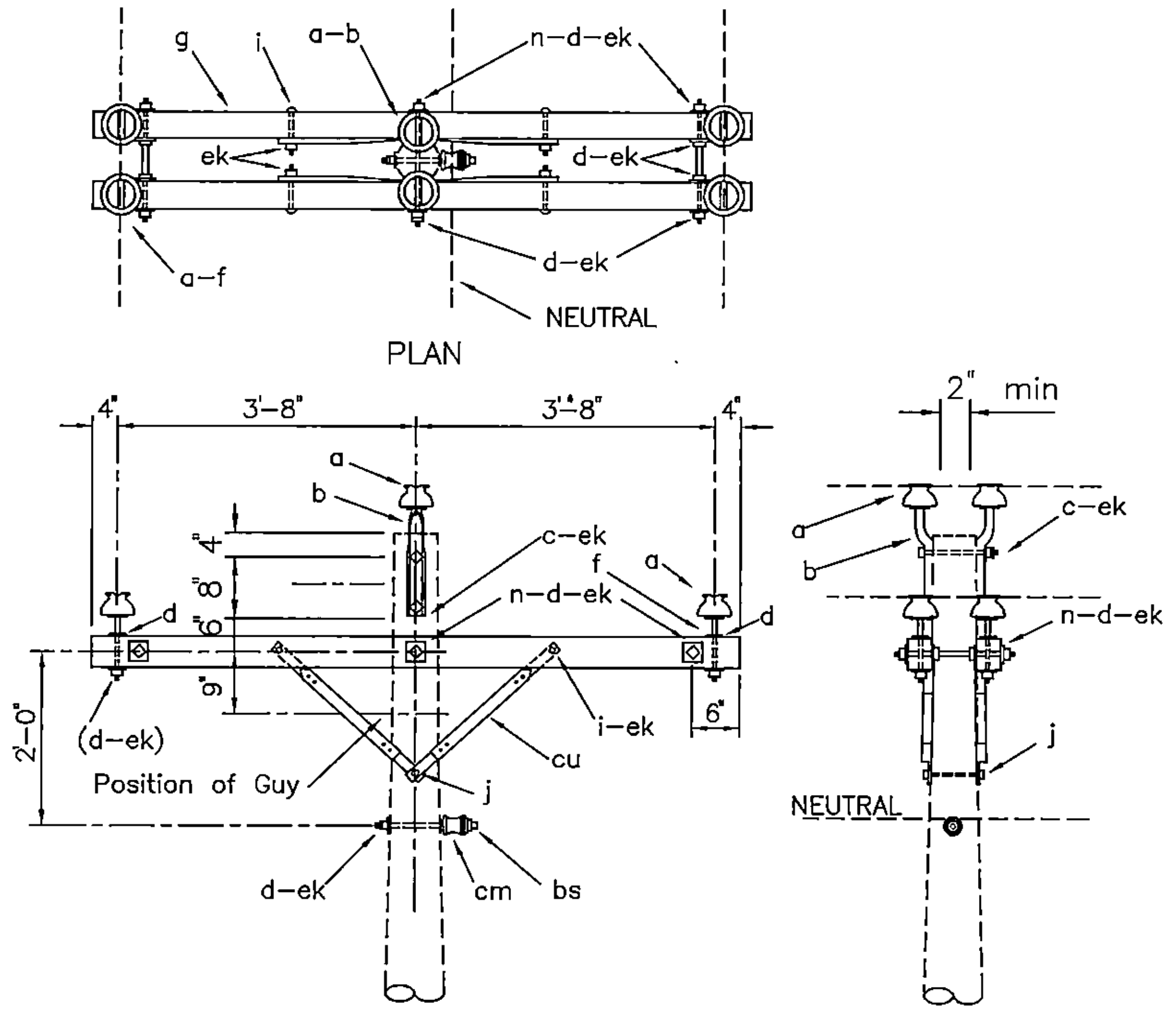
ITEM	QTY	MATERIAL
c	5	Bolt, machine, 5/8" x req'd length
c	4	Bolt, machine, 1/2" x req'd length
d	14	Washer, square, 2 1/4"
d	4	Washer, round, 1 3/8"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8' 0"
n	3	Bolt, double arming, 5/8" x req'd length
cu	2	Brace, wood, 60" span
da	1	Bracket, insulated
ea	6	Insulator, post type (12.47/7.2 kV)
eb	2	Bracket, pole top
ek	19	Locknuts

DESIGN PARAMETERS:

See TABLE IV

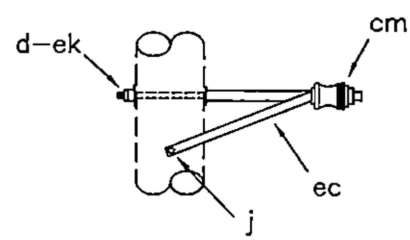
DOUBLE SUPPORT ON CROSSARMS
(POST INSULATORS)

APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	C2.21P (C1-3P)



NOTE: These assemblies used for
NESC Grade B construction.

ITEM	MATERIAL (ASSEMBLY: C2.)	24 QTY	25 QTY
a	Insulator, pin type (12.47/7.2kV)	6	6
b	Pin, pole top, 20", straight or offset	2	2
c	Bolt, machine, 5/8" x req'd length	2	2
d	Washer, square 2 1/4"	15	15
f	Pin, crossarm, steel, 5/8" x 10 3/4"	4	4
g	Crossarm, 3 5/8" x 4 5/8" x 8'–0"	2	2
i	Bolt, carriage, 3/8" x 4 1/2"	4	4
j	Screw, lag, 1/2" x 4"	2	4
n	Bolt, double arm, 5/8" x req'd length	3	3
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	Brace, 28"	4	4
ec	Bracket, offset neutral		1
ek	Locknuts	17	17



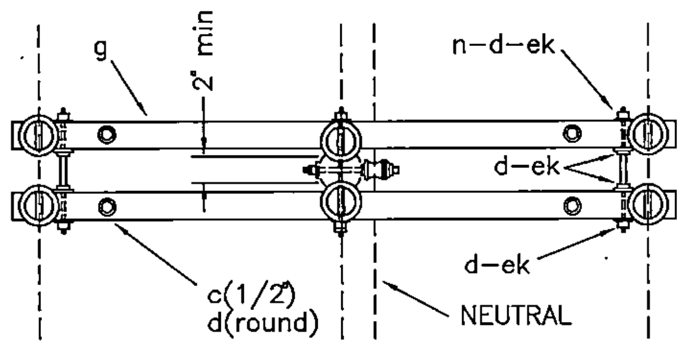
Specify C2.25 for
offset neutral assembly

DESIGN PARAMETERS:

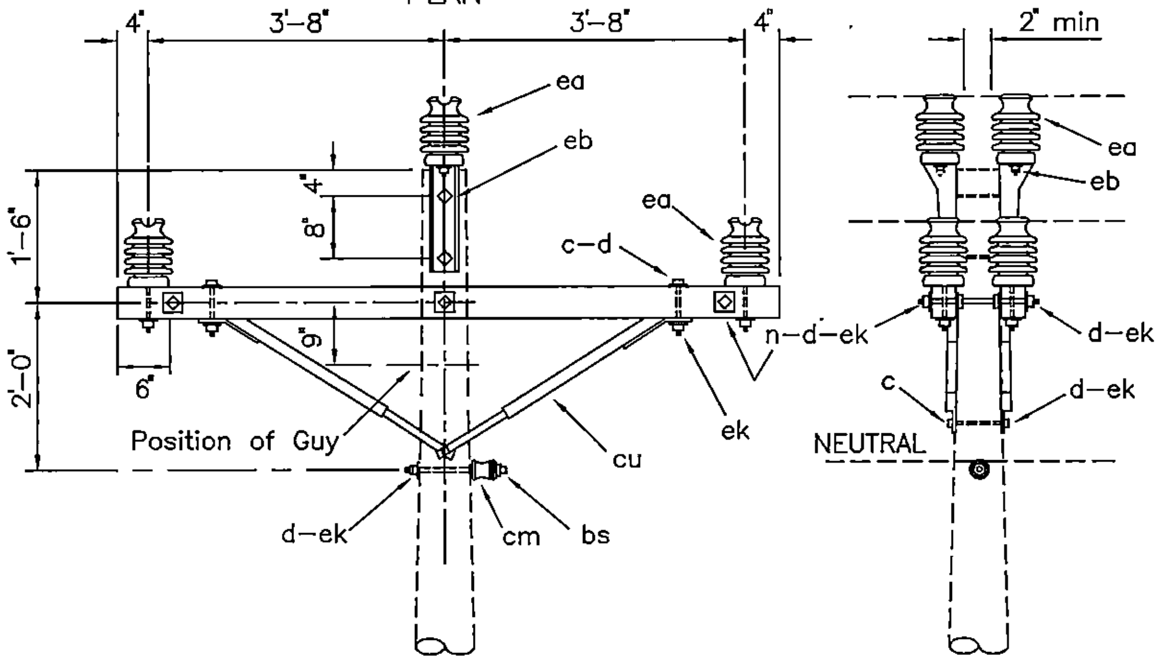
MAXIMUM LINE ANGLES:
5°–Small Conductors
2°–Larger than #1/0

DOUBLE SUPPORT ON CROSSARMS–TANGENT

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C2.24,C2.25 (C1–1,C1–1A)

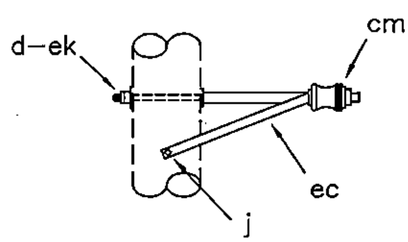


PLAN



NOTE: These assemblies used for NESC Grade B construction.

		ASSEMBLY: C2.	24P	25P
ITEM	MATERIAL		QTY	QTY
c	Bolt, machine, 5/8" x req'd length		3	3
c	Bolt, machine, 1/2" x req'd length		4	4
d	Washer, square, 2 1/4"		12	12
d	Washer, round, 1 3/8"		4	4
g	Crossarm, 3 5/8" x 4 5/8" x 8'–0"		2	2
n	Bolt,double arming,5/8" x req'd length		3	3
bs	Bolt, single, upset		1	
cm	Insulator, spool, 3"		1	1
cu	Brace, wood, 60" span		2	2
ea	Insulator, post type (12.47/7.2kV)		6	6
eb	Bracket, pole top		2	2
ec	Bracket, offset neutral			1
ek	Locknuts		18	18



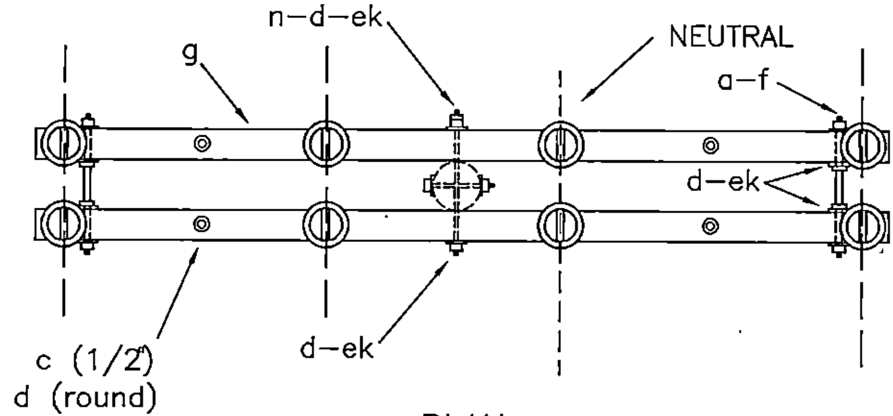
Specify C2.25P for offset neutral assembly

DESIGN PARAMETERS:

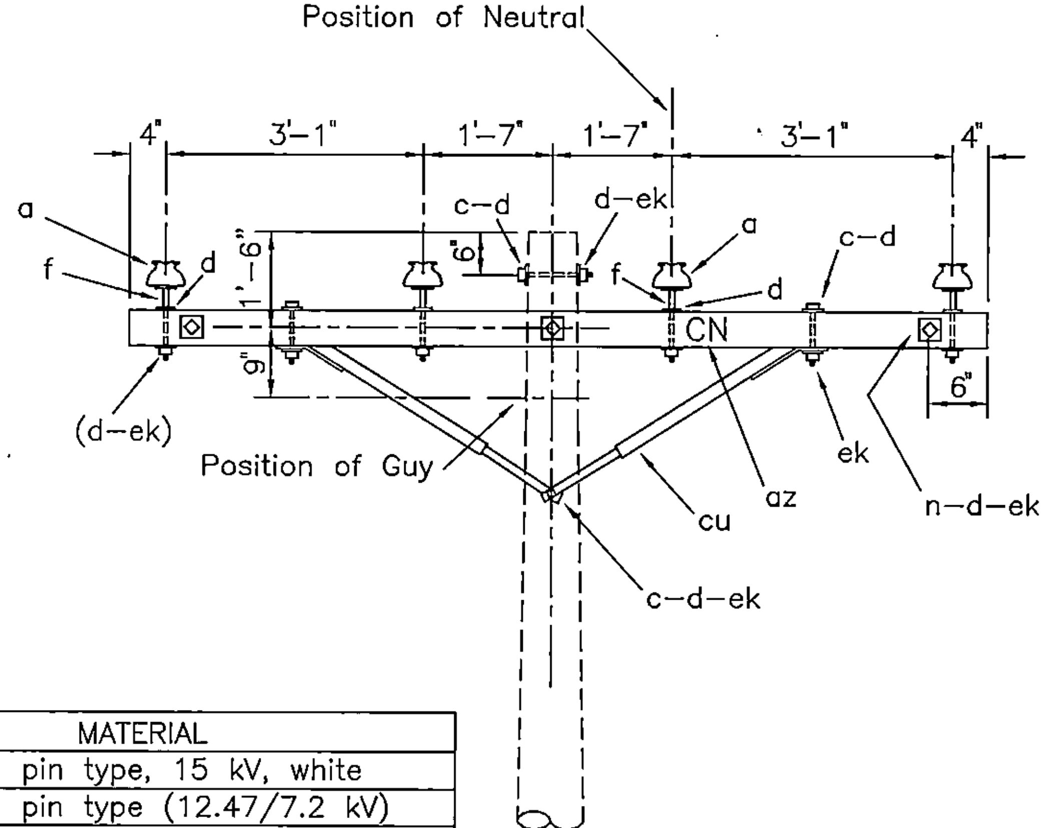
MAXIMUM LINE ANGLES:
5°–Small Conductors
2°–Larger than #1/0

DOUBLE SUPPORT ON CROSSARMS–TANGENT
(POST INSULATORS)

APRIL 2005	3 – PHASE PRIMARY	C2.24P,C2.25P
RUS	12.47/7.2 kV	(C1–1P,C1–1AP)



PLAN



ITEM	QTY	MATERIAL
a	2	Insulator, pin type, 15 kV, white
a	6	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 1/2" x req'd length
c	2	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	21	Washer, square, 2 1/4"
f	8	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'–0"
n	3	Bolt double arming,5/8"x req'd length
az	4	Letters, 2" C, 2" N, with 1" nails
cu	2	Brace, wood, 60" span
ek	16	Locknuts

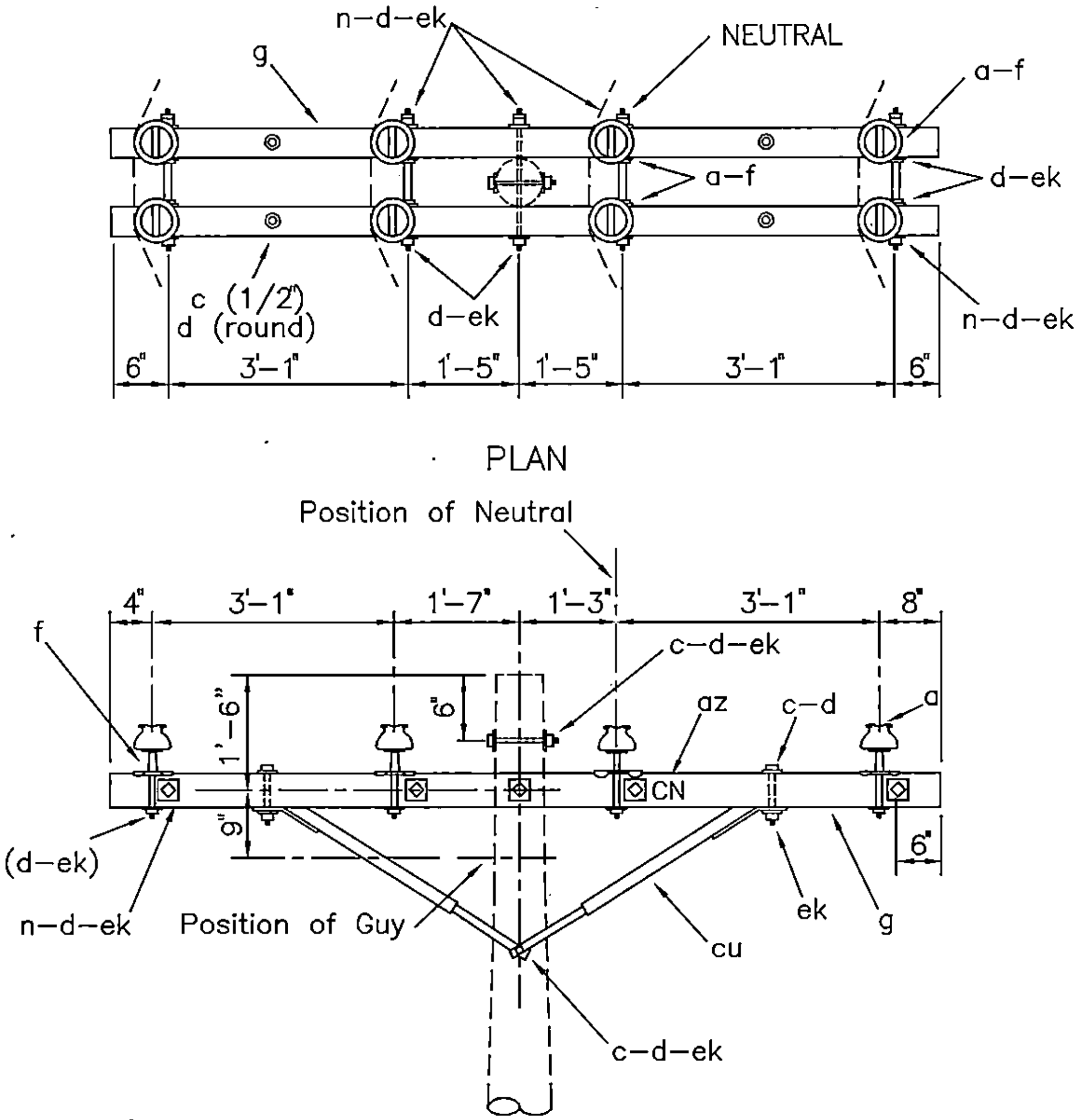
NOTE: Install either identification letters or white insulators in neutral position.

DESIGN PARAMETERS:

See TABLE IV

DOUBLE SUPPORT, NEUTRAL ON CROSSARMS

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C2.51 (C9)



ITEM	QTY	MATERIAL
a	2	Insulator, pin type, 15 kV, white
a	6	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 1/2" x req'd length
c	2	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	21	Washer, square, 2 1/4"
f	8	Pin, crossarm, steel clamp type
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
n	5	Bolt, double arming, 5/8"x req'd length
az	4	Letters, 2" C, 2" N, with 1" nails
cu	2	Brace, wood, 60" span
ek	24	Locknuts

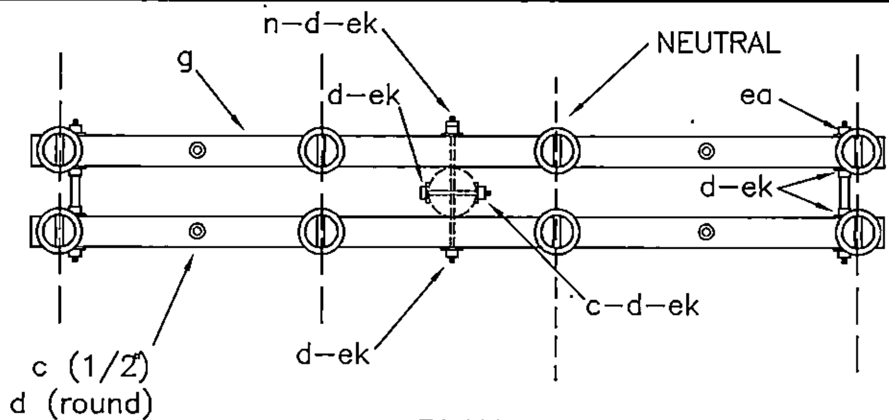
NOTE: Install either identification letters (az) or white insulators in neutral position.

DESIGN PARAMETERS:

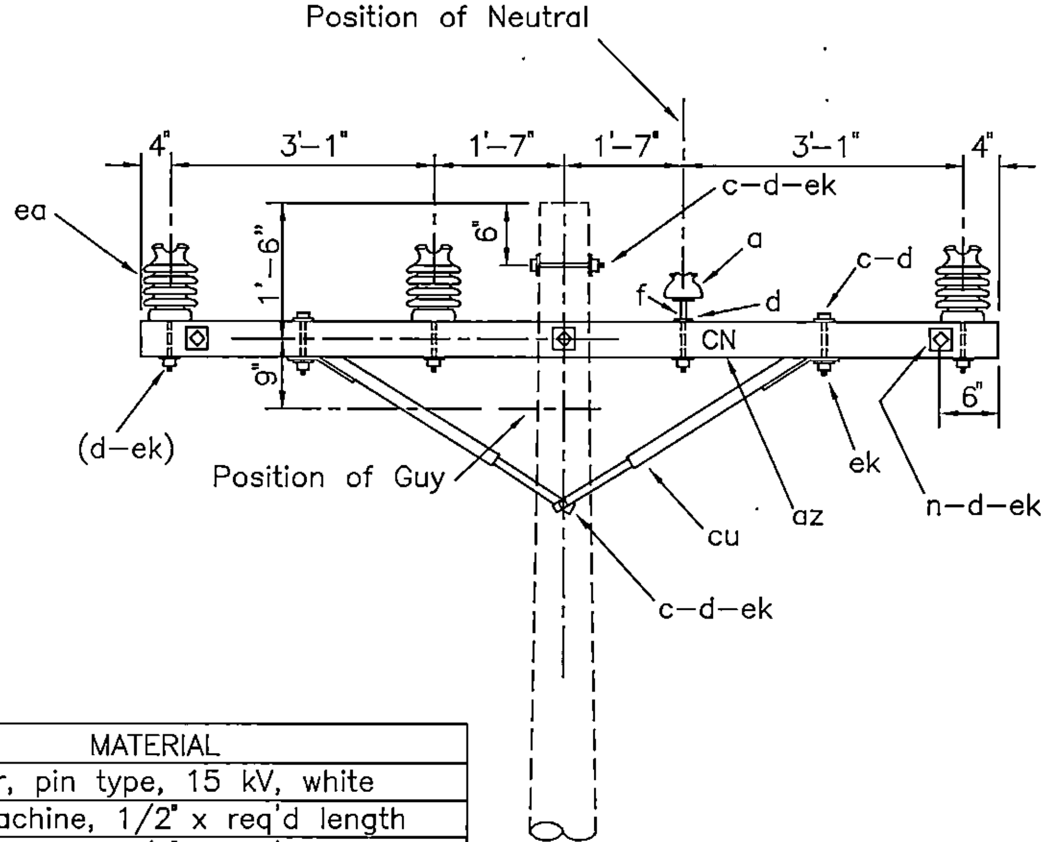
See TABLE V

DOUBLE SUPPORT, NEUTRAL ON CROSSARMS (LARGE CONDUCTORS)

APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	C2.51L (C9-2)



PLAN



ITEM	QTY	MATERIAL
a	2	Insulator, pin type, 15 kV, white
c	4	Bolt, machine, 1/2" x req'd length
c	2	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	15	Washer, square, 2 1/4"
f	2	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
n	3	Bolt double arming,5/8"x req'd length
az	4	Letters, 2" C, 2" N, with 1" nails
cu	2	Brace, wood, 60" span
ea	6	Insulator, post type (12.47/7.2 kV)
ek	16	Locknuts

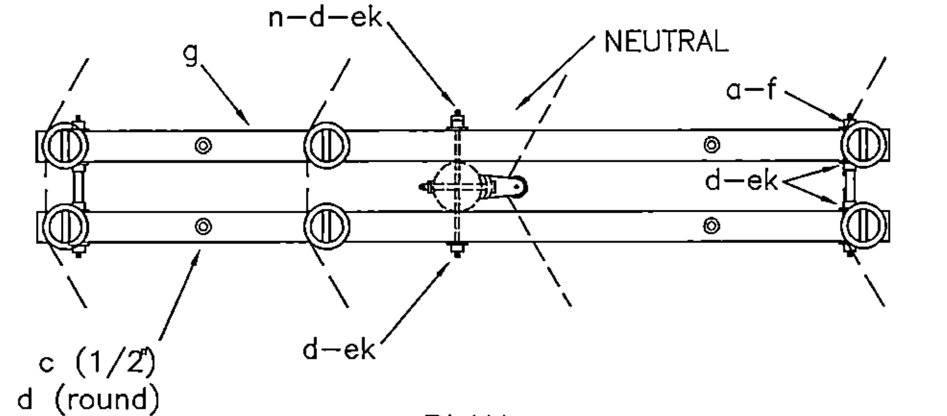
NOTE: Install identification letters (az) (optional) in neutral position.

DESIGN PARAMETERS:

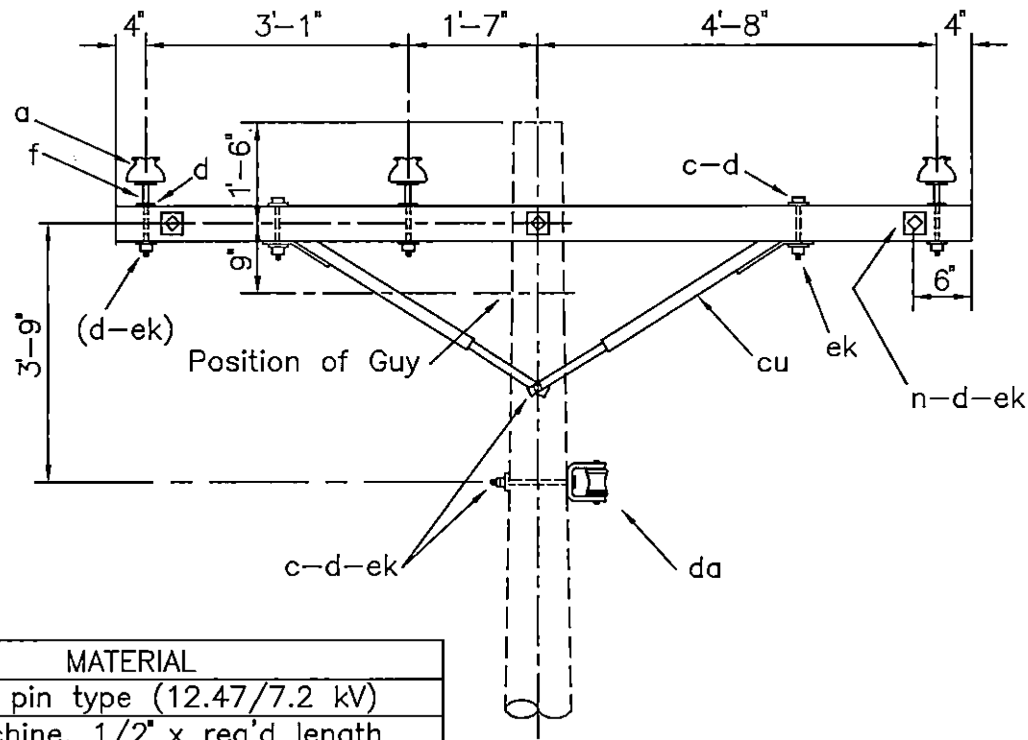
See TABLE IV

DOUBLE SUPPORT, NEUTRAL ON CROSSARMS (POST INSULATORS)

APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	C2.51P (C9-2PL)



PLAN



ITEM	QTY	MATERIAL
a	6	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 1/2" x req'd length
c	2	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	18	Washer, square, 2 1/4"
f	6	Pin, crossarm, steel, 5/8" X 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
n	3	Bolt, double arm, 5/8" x req'd length
cu	2	Brace, wood, 60" span
da	1	Bracket, insulated
ek	16	Locknuts

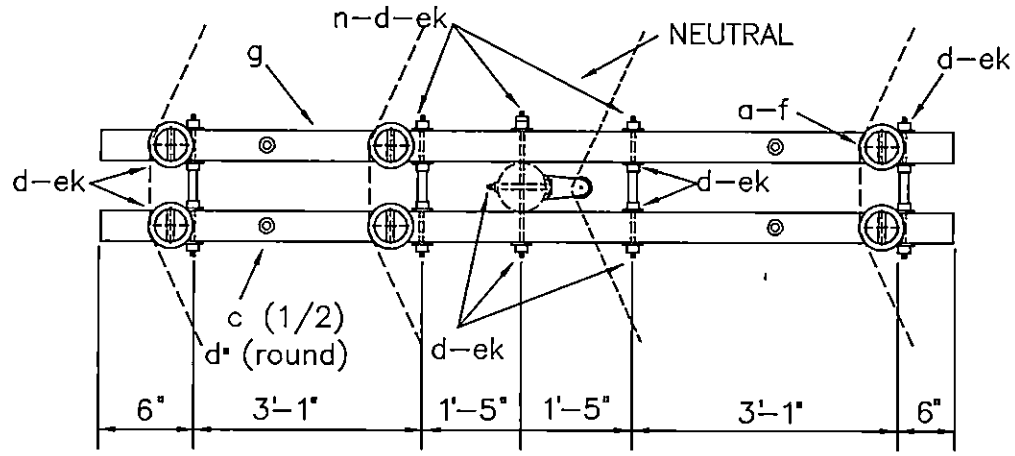
NOTE:
Neutral assembly may be installed on opposite side of pole when necessary to increase midspan conductor clearance.

DESIGN PARAMETERS:

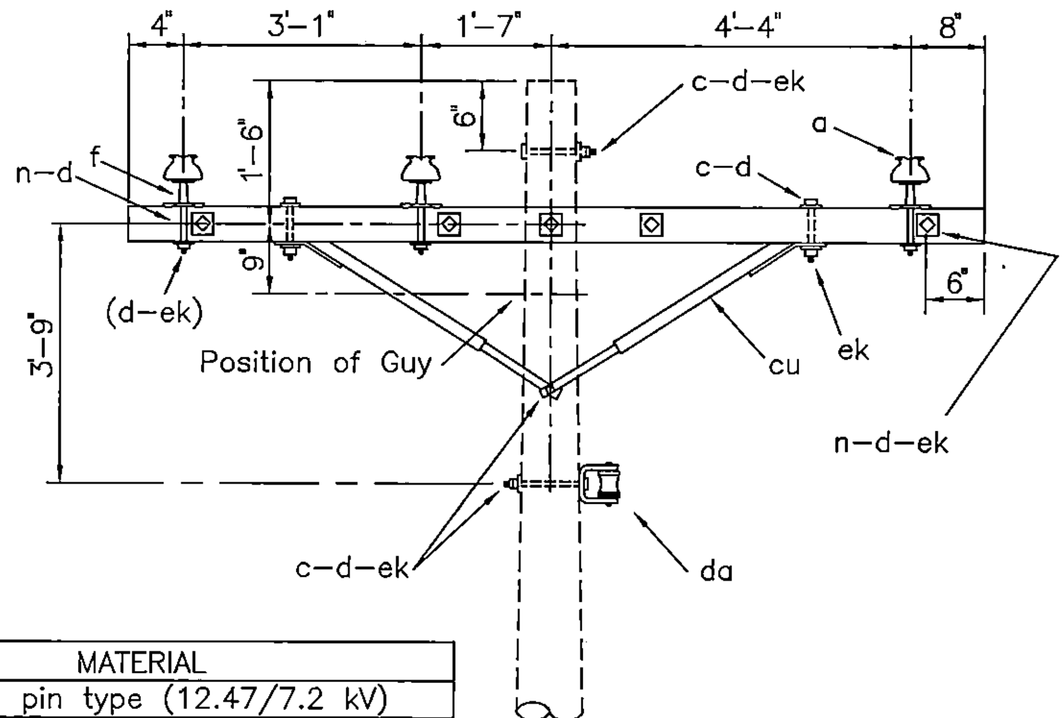
See TABLE IV

DOUBLE SUPPORT ON 10 FOOT CROSSARMS

APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	C2.52 (C2-1)



PLAN



ITEM	QTY	MATERIAL
a	6	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 1/2" x req'd length
c	3	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	22	Washer, square, 2 1/4"
f	6	Pin, crossarm, steel, clamp type
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
n	5	Bolt, double arm, 5/8" x req'd length
cu	2	Brace, wood, 60" span
da	1	Bracket, w/ 3" x 3" spool insulator
ek	25	Locknuts

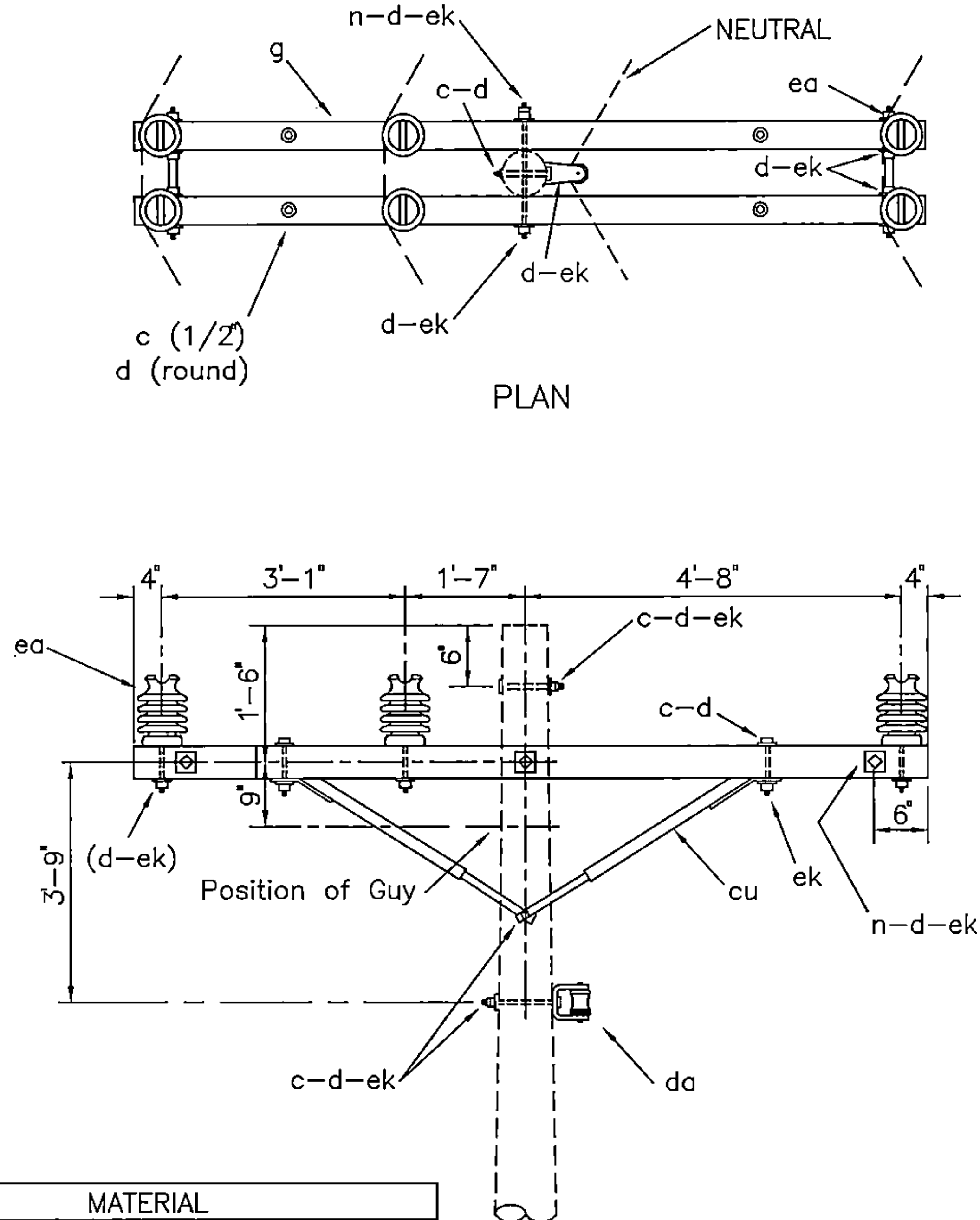
NOTE:
Neutral assembly may be installed on opposite side of pole when necessary to increase midspan conductor clearance.

DESIGN PARAMETERS:

See TABLE V

DOUBLE SUPPORT ON 10 FOOT CROSSARMS
(LARGE CONDUCTORS)

APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	C2.52L (C2-2)



ITEM	QTY	MATERIAL
c	4	Bolt, machine, 1/2" x req'd length
c	3	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	14	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
n	3	Bolt, double arm, 5/8" x req'd length
cu	2	Brace, wood, 60" span
da	1	Bracket, Insulated
ea	6	Insulator, post type (12.47/7.2 kV)
ek	17	Locknuts

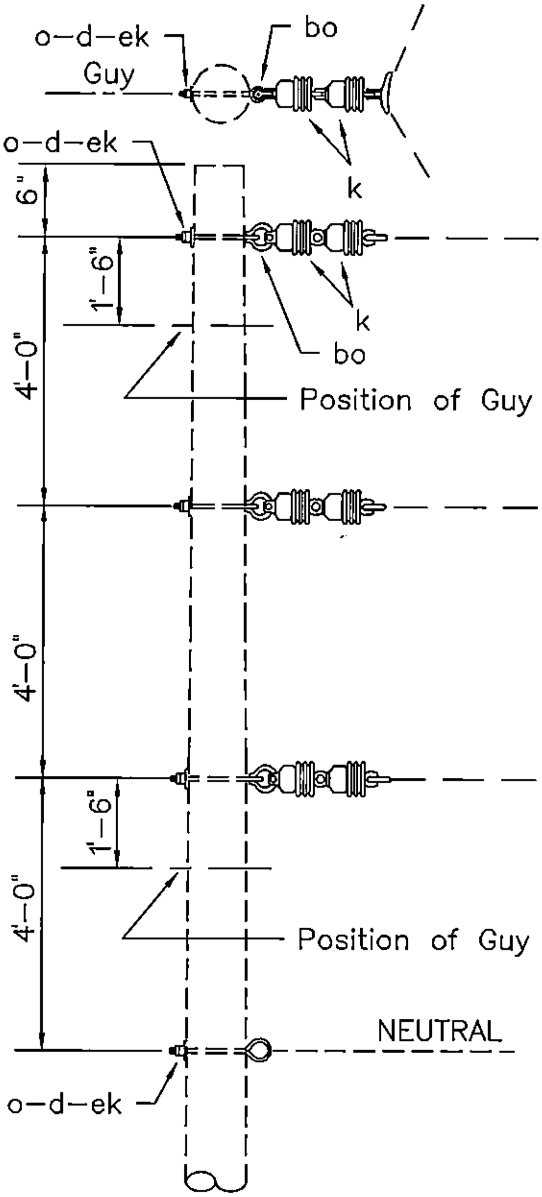
NOTE:
Neutral assembly may be installed on opposite side of pole when necessary to increase midspan conductor clearance.

DESIGN PARAMETERS:

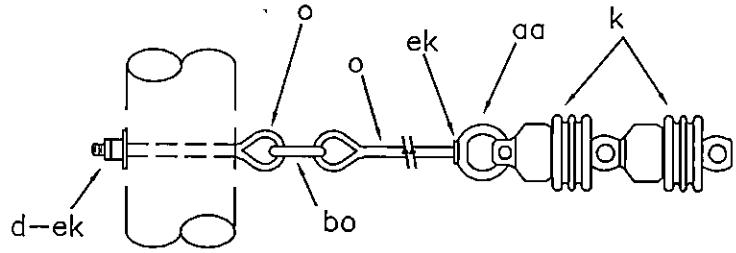
See TABLE IV

DOUBLE SUPPORT ON 10 FOOT CROSSARMS (POST INSULATORS)

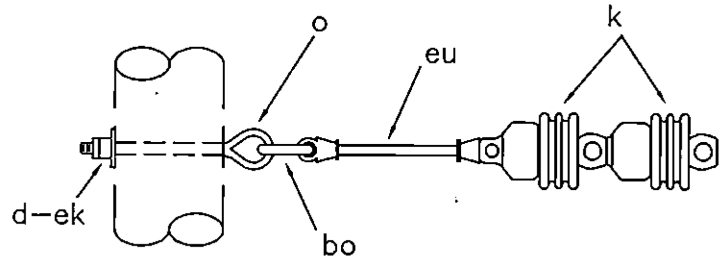
APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	C2.52P (C2-2PL)



C3.1



C3.2



C3.3

NOTE: Extension link (item "eu" or "du") or eyebolt (item "o"), eyenut (item "aa") and locknut (item "ek") may be installed in 2 lower primary positions. Adjust material as required.

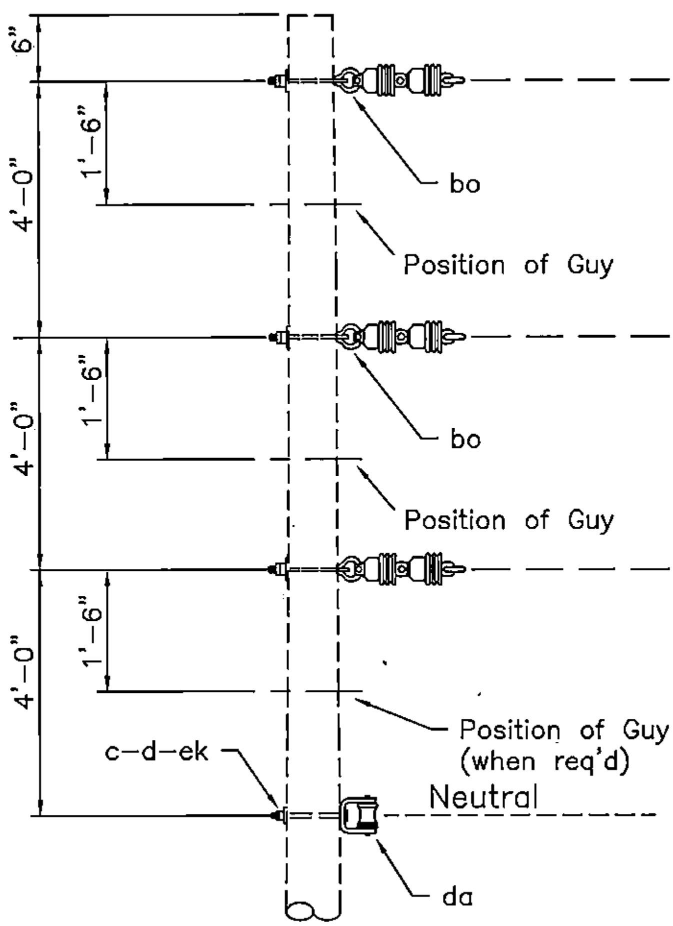
	ASSEMBLY: C3	.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 3", curved	4	4	4
k	Insulator, suspension, 4 1/4"	6	6	6
o	Bolt, eye, 5/8"x req'd length	4	7	4
aa	Nut, eye		3	
bo	Shackle, anchor	4	4	4
ek	Locknuts	4	7	4
eu	Link, extension, insulated			3
(du)	(Link, extension) – (optional)			(3)

DESIGN PARAMETERS:

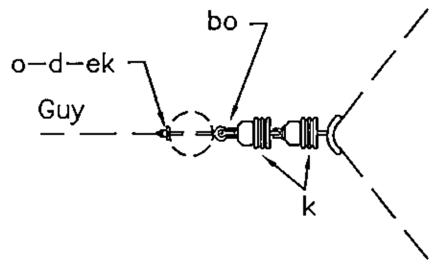
PERMITTED TRANSVERSE
LOAD= 5000 lbs./Conductor
20° – 60°: #1/0 ACSR & Larger
30° – 60°: Smaller Conductors

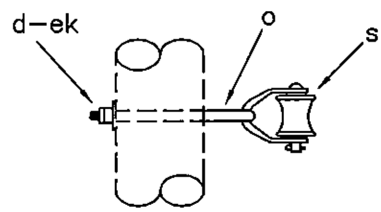
SUSPENSION ANGLE

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C3.1,C3.2,C3.3 (C3)



C3.4





C3.7

C3.5 = C3.4 neutral assembly + C3.2 primary subassembly
C3.6 = C3.4 neutral assembly + C3.3 primary subassembly
C3.8 = C3.7 neutral assembly + C3.2 primary subassembly
C3.9 = C3.7 neutral assembly + C3.3 primary subassembly

NOTE: Extension link (item "eu" or "du") or eyebolt (item "o"), eyenut (item "aa") and locknut (item "ek") may be installed in lower primary positions. Adjust material as required.

	ASSEMBLY: C3	.4	.5	.6	.7	.8	.9
ITEM	MATERIAL	QTY	QTY	QTY	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	1	1	1			
d	Washer, square, 3", curved	4	4	4	4	4	4
k	Insulator, suspension, 4 1/4"	6	6	6	6	6	6
o	Bolt, eye, 5/8"x req'd length	3	6	3	4	7	4
s	Clevis, secondary, swinging, insulated				1	1	1
aa	Nut, eye		3			3	
bo	Shackle, anchor	3	3	3	3	3	3
da	Bracket, insulated	1	1	1			
ek	Locknuts	4	7	4	4	7	4
eu (du)	Link, extension, insulated (Link, extension) – (optional)			3 (3)			3 (3)

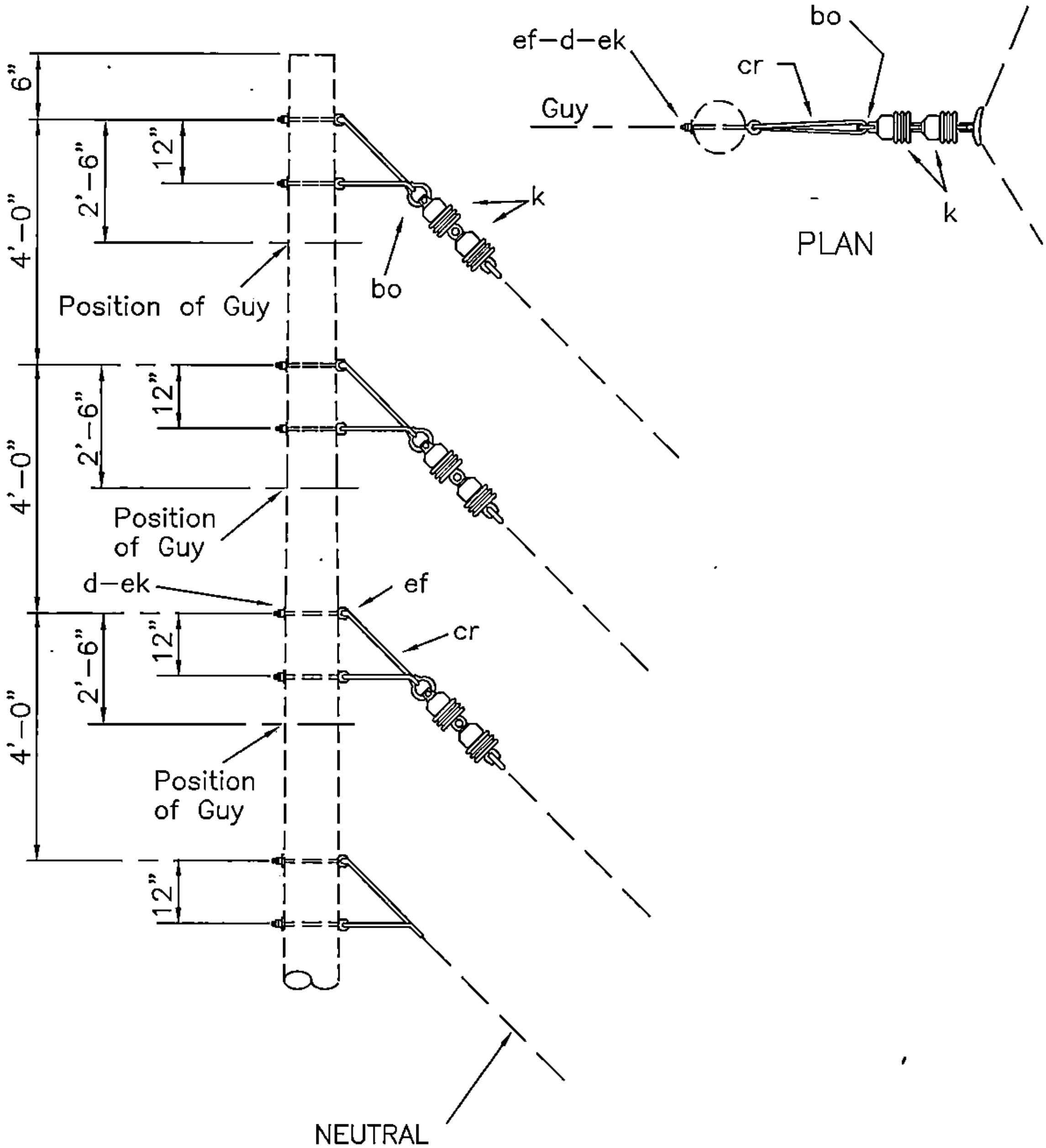
DESIGN PARAMETERS:

For ANSI Class 53-2 Spool Insulator (1 3/4") See Table VI

For ANSI Class 53-4 Spool Insulator (3") See Table VII

SUSPENSION ANGLE

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C3.4 – C3.9



ITEM	QTY	MATERIAL
d	8	Washer, square, 3", curved
k	6	Insulator, suspension, 4 1/4"
bo	3	Shackle, anchor
cr	4	Bracket, angle, 5/8"
ef	8	Bolt, clevis, 5/8" x req'd length
ek	8	Locknuts

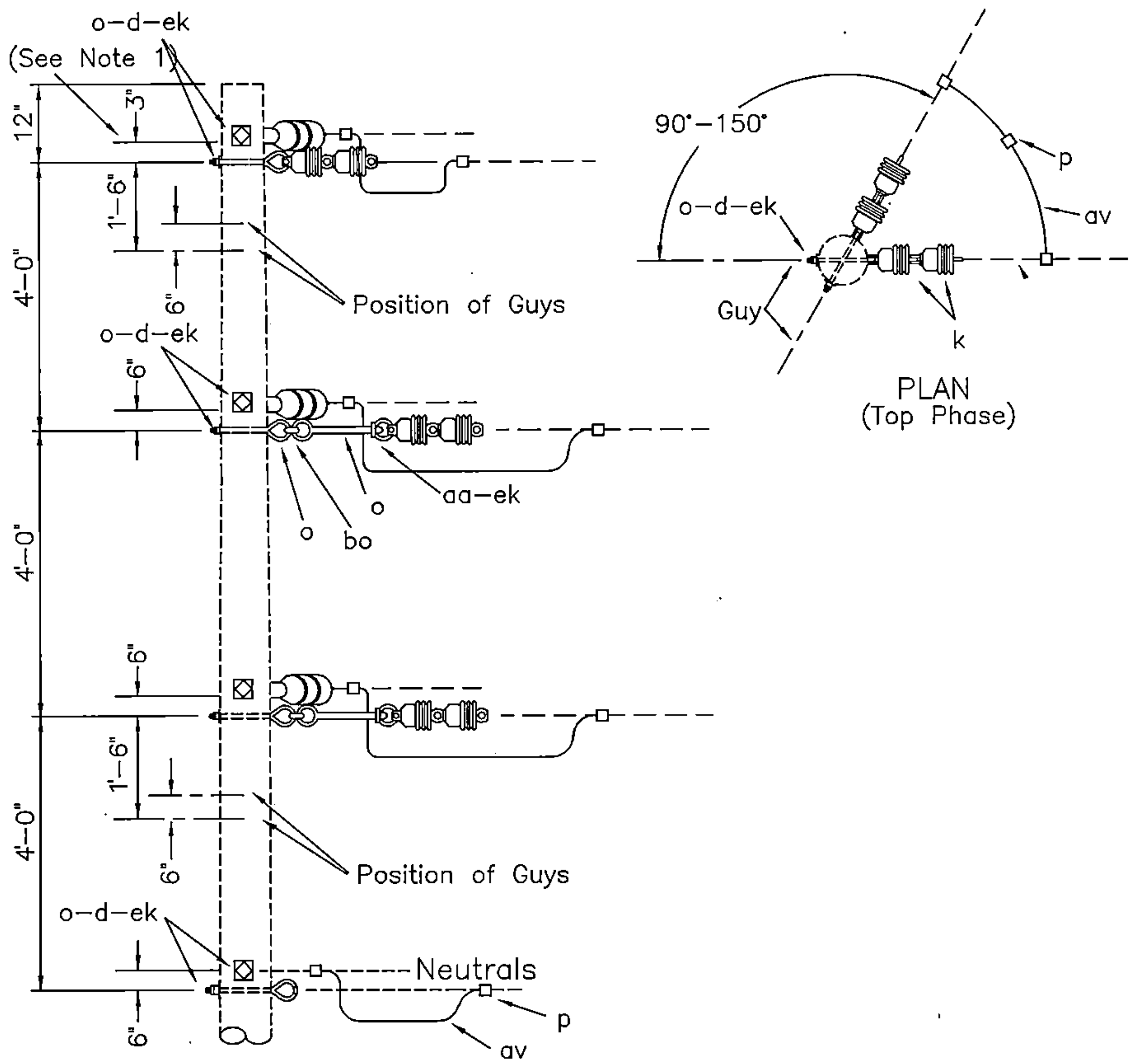
DESIGN PARAMETERS:

PERMITTED TRANSVERSE
LOAD= 5000 lbs./Conductor

10° –30° Angles

SUSPENSION ANGLE
(LARGE CONDUCTORS)

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C3.1L (C3–1)



NOTES:

1. Separate 6" (top position only) when angle equals 90°.
2. This drawing shows two B5.1 plus two A5.02 assemblies and their material as an example. Any combination of B5.1 – B5.9, A4.1 – A5.9 and A5.01 – A5.03 assemblies may be installed. Record assemblies separately on staking sheets. CAUTION: Use the appropriate permitted longitudinal loads.

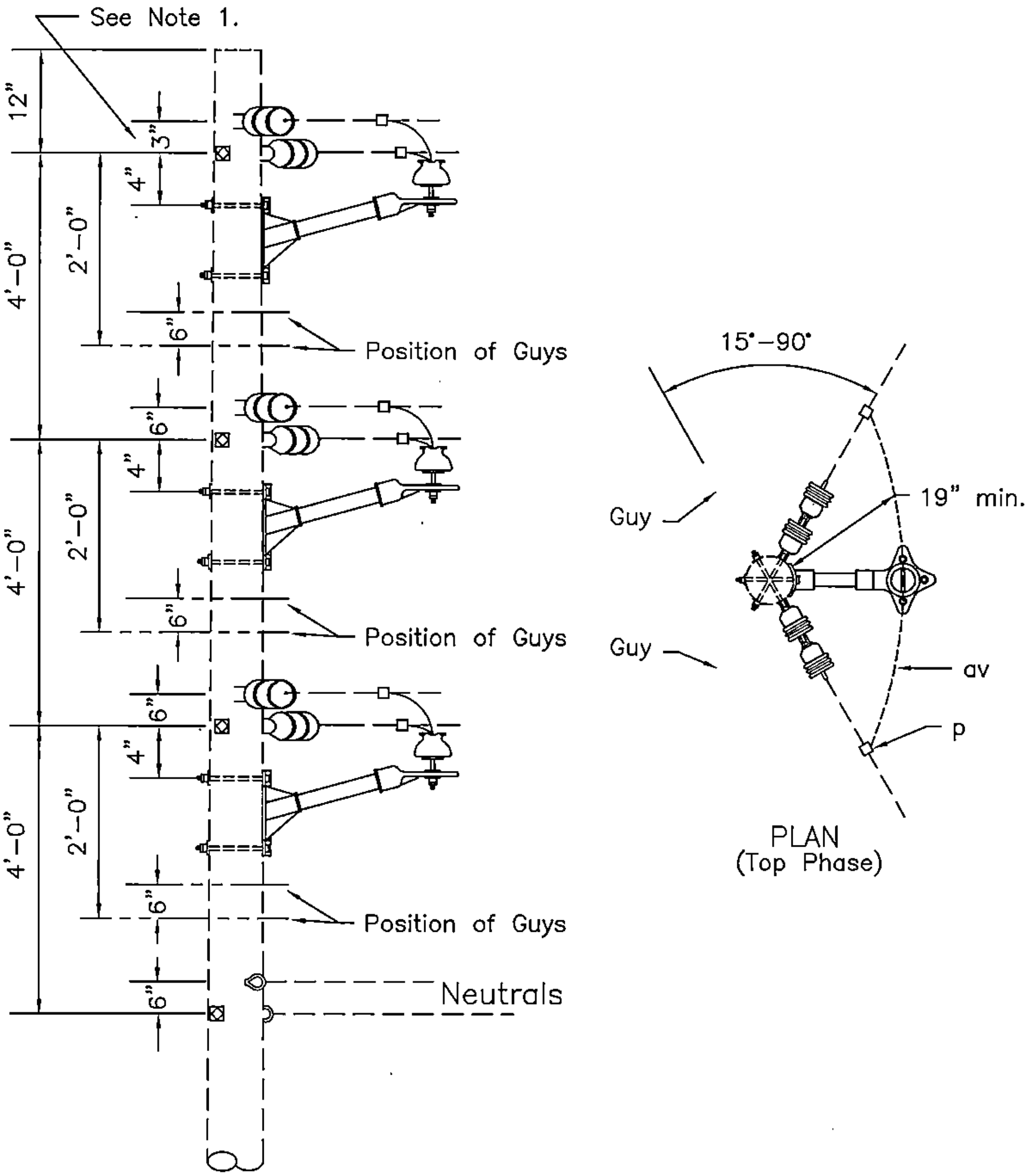
ITEM	QTY	MATERIAL
		Primary Assemblies, as req'd (See Note 2)
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE GUIDE (90°–150°)

APRIL 2005	3 – PHASE PRIMARY	C4.1G
RUS	12.47/7.2 kV	(C4–1)



NOTES:

1. Separate 6" (top position only) when angle equals 90°.
2. This drawing shows three C5.1 and three A1.04N assemblies as an example. Any combination of three A1.04N plus C5.1 – C5.9, or A5.1 – A5.9 and A5.01 – A5.03 assemblies may be installed. Record assemblies separately on staking sheets.
   CAUTION: Use the appropriate permitted longitudinal loads.

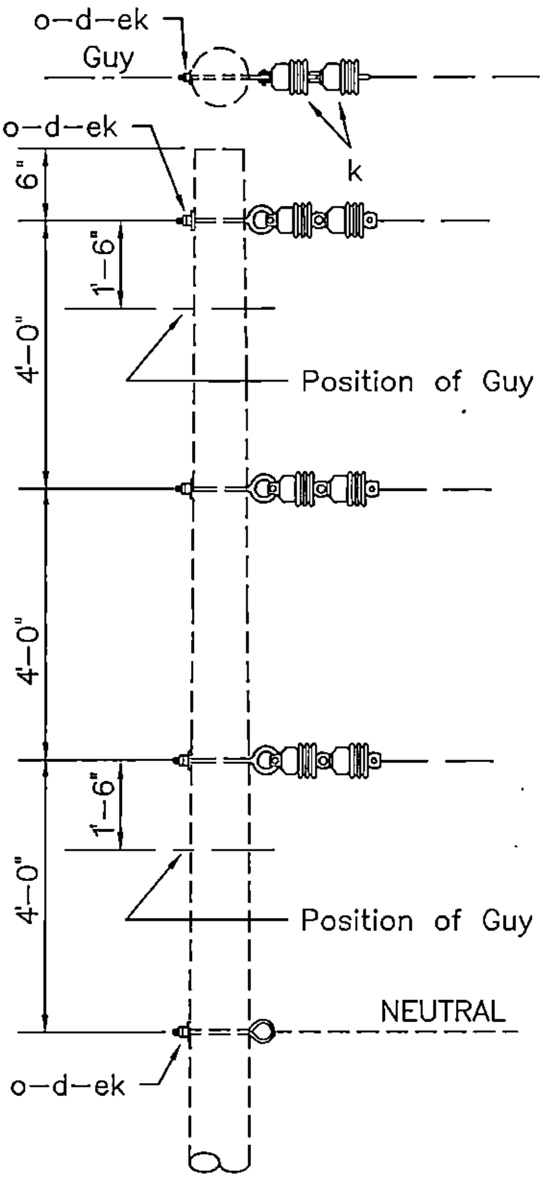
ITEM	QTY	MATERIAL
		Primary Assemblies, as req'd (See Note 2)
	3	A1.04N primary assemblies
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

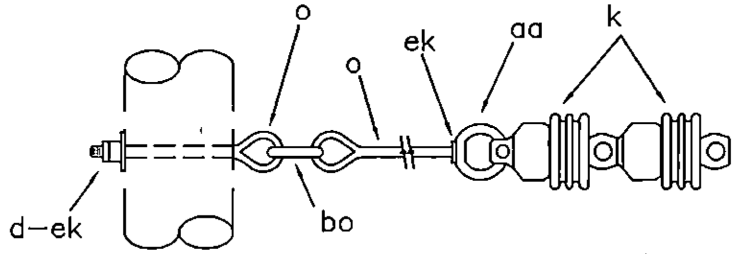
PERMITTED LONGITUDINAL LOAD = 5000 lbs./Conductor

DEADEND ANGLE GUIDE (15°–90°)

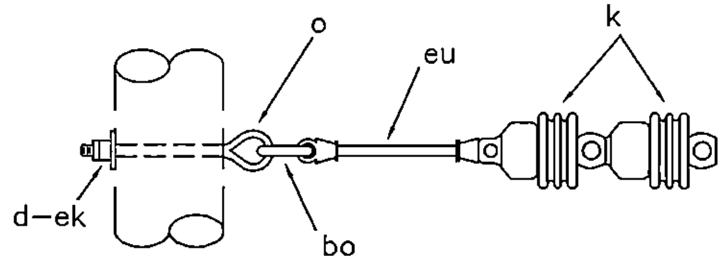
APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C4.2G



C5.1



C5.2



C5.3

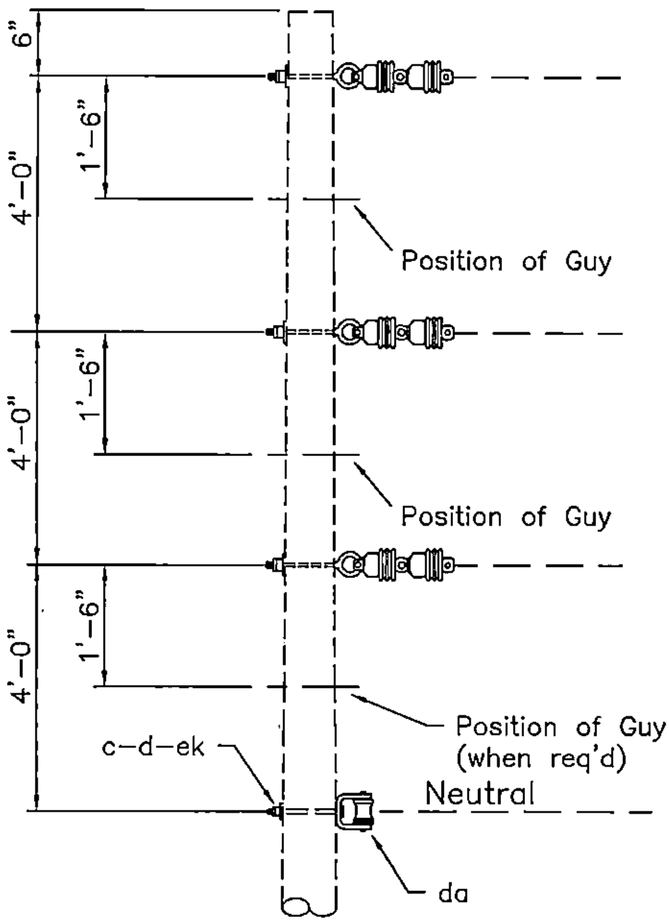
NOTE: Extension link (item "eu" or "du") or eyebolt (item "o"), eyenut (item "aa") and locknut (item "ek") may be installed in 2 lower primary positions on assembly C5.1. Adjust material as required.

	ASSEMBLY: C5	.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square, 3", curved	4	4	4
k	Insulator, suspension, 4 1/4"	6	6	6
o	Bolt, eye, 5/8"x req'd length	4	7	4
aa	Nut, eye		3	
bo	Shackle, anchor		3	3
ek	Locknuts	4	7	4
eu	Link, extension, insulated			3
(du)	(Link, extension) – (optional)			(3)

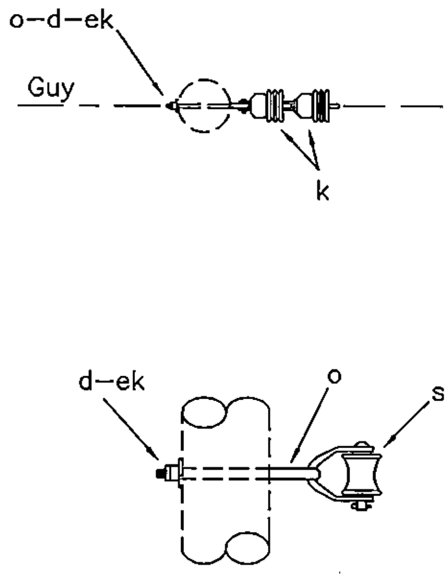
DESIGN PARAMETERS:
PERMITTED LONGITUDINAL
LOAD = 5000 lbs./Conductor

SINGLE DEADENDS

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C5.1,C5.2,C5.3 (C5.1)



C5.4



C5.7

C5.5 = C5.4 neutral assembly + C5.2 primary subassembly
C5.6 = C5.4 neutral assembly + C5.3 primary subassembly
C5.8 = C5.7 neutral assembly + C5.2 primary subassembly
C5.9 = C5.7 neutral assembly + C5.3 primary subassembly

NOTE: Extension link (item "eu" or "du") or eyebolt (item "o"), eyenut (item "aa") and locknut (item "ek") may be installed in 2 lower primary positions in assembly C5.4. Adjust material as required.

	ASSEMBLY: C5	.4	.5	.6	.7	.8	.9
ITEM	MATERIAL	QTY	QTY	QTY	QTY	QTY	QTY
c	Bolt, machine, 5/8" x req'd length	1	1	1			
d	Washer, square, 3", curved	4	4	4	4	4	4
k	Insulator, suspension, 4 1/4"	6	6	6	6	6	6
o	Bolt, eye, 5/8"x req'd length	3	6	3	4	7	4
s	Clevis, secondary, swinging, insulated				1	1	1
aa	Nut, eye		3			3	
bo	Shackle, anchor		3	3		3	3
da	Bracket, insulated	1	1	1			
ek	Locknuts	4	7	4	4	7	4
eu	Link, extension, insulated			3			3
(du)	(Link, extension) – (optional)			(3)			(3)

DESIGN PARAMETERS:

For ANSI Class 53-2 Spool Insulator (1 3/4") See Table VI

For ANSI Class 53-4 Spool Insulator (3") See Table VII

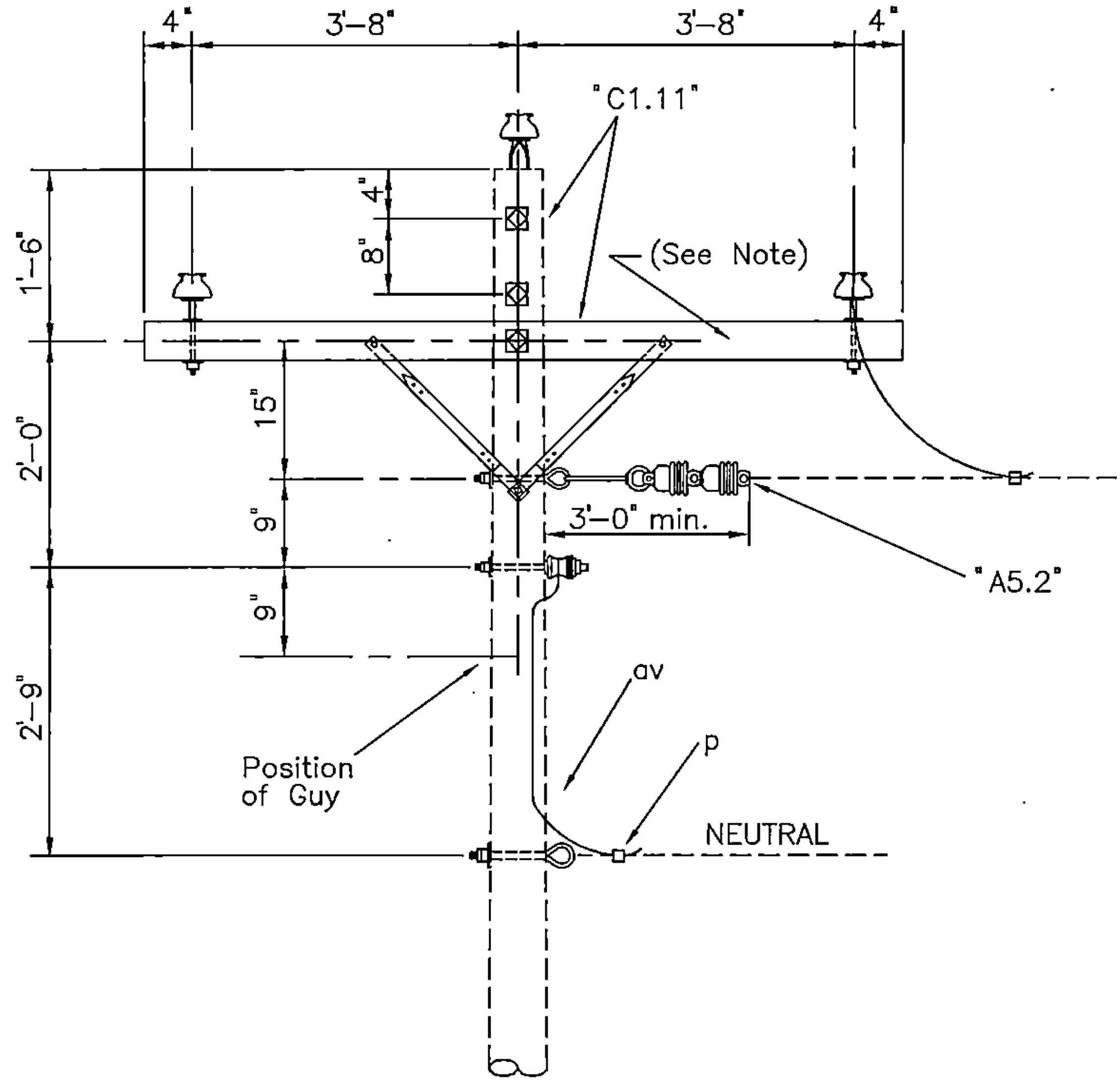
SINGLE DEADENDS

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C5.4 – C5.9



NOTE:
When tapping center phase, install post type insulator, "A1.011P", horizontally on crossarm, 19 inches (minimum) from surface of pole and fasten jumper to insulator.

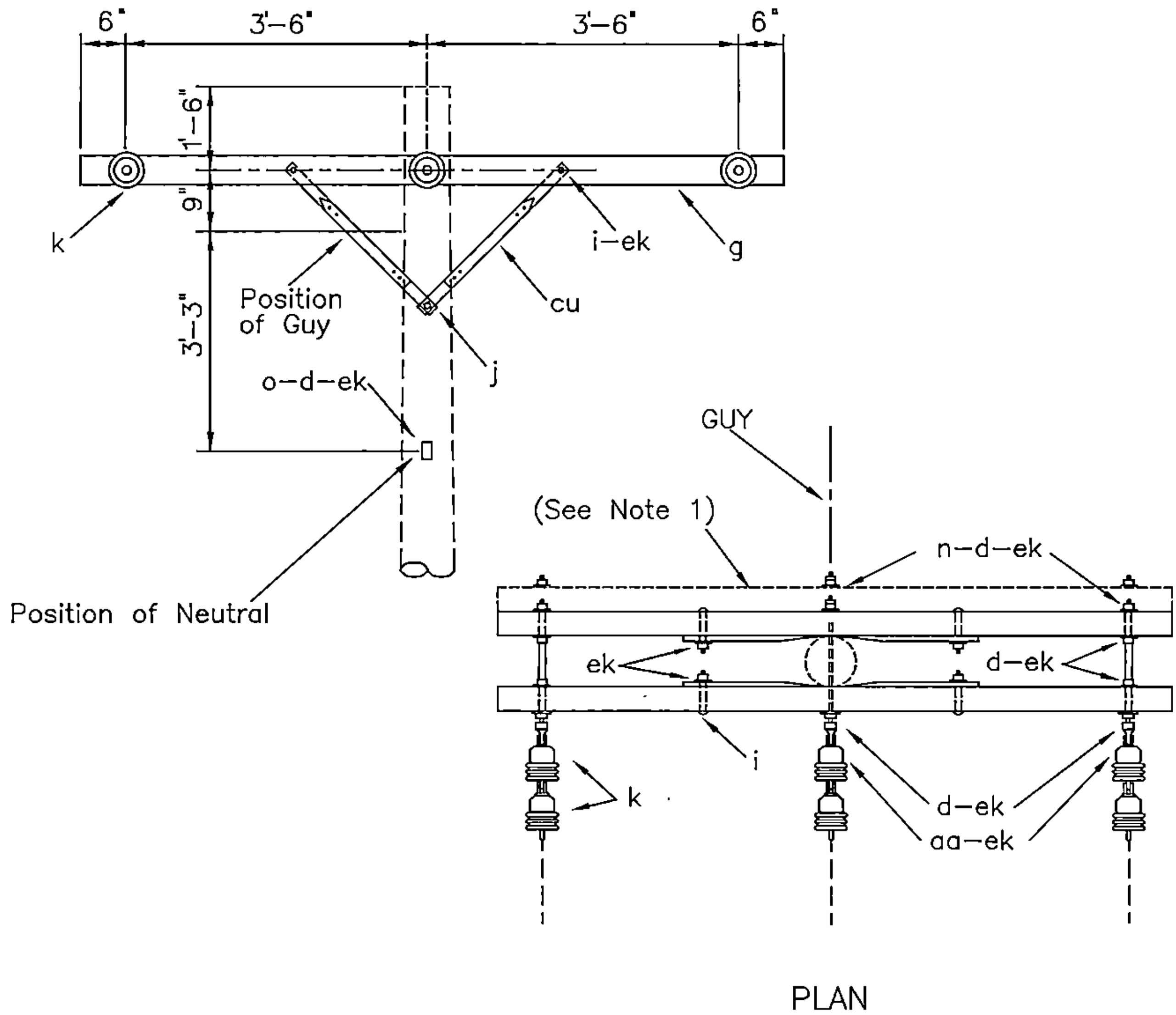
ITEM	QTY	MATERIAL
	1	"C1.11" Primary Assembly
	1	"A5.2" Primary Assembly
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL
LOAD = 5,000 lbs./Conductor

SINGLE PHASE TAP GUIDE

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C5.11G



ITEM	QTY	MATERIAL
d	1	Washer, square, 3", curved
d	10	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
k	6	Insulator, suspension, 4 1/4"
n	3	Bolt,double arming,5/8" x req'd length
o	1	Bolt, eye, 5/8" x req'd length
aa	3	Nut, eye, 5/8"
cu	4	Brace, 28"
ek	18	Locknuts

NOTES:

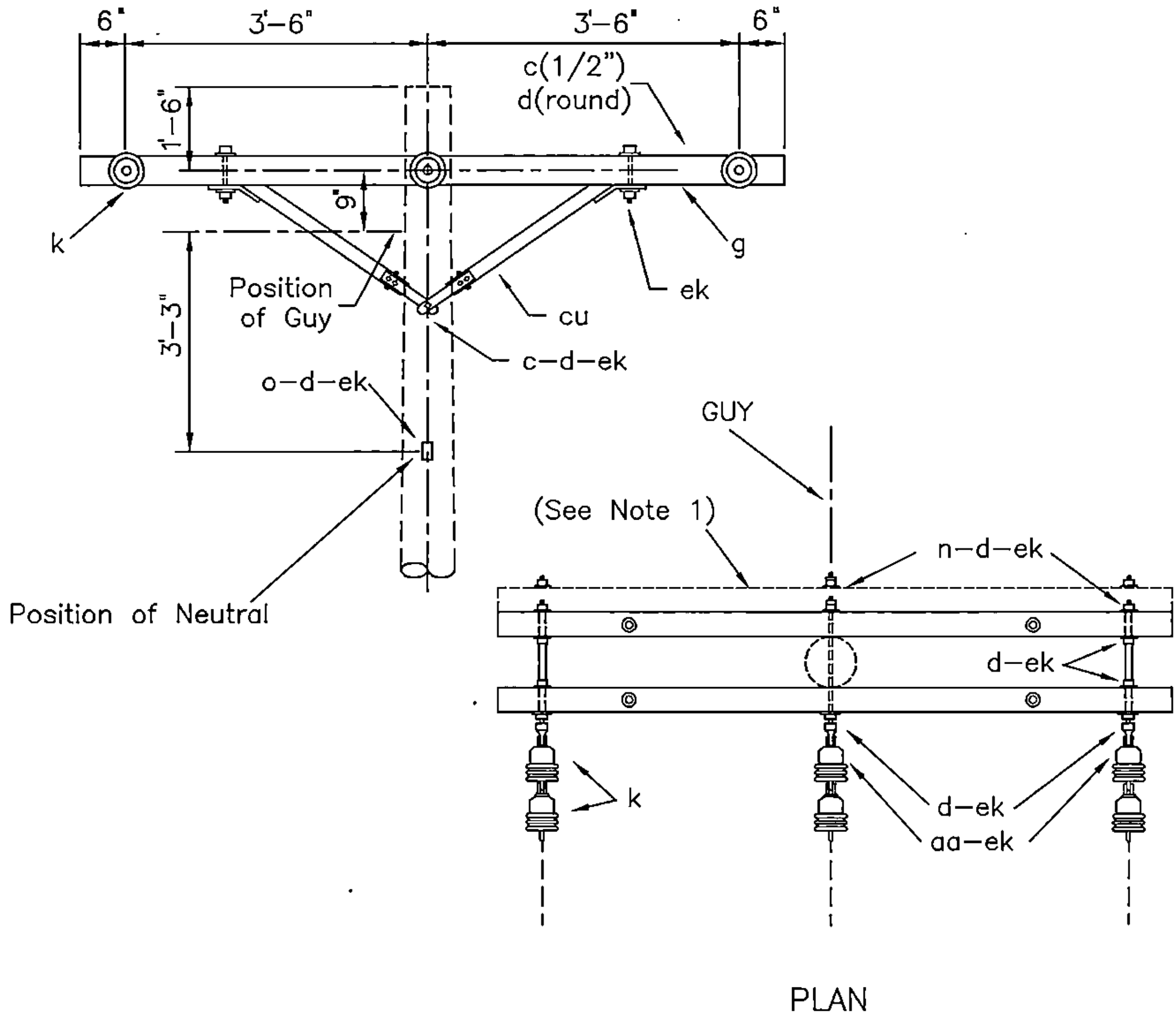
1. Designate as "C5.31" for assembly with three crossarms.
2. Double arming eye bolt, item "dy," may be used instead of double arming bolt, item "n," and eye nut, item "aa."
3. Other neutral assemblies may be used. See Section N. Adjust material as needed.

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table A (Exhibit 2)

SINGLE DEADEND ON CROSSARMS

APRIL 2005	3 – PHASE PRIMARY 12.47/7.2 kV	C5.21,C5.31 (C7),(C7-1)
RUS		



ITEM	QTY	MATERIAL
c	4	Bolt, machine, 1/2" x req'd length
d	4	Washer, round, 1 3/8"
d	1	Washer, square, 3", curved
d	11	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
k	6	Insulator, suspension, 4 1/4"
n	3	Bolt,double arming,5/8" x req'd length
o	1	Bolt, eye, 5/8" x req'd length
aa	3	Nut, eye, 5/8"
cu	2	Brace, wood, 60" span
ek	18	Locknuts

NOTES:

1. Designate as "C5.31L" for assembly with three crossarms.
2. Double arming eye bolt, item "dy," may be used instead of double arming bolt, item "n," and eye nut, item "aa."

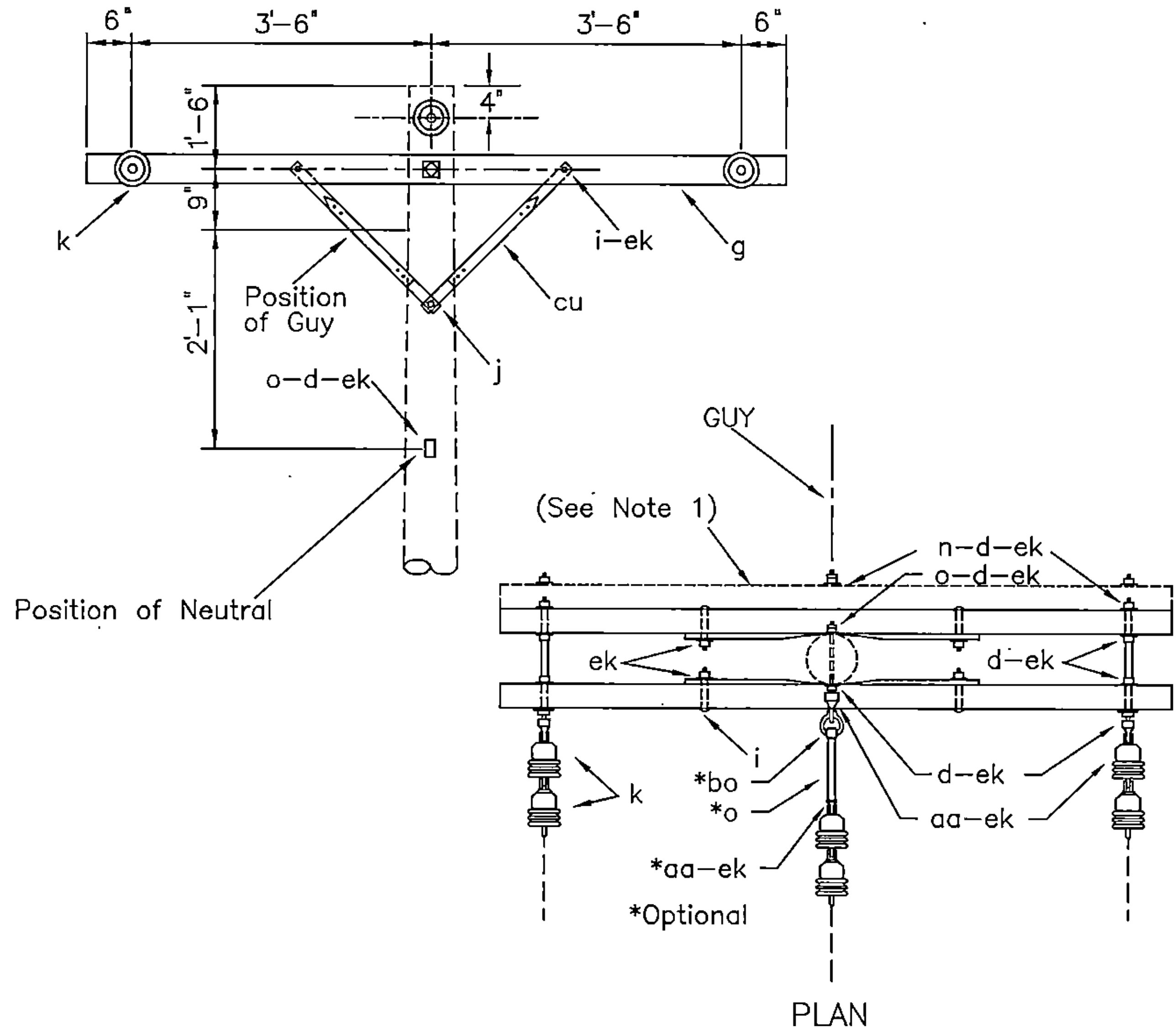
DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:

See Table A (Exhibit 2)

SINGLE DEADEND ON CROSSARMS (LARGE CONDUCTORS)

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C5.21L,C5.31L



ITEM	QTY	MATERIAL
d	2	Washer, square, 3", curved
d	10	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
k	6	Insulator, suspension, 4 1/4"
n	3	Bolt,double arming,5/8" x req'd length
o	3	Bolt, eye, 5/8" x req'd length
aa	3	Nut, eye, 5/8"
bo	1	Shackle, anchor
cu	4	Brace, 28"
ek	19	Locknuts

NOTES:

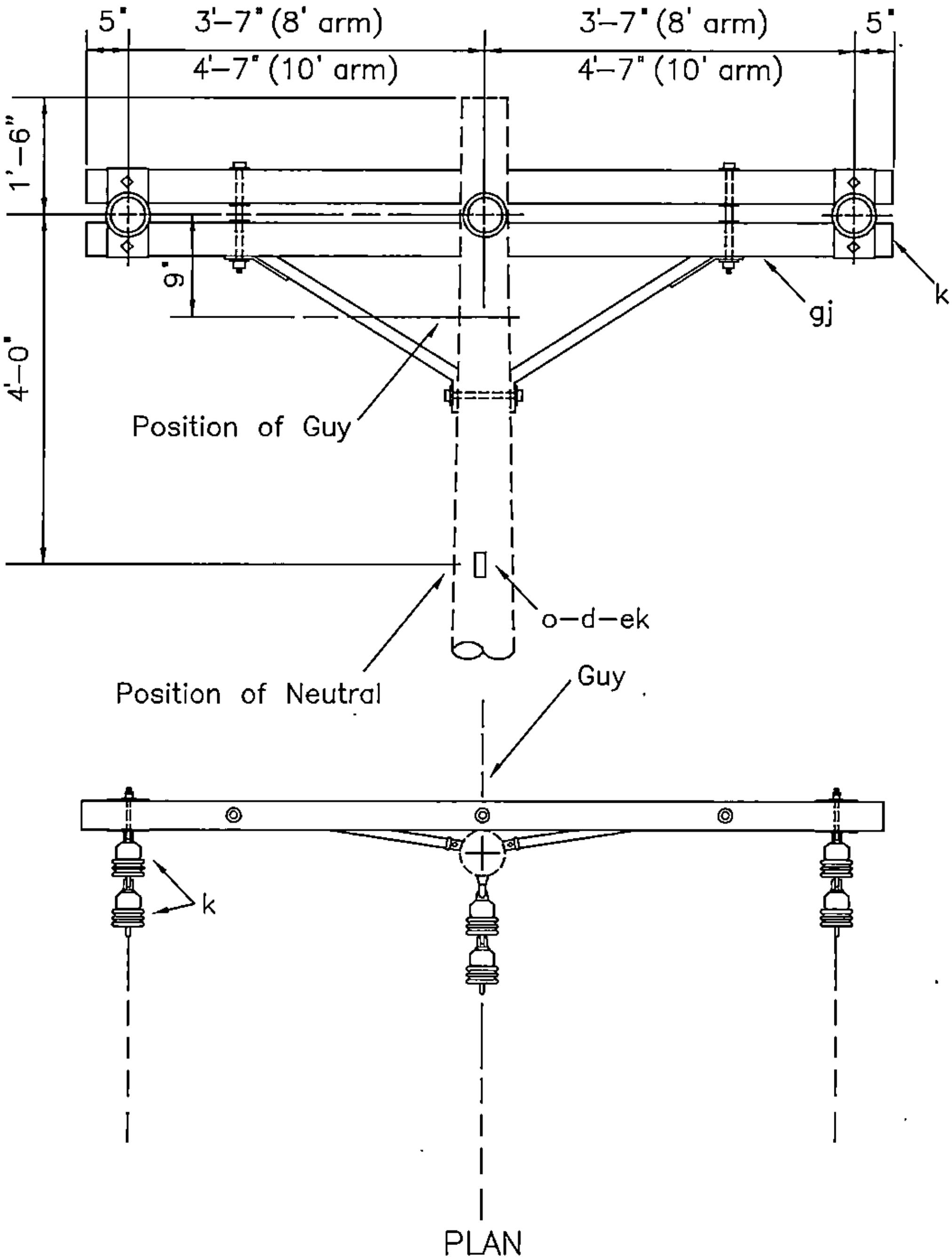
1. Designate as "C5.32" for assembly with three crossarms.
2. Double arming eye bolt, item "dy," may be used instead of double arming bolt, item "n," and eye nut, item "aa."
3. Other neutral assemblies may be used. See Section N. Adjust material as needed.

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table A (Exhibit 2)

SINGLE DEADEND ON CROSSARMS—ALTERNATIVE

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C5.22,C5.32 (C7–2)



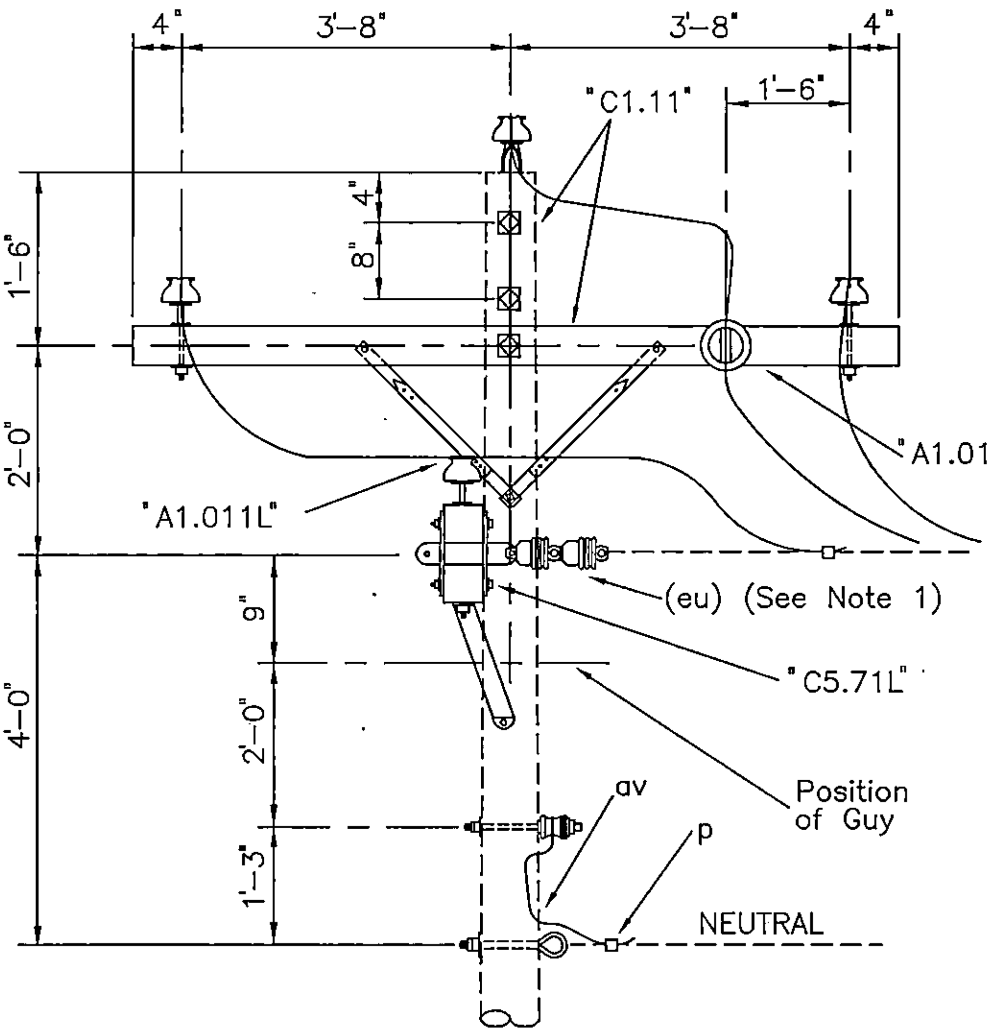
ITEM	QTY	MATERIAL
d	1	Washer, square, 3", curved
k	6	Insulator, suspension, 4 1/4"
o	1	Bolt, eye, 5/8" x req'd length
ek	1	Locknuts
gj	1	Crossarm Assembly

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD EQUALS LESSER OF:
5,000 lbs/Conductor, or
Manufacturer's specifications times NESC strength factor.

SINGLE DEADEND ON CROSSARM ASSEMBLY

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C5.71L (C7A)



NOTES:

1. Install insulated extension link, item "eu", in center phase of tap.
2. Jumper wires to be a minum of 19 inches to surface of pole.

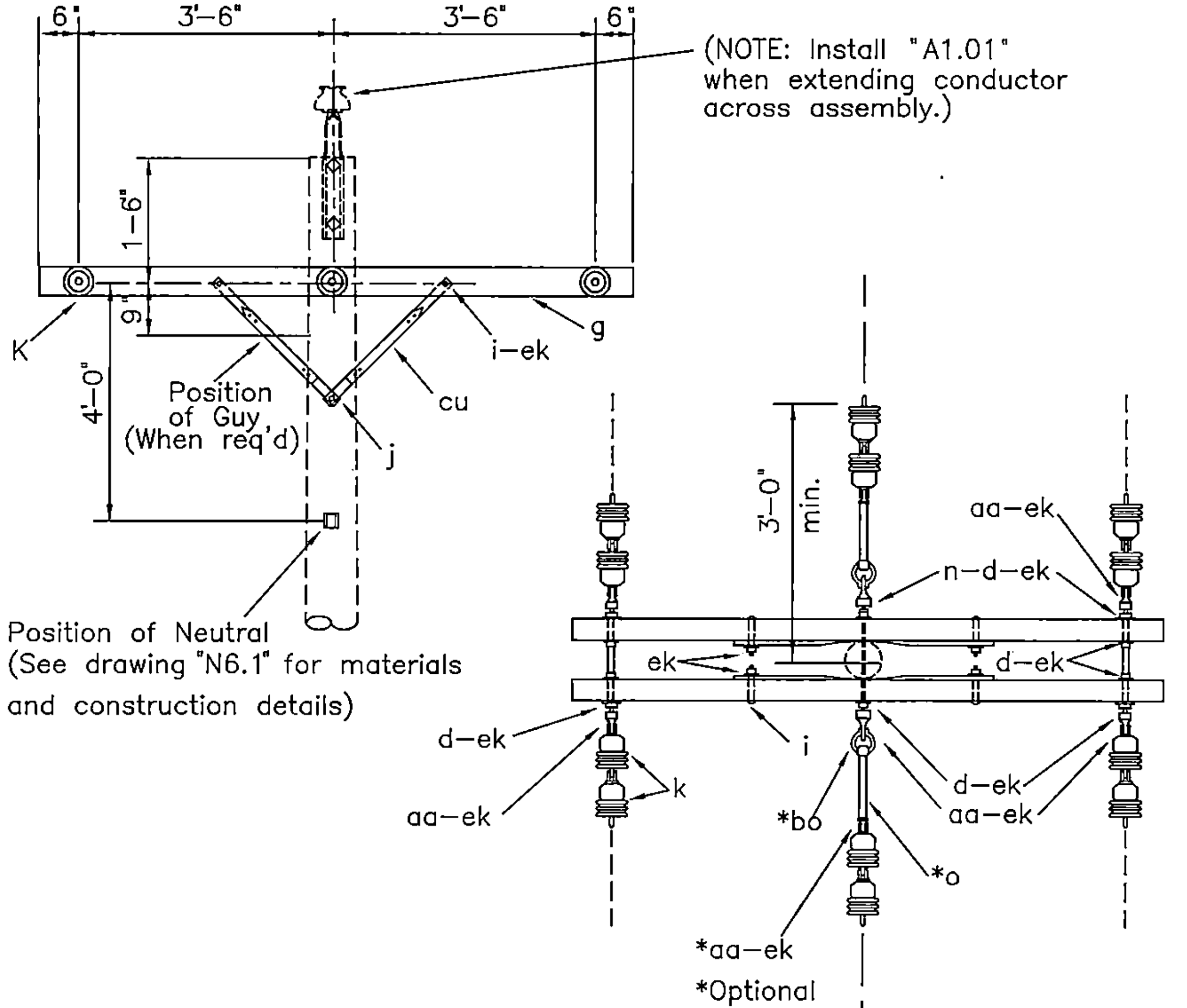
ITEM	QTY	MATERIAL
	1	C1.11 Primary Assembly
	1	C5.71L Primary Assembly
	(1)	(C5.21 or C5.31 Primary Assembly)
		(Use Table A – Exhibit 2)
	1	A1.011L Misc. Single Support
	1	A1.011P Misc. Single Support
p		Connectors, as req'd
av		Jumpers, as req'd
bo	1	Shackle, anchor
eu	1	Link, extension, insulated (18" min.)

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOAD EQUALS LESSER OF:
5,000 lbs./Conductor, or
Manufacturer's specifications times NESC strength factor.

THREE PHASE HORIZONTAL TAP GUIDE

APRIL 2005	3 – PHASE PRIMARY	C5.82G
RUS	12.47/7.2 kV	



ITEM	QTY	MATERIAL
d	2	Washer, square, 3", curved
d	10	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
k	12	Insulator, suspension, 4 1/4"
n	4	Bolt,double arming,5/8" x req'd length
o	2	Bolt, eye, 5/8" x req'd length
p		Connectors, as req'd
aa	8	Nut, eye, 5/8"
av		Jumpers, as req'd
bo	2	Shackle, anchor
cu	4	Brace, 28"
ek	26	Locknuts

NOTES:

1. Double arming bolt, item "n," and eye nut, item "aa," may be replaced with double arming eye bolt, item "dy."
2. Maximum line angle may be increased to 15° by installing anchor shackles, item "bo," to (horizontal) eye nuts and installing side guys as req'd.
3. Designate as C6.31 for assembly with three crossarms.

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:

See Table A (Exhibit 2)

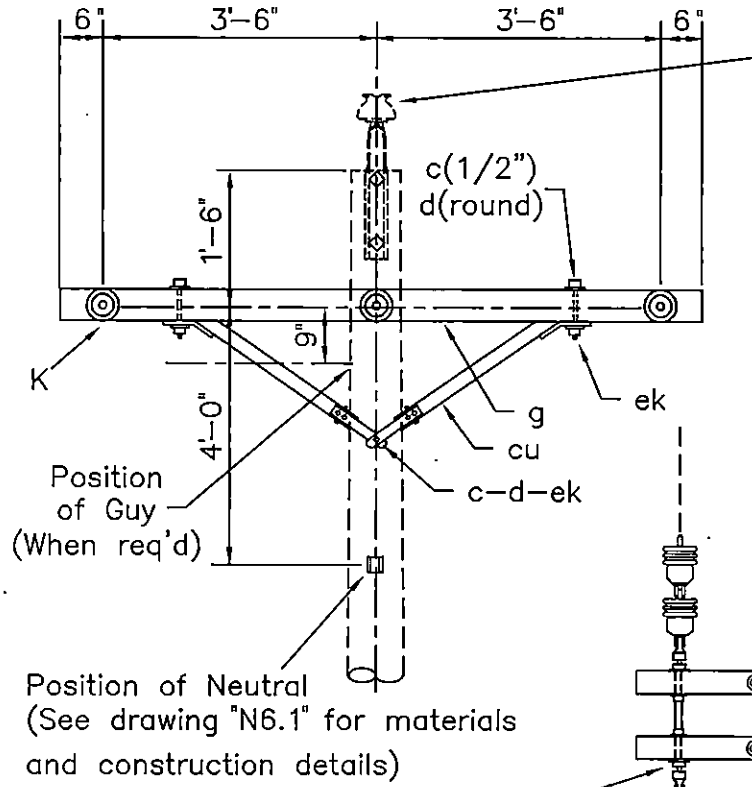
MAXIMUM LINE ANGLE = 5°
(See Note 2)

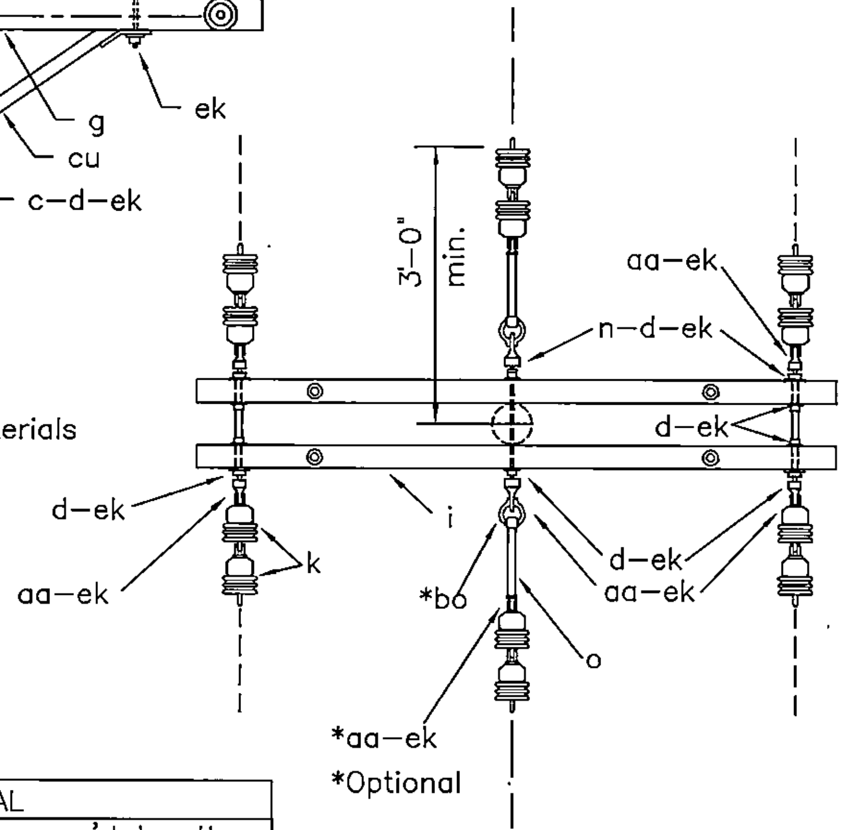
DOUBLE DEADEND ON CROSSARMS

APRIL 2005
RUS

3 - PHASE PRIMARY
12.47/7.2 kV

C6.21 (C8)
C6.31





ITEM	QTY	MATERIAL
c	1	Bolt, machine, 5/8" x req'd length
c	4	Bolt, machine, 1/2" x req'd length
d	4	Washer, round, 1 3/8"
d	2	Washer, square, 3", curved
d	11	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0
k	12	Insulator, suspension, 4 1/4"
n	4	Bolt,double arming,5/8" x req'd length
o	2	Bolt, eye, 5/8" x req'd length
p		Connectors, as req'd
aa	8	Nut, eye, 5/8"
av		Jumpers, as req'd
bo	2	Shackle, anchor
cu	2	Brace, wood, 60" span
ek	27	Locknuts

NOTES:

1. Double arming bolt, item "n," and eye nut, item "aa," may be replaced with double arming eye bolt, item "dy."
2. Maximum line angle may be increased to 15° by installing anchor shackles, item "bo," to (horizontal) eye nuts and installing side guys as req'd.
3. Designate as C6.31L for assembly with three crossarms.

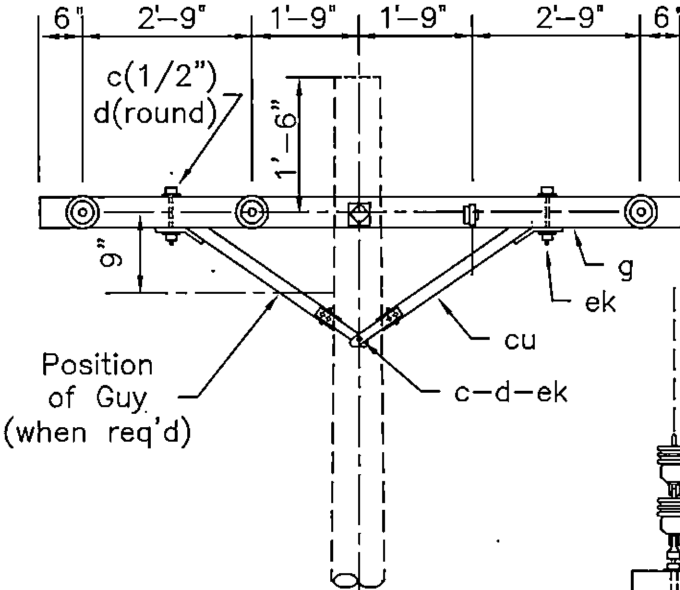
DESIGN PARAMETERS:

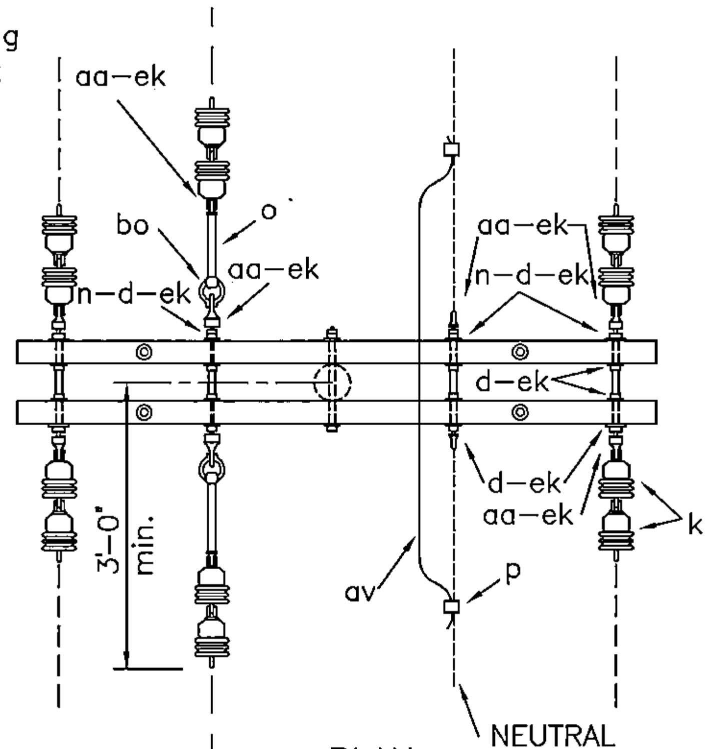
PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table A (Exhibit 2)

MAXIMUM LINE ANGLE = 5°
(See Note 2)

DOUBLE DEADEND ON CROSSARMS
(LARGE CONDUCTORS)

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C6.21L C6.31L (C8-3)





PLAN

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 1/2" x req'd length
c	2	Bolt, machine, 5/8" x req'd length
d	4	washer, round, 1 3/8"
d	19	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'–0"
k	12	Insulator, suspension, 4 1/4"
n	4	Bolt, double arm, 5/8" x req'd length
o	2	Bolt, eye, 5/8" x req'd length
p		Connectors, as req'd
aa	10	Nut, eye, 5/8"
av		Jumpers, as req'd
bo	2	Shackle, anchor
cu	2	Brace, wood, 60" span
ek	29	Locknuts

NOTES:

1. Double arming bolt, item "n" and eye nut, item "aa", may be replaced with double arming eye bolt, item "dy."
2. Maximum line angle may be increased to 15° by installing anchor shackles, item "bo", to (horizontal) eye nuts and installing side guys as req'd.
3. See drawing "N6.21" for additional details.
4. Designate as "C6.53" for assembly with 3 crossarms.

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:
See Table B (Exhibit 2)

MAXIMUM LINE ANGLE = 5°
(See Note 2)

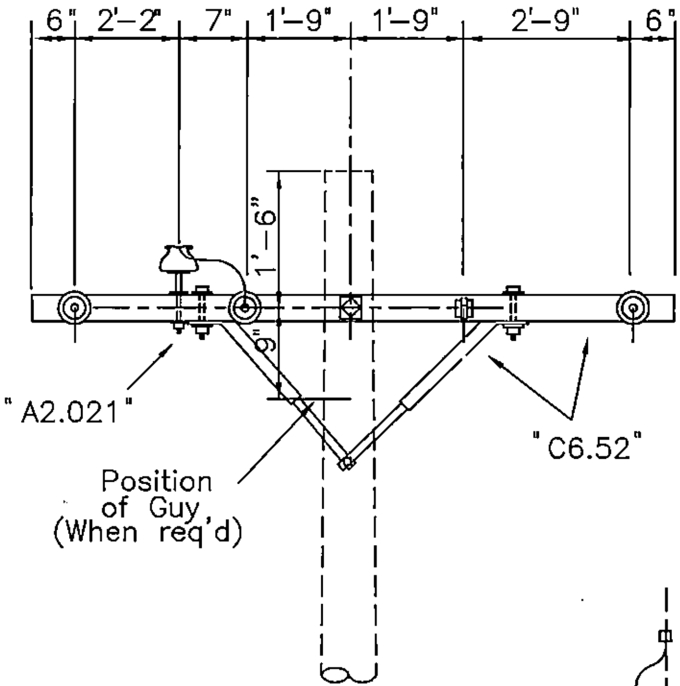
DOUBLE DEADEND ON 10 FOOT CROSSARMS

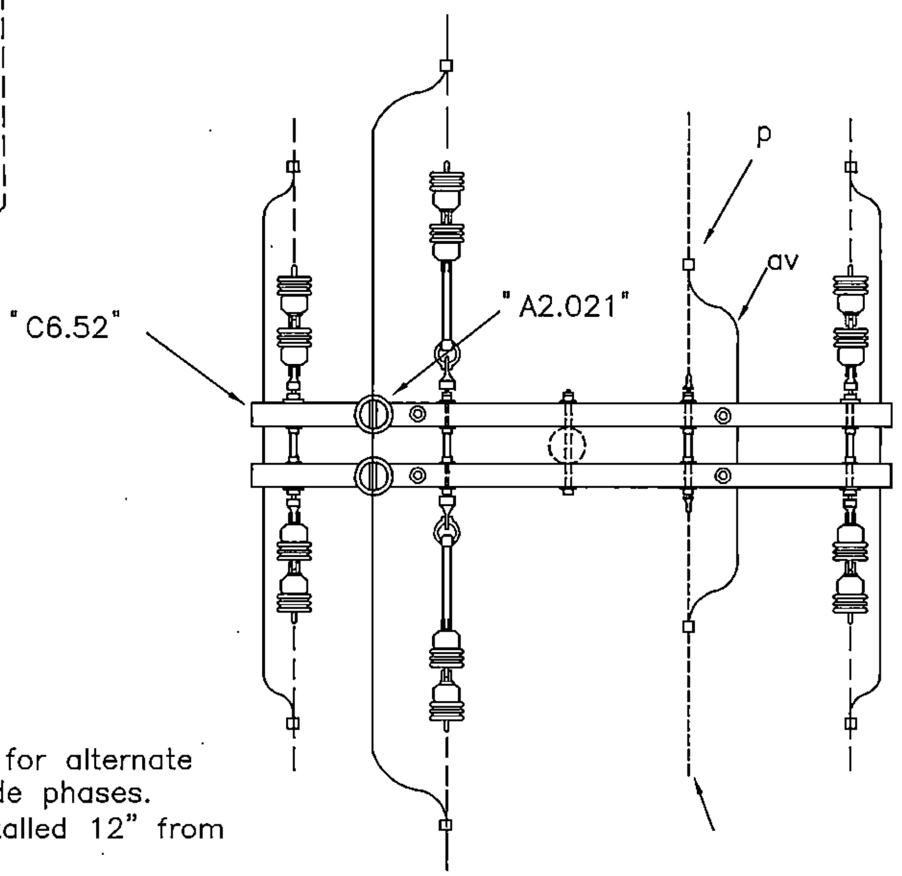
APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

C6.52,C6.53





PLAN

NOTES:

1. See drawing "A6.22G" for alternate feed through of outside phases.
2. Crossarm may be installed 12" from top of pole.

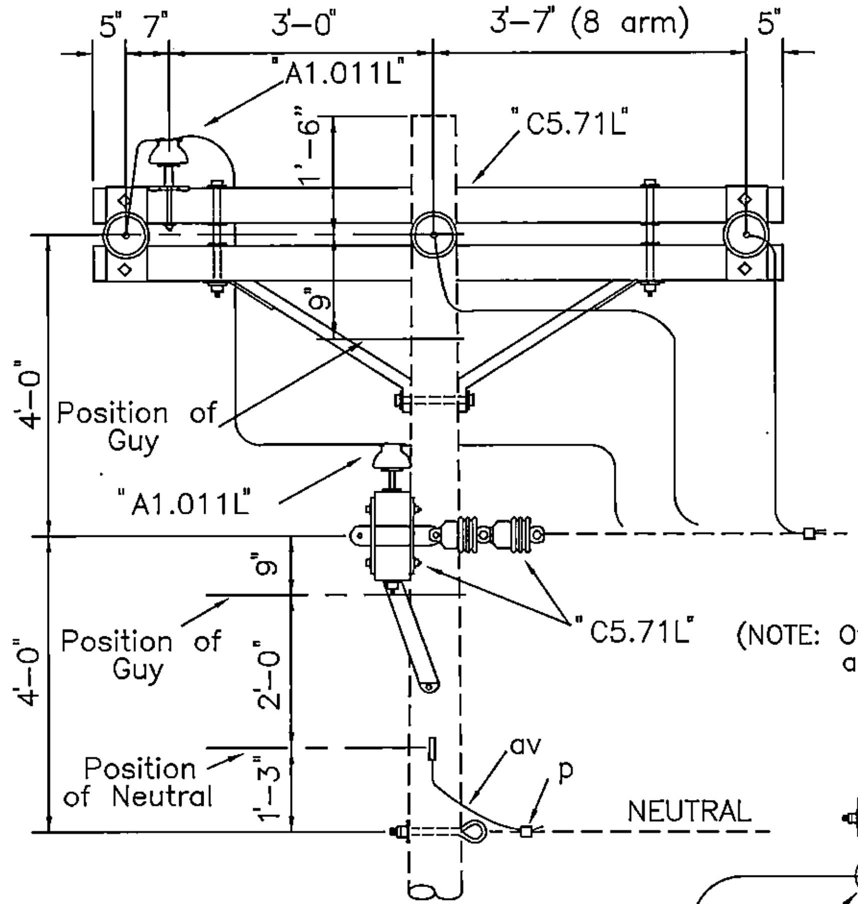
ITEM	QTY	MATERIAL
	1	C6.51 Primary Assembly
	1	A2.021 Primary Assembly
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

See: Table B (Exhibit 2)

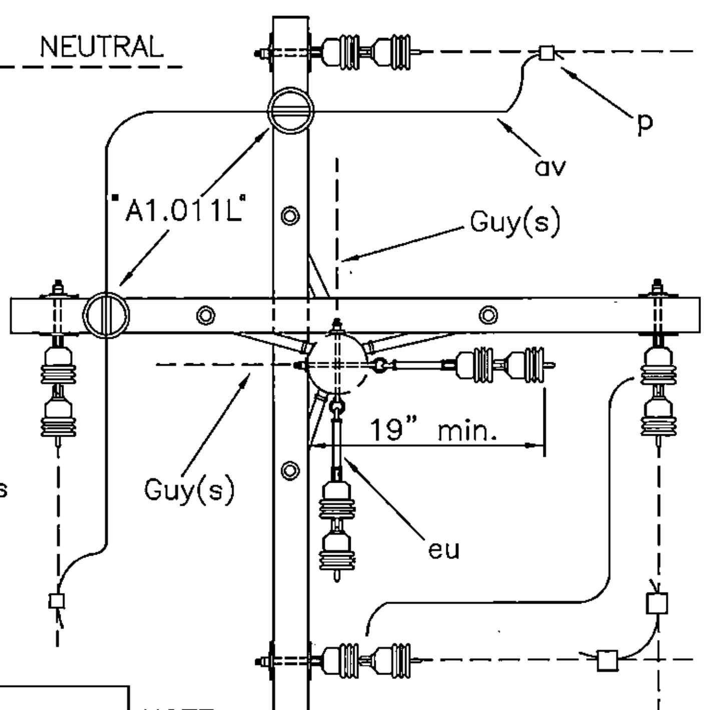
DOUBLE DEADEND ON 10 FOOT CROSSARMS
(FEEDTHROUGH GUIDE)

APRIL 2005	3 – PHASE PRIMARY	
RUS	12.47/7.2 kV	C6.52G



(NOTE: Other double or triple crossarm assemblies may be used.)

PLAN



NOTE: Guy angle of top down guy needs to be less than 39° (4:5 guy lead to height ratio). A 1:1 guy ratio is permitted if 10 foot crossarm assembly is used in bottom position. Install guy strain insulator, "w" 60" minimum, in top down guy. (See "E1.5")

ITEM	QTY	MATERIAL
	2	C5.71L Primary (Crossarm) Assembly
	2	A1.011L Misc. Single Support
p		Connectors, as req'd
av		Jumpers, as req'd
eu	2	Link, extension, insulated, 12" min.

NOTE:
Vertical deadends, Dwg. "C4.1," is preferred construction.

DESIGN PARAMETERS:

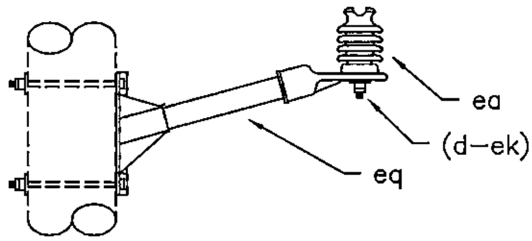
PERMITTED LONGITUDINAL LOAD EQUALS LESSER OF:
5,000 lbs./Conductor, or Manufacturer's specifications times NESC strength factor.

DOUBLE DEADENDS (BUCKARMS) GUIDE

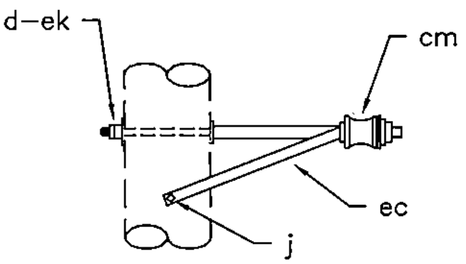
APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	C6.91G

DOUBLE CIRCUIT PRIMARY POLE TOP ASSEMBLY UNITS

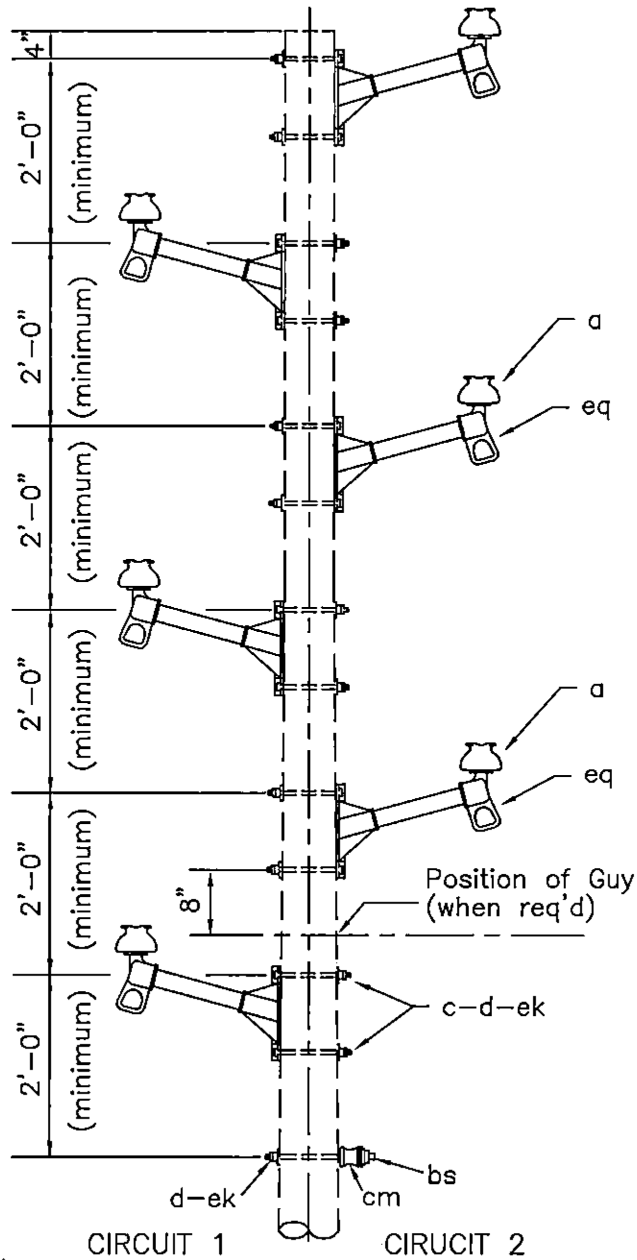
DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
D1.4N D1.4NP D1.5N D1.5NP		SINGLE SUPPORT - NARROW PROFILE (TANGENT) (and POST INSULATORS)
D1.81 D1.82	(DC-C1)	SINGLE SUPPORT ON CROSSARMS (TANGENT)
D1.81L D1.82L		SINGLE SUPPORT ON CROSSARMS (TANGENT) (LARGE CONDUCTORS)
D1.81P D1.82P		SINGLE SUPPORT ON CROSSARMS (TANGENT) (POST INSULATORS)
D1.83		SINGLE SUPPORT ON CROSSARMS
D1.83L		SINGLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)
D1.83P		SINGLE SUPPORT ON CROSSARMS (POST INSULATORS)
D2.9N D2.9NP		DOUBLE SUPPORT - NARROW PROFILE (and POST INSULATORS)
D2.91	(DC-C2-1)	DOUBLE SUPPORT ON CROSSARMS
D2.91L		DOUBLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)
D2.91P		DOUBLE SUPPORT ON CROSSARMS (POST INSULATORS)
D3.1G		SUSPENSION ANGLE GUIDE
D4.1G		DEADEND ANGLE GUIDE
D5.91G		THREE PHASE TAP GUIDE
D6.91	(DC-C8)	DOUBLE DEADENDS ON CROSSARMS (FEEDTHROUGH)



Specify D1.4NP or D1.5NP for post type insulators.



Specify D1.5N or D1.5NP for offset neutral assembly.



NOTE: If additional guying is required, use assembly D2.9N or D2.9NP.

	ASSEMBLY: D1.	4N	4NP	5N	5NP	
ITEM	MATERIAL	QTY	QTY	QTY	QTY	
a	Insulator, pin type (12.47/7.2 kV)	6		6		
c	Bolt, machine, 5/8" x req'd length	12	12	12	12	
d	Washer, square 2 1/4"	13	13	13	13	
(f)	(Pin, crossarm, 5/8" x 6 1/2")	(6)		(6)		(if req'd)
j	Screw, lag, 1/2" x 4"			2	2	
bs	Bolt, single, upset	1	1			
cm	Insulator, spool, 3"	1	1	1	1	
ea	Insulator, post type (12.47/7.2kV)		6		6	
ec	Bracket, offset, neutral			1	1	
ek	Locknuts	13	13	13	13	
eq	Bracket, insulator/equipment	6	6	6	6	

Design Parameters:

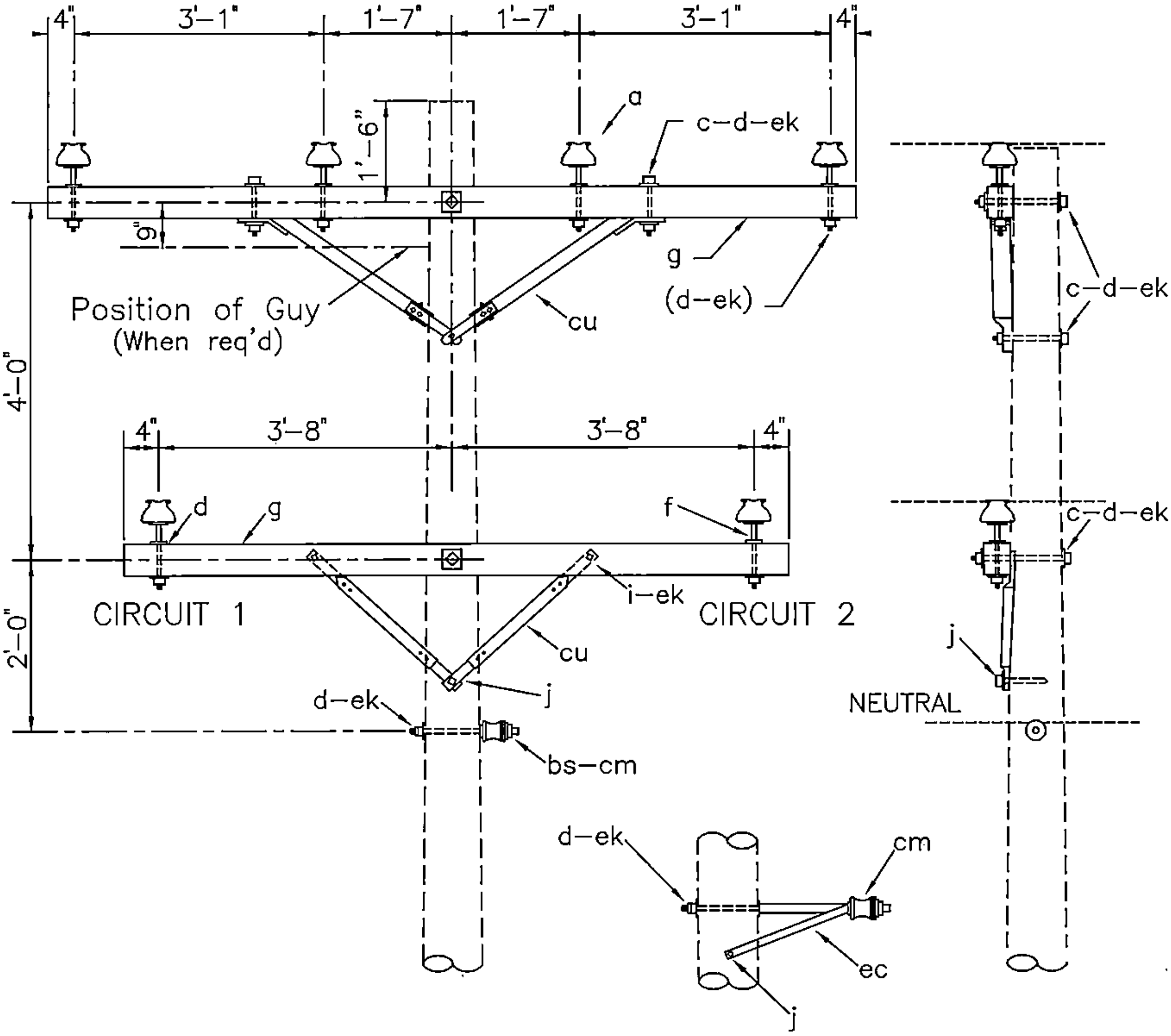
MAXIMUM LINE ANGLES:
5°-Small Conductors
2°-Larger than #1/0

SINGLE SUPPORT-NARROW PROFILE
(TANGENT)

APRIL 2005
RUS

DOUBLE CIRCUIT PRIMARY
12.47/7.2 kV

D1.4N,D1.4NP
D1.5N,D1.5NP



Specify D1.82 for
offset neutral assembly

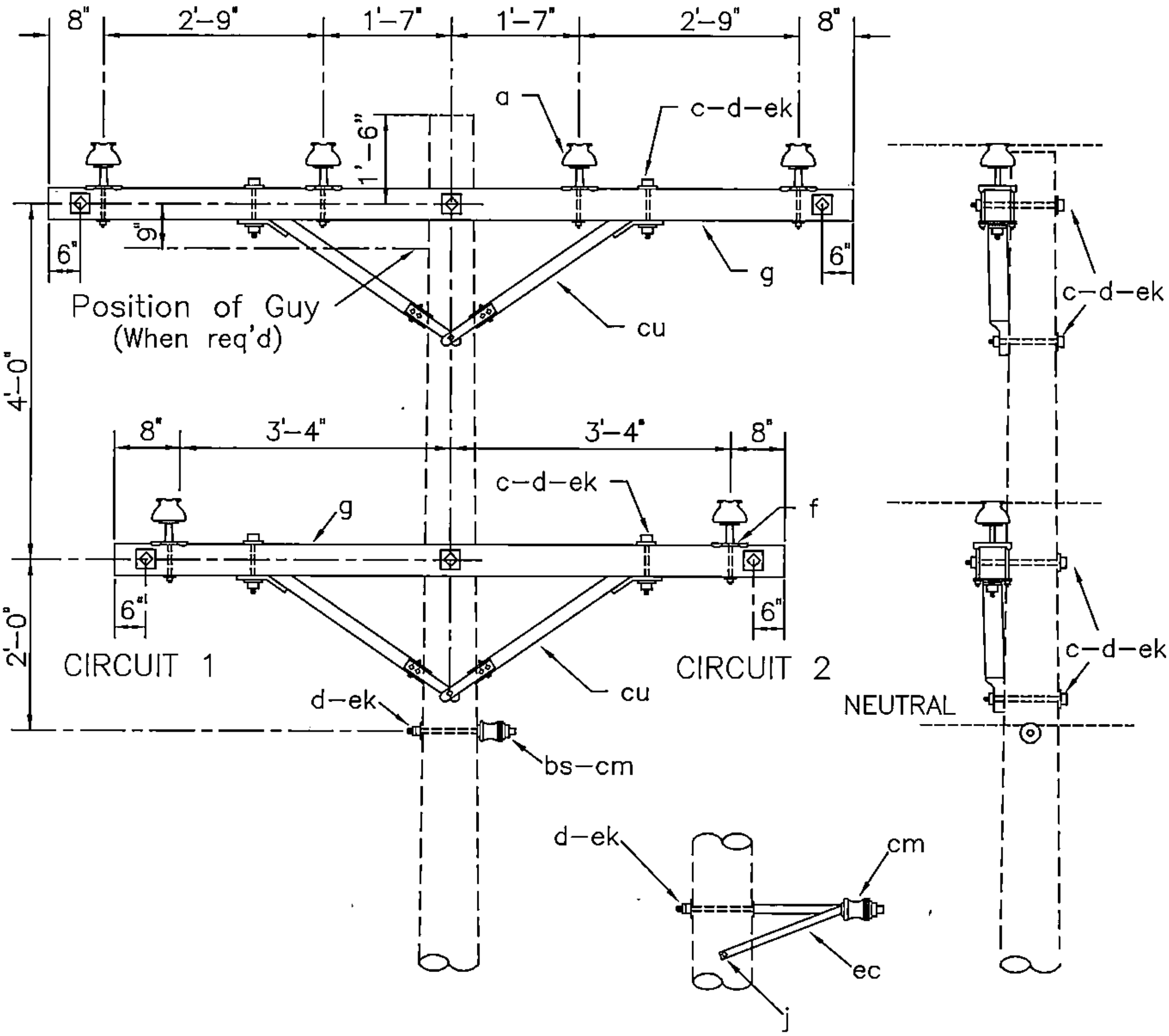
ITEM	MATERIAL (ASSEMBLY: D1.)	81 QTY	82 QTY
a	Insulator, pin type, (12.47/7.2 kV)	6	6
c	Bolt, machine, 1/2" x req'd length	2	2
c	Bolt, machine, 5/8 x req'd length	3	3
d	Washer, round, 1 3/8"	2	2
d	Washer, square, 2 1/4"	12	12
f	Pin, crossarm, steel, 5/8" x 10 3/4"	6	6
g	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"	1	1
g	Crossarm, 3 5/8" x 4 5/8" x 10'– 0"	1	1
i	Bolt, carriage, 3/8" x 4 1/2"	2	2
j	Screw, lag, 1/2" x 4"	1	3
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	Brace, 28"	2	2
cu	Brace, wood, 60" span	1	1
ec	Bracket, offset, neutral		1
ek	Locknuts	8	8

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT ON CROSSARMS (TANGENT)

APRIL 2005 / RUS	DOUBLE CIRCUIT PRIMARY 12.47/7.2 kV	D1.81 (DC–C1) D1.82



Specify D1.82L for offset neutral assembly

ITEM	MATERIAL (ASSEMBLY: D1.)	81L QTY	82L QTY
a	Insulator, pin type, (12.47/7.2 kV)	6	6
c	Bolt, machine, 1/2" x req'd length	4	4
c	Bolt, machine, 5/8 x req'd length	8	8
d	Washer, round, 1 3/8"	4	4
d	Washer, square, 2 1/4"	15	15
f	Pin, crossarm, steel, clamp type	6	6
g	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"	1	1
g	Crossarm, 3 5/8" x 4 5/8" x 10'- 0"	1	1

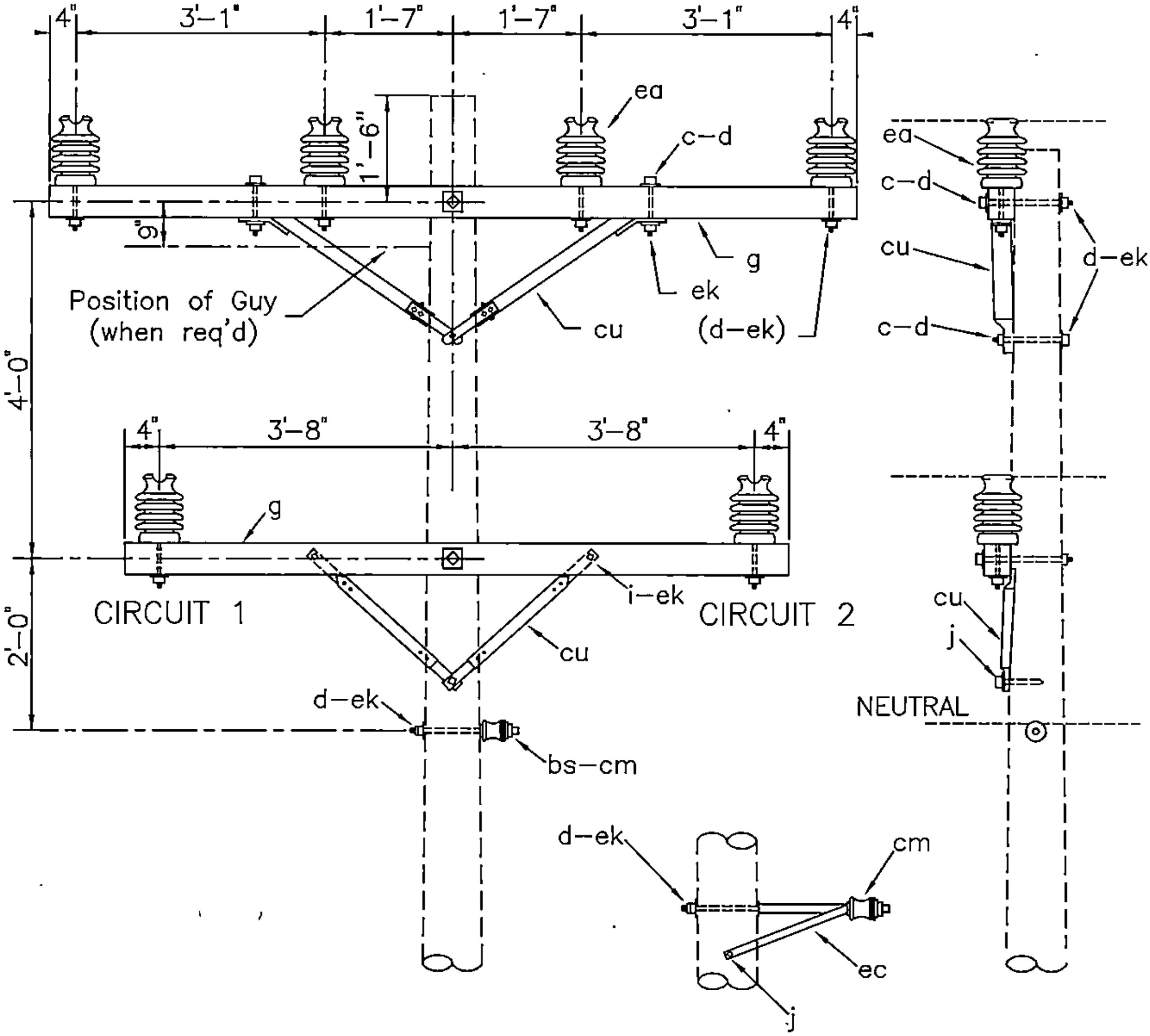
ITEM	MATERIAL (ASSEMBLY: D1.)	81L QTY	82L QTY
j	Screw, lag, 1/2" x 4"	0	3
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	brace, wood, 60" span	2	2
ec	Bracket, offset, neutral		1
ek	Locknuts	13	13

DESIGN PARAMETERS:

MAXIMUM LINE ANGLE = 2°

SINGLE SUPPORT ON CROSSARMS (TANGENT) (LARGE CONDUCTORS)

APRIL 2005 / RUS	DOUBLE CIRCUIT PRIMARY 12.47/7.2 kV	D1.81L / D1.82L



Specify D1.82P for
offset neutral assembly

	ASSEMBLY: D1.	81P	82P
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 1/2" x req'd length	2	2
c	Bolt, machine, 5/8 x req'd length	3	3
d	Washer, round, 1 3/8"	2	2
d	Washer, square, 2 1/4"	6	6
g	Crossarm, 3 5/8" x 4 5/8" x 8' – 0"	1	1
g	Crossarm, 3 5/8" x 4 5/8" x 10'– 0"	1	1
i	Bolt, carriage, 3/8" x 4 1/2"	2	2
j	Screw, lag, 1/2" x 4	1	3

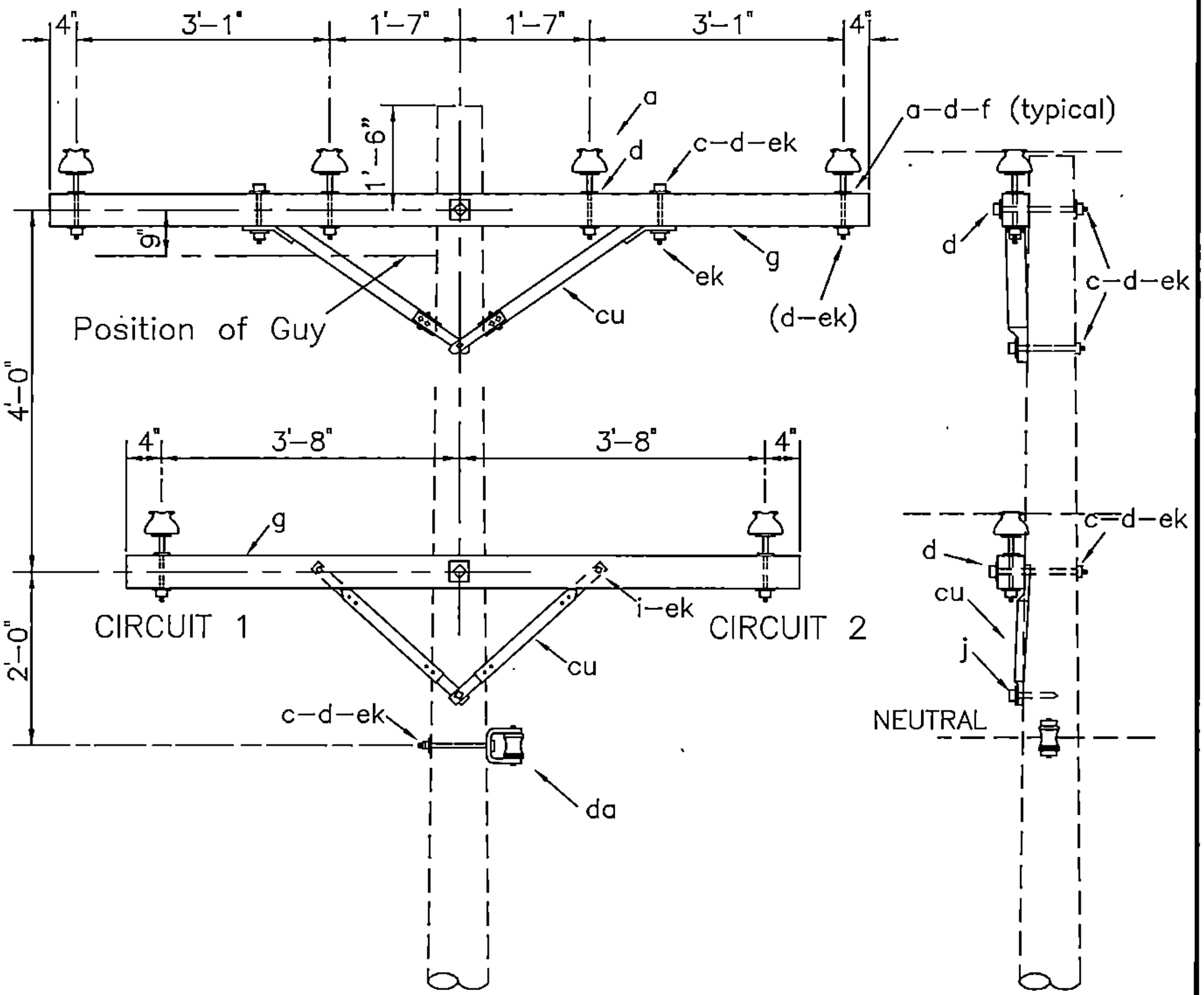
	ASSEMBLY: D1.	81P	82P
ITEM	MATERIAL	QTY	QTY
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
cu	Brace, 28"	2	2
cu	Brace, wood, 60" span	1	1
ea	Insulator, post type, (12.47/7.2 kV)	6	6
ec	Bracket, offset, neutral		1
ek	Locknuts	8	8

DESIGN PARAMETERS:

MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

SINGLE SUPPORT ON CROSSARMS
(TANGENT) (POST INSULATORS)

APRIL 2005	DOUBLE CIRCUIT PRIMARY	D1.81P
RUS	12.47/7.2 kV	D1.82P



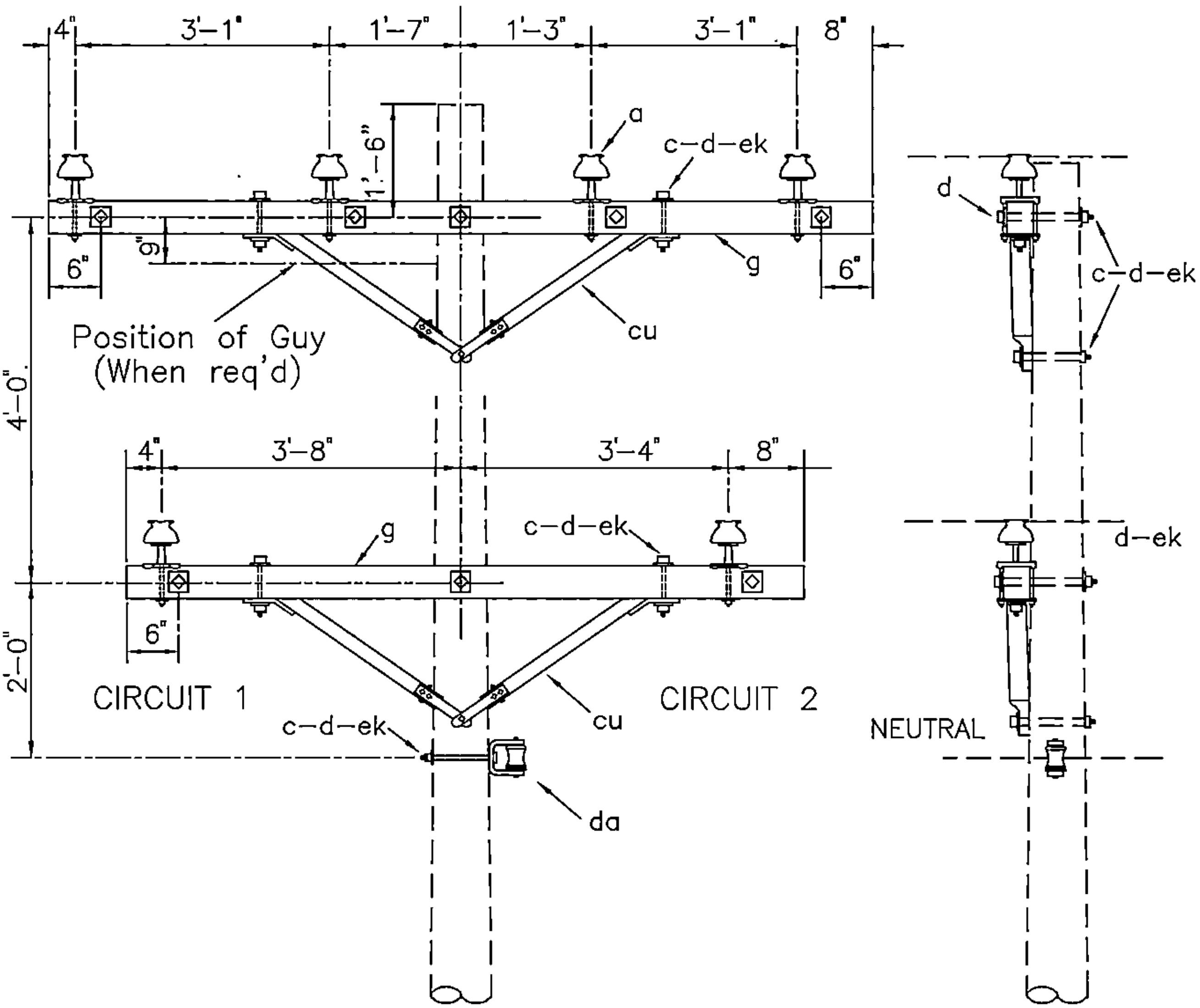
ITEM	QTY	MATERIAL
a	6	Insulator, pin type, (12.47/7.2 kV)
c	2	Bolt, machine, 1/2" x req'd length
c	4	Bolt, machine, 5/8" x length
d	2	Washer, round, 1 3/8"
d	12	Washer, square, 2 1/4"
f	6	Pin, crossarm, steel, 5/8" x 10 3/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8'-0"

ITEM	QTY	MATERIAL
g	1	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
cu	2	Brace, 28"
cu	1	Brace, wood, 60" span
da	1	Bracket, insulated
ek	8	Locknuts

DESIGN PARAMETERS:
See Table II

SINGLE SUPPORT ON CROSSARMS

APRIL 2005	DOUBLE CIRCUIT PRIMARY 12.47/7.2 kV	D1.83
RUS		



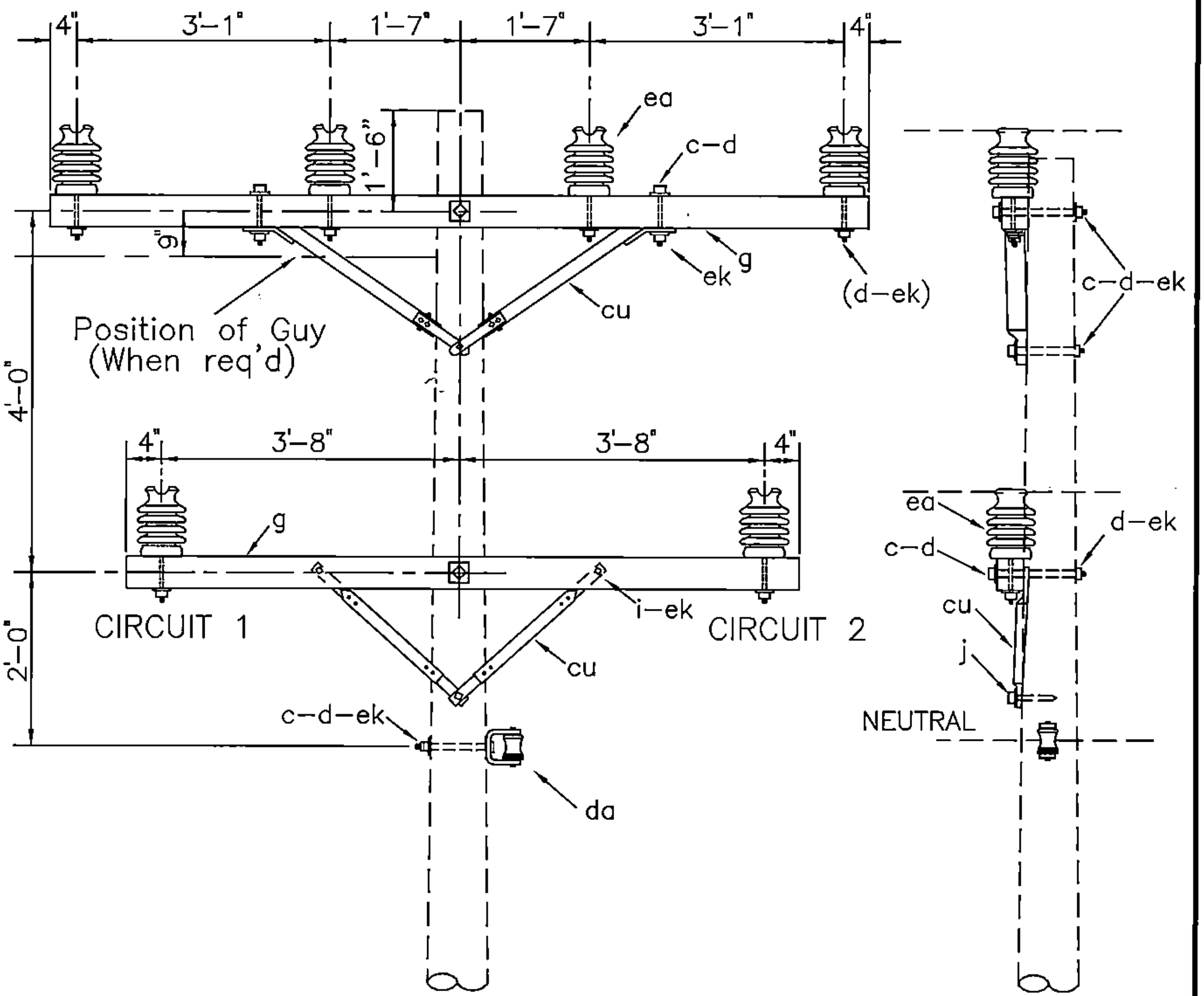
ITEM	QTY	MATERIAL
a	6	Insulator, pin type, (12.47/7.2 kV)
c	4	Bolt, machine, 1/2" x req'd length
c	11	Bolt, machine, 5/8" x length
d	4	Washer, round, 1 3/8"
d	19	Washer, square, 2 1/4"
f	6	Pin, crossarm, steel, clamp type
g	1	Crossarm, 3 5/8" x 4 5/8" x 8'-0"

ITEM	QTY	MATERIAL
g	1	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
cu	2	Brace, wood, 60" span
da	1	Bracket, insulator
ek	15	Locknuts

DESIGN PARAMETERS:
See Table III

SINGLE SUPPORT ON CROSSARMS
(LARGE CONDUCTORS)

APRIL 2005	DOUBLE CIRCUIT PRIMARY	
RUS	12.47/7.2 kV	D1.83L



ITEM	QTY	MATERIAL
c	2	Bolt, machine, 1/2" x req'd length
c	4	Bolt, machine, 5/8" x req'd length
d	2	Washer, round, 1 3/8"
d	6	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8'–0"
g	1	Crossarm, 3 5/8" x 4 5/8" x 10'–0"
i	2	Bolt, carriage, 3/8" x 4 1/2"

ITEM	QTY	MATERIAL
j	1	Screw, lag, 1/2" x 4"
cu	2	Brace, 28"
cu	1	Brace, wood, 60" span
da	1	Bracket, insulated
ea	6	Insulator, post type, (12.47/7.2 kV)
ek	8	Locknuts

DESIGN PARAMETERS:
See Table II

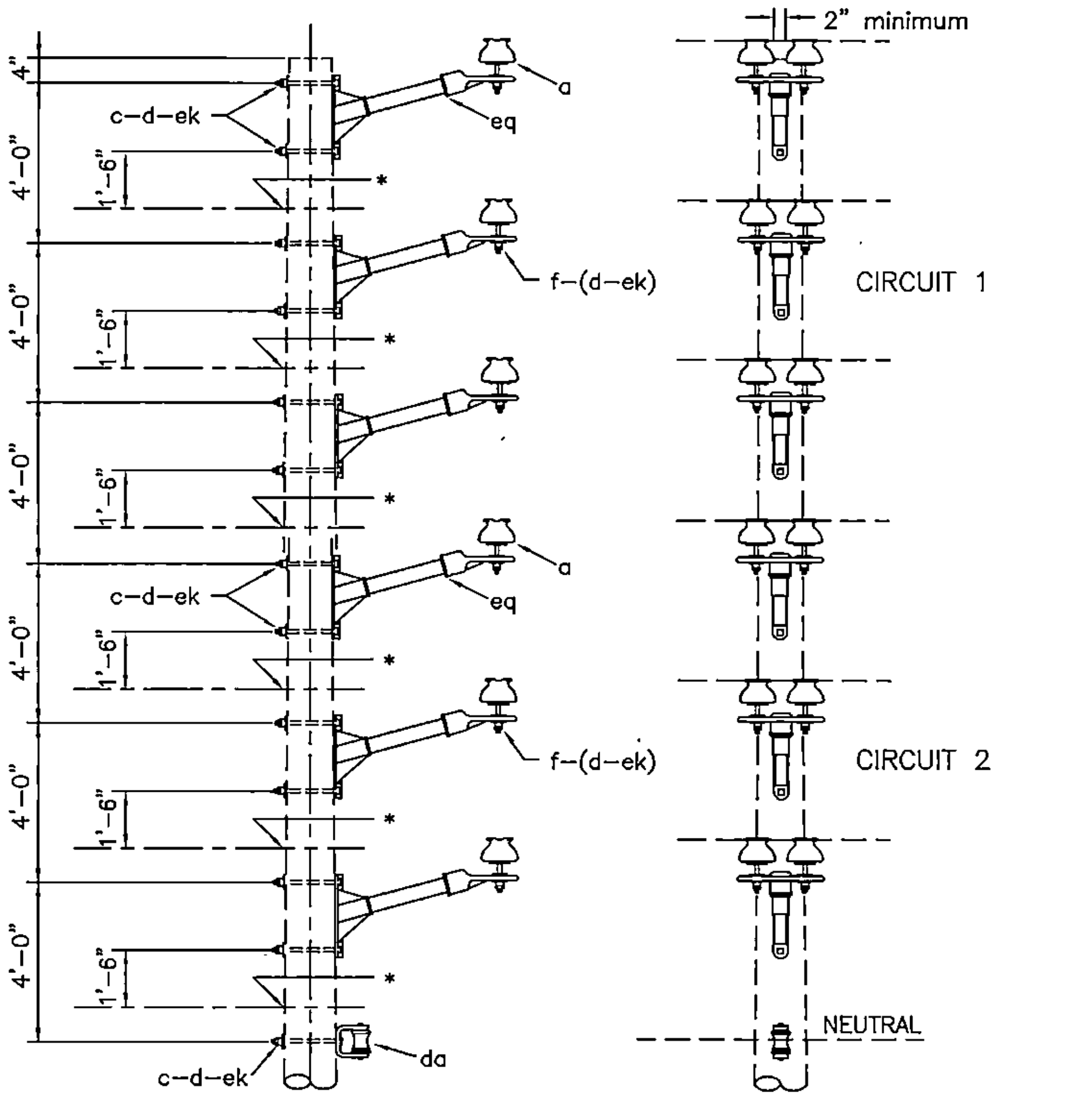
SINGLE SUPPORT ON CROSSARMS
(POST INSULATORS)

APRIL 2005

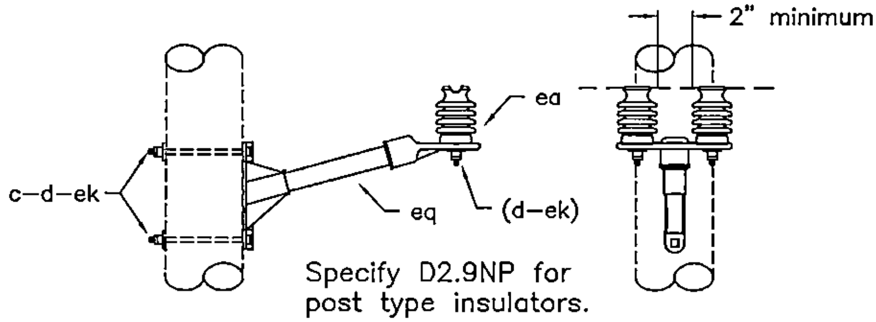
RUS

DOUBLE CIRCUIT PRIMARY
12.47/7.2 kV

D1.83P



* Position of guys
as required.



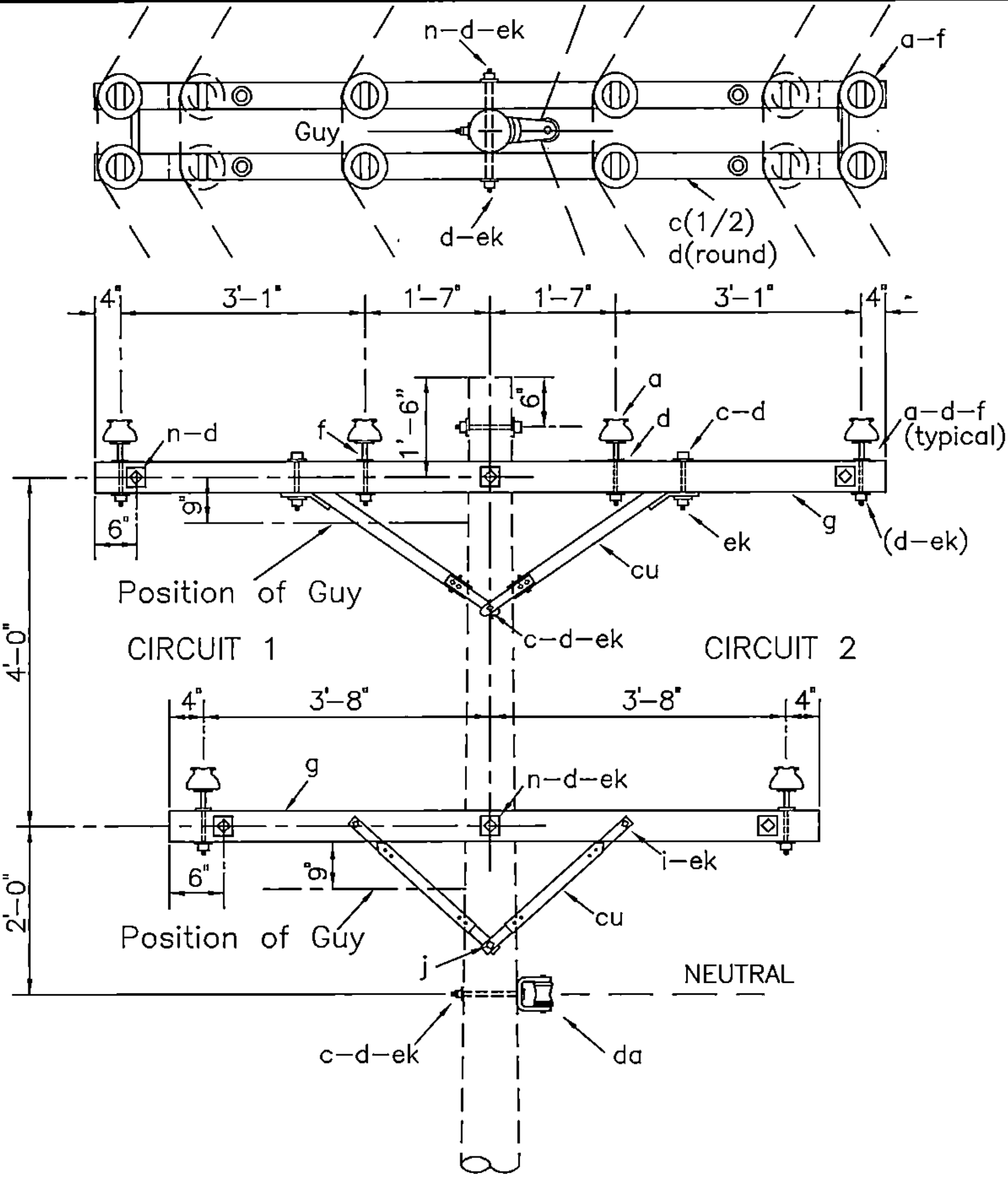
NOTE: See D3.1G or D4.1G
for alternative construction.

	Assembly: D2.	9N	9NP
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type (12.47/7.2 kV)	12	
c	Bolt, machine, 5/8" x req'd length	13	13
d	Washer, square 2 1/4"	13	13
f	Pin, crossarm, 5/8" x 6 1/2"	12	
da	Bracket, insulated	1	1
ea	Insulator, post type (12.47/7.2kV)		12
ek	Locknuts	13	13
eq	Bracket, insulator/equipment	6	6

Design Parameters:
Maximum Line Angles
See TABLE IV

DOUBLE SUPPORT–NARROW PROFILE

APRIL 2005	DOUBLE CIRCUIT PRIMARY	D2.9N
RUS	12.47/7.2 kV	D2.9NP



ITEM	QTY	MATERIAL
a	12	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 1/2" x req'd length
c	3	Bolt, machine, 5/8" x length
d	4	Washer, round, 1 3/8"
d	36	Washer, square, 2 1/4"
f	12	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"

ITEM	QTY	MATERIAL
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
n	6	Bolt,double arming, 5/8"xreq'd length
cu	4	Brace, 28"
cu	2	Brace, wood, 60" span
da	1	Bracket, insulated
ek	27	Locknuts

DESIGN PARAMETERS:
See Table IV

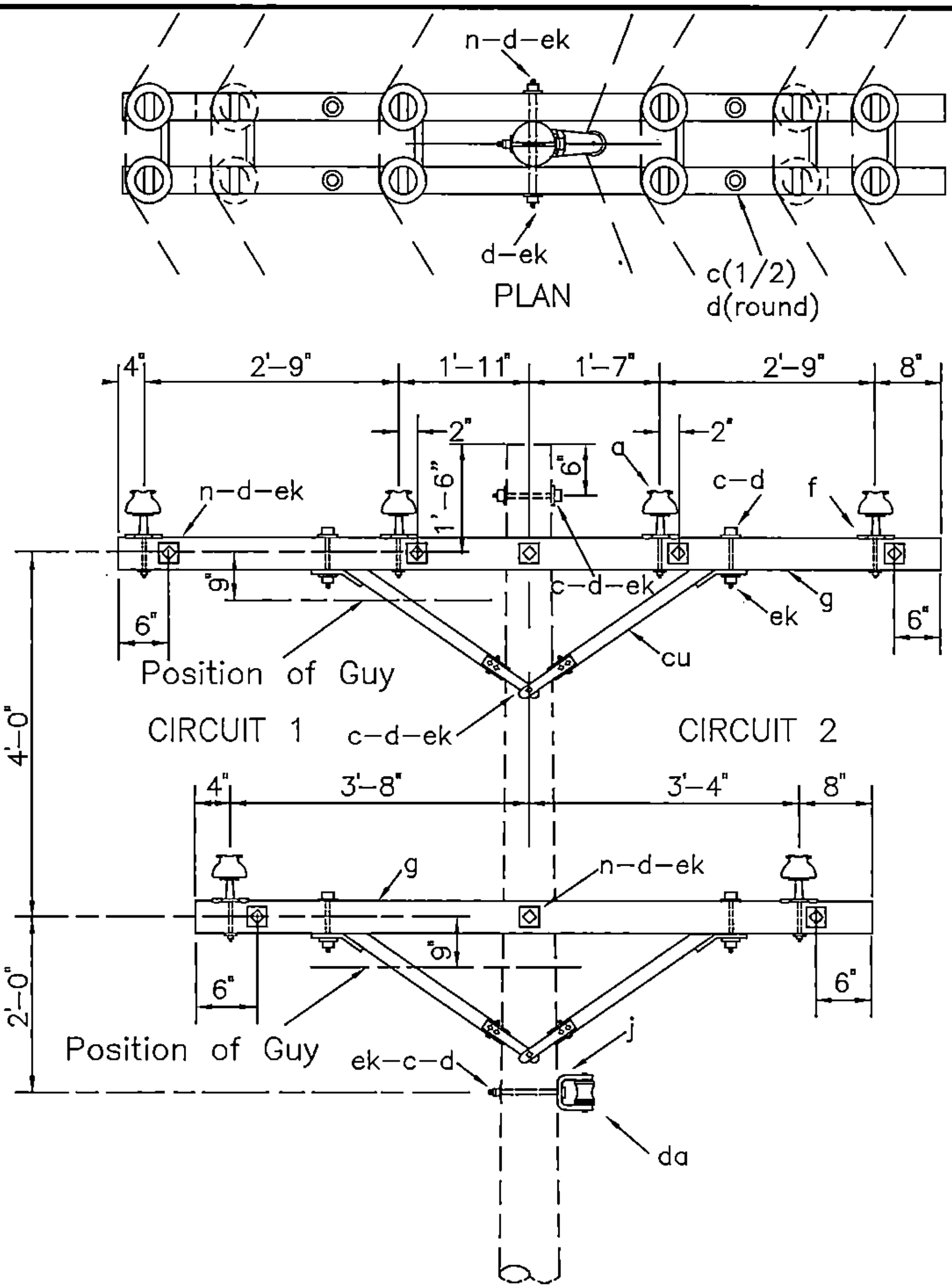
DOUBLE SUPPORT ON CROSSARMS

APRIL 2005

RUS

DOUBLE CIRCUIT PRIMARY
12.47/7.2 kV

D2.91
(DC-C2-1)



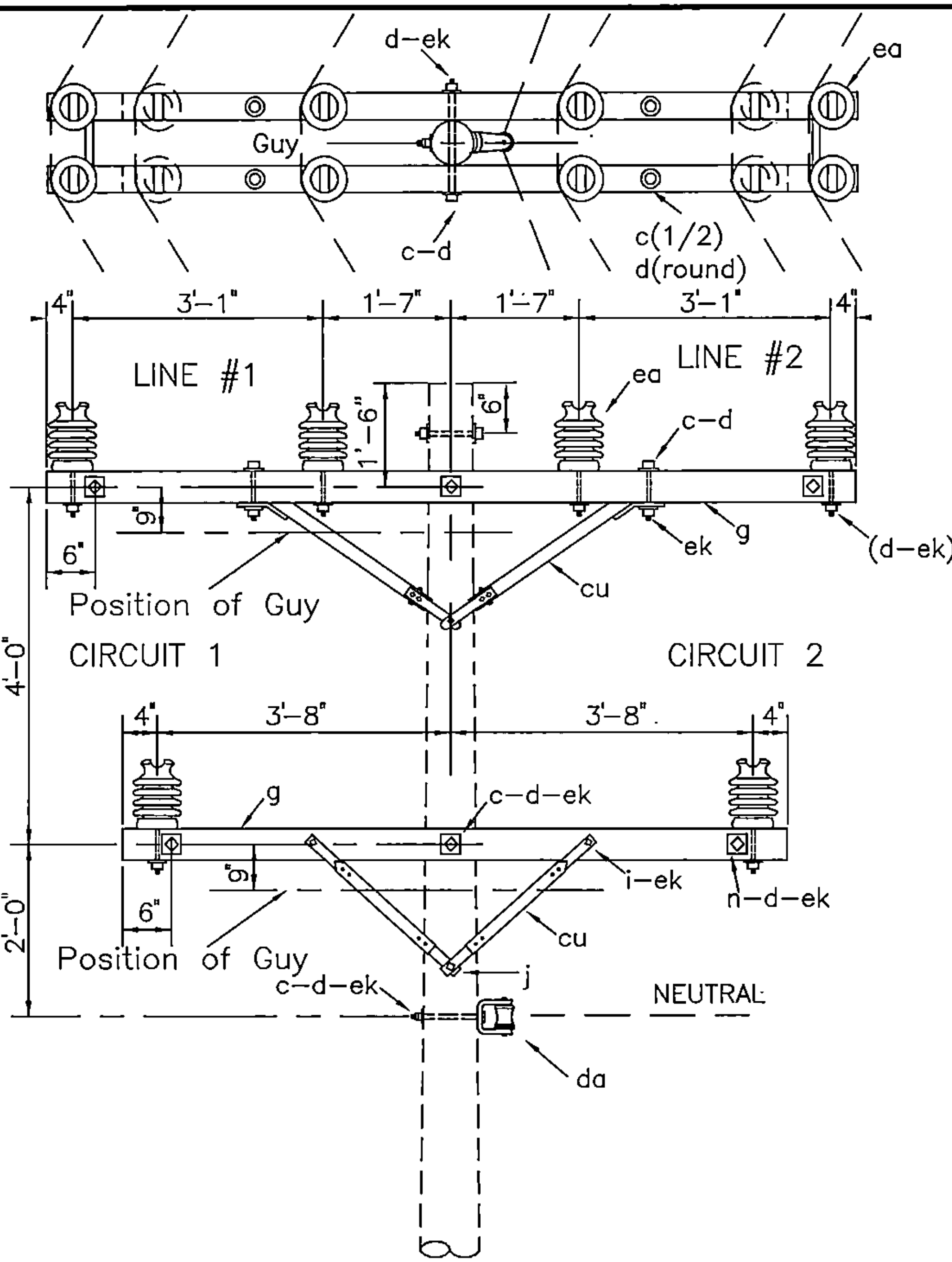
ITEM	QTY	MATERIAL
a	12	Insulator, pin type (12.47/7.2 kV)
c	8	Bolt, machine, 1/2" x req'd length
c	4	Bolt, machine, 5/8" x req'd length
d	8	Washer, round, 1 3/8" diam.
d	33	Washer, square, 2 1/4"
f	12	Pin, crossarm, steel, clamp type
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'–0"

ITEM	QTY	MATERIAL
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'–0"
n	8	Bolt, double arming, 5/8" x req'd length
cu	4	Brace, wood, 60" span
da	1	Bracket, insulated
ek	40	Locknuts

DESIGN PARAMETERS:
See Table V

DOUBLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)

APRIL 2005	DOUBLE CIRCUIT PRIMARY 12.47/7.2 kV	
RUS		D2.91L



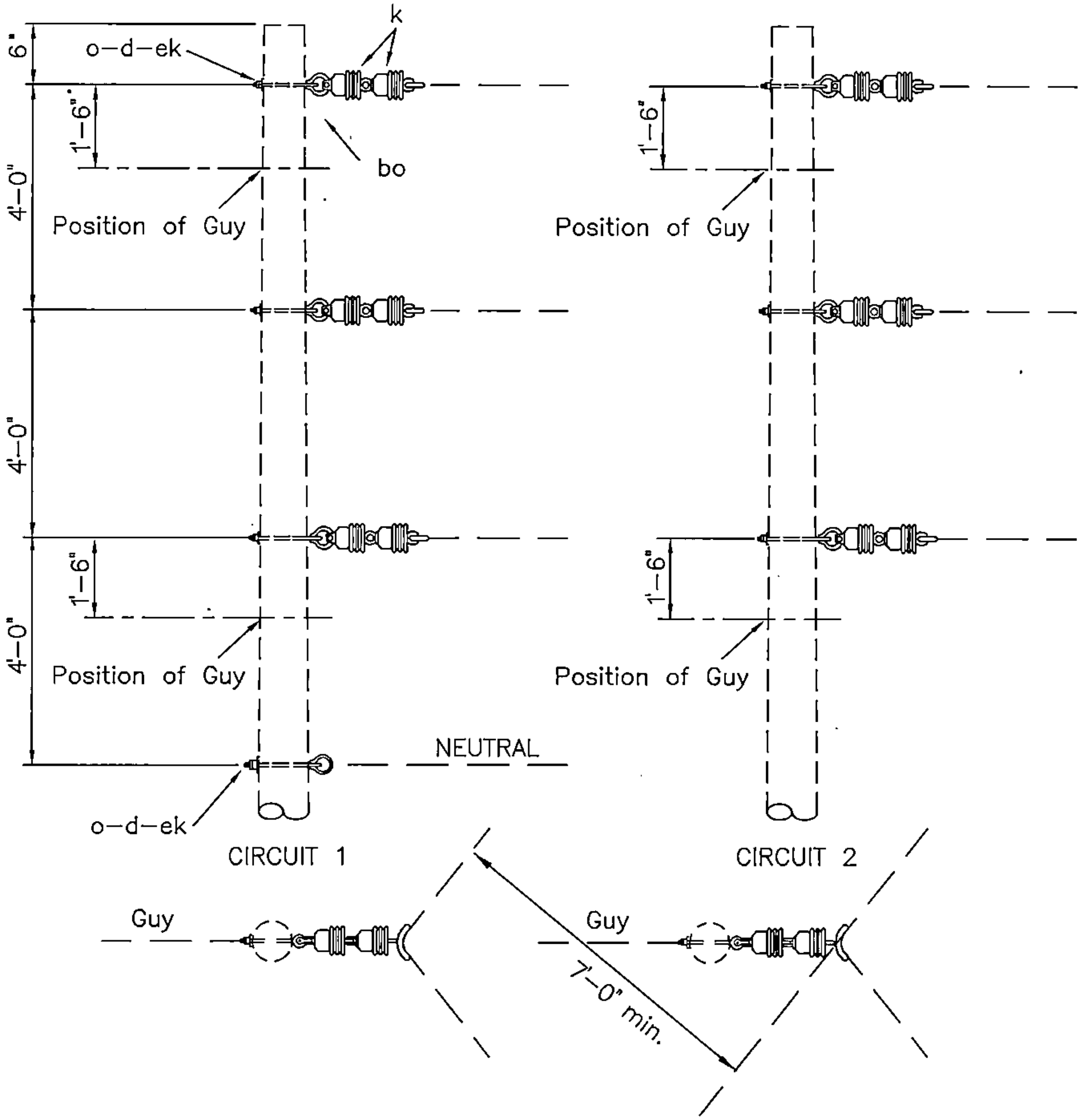
ITEM	QTY	MATERIAL
c	4	Bolt, machine, 1/2" x req'd length
c	5	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	24	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
i	4	Bolt, carriage, 3/8" x 4 1/2"

ITEM	QTY	MATERIAL
j	2	Screw, lag, 1/2" x 4"
n	4	Bolt,double arming, 5/8"xreq'd length
cu	4	Brace, 28"
cu	2	Brace, wood, 60" span
da	1	Bracket, insulated
ea	12	Insulator, post type, (12.47/7.2 kV)
ek	25	Locknuts

DESIGN PARAMETERS:
See Table IV

DOUBLE SUPPORT ON CROSSARMS
(POST INSULATORS)

APRIL 2005	DOUBLE CIRCUIT PRIMARY	
RUS	12.47/7.2 kV	D2.91P



NOTE: 1. The NESC requires a minimum separation of 5 feet between any energized conductor and any guy wire.
2. See guy assembly "E2.1G", "E3.1LG", "E4.3LG".

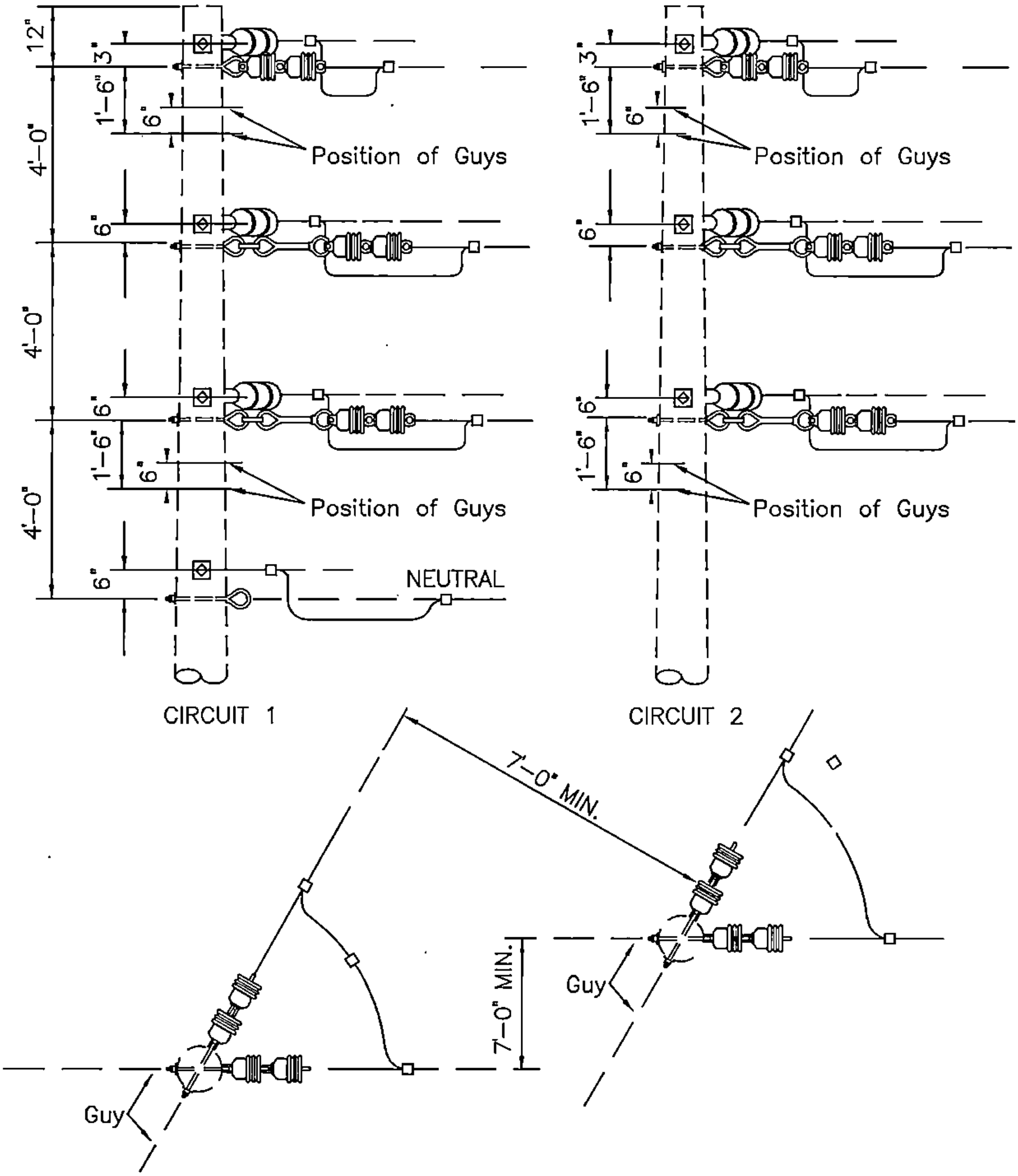
ITEM	QTY	MATERIAL
	2	"C3.1" through "C3.9" Primary Assemblies (Delete material for one neutral subassembly: "o–d–ek")
	(2)	(Use "C3.1L" Primary Assembly for large conductors.) (Delete material for one neutral subassembly)

DESIGN PARAMETERS:

See "C3.1 through "C3.9"

SUSPENSION ANGLE GUIDE

APRIL 2005	DOUBLE CIRCUIT PRIMARY	
RUS	12.47/7.2 kV	D3.1G



NOTES:
1. The NESC requires a minimum separation of 5 feet between any energized conductor and any guy wire.
2. See guy assembly "E2.G", "E3.1LG" or "E4.3LG".

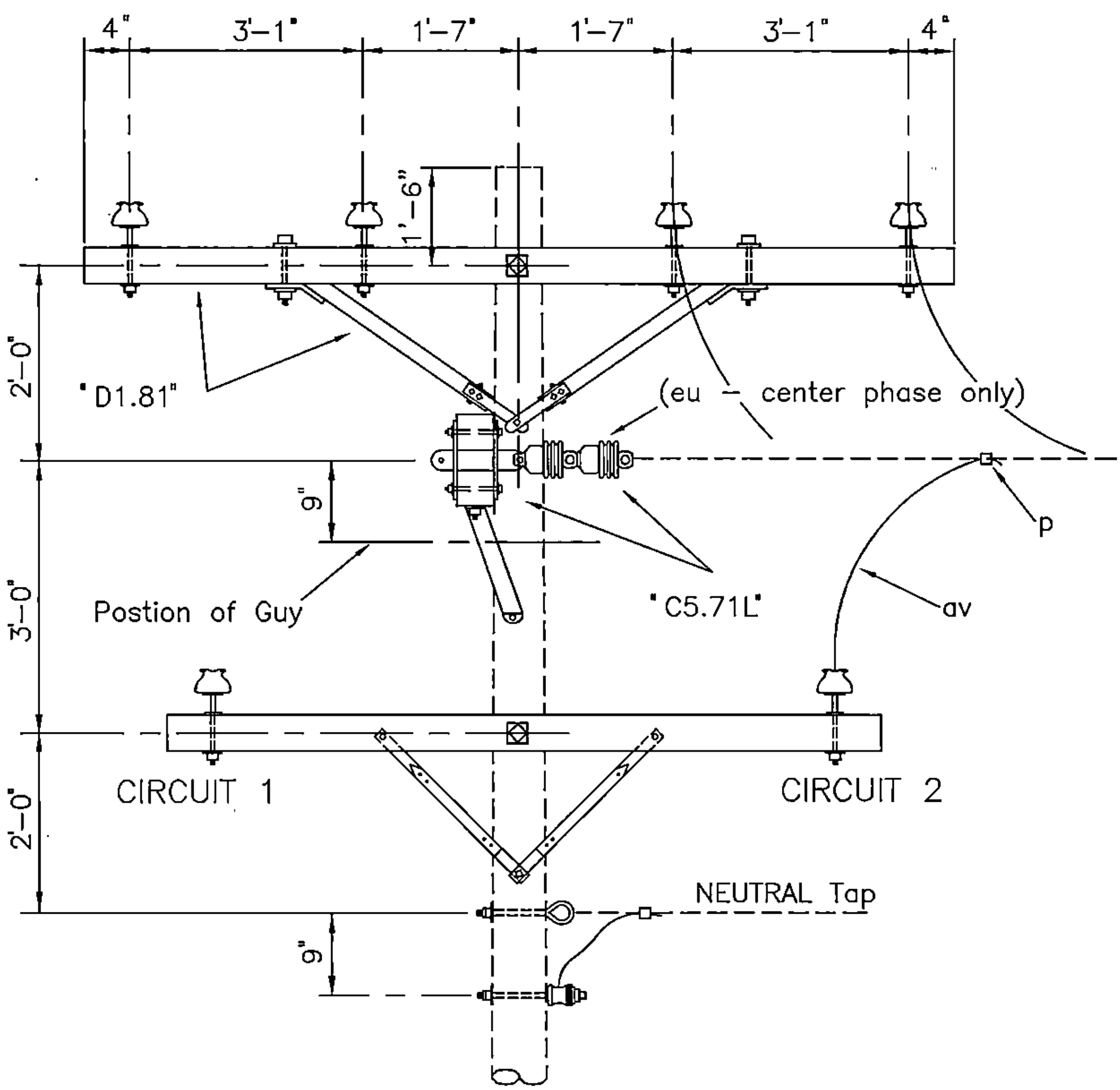
ITEM	QTY	MATERIAL
	4	"C3.1" through "C3.9" Primary Assemblies (Delete material for two neutral subassemblies: "o-d-ek")
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:

See: "C4.1G"
"C4.2G"

DEADEND ANGLE GUIDE

APRIL 2005	DOUBLE CIRCUIT PRIMARY 12.47/7.2 kV	
RUS		D4.1G



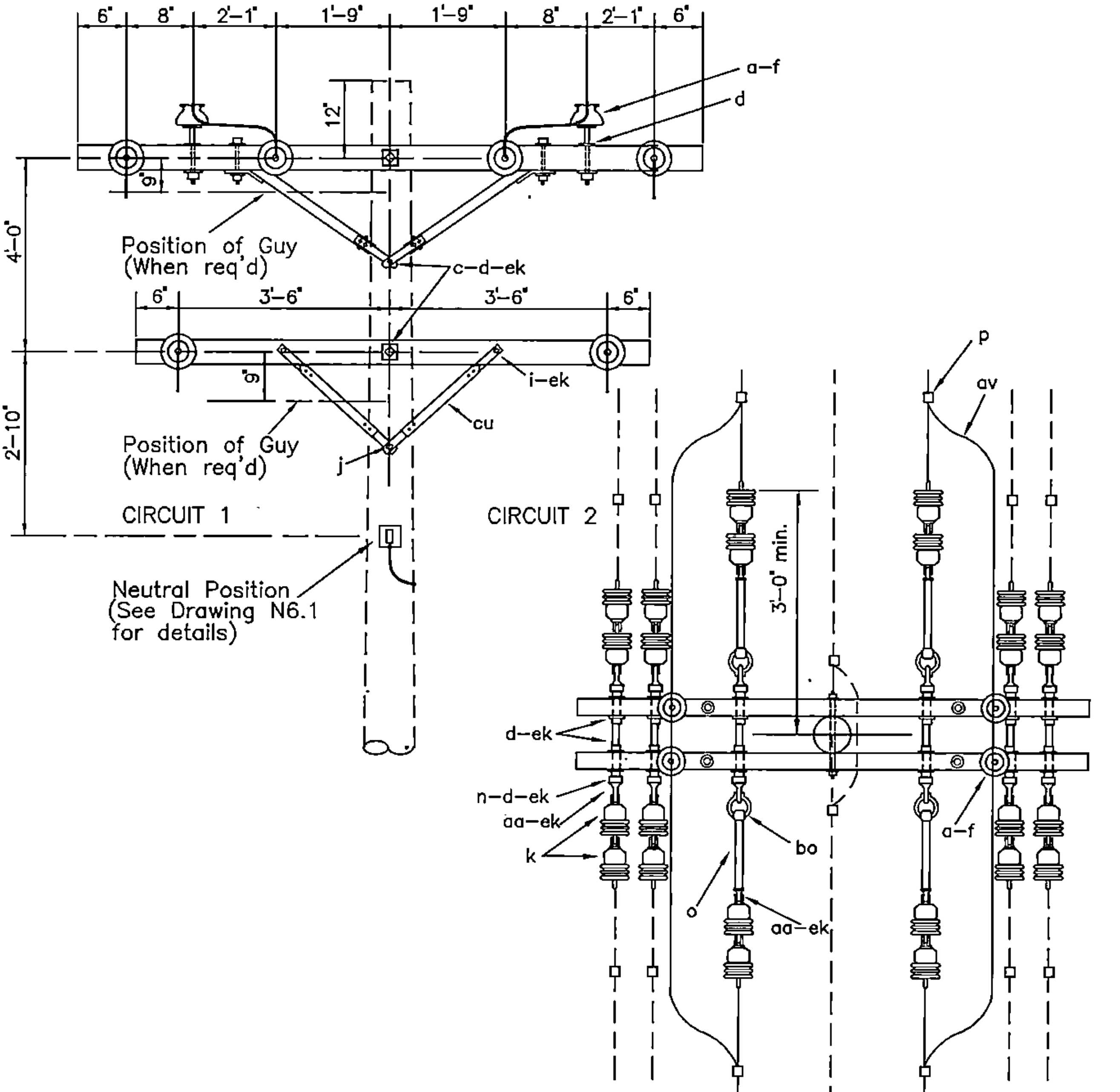
ITEM	QTY	MATERIAL
	1	C5.71L Primary Assembly
	1	D1.81 Primary Assembly
p		Connectors, as required
av		Jumpers, as required
eu		Link, extension, insulated, 12" min.

DESIGN PARAMETERS:

SEE: "C5.71L"
"D1.81"

THREE PHASE TAP GUIDE

APRIL 2005	DOUBLE CIRCUIT PRIMARY 12.47/7.2 kV	D5.91G
RUS		



ITEM	QTY	MATERIAL
a	4	Insulator, pin type (12.47/7.2 kV)
c	4	Bolt, machine, 1/2 x req'd length
c	3	Bolt, machine, 5/8" x length
d	4	Washer, round, 1 3/8
d	33	Washer, square, 2 1/4
d	2	Washer, square, 3", curved
f	4	Pin, crossarm, steel, 5/8" x 10 3/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"

ITEM	QTY	MATERIAL
k	24	Insulator, suspension, 4 1/2"
n	7	Bolt, double arm, 5/8 x req'd length
o	4	Bolt, eye, 5/8" x req'd length
p		Connectors, as req'd
aa	18	Nut, eye
av		Jumpers, as req'd
bo	4	Shackle, anchor
cu	2	Brace, wood, 60" span
cu	4	Brace, 28"
ek	47	Locknuts

DESIGN PARAMETERS:

PERMITTED UNBALANCED CONDUCTOR TENSION:

See Table B (Exhibit 2)

(See Notes on Drawing "C6.52")

DOUBLE DEADENDS ON CROSSARMS (FEEDTHROUGH)

APRIL 2005	DOUBLE CIRCUIT PRIMARY	D6.91
RUS	12.47/7.2 kV	(DC-C8)

GUYING ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
E1.1	(E1-2)	SINGLE DOWN GUY (THROUGH BOLT TYPE)
E1.1L	(E1-3)	SINGLE DOWN GUY - HEAVY DUTY (THROUGH BOLT TYPE)
E1.2	(E3-3)	SINGLE DOWN GUY (WRAPPED TYPE)
E1.3L		SINGLE DOWN GUY - LARGE CONDUCTORS (POLE BAND TYPE)
E1.4	(E2-2)	SINGLE OVERHEAD GUY - (THROUGH BOLT TYPE)
E1.4L	(E2-3)	SINGLE OVERHEAD GUY - HEAVY DUTY (THROUGH BOLT TYPE)
E1.5		GUY STRAIN INSULATOR
E2.1G		DOUBLE DOWN GUY GUIDE - (THROUGH BOLT TYPE)
E3.1LG		THREE DOWN GUY GUIDE - HEAVY DUTY (THROUGH BOLT TYPE)
E4.3LG		FOUR DOWN GUY GUIDE - LARGE CONDUCTORS (POLE BAND TYPES)

CONSTRUCTION SPECIFICATIONS FOR GUYS

The design engineer shall determine the number and type of guys needed to be installed.

Guys shall be attached to the pole as shown in the construction drawings and shall be installed before conductors are strung. Deadend structure guys shall be installed, as nearly as practicable, in line with the pull of conductors. Guys that bisect line angles (bisector guys) at line angle structures shall be installed as nearly as practicable to the true bisector of the line angle.

The distance from the pole to the anchor rod (the guy lead) is recommended to be the same distance as from the ground to the guy attachment on the pole. This 1:1 guy slope is especially recommended on deadend structures.

Written permission from RUS is required prior to the installation of sidewalk guys and push poles. RUS will consider the use of sidewalk guys and push poles on a case-by-case basis.

The NESC requires that the grade of construction of guys be the same or higher as the grade of construction of: (1) the pole or structure to which they are attached, or (2) the highest grade required for any conductors supported by the pole or structure.

The permitted loads shown in the design parameters for guying assemblies have already been calculated by RUS by multiplying a strength factor of 0.85 to the RUS designated loading (or strength) of the guying assemblies. The strength factor of 0.85 was used by RUS as an additional safety factor and is based on the spirit of the rules of NESC Section 261 and NESC Table 261-1A.

The permitted loads shown on the guy assembly drawings shall be reduced by 25 percent for NESC Grade B construction.

The permitted loads on guy wires shall be determined by multiplying the rated breaking strength of the guy wire by the strength factor of 0.90 given in NESC Table261-1A.

Guy strength that must be provided is determined by totaling all loads expected to be exerting tension on the guy assembly and guy wire(s) and multiplying this total load by the appropriate overload factors according to NESC Rule 253 and as shown in NESC Table 253-1.

CONSTRUCTION SPECIFICATIONS FOR GUYS *(cont.)*

If the separation on the pole between any guy attachment bolt or hardware and any phase conductor attachment bolt is less than 15 inches, then a guy strain insulator assembly (E5.1) shall be installed at the top of the guy and the guy wire shall be effectively grounded below the insulator by bonding the guy wire to the system neutral and the pole ground if present. Alternatively, an insulated extension link (item "eu") shall be installed in the primary conductor tap, deadend, or suspension angle subassembly where it attaches to the pole.

The purpose of this specification is to maintain minimum basic insulation impulse levels (BIL) and to increase clearances for line workers.

Down guy and overhead guy wires shall be effectively grounded in accordance with Rule 215C2 of the NESC and in accordance with the RUS assembly drawings. Effectively grounded guy wires provide a direct path to ground and thus decrease the chances of electric shock, serious injury and even death to a person standing on the ground and making contact with a guy wire that has accidentally become energized by means of contact with a primary, secondary, service or neutral conductor. Furthermore, effectively grounded guy wires bonded to anchor rods decrease the overall system impedance to ground and improve the chances of primary overcurrent protection devices to operate as designed.

Down guy and overhead guy wires may be insulated in portions of a borrower's service area if all 5 of the following conditions are met:

(1) The borrower: (1) has records documenting that anchors or anchor rods have failed due to corrosion after less than 20 years of service, <u>or</u> (2) has performed and documented a study that has determined that insulating down guy wires is an adequate and economical method to mitigate predicted premature corrosion of anchors and anchor rods in the service area covered by the study. Such studies or records shall be made available for RUS review upon request;

(2) Insulated down guys and their component parts shall be in compliance with all of the applicable rules of the NESC;

(3) Only fiberglass guy strain insulators (item "w") shall be used to insulate guy wires and the insulators shall be installed at the top of the guy wire as depicted in assembly drawing E1.5;

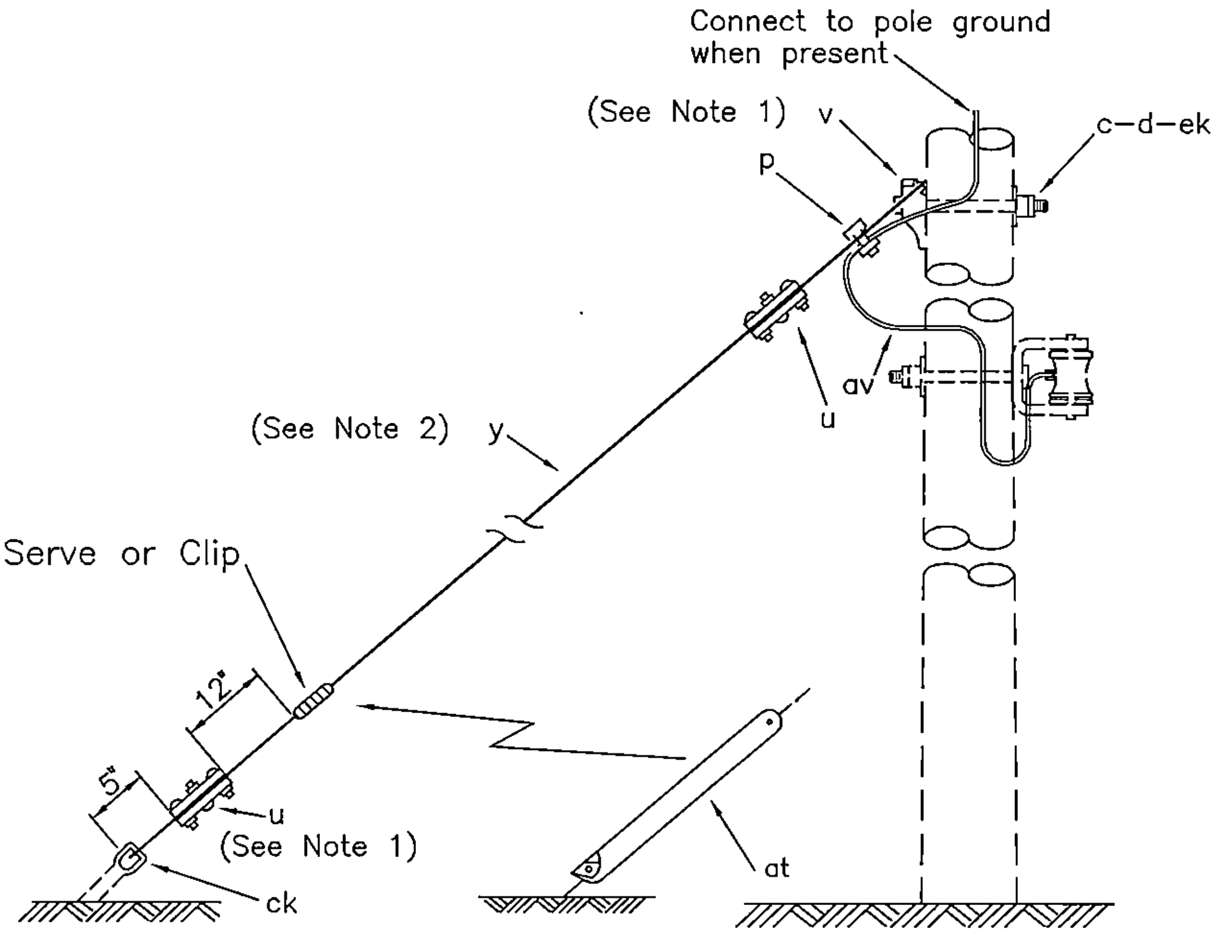
(4) RUS required bonding clamps are securely installed between the anchor rod and the guy wire attached to the anchor rod; and

(5) The borrower has a special regimented maintenance program in place that periodically (as experience indicates) checks the insulation integrity of installed guy insulators.

CONSTRUCTION SPECIFICATIONS FOR GUYS ***(cont.)***

Down guys installed on tangent, double deadend assemblies (e.g., A6.1) shall have a minimum clearance to the neutral conductor of 6 inches and shall have a guy strain insulator(s) installed at the top of the guy that extends from the pole attachment to at least 12 inches past the neutral conductor.[1] Alternatively, two down guys without guy strain insulators may be installed, one on each side of the neutral, such that clearance between each down guy wire and the neutral conductor is a minimum of 12 inches. For either of the above designs, the down guy wire shall be effectively bonded to ground in accordance with RUS specifications and the rules of the NESC.

[1] For example, the 6-inch clearance can be met for a down guy with a 30-foot guy lead that is attached to the pole 30 feet above the ground and 2.5 feet above the neutral by installing (offsetting) the guy anchor 6 feet perpendicular to the line of the neutral conductor.



NOTES:

1. Other accepted and equivalent guy deadend (item "u") and attachment (item "v") material may be substituted for the ones shown.
2. Some types of guy attachments use 2 bolts and washer or lag screw (item"j"), change materials accordingly.
3. Specify guy wire size, type and required length.

ITEM	QTY	MATERIAL
c	1	Bolt, machine, 5/8" x req'd length
d	1	Washer, 3" square, curved
p		Connectors, guy bond and as req'd
u	2	Deadend for guy strand (See Note 1)
v	1	Guy attachment (See Note 1)
y		Guy wire, as req'd (See Note 3)
at	1	Guy marker
av		Jumpers, as req'd
ck	1	Clamp, anchor bonding
ek	1	Locknuts

DESIGN PARAMETERS:

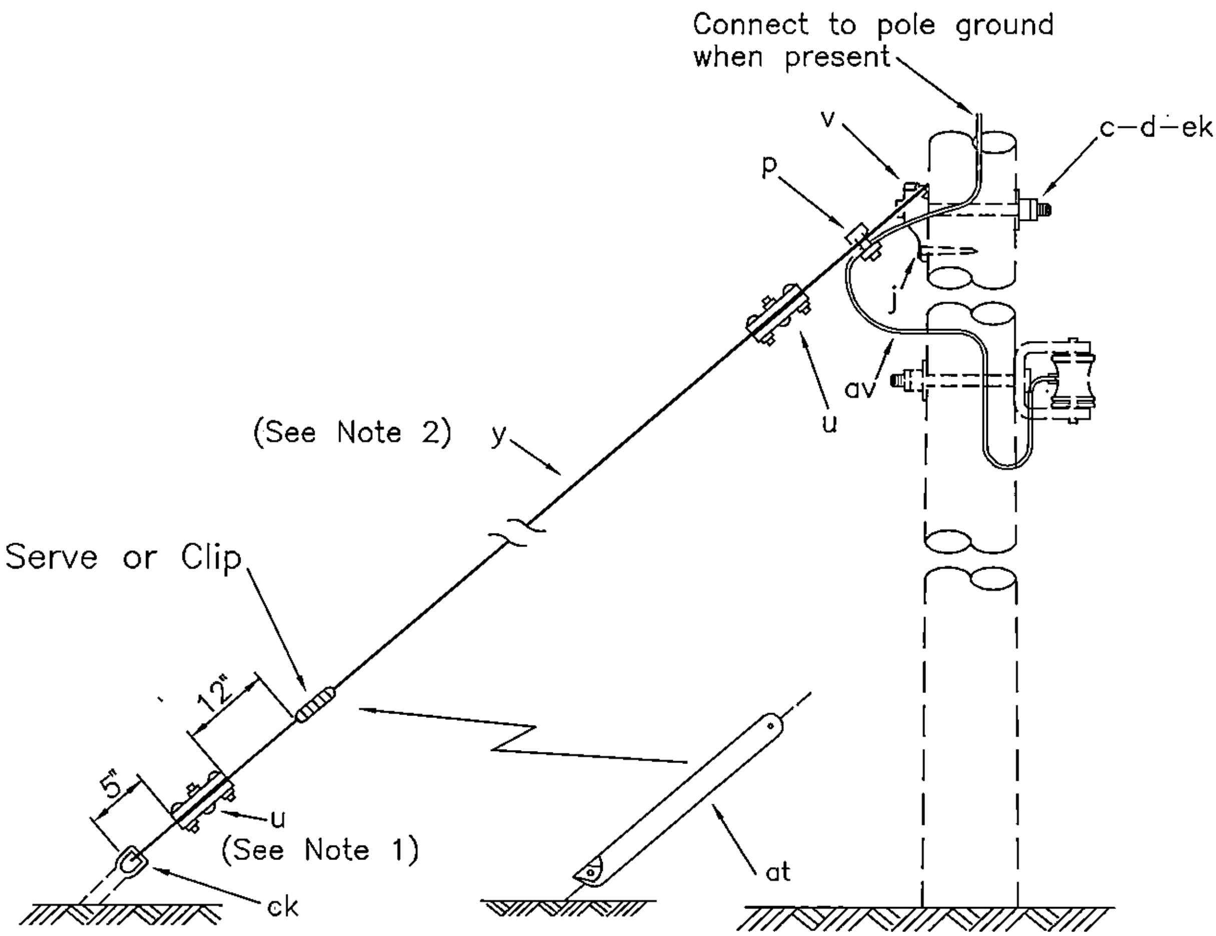
PERMITTED LOAD IS LESSER OF:
6,600 lbs (in any direction)
or 90% of RATED BREAKING STRENGTH OF GUY WIRE

SINGLE DOWN GUY
(THROUGH BOLT TYPE)

APRIL 2005

RUS

E1.1
(E1–2)



NOTES:
1. Other accepted and equivalent, heavy duty, guy deadend material (item "u") may be substituted for the ones shown.
2. Pole eye plate guy attachment and anchor shakle (item "bo") may be used.

ITEM	QTY	MATERIAL
c	1	Bolt, machine, 3/4" x req'd length
d	1	Washer, square, 4", curved
p		Connectors, guy bond and as req'd
j	1	Screw, lag, 1/2" x 4"
u	2	Deadend for guy strand, heavy duty
v	1	Guy attachment, guy hook type
y		Guy wire, as req'd (See Note 4)
at	1	Guy marker
av		Jumpers, as req'd
ck	1	Clamp, anchor bonding
ek	1	Locknuts

3. 2–5/8 machine bolts and 2–3 square curved washers may be used to install guy attachment.
4. Specify guy wire size, type and required length.

DESIGN PARAMETERS:

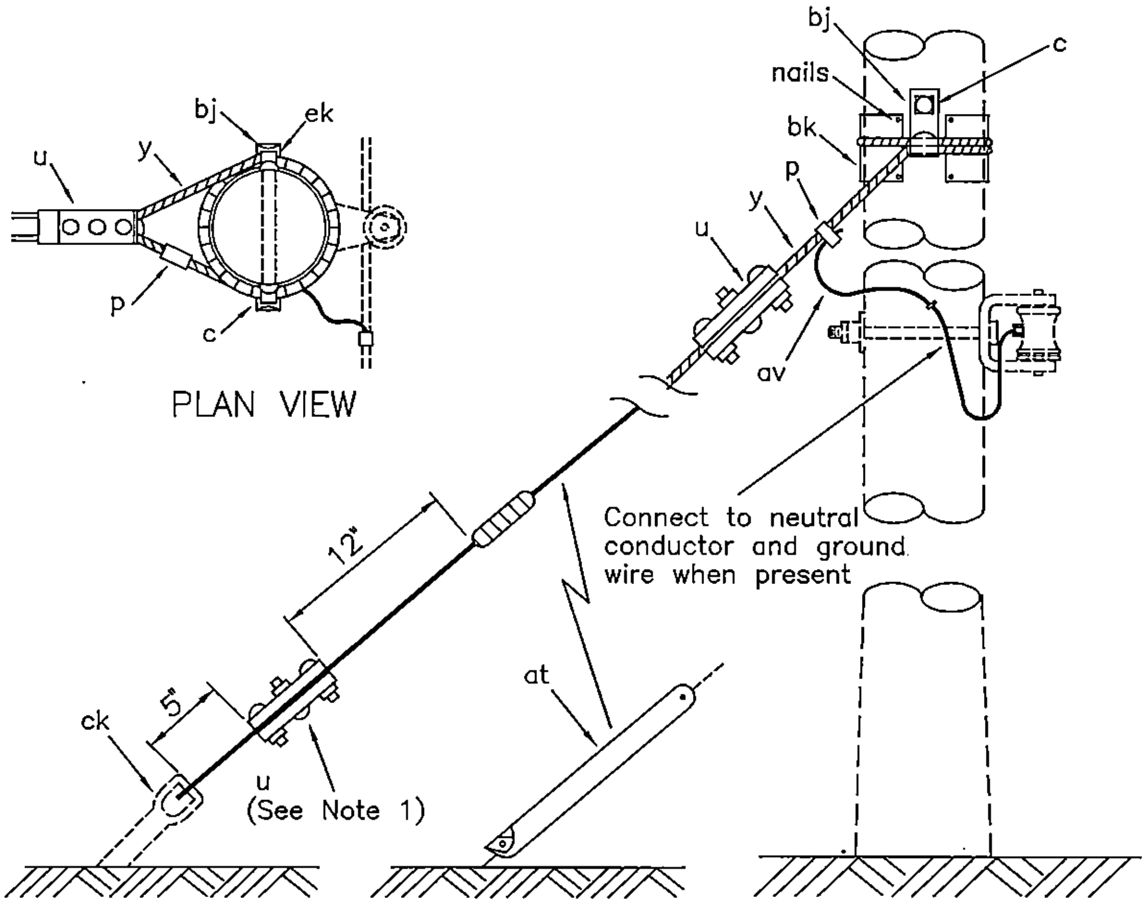
PERMITTED LOAD IS LEAST OF:
8,500 lbs (in any direction)
or 90% of RATED BREAKING
STRENGTH OF GUY WIRE

SINGLE DOWN GUY – HEAVY DUTY
(THROUGH BOLT TYPE)

APRIL 2005

RUS

E1.1L
(E1–3)



NOTES:

1. Other accepted and equivalent, heavy duty, guy clamps, (item"u"), may be substituted for the 3–bolt clamps shown
2. Specify guy wire size, type and required length.

ITEM	QTY	MATERIAL
c	1	Bolt, machine, 5/8" x req'd length
p		Connectors, guy bond and as req'd
u	2	Deadend for guy strand, heavy duty
y		Guy wire, as req'd (See Note 2)
at	1	Guy marker
av		Jumpers, as req'd
bj	2	Guy hook
bk	2	Guy Plate, 4" x 8", 14 gauge
ck	1	Clamp, anchor rod bonding
ek	1	Locknuts
	8	Nails, 8 penny galv.

DESIGN PARAMETERS:

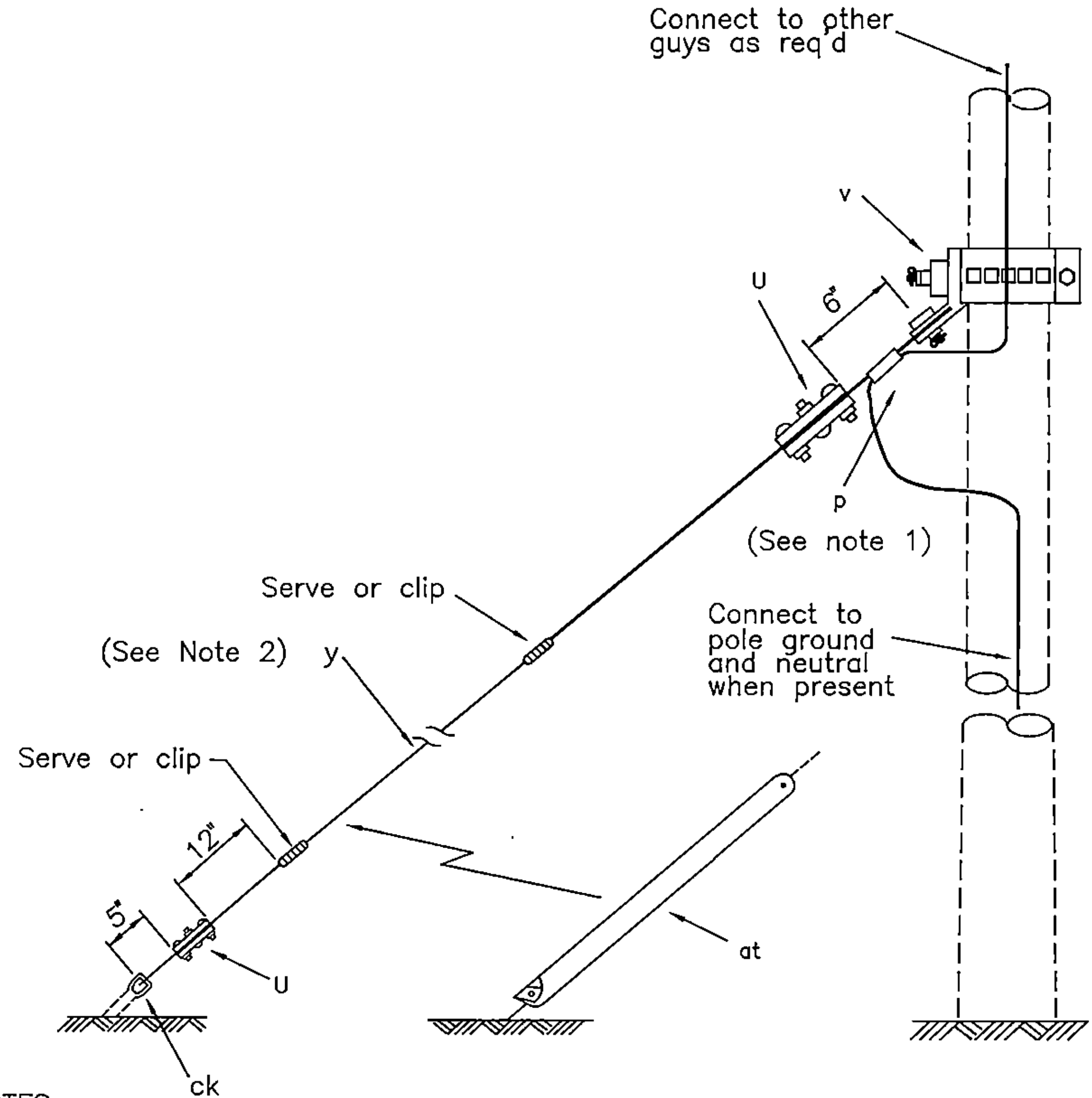
PERMITTED LOAD = 90% of RATED BREAKING STRENGTH OF GUY WIRE

SINGLE DOWN GUY (WRAPPED TYPE)

APRIL 2005

RUS

E1.2 (E3–3)



NOTES:

1. Other accepted and equivalent, heavy duty, guy deadend material (item "u") may be substituted for the ones shown.
2. Specify guy wire size, type and required length.

ITEM	QTY	MATERIAL
p		Connectors, guy bond as req'd
u	2	Deadend for guy strand, heavy duty
v	1	Guy attachment, pole band type
y		Guy wire, as req'd (See Note 2)
at	1	Guy marker
av		Jumpers, as req'd
ck	1	Clamp, anchor bonding

DESIGN PARAMETERS:

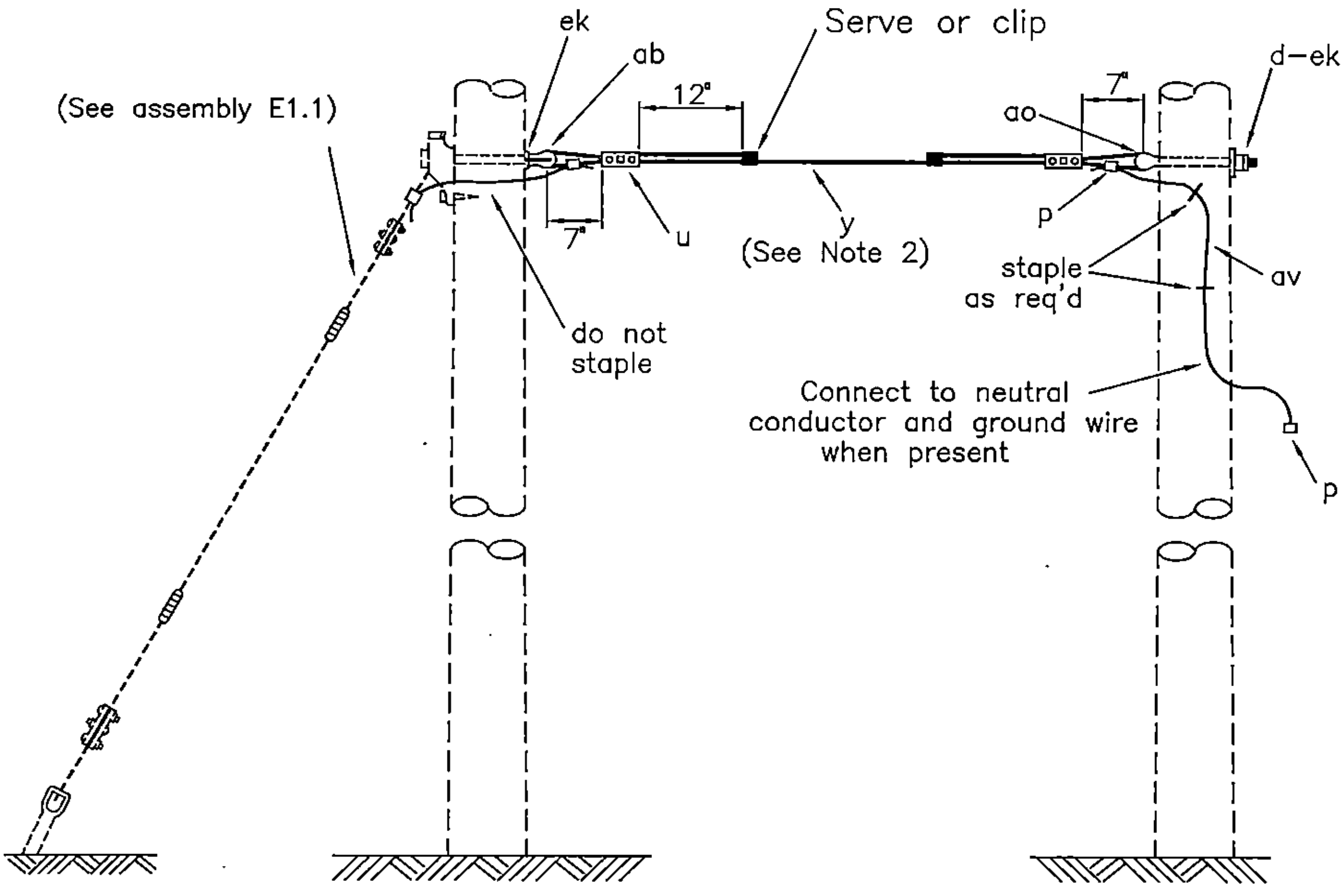
PERMITTED LOAD IS LESSER OF:
8,500 lbs. (in any direction)
or 90% of RATED BREAKING
STRENGTH OF GUY WIRE

SINGLE DOWN GUY – LARGE CONDUCTORS
(POLE BAND TYPE)

APRIL 2005

RUS

E1.3L



NOTES:

1. Other accepted and equivalent, guy deadends (item "u"), may be substituted for the 3-bolt clamps shown.
2. Specify guy wire size, type and required length.
3. Wrapped type overhead guys may be used. (See drawing E1.2 as guide)

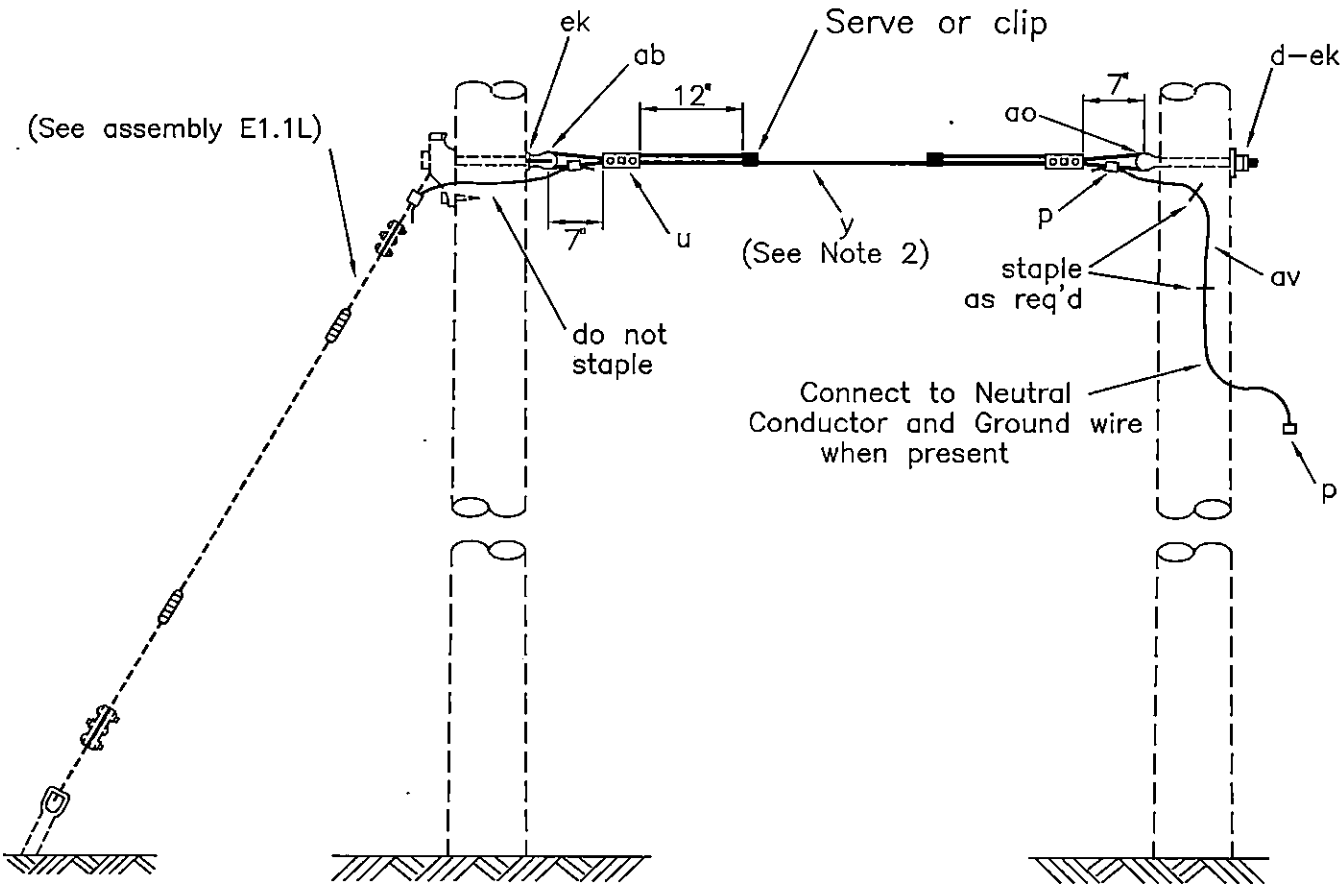
ITEM	QTY	MATERIAL
d	1	Washer, 3" square, curved
p		Connectors, guy bond and as req'd
u	2	Deadend for guy strand, heavy duty
y		Guy wire, as req'd (See Note 2)
ab	1	Nut, thimble eye type, 5/8"
ao	1	Bolt, thimble eye, 5/8"x req'd length
av		Jumpers, as req'd
ek	2	Locknuts

DESIGN PARAMETERS:

PERMITTED LOAD IS LESSER OF:
6,600 lbs. (HORIZONTAL)
or 90 % of RATED BREAKING STRENGTH OF GUY WIRE

SINGLE OVERHEAD GUY
(THROUGH BOLT TYPE)

APRIL 2005		E1.4 (E2-2)
RUS		



NOTES:

1. Other accepted and equivalent, guy deadends (item "u"), may be substituted for the 3–bolt clamps shown.
2. Specify guy wire size, type and required length.
3. Wrapped type overhead guys may be used. (See drawing E1.2 as guide)
4. Assembly requires 3/4" bolt on down guy assembly attachment.

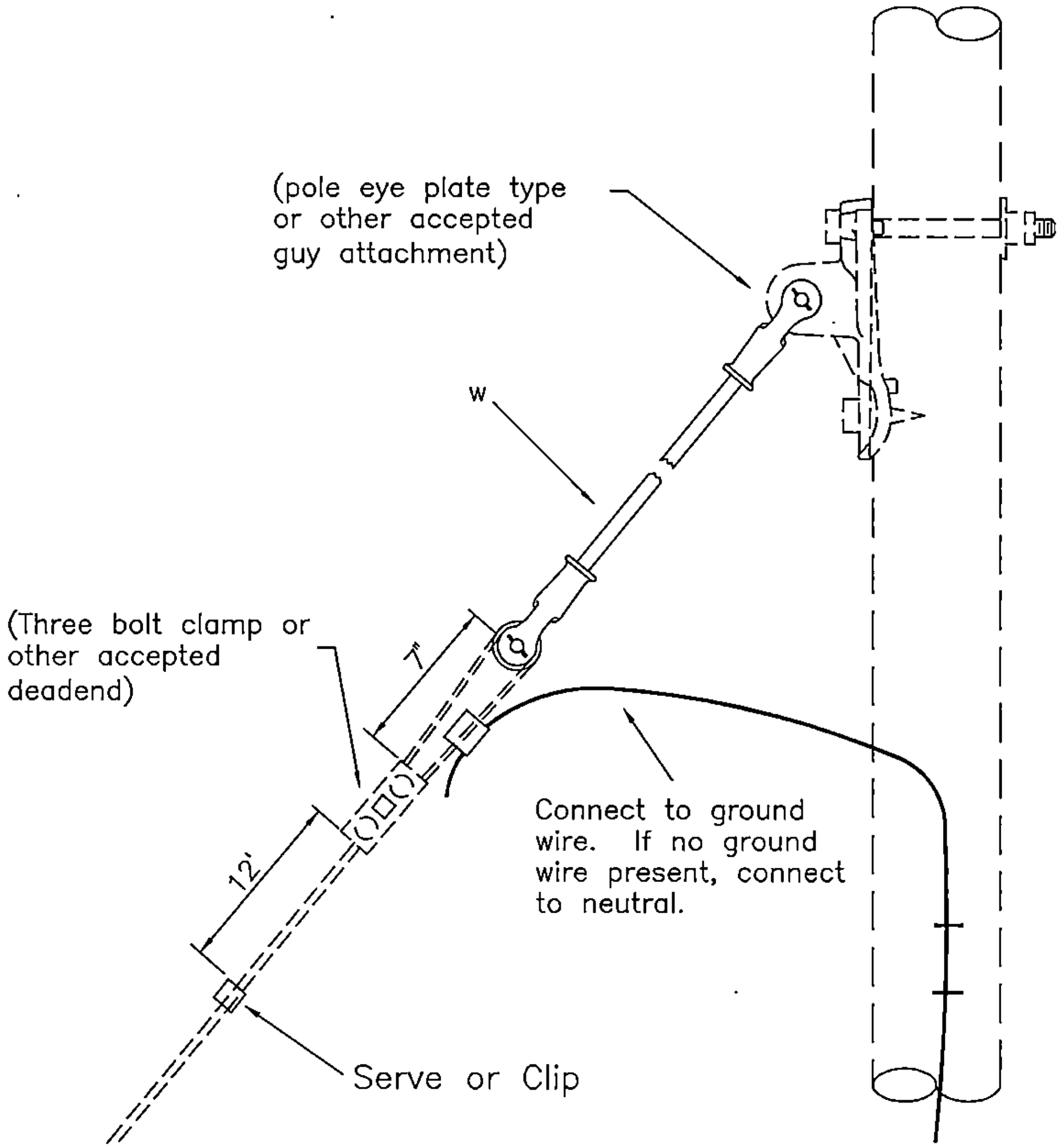
ITEM	QTY	MATERIAL
d	1	Washer, 4" square, curved
p		Connectors, guy bond and as req'd
u	2	Deadend for guy strand, heavy duty
y		Guy wire, as req'd (See Note 2)
ab	1	Nut, thimble eye type, 3/4"
ao	1	Bolt, thimble eye, 3/4"x req'd length
av		Jumpers, as req'd
ek	2	Locknuts

DESIGN PARAMETERS:

PERMITTED LOAD IS LESSER OF:
8,500 lbs. (HORIZONTAL)
or 90 % of RATED BREAKING STRENGTH OF GUY WIRE

SINGLE OVERHEAD GUY – HEAVY DUTY
(THROUGH BOLT TYPE)

APRIL 2005		E1.4L
RUS		(E2–3)



NOTE: Ground wire jumper may be attached to down guy wire below guy deadend connector.

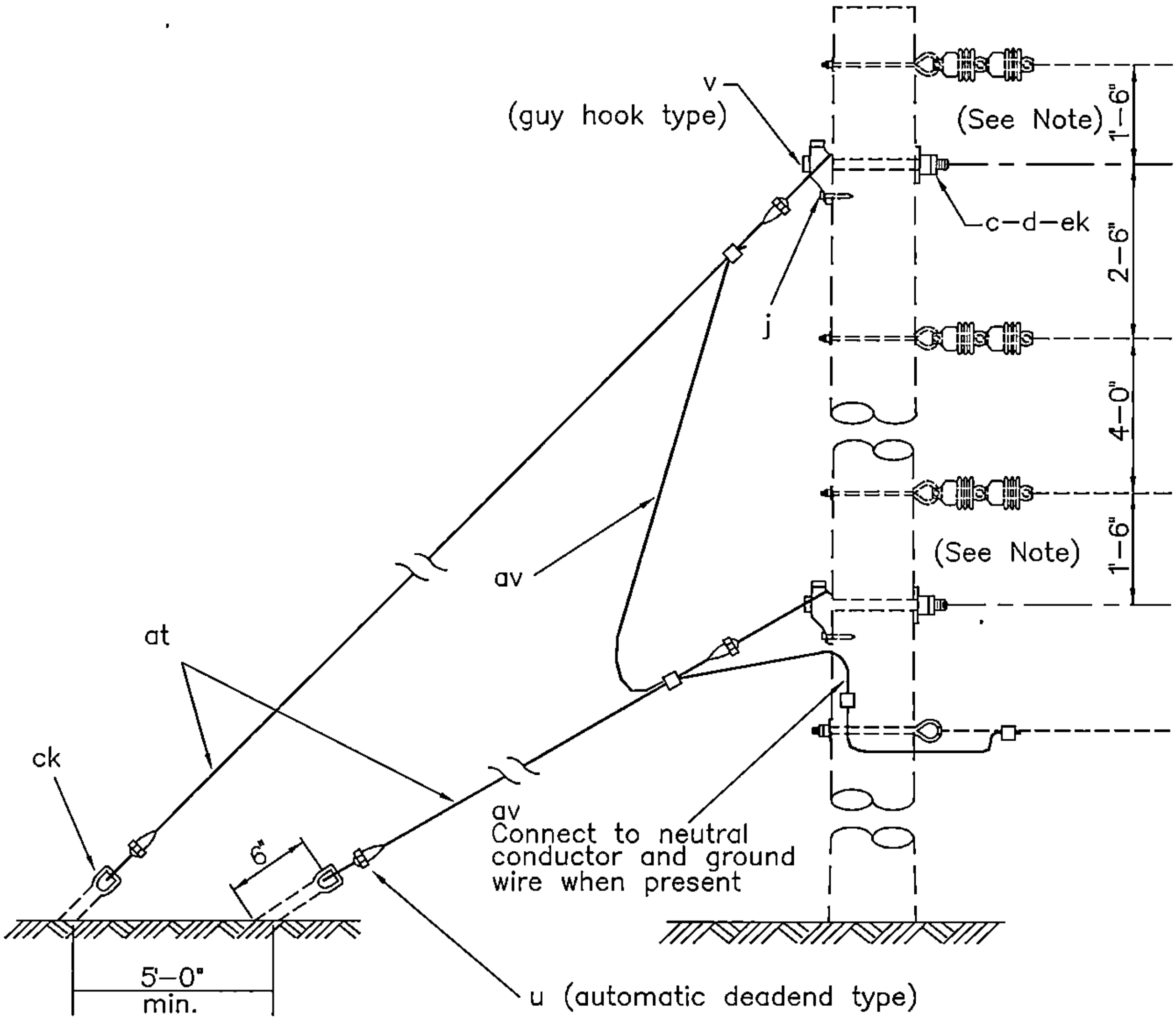
ITEM	MATERIAL
w	Insulator, guy strain

DESIGN PARAMETERS:

PERMITTED LOAD = 8,500 lbs.

GUY STRAIN INSULATOR

APRIL 2005		
RUS		E1.5



NOTES:
Position guys as shown on applicable pole top assembly unit if different than shown here. If distance between primary assembly and down guy is less than 12", install (minimum 12") guy strain insulator,(item "w"), or insulated extension link, (item "eu"), (mininum 12"), in primary assembly.

The following single down guy assemblies may be used,
(multiply material quantities by 2):

E1.1:	Through Bolt Type (shown above)
E1.1L:	Through Bolt Type, Heavy Duty
E1.2:	Wrapped Type
E1.3L:	Pole Band Type

DESIGN PARAMETERS:

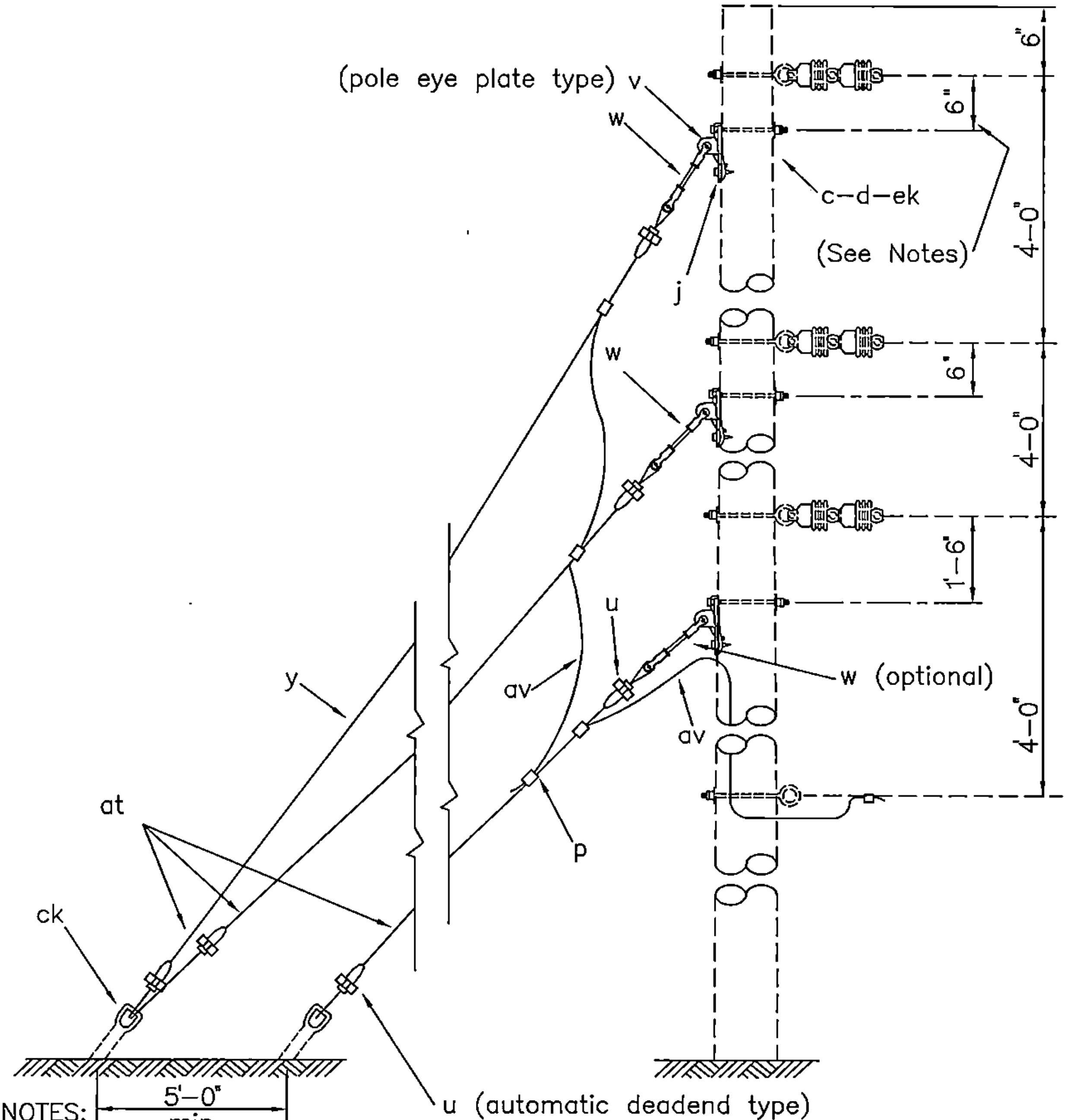
(See Single Down Guy drawings)

DOUBLE DOWN GUY GUIDE
(THROUGH BOLT TYPE)

APRIL 2005

RUS

E2.1G



NOTES:
Position guys as shown on applicable pole top assembly unit if different than shown here. If distance between primary assembly and down guy is less than 12", install (minimum 12") guy strain insulator, (item "w"), or insulated extension link, (item "eu"), (mininum 12"), in primary assembly.
The following single down guy assemblies may be used, (multiply material quantities by 3):

E1.1:	Through Bolt Type
E1.1L:	Through Bolt Type, Heavy Duty (shown above)
E1.2:	Wrapped Type
E1.3L:	Pole Band Type

DESIGN PARAMETERS:

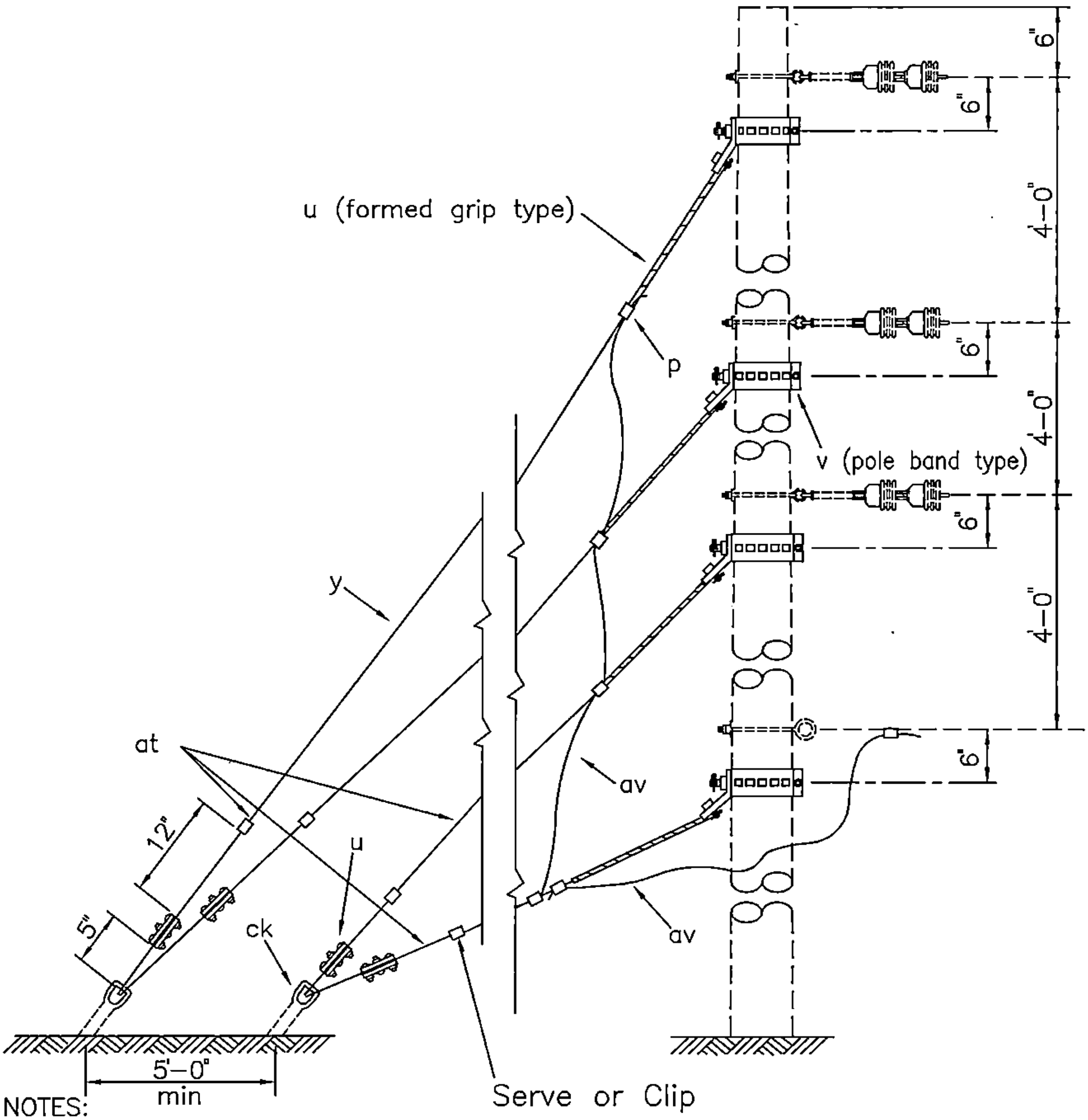
(See Single Down Guy drawings)

THREE DOWN GUY GUIDE – HEAVY DUTY (THROUGH BOLT TYPE)

APRIL 2005

RUS

E3.1LG



NOTES:
Position guys as shown on applicable pole top assembly unit if different than shown here. If distance between primary assembly and down guy is less than 12", install (minimum 12") guy strain insulator, (item "w"), or insulated extension link, (item "eu"), (mininum 12"), in primary assembly.

The following single down guy assemblies may be used, (multiply material quantities by 4):

E1.1 :	Through Bolt Type
E1.1L:	Through Bolt Type, Heavy Duty
E1.2 :	Wrapped Type
E1.3L:	Pole Band Type (Shown Above)

DESIGN PARAMETERS:

(See Single Down Guy drawings)

FOUR DOWN GUY GUIDE – LARGE CONDUCTORS
(POLE BAND TYPE)

APRIL 2005

RUS

E4.3LG

ANCHOR ASSEMBLY UNITS

DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804 (New)	**Bulletin 50-3** (Old)	
F1.6	(F1-1)	EXPANDING TYPE ANCHORS
F1.8	(F1-2)	
F1.10	(F1-3)	
F1.12	(F1-4)	
F2.6	(F1-1S)	SCREW ANCHORS (POWER INSTALLED)
F2.8	(F1-2S)	
F2.10	(F1-3S)	
F2.12	(F1-4S)	
F3.6	(F1-1P)	PLATE TYPE ANCHORS
F3.8	(F1-2P)	
F3.10	(F1-3P)	
F3.12	(F1-4P)	
F4.1	(F4-1E)	SERVICE ANCHORS
F4.2	(F4.1S)	
F5.1	(F5-1)	ROCK ANCHORS
F5.2	(F5-2)	
F5.3	(F5-3)	
F6.6	(F6-1)	SWAMP ANCHORS (POWER INSTALLED)
F6.8	(F6-2)	
F6.10	(F6-3)	

CONSTRUCTION SPECIFICATIONS FOR ANCHORING

As much as practicable, anchors and rods shall be installed in line with, and in the opposite direction of, the resultant strain of the conductors. Anchor assemblies shall be installed so that approximately 6 inches of the rod remains out of the ground. In cultivated fields or other locations as deemed necessary, the projection of the anchor rod above earth may be increased to a maximum of 12 inches to prevent burial of the rod eye.

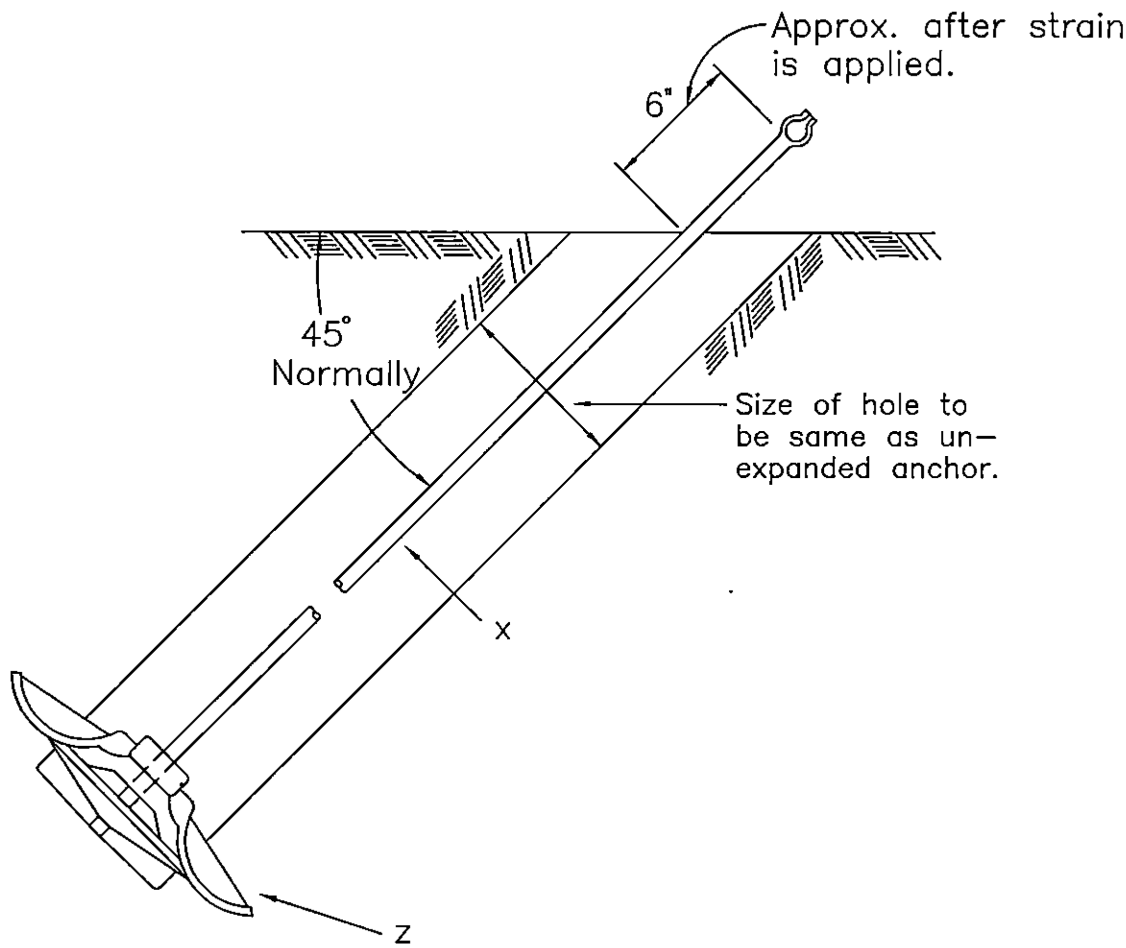
The backfill of all anchor holes must be thoroughly tamped the full depth. After a cone anchor has been set in place, the hole shall be backfilled with coarse crushed rock for 2 feet above the anchor and tamped during the filling. The remainder of the hole shall be backfilled and tamped with dirt.

The designated holding powers shown on the anchor assembly drawings are based on the maximum holding power of average, Class 5 soil. When the anchor is installed in poorer soils, the holding power of the anchor shall be derated. A suggested guide is to derate by 25 percent in Class 6 soil and by 50 percent in Class 7 soil. For Class 8 soil it is usually necessary to use swamp anchors or power driven screw anchors which can penetrate the poor soil into firmer soil. See the "Soil Classifications" table on the following page for soil classes.

Log type anchors are acceptable for use on distribution systems. Refer to the appropriate drawings in RUS Bulletin 1728F-811,"Electric Transmission Specifications and Drawings, 115 kV through 230 kV" for assembly units and construction details.

SOIL CLASSIFICATIONS

Class	Engineering Description
0	Sound hard rock, unweatherd
1	Very dense and/or cemented sands; coarse gravel and cobbles
2	Dense fine sand; very hard silts and clays (may be preloaded)
3	Dense clayed sand and gravel; very stiff to hard silts and clays
4	Medium dense sandy gravel; very stiff to hard silts and clays
5	Medium dense coarse sand and sandy gravels; stiff to very stiff silts and clays
6	Loose to medium dense fine to coarse sand; firm to stiff clays and silts
7	Loose fine sand; alluvium; loess; soft-firm clays; varved clays; fill
8	Peat; organic silts; inundated silts; fly ash



NOTE: Designated maximum holding power rating assumes proper installation in class 5 soil.

	ASSEMBLY: F1	.6	.8	.10	.12
	Minimum Area (sq. in.)	90	100	120	135
ITEM	MATERIAL	QTY	QTY	QTY	QTY
x	Rod, anchor, thimble eye, 5/8" x 7'0"	1	1		
x	Rod, anchor, twin eye, 3/4" X 8'0"			1	1
z	Anchor, expanding type	1	1	1	1

ASSEMBLY NUMBERS	
NEW	(OLD)
F1.6	(F1–1)
F1.8	(F1–2)
F1.10	(F1–3)
F1.12	(F1–4)

DESIGN PARAMETERS:
DESIGNATED MAXIMUM
HOLDING POWER (lbs.)

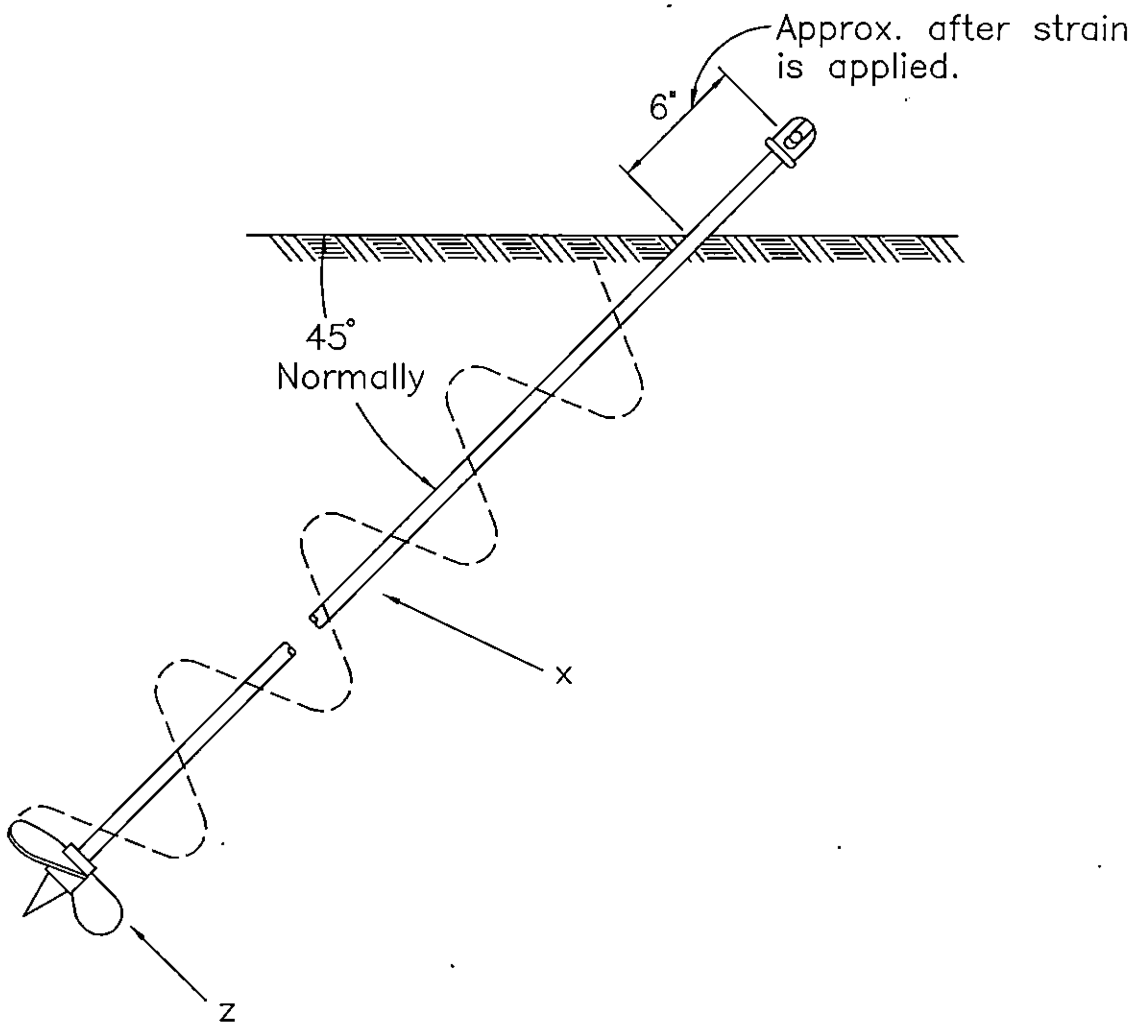
F1.6:	6,000
F1.8:	8,000
F1.10:	10,000
F1.12:	12,000

EXPANDING TYPE ANCHORS

APRIL 2005

RUS

F1.6, F1.8, F1.10, F1.12



NOTE: Designated maximum holding power rating assumes proper installation in class 5 soil.

	ASSEMBLY: F2	.6	.8	.10	.12
	Minimum Area (sq. in.)	90	100	120	135
ITEM	MATERIAL	QTY	QTY	QTY	QTY
x	Rod, anchor, thimble eye, 5/8" x 7'0"	1	1		
x	Rod, anchor, twin eye, 3/4 X 8'0			1	1
z	Anchor, screw type, power installed	1	1	1	1

ASSEMBLY NUMBERS	
NEW	(OLD)
F2.6	(F1-1S)
F2.8	(F1-2S)
F2.10	(F1-3S)
F2.12	(F1-4S)

DESIGN PARAMETERS:
DESIGNATED MAXIMUM
HOLDING POWER (lbs.)

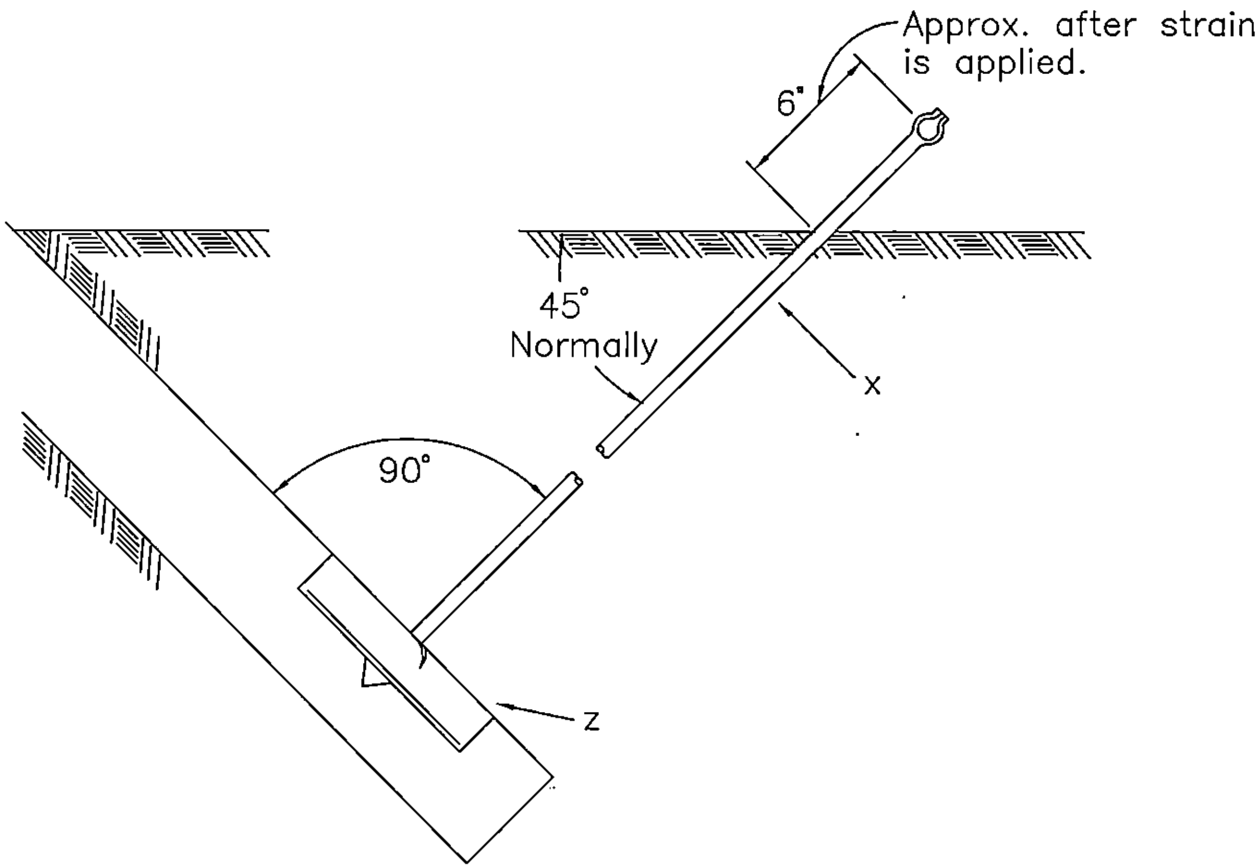
F2.6:	6,000
F2.8:	8,000
F2.10:	10,000
F2.12:	12,000

SCREW ANCHORS, (POWER INSTALLED)

APRIL 2005

RUS

F2.6, F2.8, F2.10, F2.12



NOTE: Designated maximum holding power rating assumes proper installation in class 5 soil.

	ASSEMBLY: F3	.6	.8	.10	.12
	Minimum Area (sq. in.)	90	100	120	135
ITEM	MATERIAL	QTY	QTY	QTY	QTY
x	Rod, anchor, thimble eye, 5/8" x 7'0"	1	1		
x	Rod, anchor, twin eye, 3/4" X 8'0"			1	1
z	Anchor, plate type	1	1	1	1

ASSEMBLY NUMBERS	
NEW	(OLD)
F3.6	(F1–1P)
F3.8	(F1–2P)
F3.10	(F1–3P)
F3.12	(F1–4P)

DESIGN PARAMETERS:
DESIGNATED MAXIMUM
HOLDING POWER (lbs.)

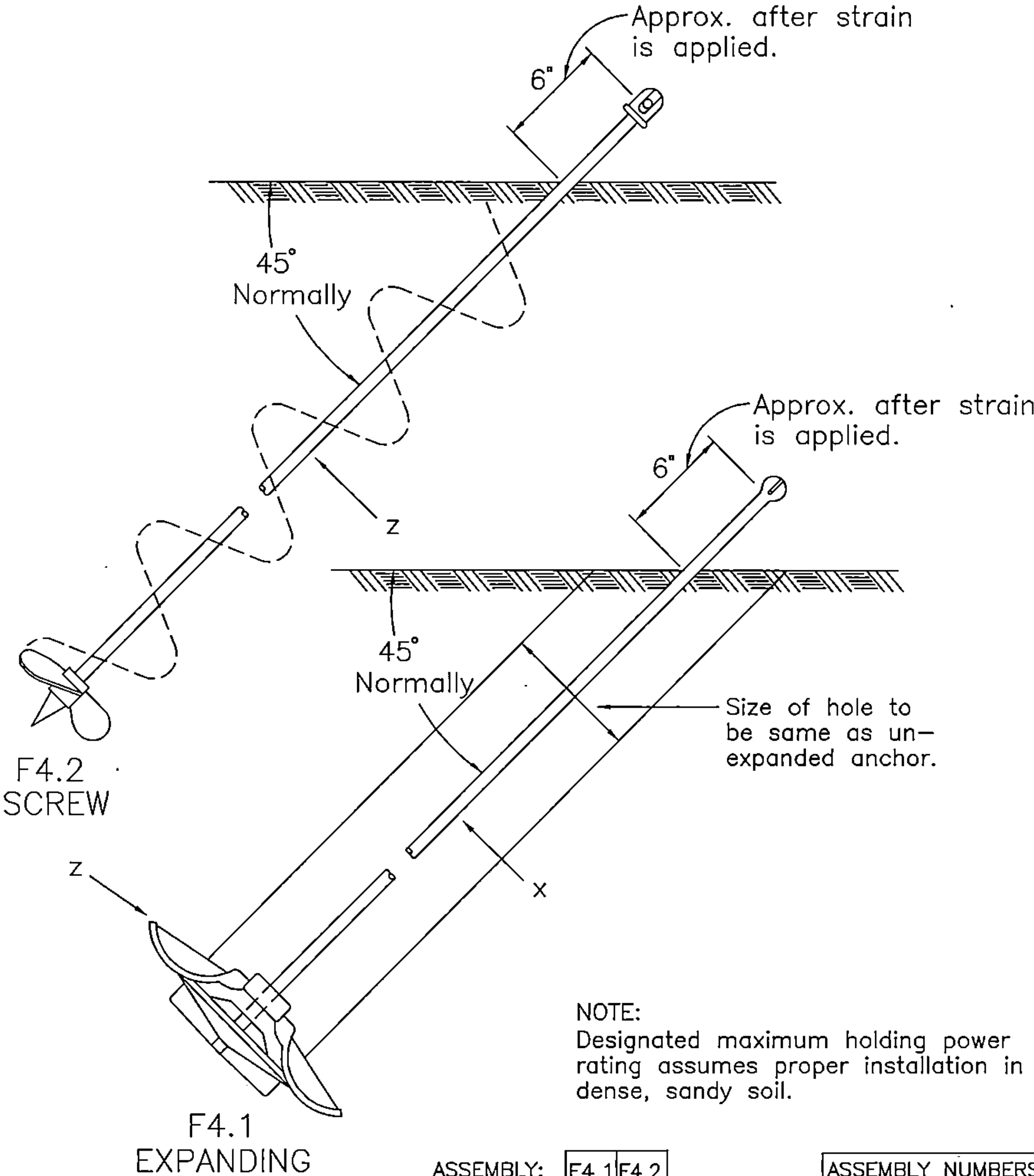
F3.6:	6,000
F3.8:	8,000
F3.10:	10,000
F3.12:	12,000

PLATE TYPE ANCHORS

APRIL 2005

RUS

F3.6, F3.8, F3.10, F3.12



NOTE:
Designated maximum holding power rating assumes proper installation in dense, sandy soil.

ITEM	MATERIAL	F4.1 QTY	F4.2 QTY
x	Rod, anchor, thimble eye type	1	
z	Anchor, service, expanding type	1	
z	Anchor, service, screw type		1

ASSEMBLY NUMBERS

NEW	(OLD)
F4.1	(F4–1E)
F4.2	(F4–1S)

DESIGN PARAMETERS:

DESIGNATED MAXIMUM HOLDING POWER (lbs.)

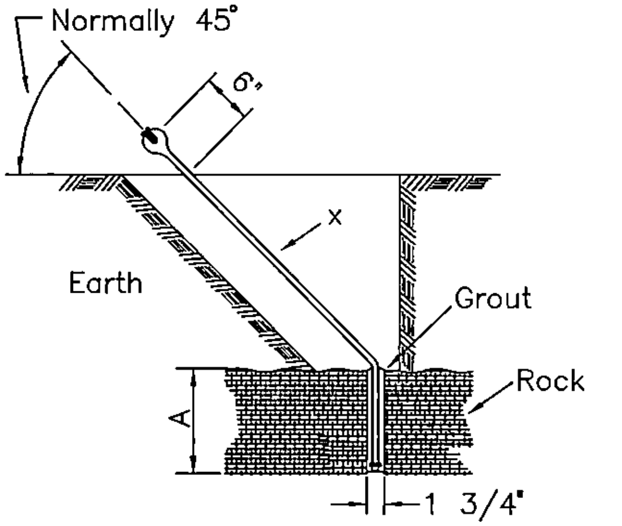
F4.1: 2,500
F4.2: 2,500

SERVICE ANCHORS

APRIL 2005

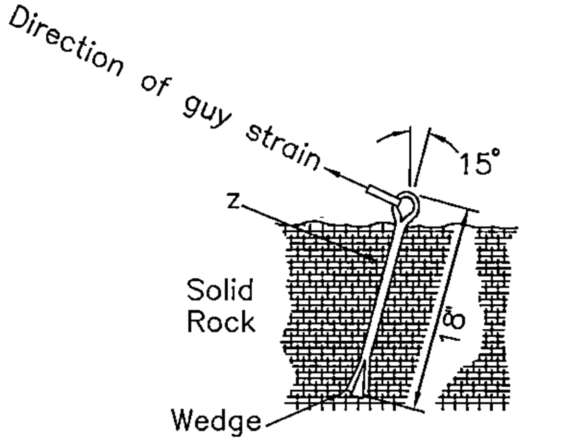
RUS

F4.1, F4.2



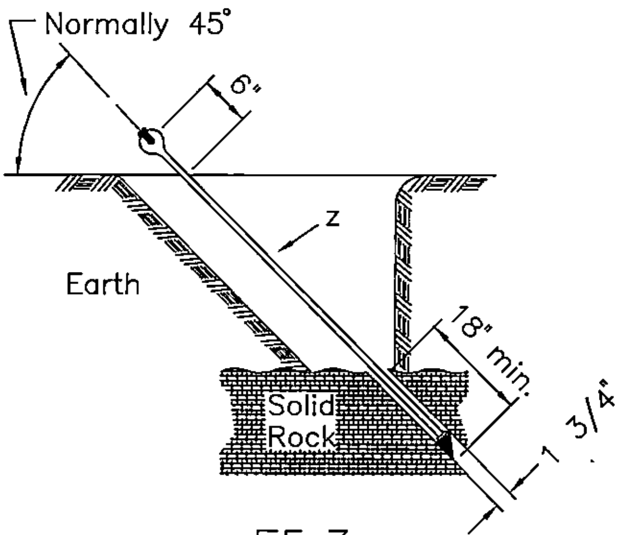
A = 18" min. for solid rock
= 30" min. for stratified rock

F5.1



NOTE: 15" expanding type rock anchor may be used

F5.2



F5.3

NOTES:

1. Only one guy shall be attached to a rock anchor. Where more than one guy is required, space anchors 2 feet minimum apart and, where practical, install in direct line with pole.
2. Do not anchor to any boulder measuring less than 4 feet in diameter.

(* See Note)

	ASSEMBLY:	F5.1	F5.2	F5.3
ITEM	MATERIAL	QTY	QTY	QTY
x	Rod, anchor or thimble eye type	1		
z	Anchor, expanding rock type		*	1
z	Anchor, rock, guy bolt type		1	

ASSEMBLY NUMBERS	
NEW	(OLD)
F5.1	(F5-1)
F5.2	(F5-2)
F5.3	(F5-3)

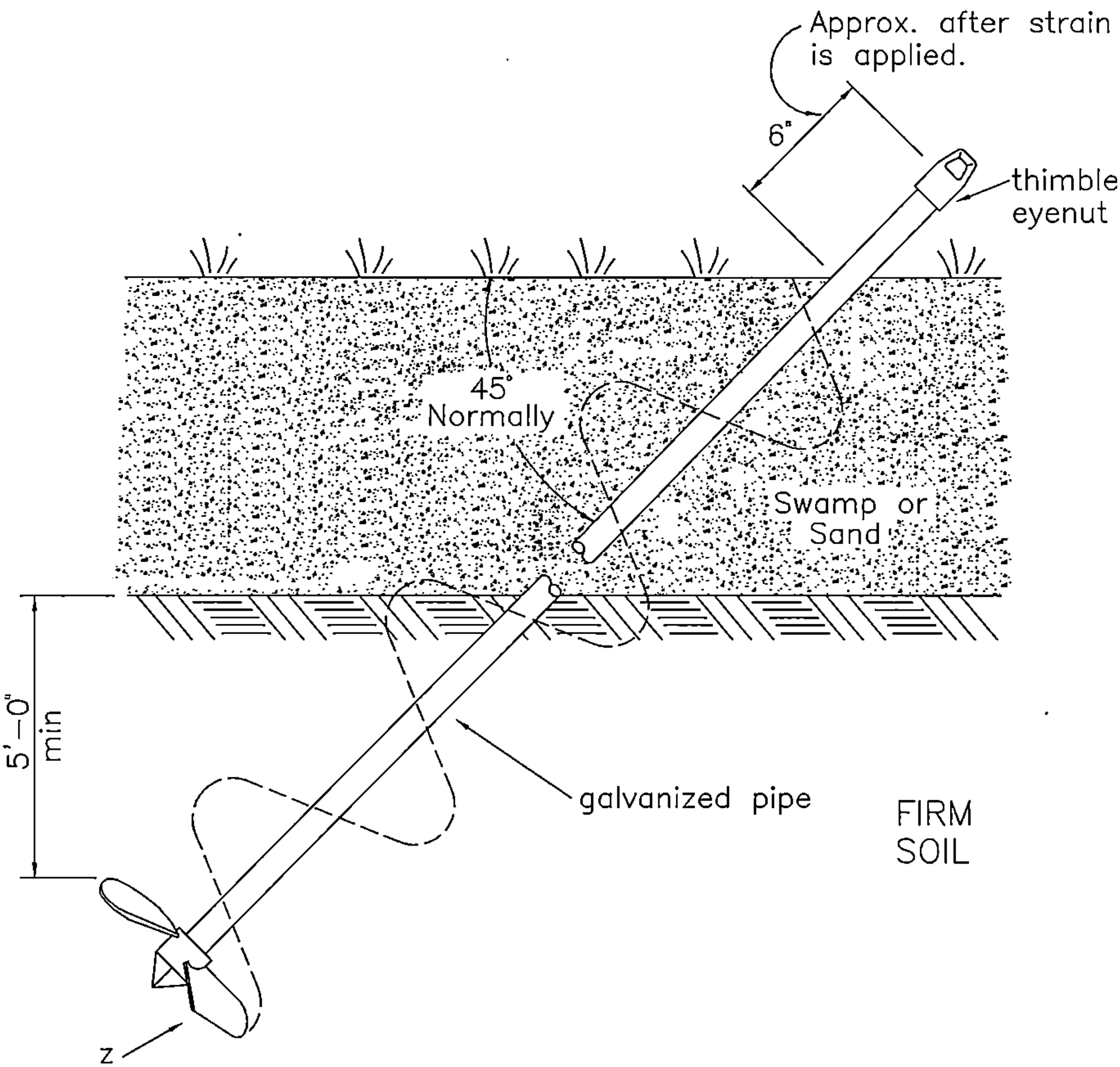
DESIGN PARAMETERS:

ROCK ANCHORS

APRIL 2005

RUS

F5.1, F5.2, F5.3



NOTE: Designated maximum holding power rating assumes proper installation. See anchor specifications for additional information.

ITEM	MATERIAL	F6.6 QTY	F6.8 QTY	F6.10 QTY
z	Anchor, swamp type (diameter)	1–10"	1–12"	1–15"
	Nut, thimble eye type	1	1	1
	Pipe, galvanized, as req'd			

ASSEMBLY NUMBERS	
NEW	(OLD)
F6.6	(F6–1)
F6.8	(F6–2)
F6.10	(F6–3)

DESIGN PARAMETERS:
DESIGNATED MAXIMUM HOLDING POWER (lbs.)

F6.6:	6,000
F6.8:	8,000
F6.10:	10,000

SWAMP ANCHORS (POWER INSTALLED)

APRIL 2005

RUS

F6.6, F6.8, F6.10

TRANSFORMER ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
G1.1G	(M27-1A)	TRANSFORMER INSTALLATION GUIDE SINGLE -PHASE, POLE-TYPE TRANSFORMER
G1.2G		POLE TYPE TRANSFORMER LOCATION GUIDE
G1.2	(G105-) (G136-)	SINGLE-PHASE, CSP TRANSFORMER (TANGENT POLE)
G1.3	(G106-)	SINGLE-PHASE, CSP TRANSFORMER (DEADEND POLE)
G1.4 G1.5		SINGLE-PHASE, CONVENTIONAL TRANSFORMER (TANGENT POLE)
G1.6		SINGLE-PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)
G1.7	(G9-) (G39-)	SINGLE-PHASE, CONVENTIONAL TRANSFORMER (TANGENT POLE)
G1.8	(G10-)	SINGLE-PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)
G2.1	(G210-)	TWO-PHASE TRANSFORMER BANK OPEN-WYE PRIMARY OPEN-DELTA, 4 WIRE SECONDARY
G2.1G		TRANSFORMER / METER CONNECTION GUIDE THREE-PHASE, OPEN-WYE - OPEN DELTA FOR 120/240 VOLT POWER LOADS
G3.1	(G310-)	THREE-PHASE TRANSFORMER BANK UNGROUNDED-WYE PRIMARY CENTER-TAP GROUNDED DELTA, 4 WIRE SECONDARY
G3.1G		TRANSFORMER / METER CONNECTION GUIDE UNGROUNDED WYE - CENTER TAP GROUNDED DELTA FOR 120/240 VOLT POWER LOADS

TRANSFORMER ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
G3.2	(G311-)	THREE-PHASE TRANSFORMER BANK UNGROUNDED WYE - PRIMARY CORNER GROUNDED DELTA, 3 WIRE SECONDARY
G3.2G		TRANSFORMER / METER CONNECTION GUIDE UNGROUNDED WYE - CORNER GROUNDED DELTA FOR 240 OR 480 VOLT POWER LOADS
G3.3	(G312-)	THREE-PHASE TRANSFORMER BANK GROUNDED-WYE PRIMARY GROUNDED WYE, 4 WIRE SECONDARY
G3.3G		TRANSFORMER / METER CONNECTION GUIDE GROUNDED WYE - GROUNDED WYE FOR 120/208 VOLT POWER LOADS

CONSTRUCTION SPECIFICATIONS FOR TRANSFORMERS

It may be necessary, and it is permissible, to lower the neutral attachment on standard single-phase conventional type transformer assemblies an additional distance not exceeding 2 feet to provide adequate clearances for cutouts.

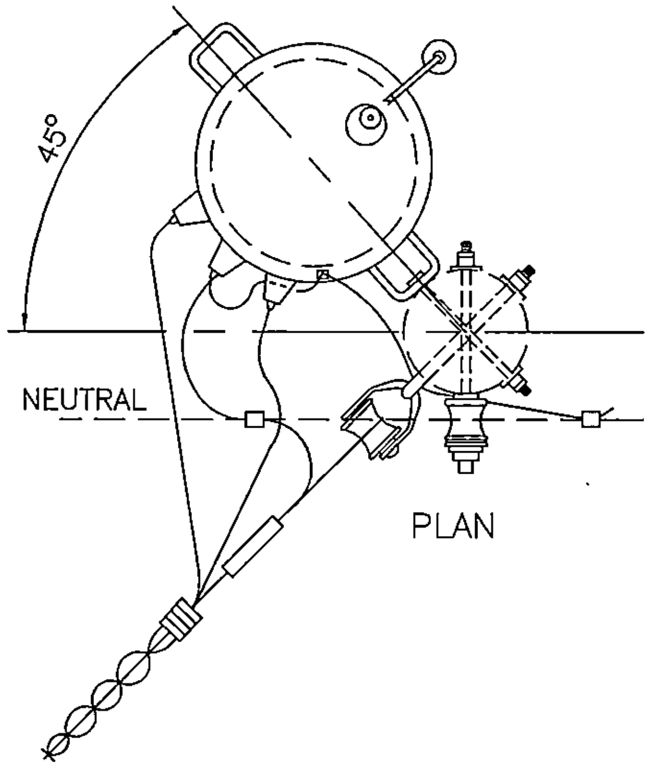
Where applicable, the external gap on surge arresters shall be set according to the manufacturer's recommended spacing.

The construction drawings for three-phase transformer banks (e.g., "G3.1") show cutouts (items "af") and arresters (items "ae) mounted adjacent to one another on the crossarm. However, a cutout and arrester, as shown, may be replaced with a combination cutout/arrester (item "ax"). This change will require a change in the assembly's material shown on the construction drawings. Moreover, the arresters may be mounted directly on the transformer tank. (The cutouts remain on the arm.) Any of the above mounting arrangements for three-phase transformer banks are acceptable; the choice is left to the design engineer.

The construction drawings for single-phase conventional transformer assemblies show surge arresters mounted directly on the transformer tank which maximizes transformer surge protection. Except for single-phase conventional transformers with open link fused cutouts (assemblies "G1.7" and "G1.8"), the arrester may be mounted on a crossarm, on a bracket (item "fn") adjacent to the cutout, or a combination cutout/arrester (item "ax") may be used. The choice of using any of these acceptable mounting arrangements is left to the design engineer.

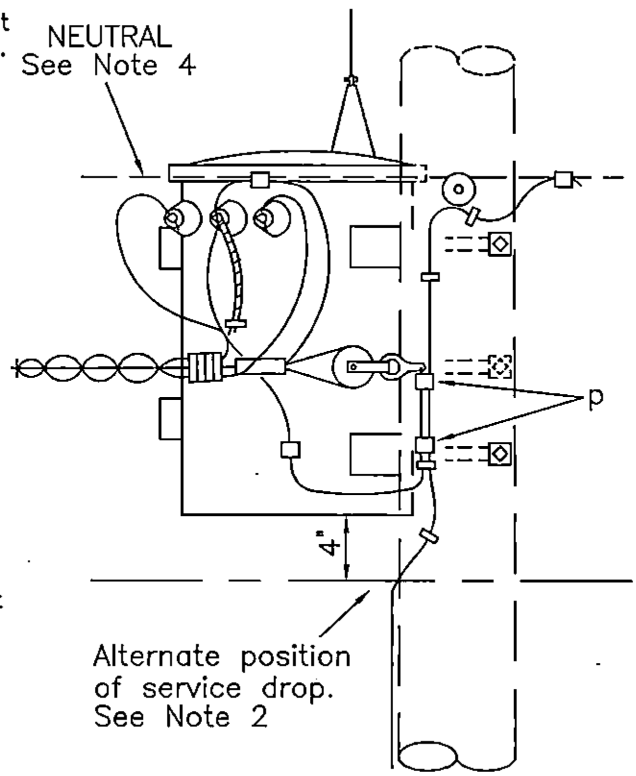
Tank-mounted arresters provide maximum surge protection to transformers because of the arresters' minimum lead lengths. However, when arresters are mounted directly on transformer tanks, the fused cutouts have less surge protection and are subject to more frequent operations. Nuisance operations on fused cutouts with minimal surge protection can be lessened with the use of dual-element fuses.

The wiring schematics on the three-phase transformer/meter connection guide drawings (e.g., "G3.1G") are based on single-phase transformers with additive polarity. ANSI Standard C57-12.20 specifies that all single-phase transformers larger than 200 kVA have subtractive polarity. If the transformer/meter connection guides are used for single-phase transformers larger than 200 kVA, the schematic diagrams will need to be modified accordingly.

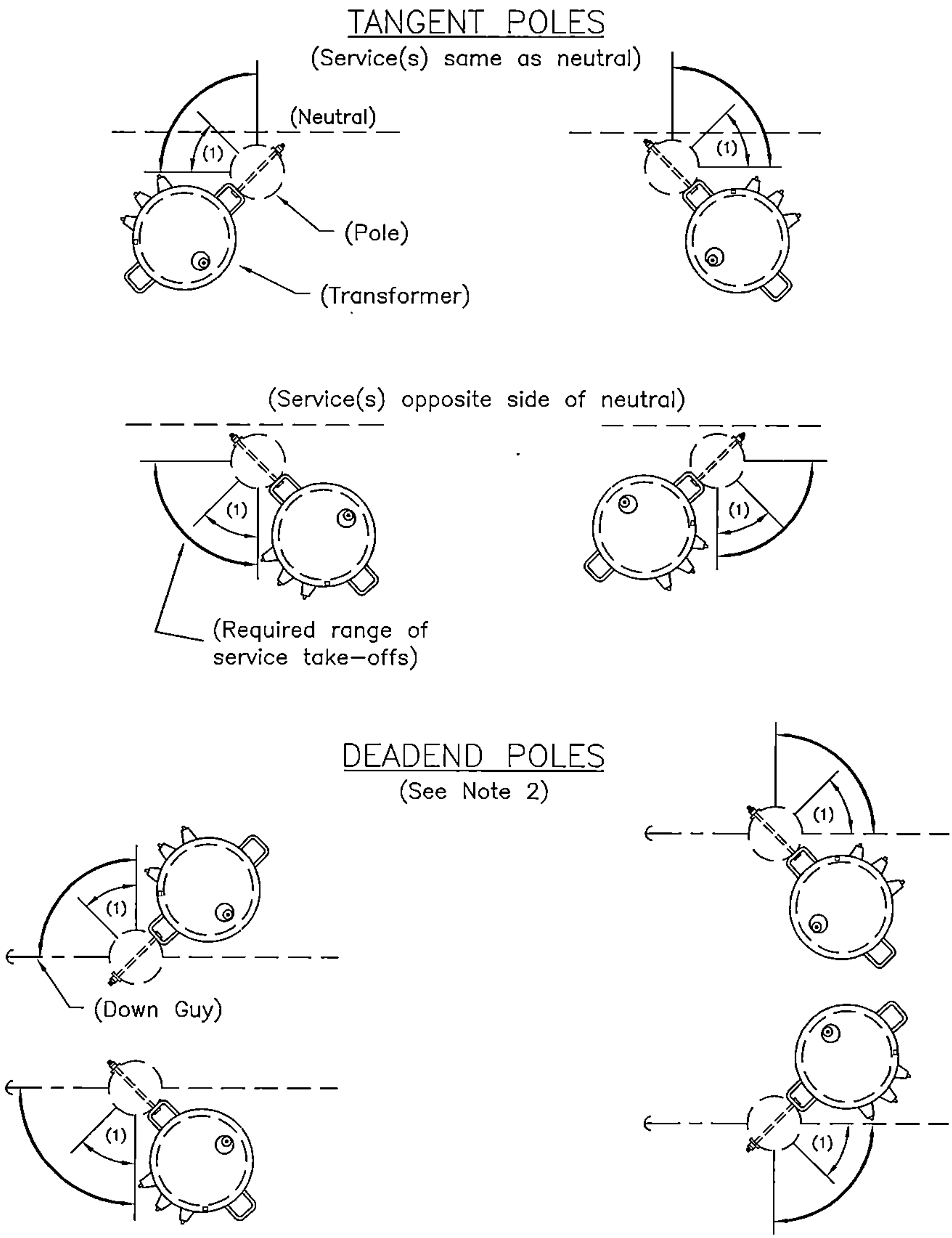


NOTES:

1. Install transformer on tangent poles on a quadrant on the opposite side of pole from primary neutral.
2. When it is necessary to install transformer in the same quadrant as a service drop, attach the service drops 4 inches below the transformer.
3. Install transformer so that primary neutral is at same height as bottom of transformer lid on tangent poles, or 3 inches above transformer lid on deadend poles.
4. Use compression type connectors (item "p").
5. Standard aluminum alloy or standard soft-drawn copper is recommended for the grounding loop conductor.
6. Transformer secondary bushings are not to be used for bi-metal connections.
7. Cover secondary terminals with moisture seal and/or dress conductor ends downward to prevent entry of moisture. (Mininum bending radius is six times the overall cable diameter).



TRANSFORMER INSTALLATION GUIDE SINGLE-PHASE, POLE-TYPE TRANSFORMER		
APRIL 2005		G1.1G (M27-1A)
RUS		

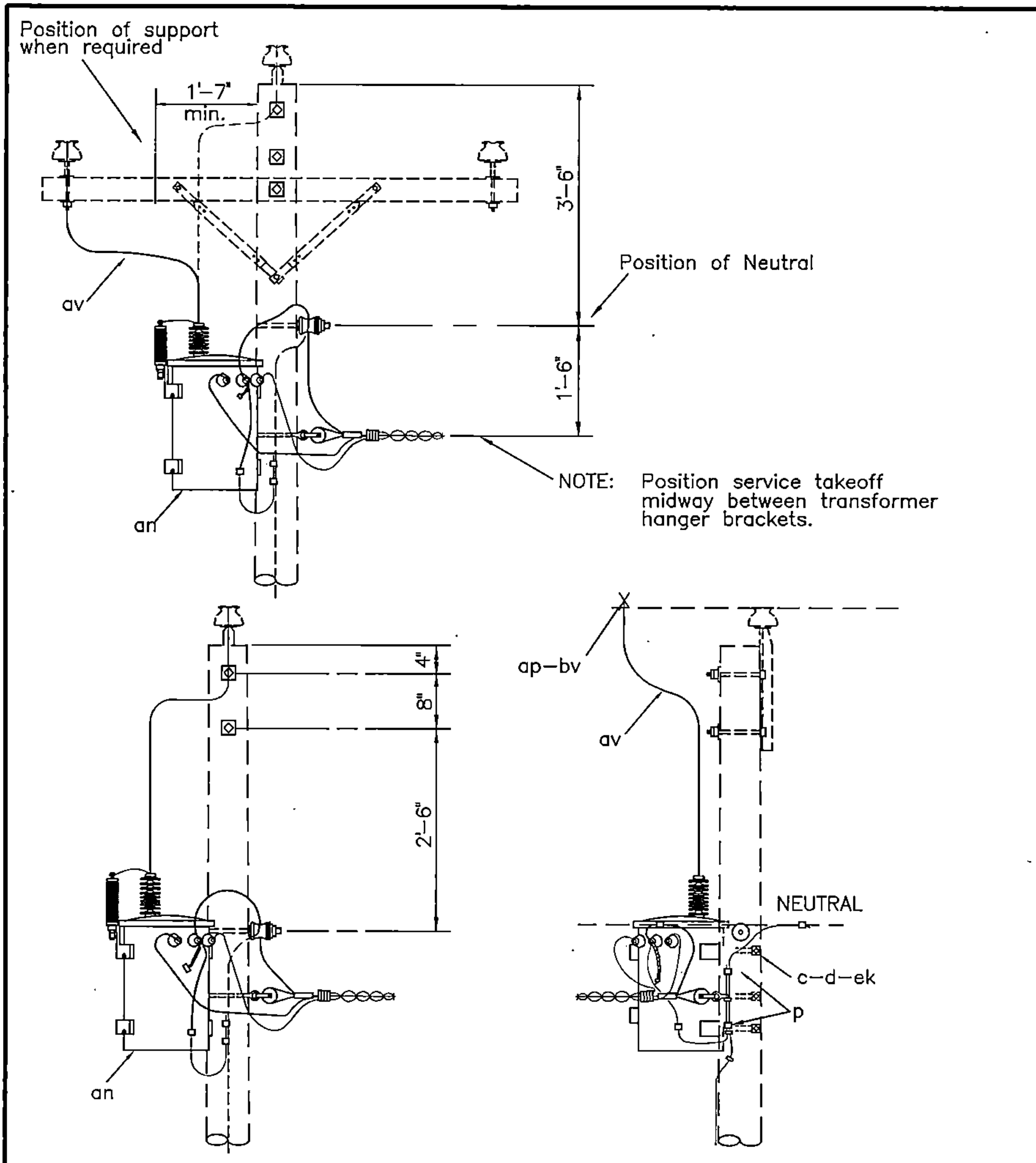


NOTES:

1. Lower service(s) to 4 inches below transformer if necessary for adequate clearances.
2. Lower transformer so that neutral is 3 inches above transformer lid.

POLE TYPE TRANSFORMER LOCATION GUIDE

APRIL 2005		G1.2G
RUS		



ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p		Connectors,compression type,as req'd
an	1	Transformer, 12.47 kV, self-protected

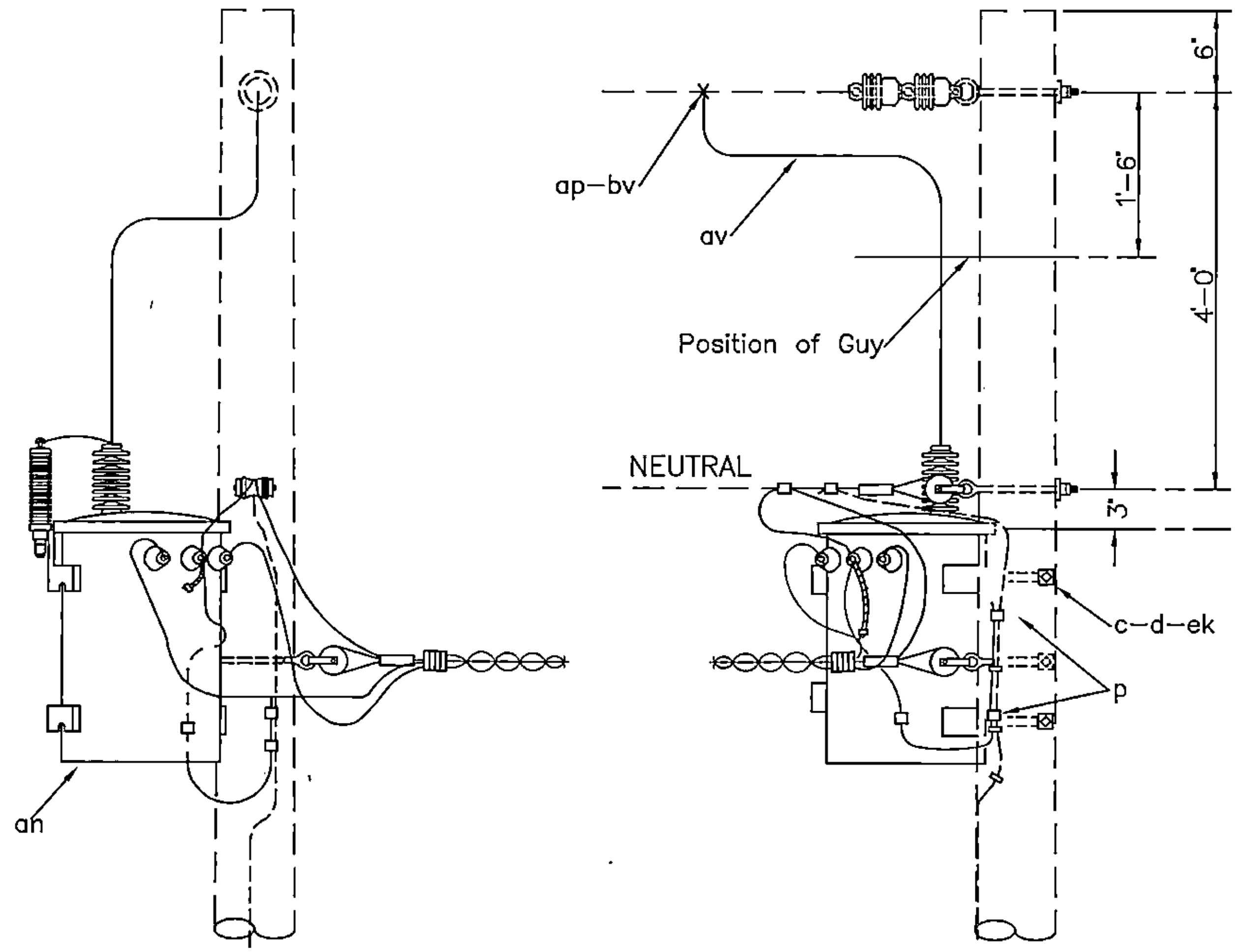
ITEM	QTY	MATERIAL
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor (as req'd)
ek	2	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

SINGLE-PHASE, CSP TRANSFORMER (TANGENT POLE)

APRIL 2005	12.47/7.2 kV	G1.2
RUS		(G105-),(G136-)



NOTE: Install transformer so that primary neutral is 3 inches above bottom of transformer lid on both single—phase and three—phase primary assemblies. See drawing "C5.21" for three—phase deadend.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p		Connectors,compression type as req'd
an	1	Transformer, 12.47 kV, self protected

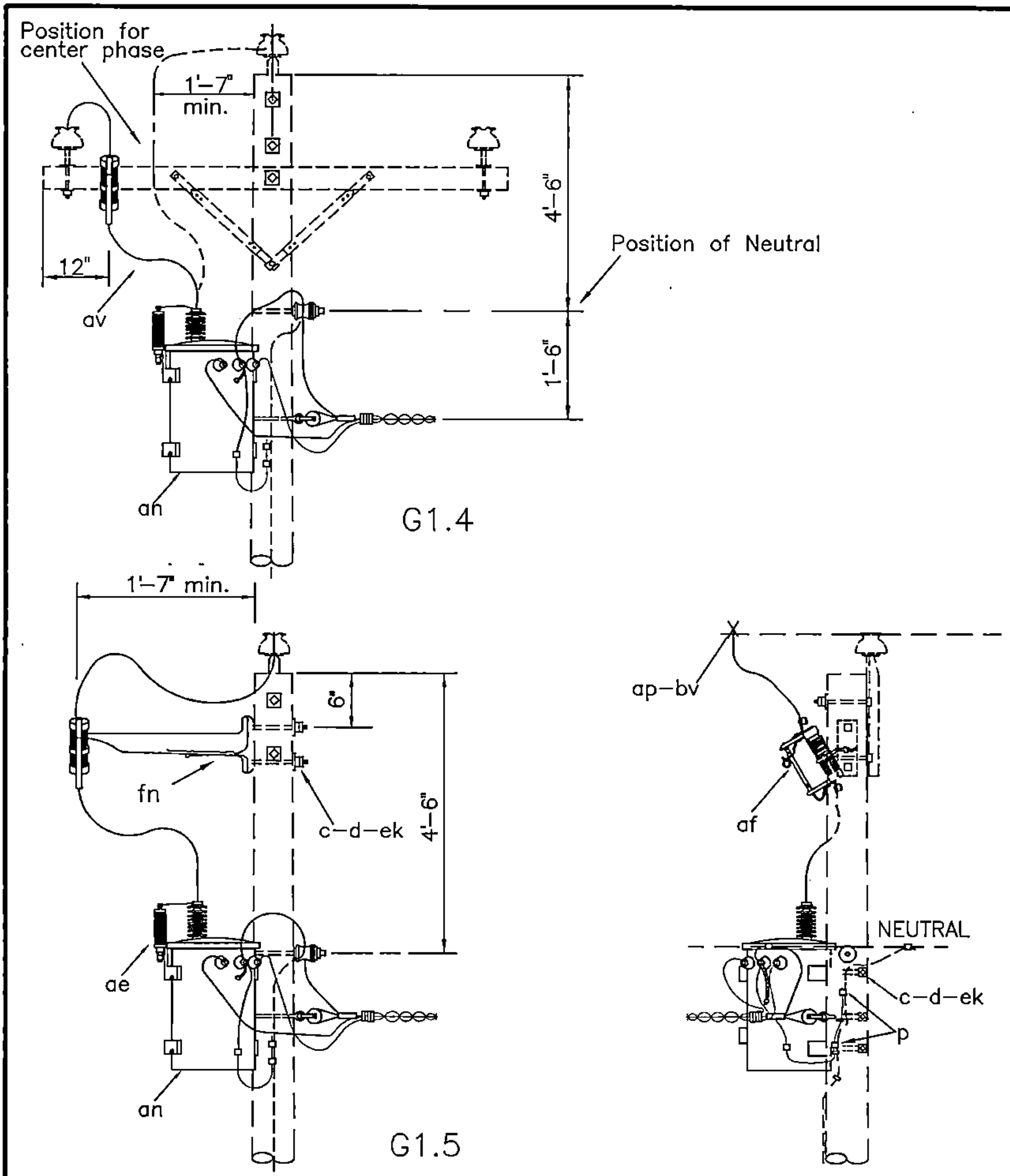
ITEM	QTY	MATERIAL
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor (as req'd)
ek	2	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

SINGLE—PHASE, CSP TRANSFORMER (DEADEND POLE)

APRIL 2005	12.47/7.2 kV	G1.3 (G106—)
RUS		



NOTE: Rotate cutout so the blade faces climbing face of pole.

ITEM	MATERIAL (ASSEMBLY: G1)	.4 QTY	.5 QTY
c	Bolt, machine, 5/8" x req'd length	2	4
d	Washer, square, 2 1/4"	2	4
p	Connectors, as req'd		
ae	Arrester, surge (9 kV)	1	1
af	Cutout, dist., open (15 kV)	1	1
an	Transformer, 12.47 kV, conventional	1	1

ITEM	MATERIAL (ASSEMBLY: G1)	.4 QTY	.5 QTY
ap	Clamp, hot line	1	1
av	Jumpers, stranded, as req'd		
bv	Rod, armor, as req'd		
ek	Locknuts,	2	4
fn	Bracket, extension		1

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

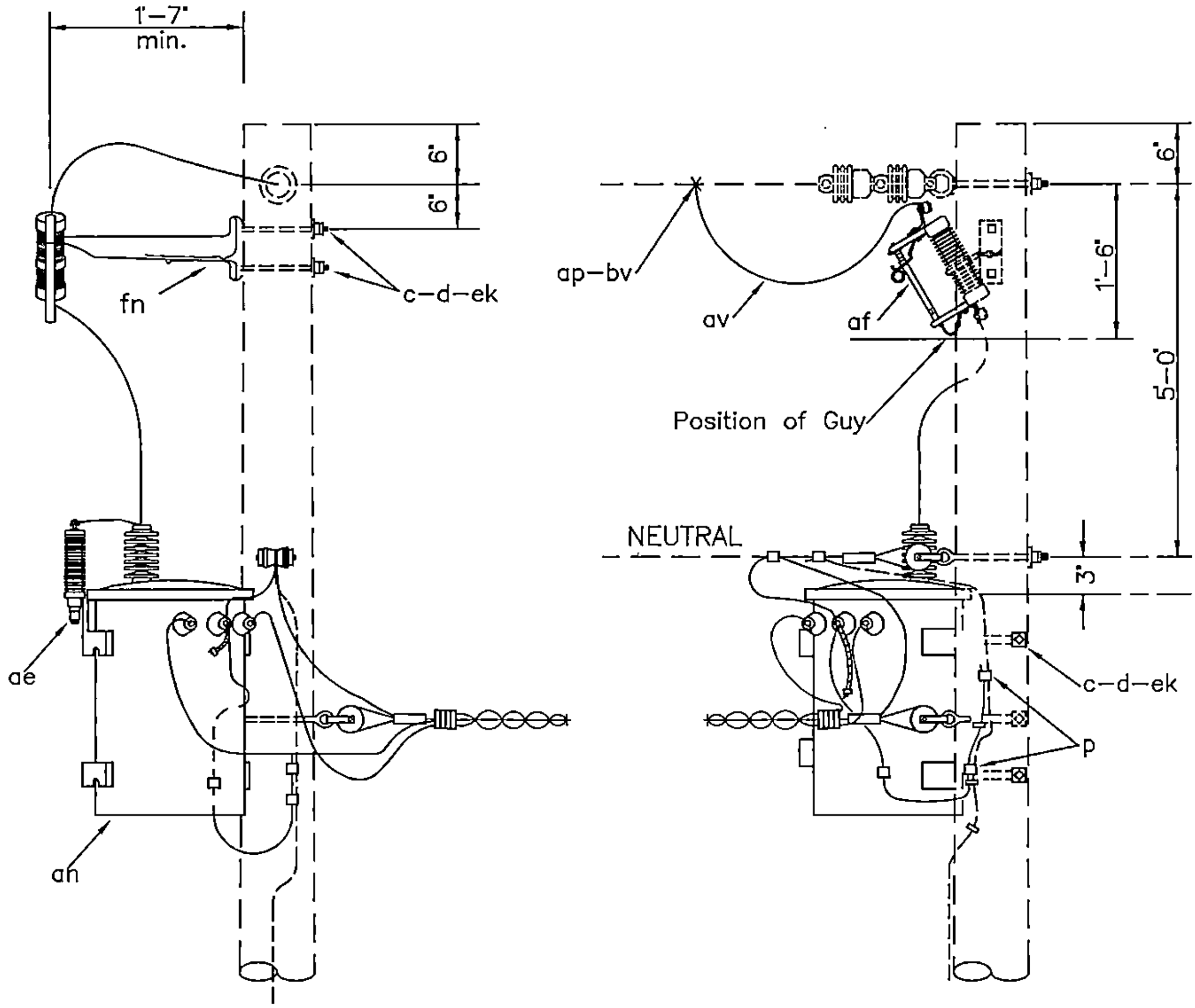
SINGLE-PHASE, CONVENTIONAL TRANSFORMER (TANGENT POLE)

APRIL 2005

RUS

12.47/7.2 kV

G1.4
G1.5



NOTE: Rotate cutout so that the blade faces climbing face of pole.

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
p		Connectors, as req'd
ae	1	Arrester, surge (9 kV)
af	1	Cutout, dist. open (15 kV)
an	1	Transformer, 12.47 kV, conventional

ITEM	QTY	MATERIAL
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor as req'd
ek	4	Locknuts
fn	1	Bracket, extension

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

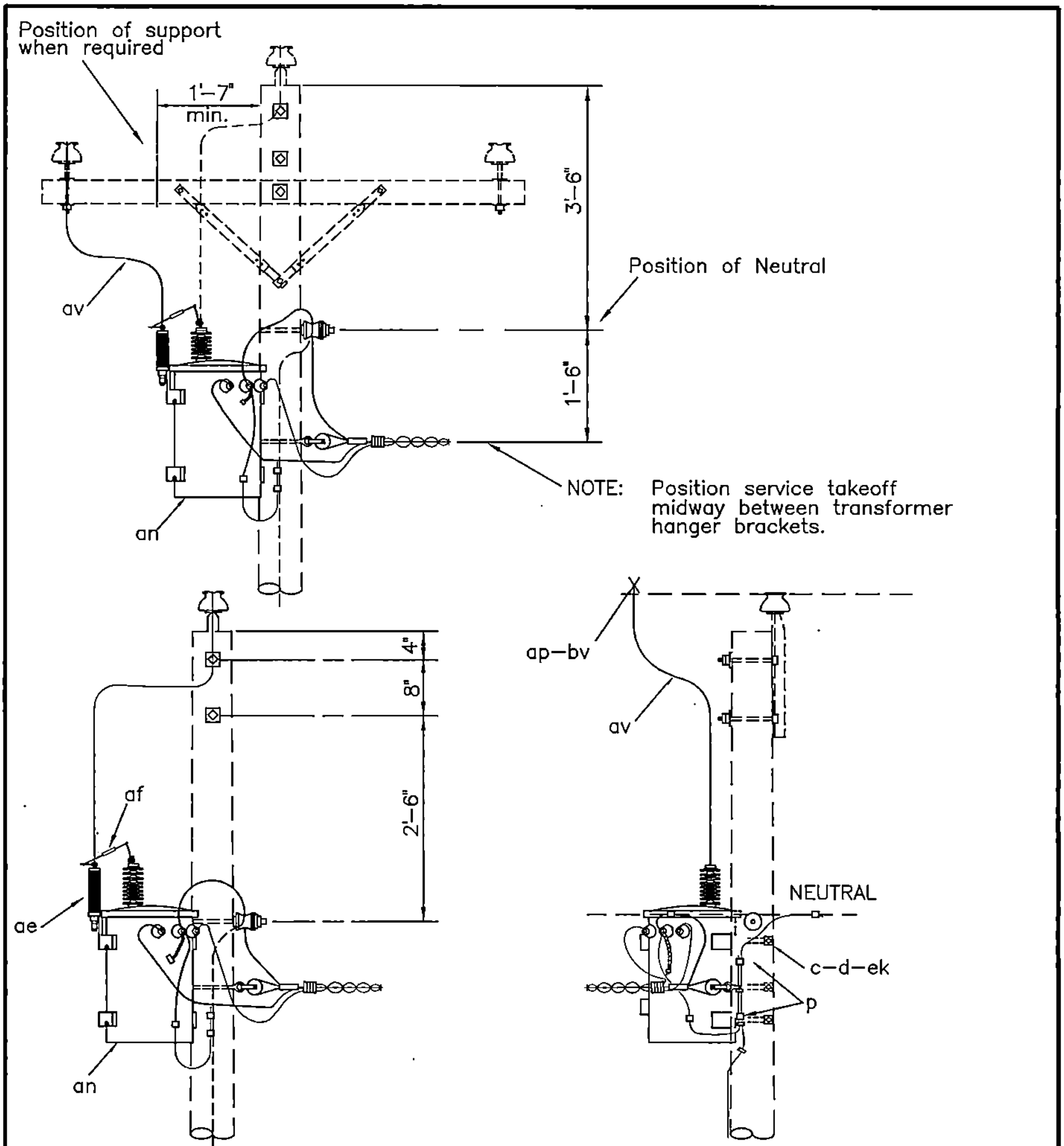
SINGLE-PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)

APRIL 2005

RUS

12.47/7.2 kV

G1.6



ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p		Connectors,compression type,as req'd
an	1	Transformer, 12.47 kV, conventional
ae	1	Arrester, surge (9 kV)

ITEM	QTY	MATERIAL
af	1	Cutout, fuse, open link
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor (as req'd)
ek	2	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

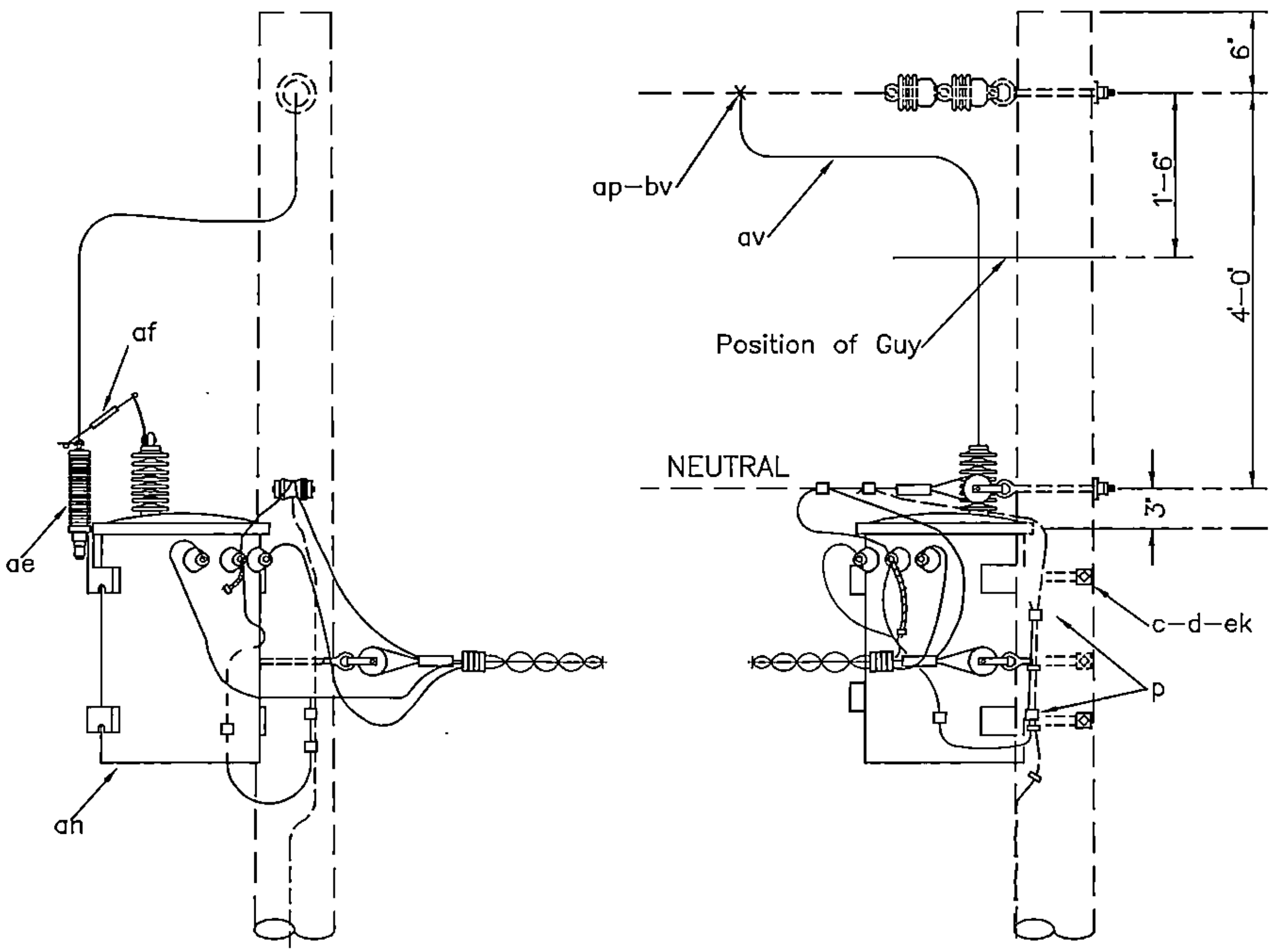
SINGLE–PHASE,
CONVENTIONAL TRANSFORMER
(TANGENT POLE)

APRIL 2005

RUS

12.47/7.2 kV

G1.7
(G9–),(G39–)



NOTE: Install transformer so that primary neutral is 3 inches above bottom of transformer lid on both single–phase and three–phase primary assemblies. See drawing "C5.21" for three–phase deadend.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p		Connectors,compression type as req'd
an	1	Transformer, 12.47 kV, conventional
ae	1	Arrester, surge (9 kV)

ITEM	QTY	MATERIAL
af	1	Cutout, fuse, open link
ap	1	Clamp, hot line
av		Jumpers, stranded, as req'd
bv	1	Rod, armor (as req'd)
ek	2	Locknuts

DESIGN PARAMETERS:

See Guide Drawing "G1.1G"

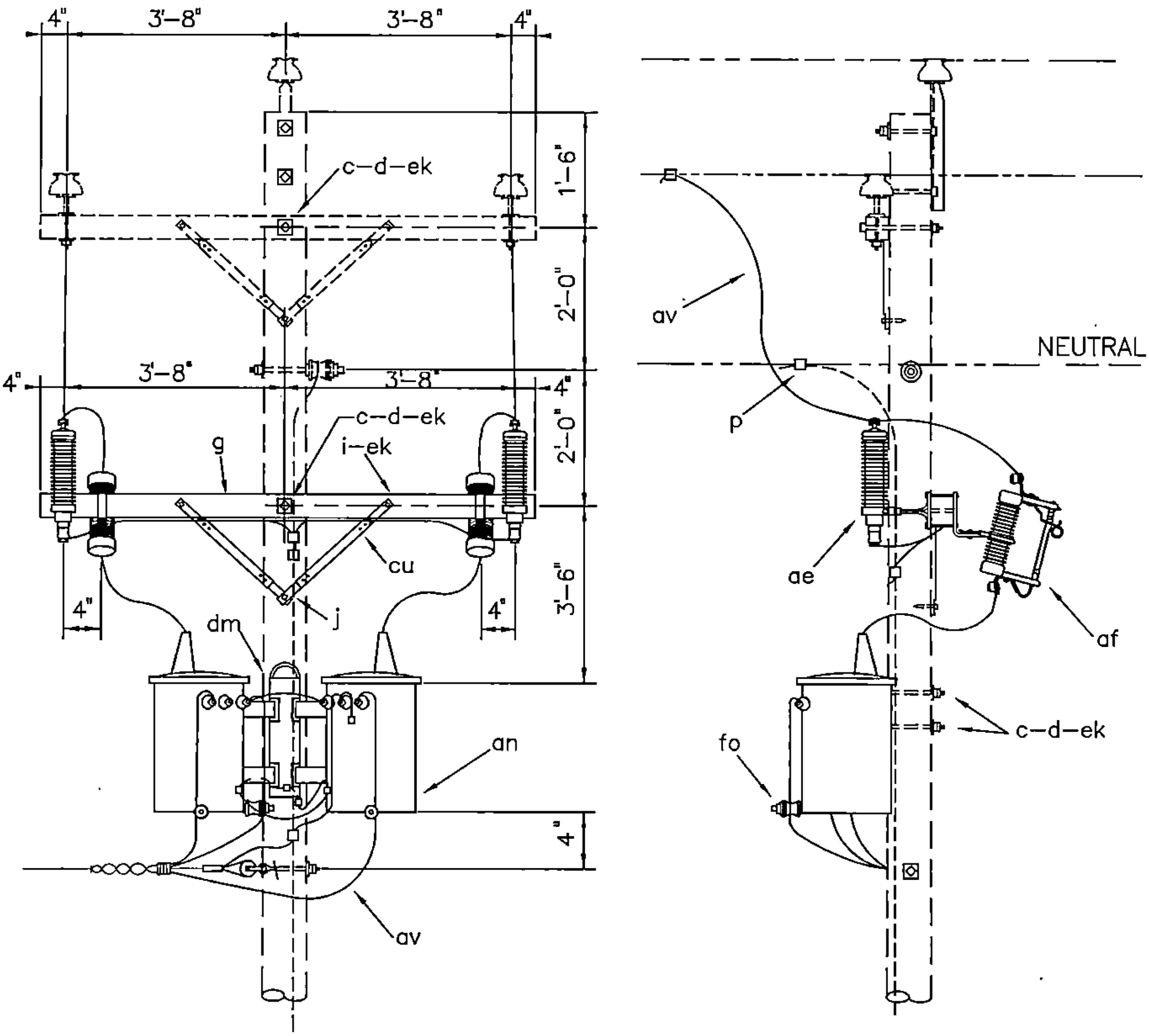
SINGLE–PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)

APRIL 2005

RUS

12.47/7.2 kV

G1.8
(G10–)



ITEM	QTY	MATERIAL
c	3	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8'–0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	2	Arrester, surge, (9 kV)

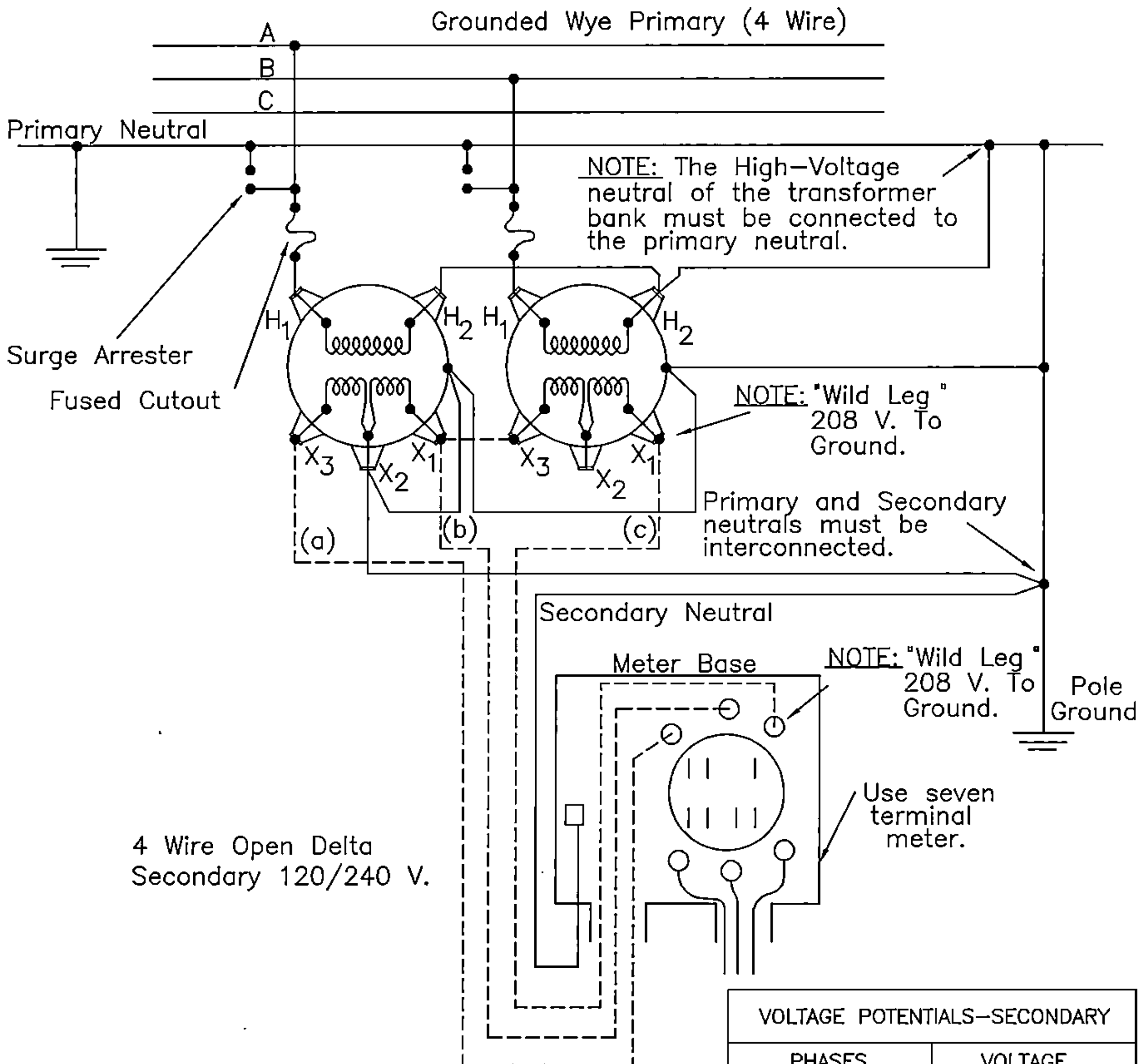
ITEM	QTY	MATERIAL
af	2	Cutout, dist. open (15 kV)
an	2	Transformer, 12.47 kV, conv.
av		Jumpers, bare, stranded, as req'd
av		Jumpers, service, as req'd
cu	2	Brace, 28"
dm	1	Bracket, transformer
ek	5	Locknuts
fo	2	Bracket, transformer, insul.

DESIGN PARAMETERS:

See Guide Drawing "G2.1G"

TWO–PHASE TRANSFORMER BANK
OPEN–WYE PRIMARY
OPEN–DELTA, 4 WIRE SECONDARY

APRIL 2005		G2.1
RUS	12.47/7.2 kV	(G210–)



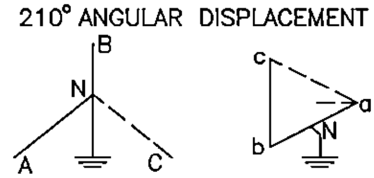
VOLTAGE POTENTIALS–SECONDARY	
PHASES	VOLTAGE
a–b	240 VOLTS
b–c	240 VOLTS
a–c	240 VOLTS
a–N	120 VOLTS
b–N	120 VOLTS
c–N	208 VOLTS

APPLICATION: Used to supply large single-phase, 120/240 volt loads with small amount of three phase loads. Also used when only two phases of primary are available or during emergencies when one unit of a four-wire, wye-delta bank is disabled.

See drawing "G2.1" or "VG2.1" for construction details. One-bushing or two-bushing transformers may be used. Usually transformers of different KVA sizes are used.

BANK RATING: This bank has only 86.6% of the rating of the two units making up the three-phase bank and only 57.7% of the three-phase rating of a closed delta-delta bank of three transformers. Thus, it is relatively inefficient where three-phase loads predominate.

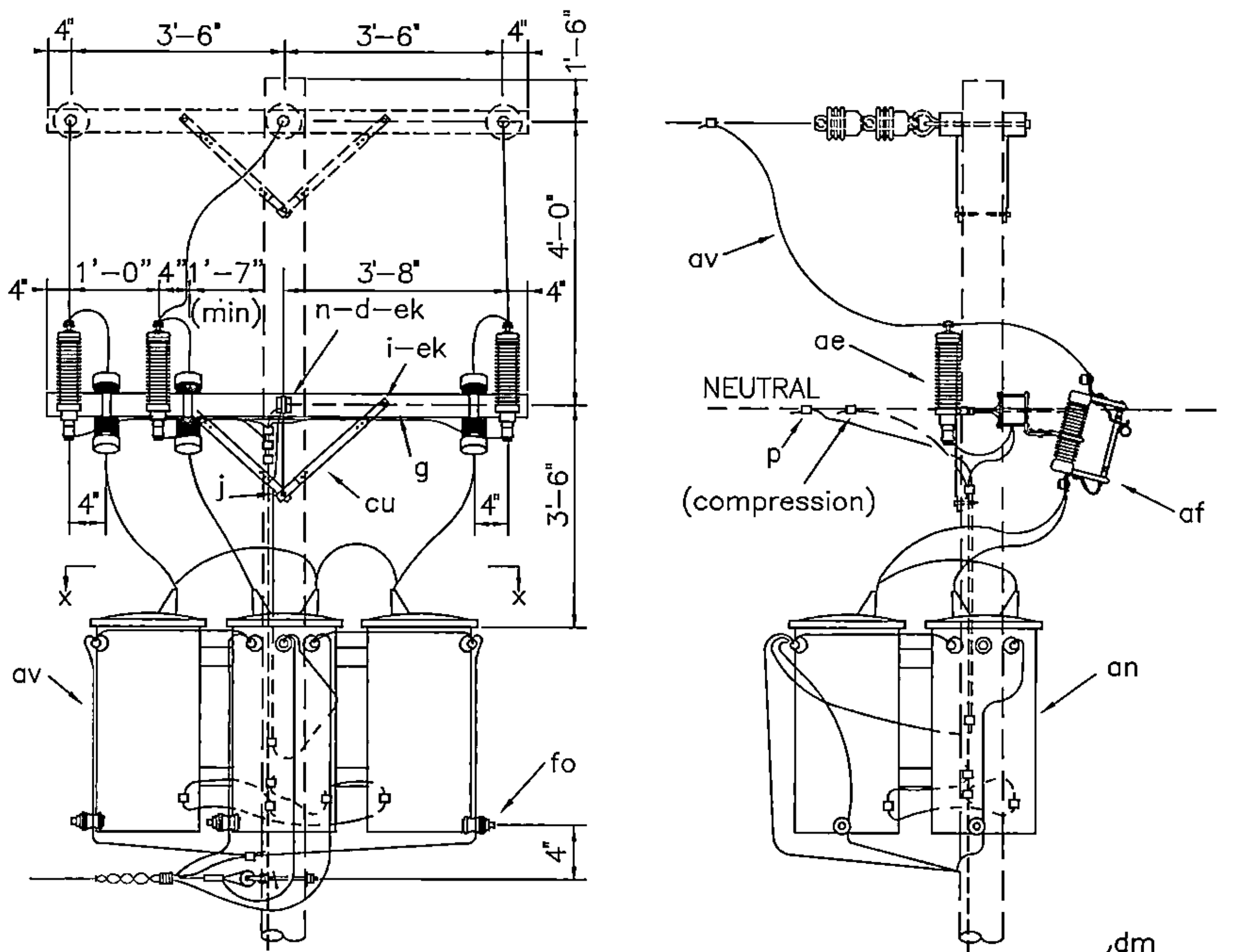
210° ANGULAR DISPLACEMENT

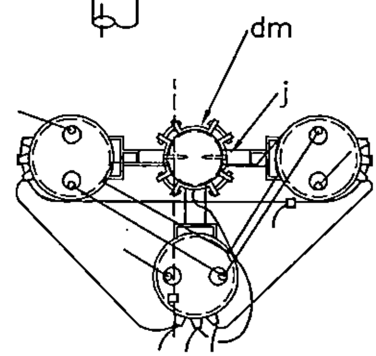


(Additive Polarity–See TRANSFORMER SPECIFICATIONS)

TRANSFORMER/METER CONNECTION GUIDE
THREE-PHASE, OPEN-WYE – OPEN DELTA
FOR 120/240 VOLT POWER LOADS

APRIL 2005		
RUS		G2.1G





SECTION X-X

NOTES:

1. See Drawing "Q3.1" for additional connection and metering details.
2. All transformer tanks must be grounded.

ITEM	QTY	MATERIAL
d	2	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j		Screw, lag, 1/2" x 4" as req'd
n	1	Bolt, dble arm, 5/8 x req'd length
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	3	Arrester, surge, (9 kV)

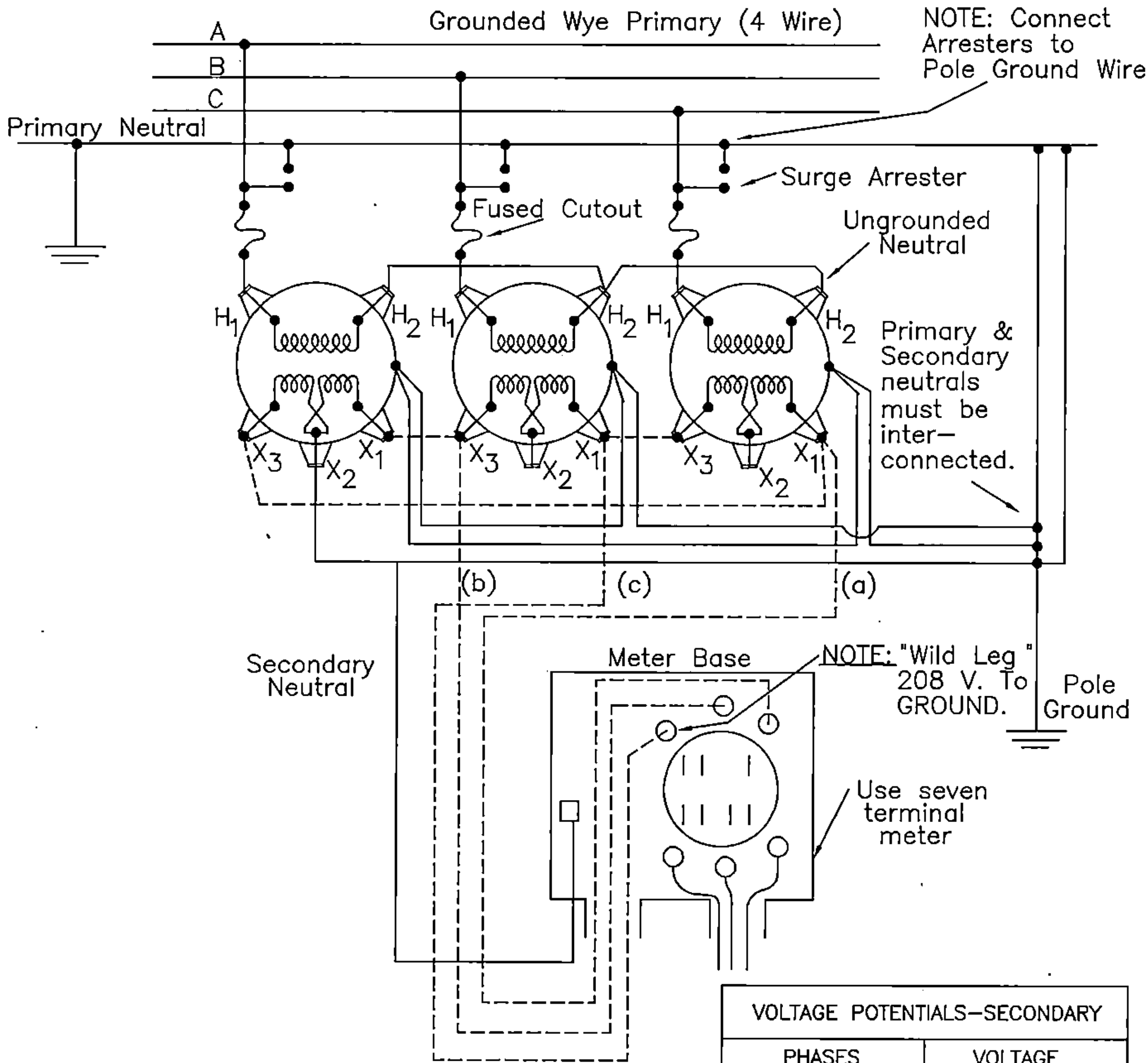
ITEM	QTY	MATERIAL
af	3	Cutout, dist. open (15 kV)
an	3	Transformer, 12.47 kV, conventional
av		Jumpers, bare, stranded
av		Jumpers, service, as req'd
cu	2	Brace, 28"
dm	1	Bracket, transformer, cluster with
		adapter plates as req'd
ek	5	Locknuts
fo	3	Bracket, transformer, insulated

DESIGN PARAMETERS:

See Guide Drawing "G3.1G"

THREE-PHASE TRANSFORMER BANK
UNGROUNDED-WYE PRIMARY
CENTER-TAP GROUNDED DELTA, 4 WIRE SECONDARY

APRIL 2005	3 - PHASE PRIMARY	G3.1
RUS	12.47/7.2 kV	(G310-)



APPLICATION: Used to supply three-phase, 240 volt loads with small amounts of 120/240 volt single-phase loads.

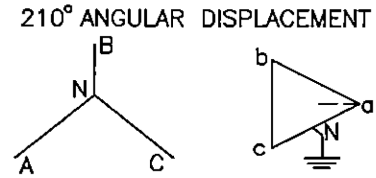
See drawing "G3.1" or "VG3.1" for construction details.

CAUTION: Only ground one secondary neutral bushing of the three transformers.
Connecting the high-voltage neutral to the system neutral may cause the transformer bank to burn out.
Largest transformer capacity should not be more than 2 times the smallest transformer kVA.

BANK RATING: The center tapped transformer carries 2/3 of the 120/240 volt single-phase load; each of the three units carry 1/3 of the 240 volt three-phase load.

VOLTAGE POTENTIALS-SECONDARY	
PHASES	VOLTAGE
a-b	240 VOLTS
b-c	240 VOLTS
a-c	240 VOLTS
a-N	120 VOLTS
b-N	120 VOLTS
c-N	208 VOLTS

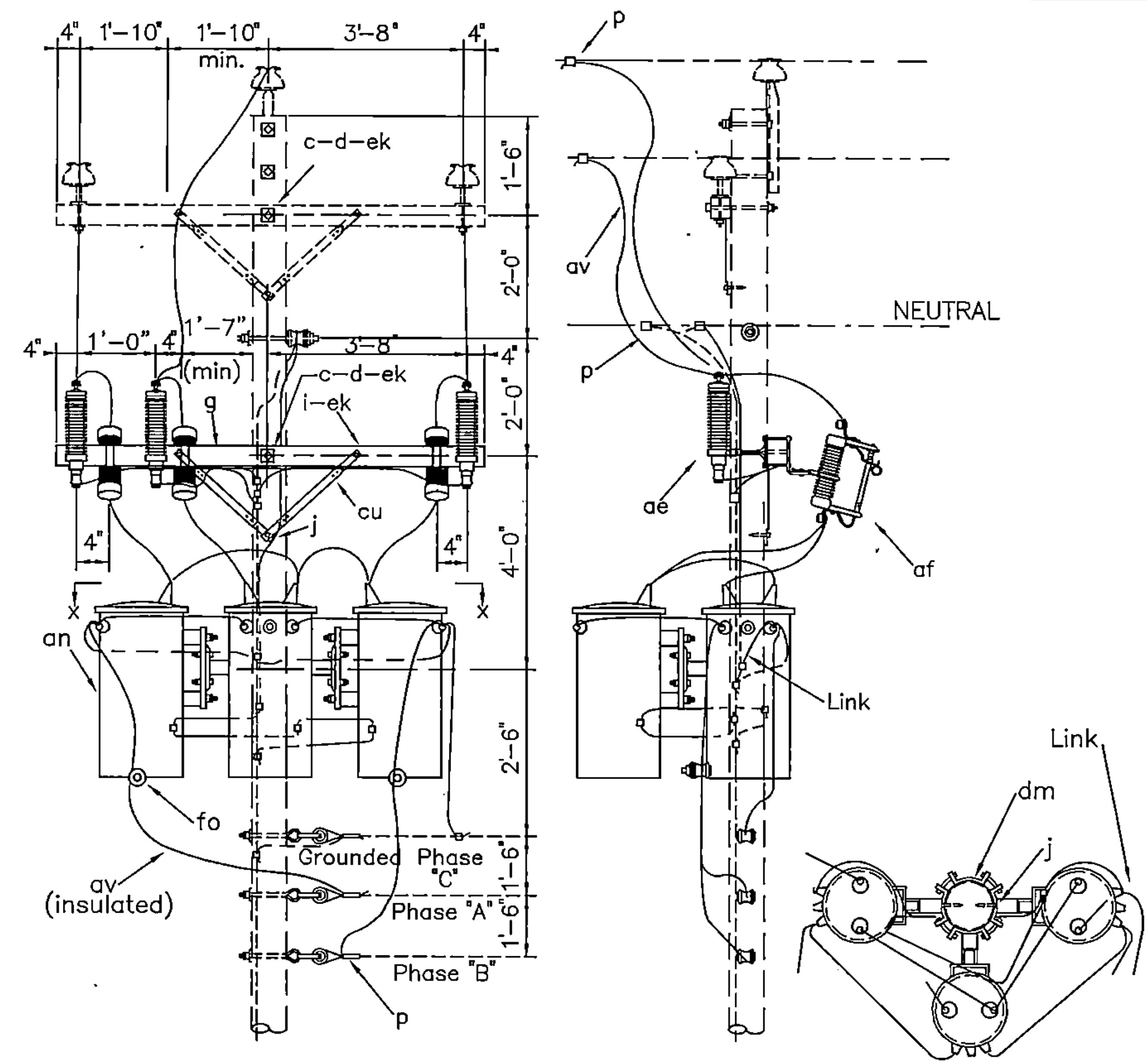
210° ANGULAR DISPLACEMENT



(Additive Polarity-See TRANSFORMER SPECIFICATIONS)

TRANSFORMER/METER CONNECTION GUIDE
UNGROUNDED WYE - CENTER TAP GROUNDED DELTA
FOR 120/240 VOLT POWER LOADS

APRIL 2005	3 - PHASE PRIMARY	
RUS		G3.1G



SECTION X-X

NOTES:
1. See Drawing "Q3.2" for additional connection and metering details.
2. This transformer connection not recommended for new services.

ITEM	QTY	MATERIAL
d	2	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j		Screw, lag, 1/2" x 4", as req'd
n	1	Bolt, dble arm, 5/8" x req'd length
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	3	Arrester, surge, (9 kV)

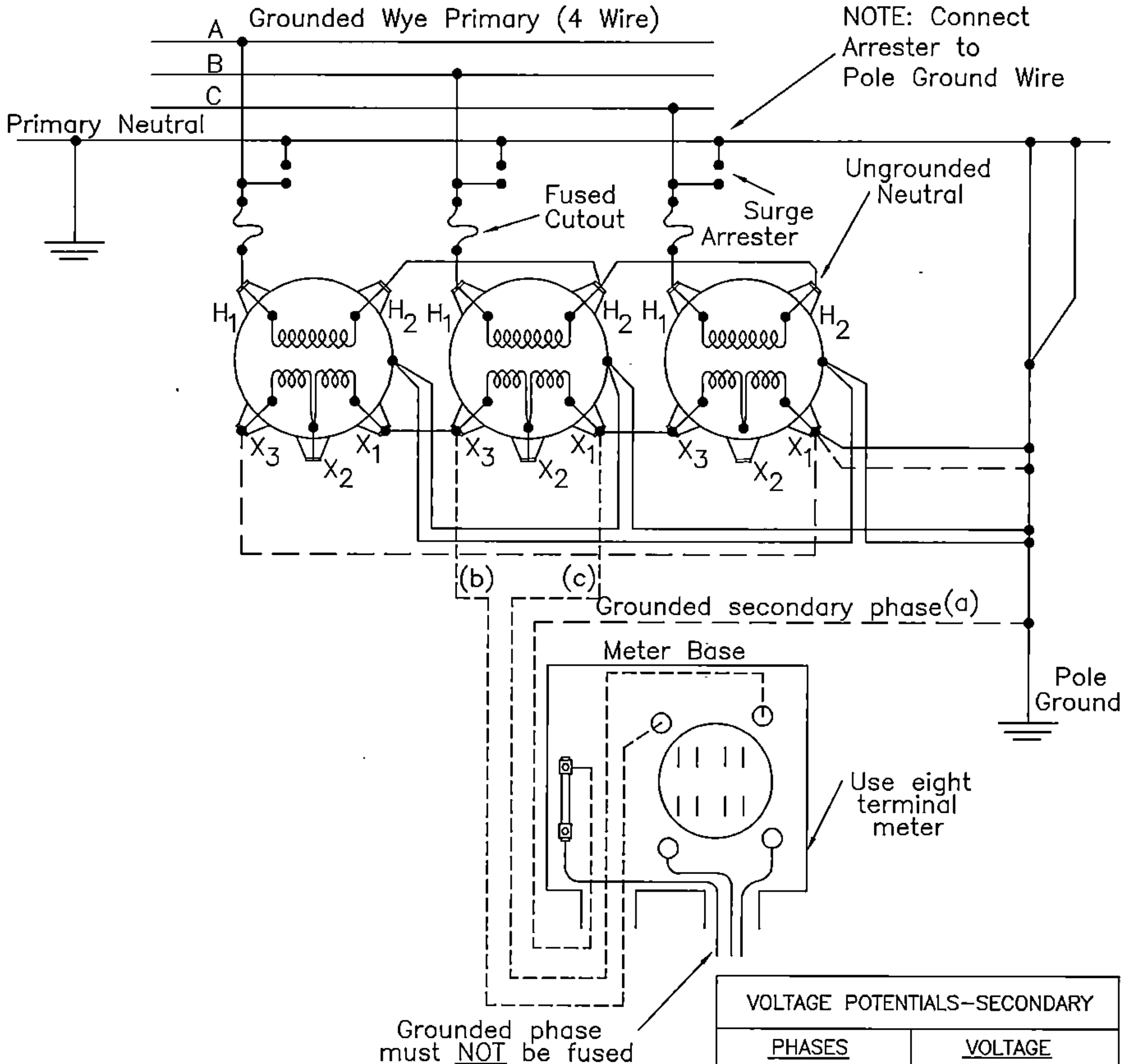
ITEM	QTY	MATERIAL
af	3	Cutout, dist. open (15 kV)
an	3	Transformer, 12.47 kV, conventional
av		Jumpers, bare, stranded
av		Jumpers, service, as req'd
cu	2	Brace, 28"
dm	1	Bracket, transformer, cluster with
		adapter plates as req'd
ek	5	Locknuts
fo	3	Bracket, transformer, insulated

DESIGN PARAMETERS:

See Guide Drawing "G3.2G"

THREE-PHASE TRANSFORMER BANK
UNGROUNDED-WYE PRIMARY
CORNER GROUNDED DELTA, 3 WIRE SECONDARY

APRIL 2005	3 - PHASE PRIMARY	G3.2
RUS	12.47/7.2 kV	(G311-)



APPLICATION: Used to supply three–phase (only), 240 or 480 volt power loads.

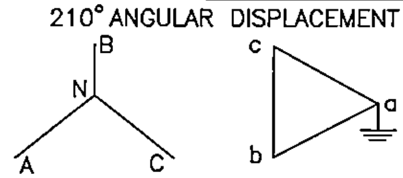
See drawing "G3.2" or "VG3.2" for construction details.

BANK RATING: The maximum safe kVA rating of the bank is three times the kVA rating of the smallest transformer.

NOTES:
One–half of the above voltages apply when a 240 volt bank is used.
All tanks to be grounded.
Disconnect all secondary neutrals from tank and do not ground.
Do not ground bank on primary side. (If grounded, the bank would be a grounding bank for the entire circuit.)
The grounding secondary wire is a current carrying phase wire operating at ground potential and must be identified throughout the circuit run. It is not a neutral.

VOLTAGE POTENTIALS–SECONDARY	
PHASES	VOLTAGE
a–b	480 VOLTS
b–c	480 VOLTS
a–c	480 VOLTS
a–GRD	0 VOLTS
b–GRD	480 VOLTS
c–GRD	480 VOLTS

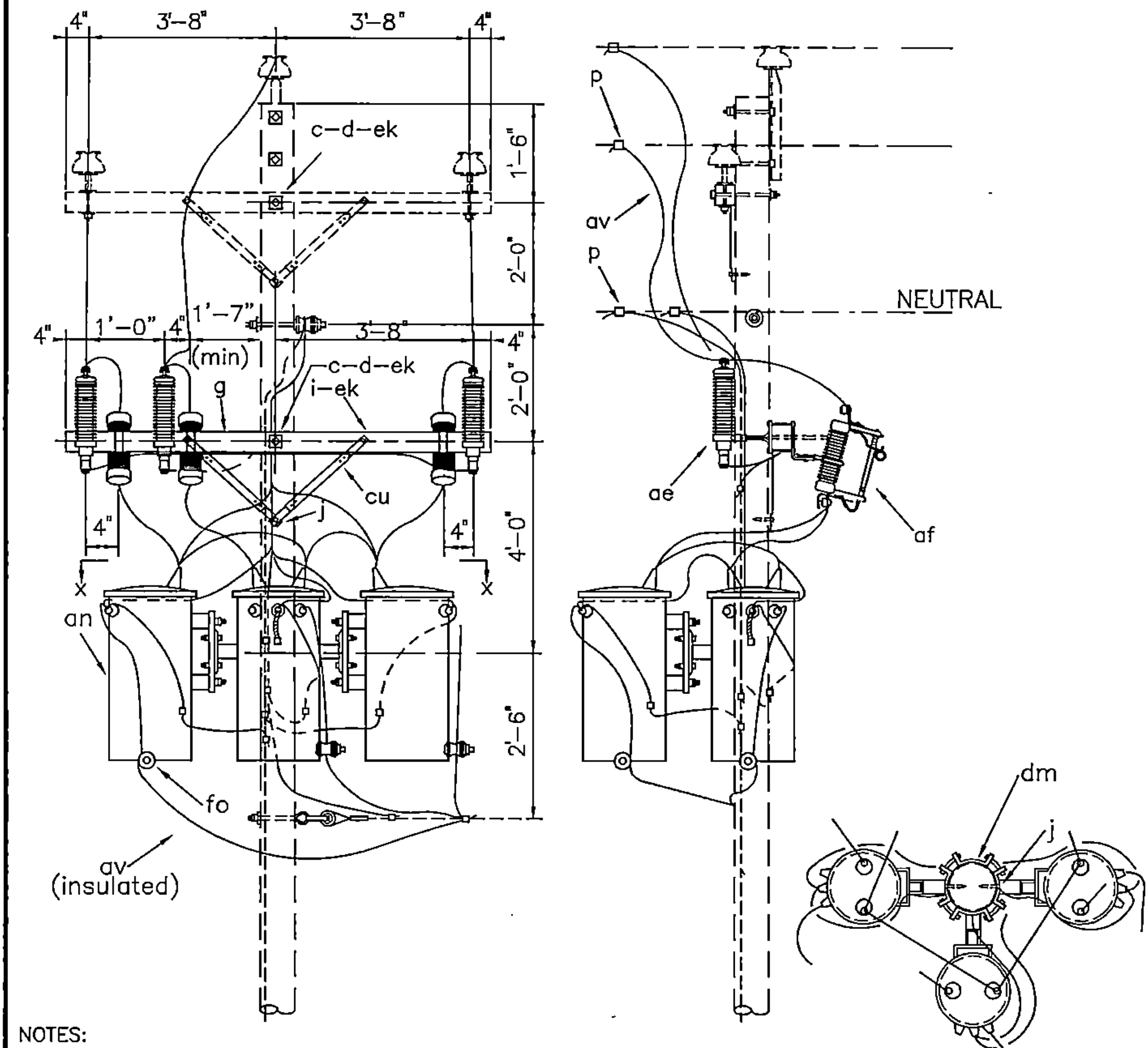
210° ANGULAR DISPLACEMENT



(Additive Polarity– See TRANSFORMER SPECIFICATIONS)

TRANSFORMER/METER CONNECTION GUIDE
UNGROUNDED WYE – CORNER GROUNDED DELTA
FOR 240 or 480 VOLT POWER LOADS

APRIL 2005	3 – PHASE PRIMARY	
RUS		G3.2G



SECTION X–X

NOTES:
1. See Drawing "Q3.3" for additional connection and metering details.

ITEM	QTY	MATERIAL
d	2	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" x 4 5/8" x 8'–0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j		Screw, lag, 1/2" x 4", as req'd
n	1	Bolt, dble arm, 5/8" x req'd length
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	3	Arrester, surge, (9 kV)

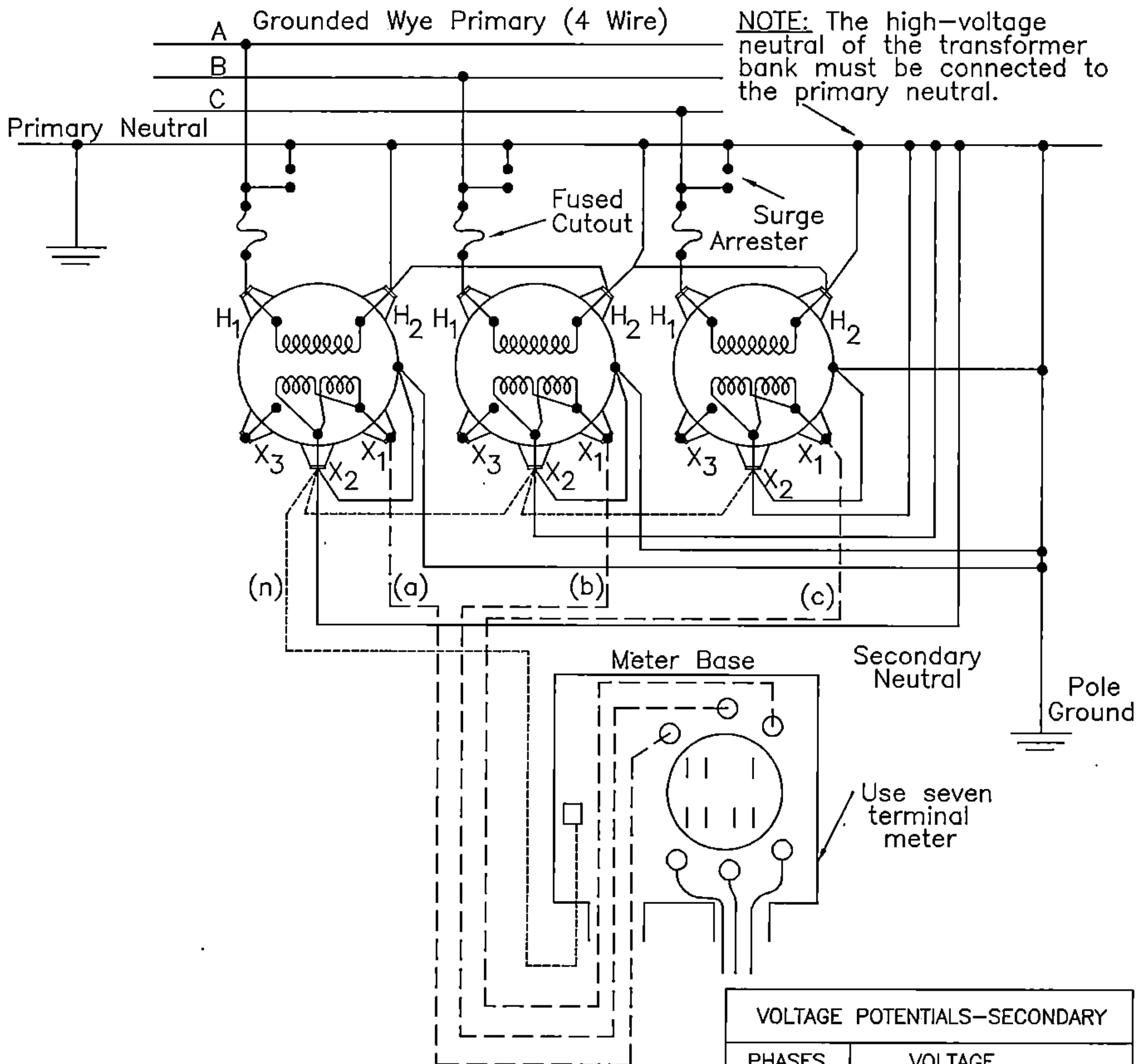
ITEM	QTY	MATERIAL
af	3	Cutout, dist. open (15 kV)
an	3	Transformer, 12.47 kV, conventional
av		Jumpers, bare, stranded
av		Jumpers, service, as req'd
cu	2	Brace, 28"
dm	1	Bracket, transformer, cluster with
		adapter plates as req'd
ek	5	Locknuts
fo	3	Bracket, transformer, insulated

DESIGN PARAMETERS:

See Guide Drawing "G3.3G"

THREE–PHASE TRANSFORMER BANK
GROUNDED–WYE PRIMARY
GROUNDED WYE, 4 WIRE SECONDARY

APRIL 2005	3 – PHASE PRIMARY	G3.3
RUS	12.47/7.2 kV	(G312–)



4 Wire–Wye Secondary
120/208 Volt (277/480)

APPLICATION: Used to supply 120/208 volt single-phase and 208 volt, three-phase power loads.

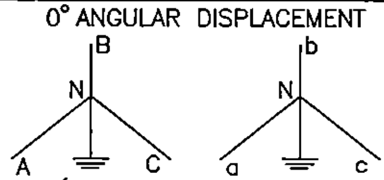
See drawing "G3.3" or "VG3.3" for construction details. Reconnect secondary windings of transformers as shown. Matched (impedance and kVA) transformers are usually used.

BANK RATING: Each unit will supply 1/3 of the three-phase load and all of the single-phase load connected to it.

CAUTION: The primary and secondary neutrals must be firmly tied together and grounded or else excessive secondary voltages may develop.

VOLTAGE POTENTIALS–SECONDARY	
PHASES	VOLTAGE
a–b	208 VOLTS (480)
b–c	208 VOLTS (480)
a–c	208 VOLTS (480)
a–N	120 VOLTS (277)
b–N	120 VOLTS (277)
c–N	120 VOLTS (277)

0° ANGULAR DISPLACEMENT



(Additive Polarity–
See TRANSFORMER SPECIFICATIONS)

TRANSFORMER/METER CONNECTION GUIDE
GROUNDED WYE – GROUNDED WYE
FOR 120/208 VOLT POWER LOADS

APRIL 2005	3 – PHASE PRIMARY	
RUS		G3.3G

GROUNDING ASSEMBLY UNITS

DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804 (New)	**Bulletin 50-3** (Old)	
H1.1	(M2-11)	GROUNDING ASSEMBLY - GROUND ROD TYPE
H2.1	(M2-13)	GROUNDING ASSEMBLY - TRENCH TYPE
H3.1	(M2-15)	GROUNDING ASSEMBLY - GROUND ROD TYPE (FOR SECTIONALIZING AIRBREAK SWITCH)
H4.1	(M2-15A)	GROUNDING ASSEMBLY - PLATFORM TYPE (FOR SECTIONALIZING AIRBREAK SWITCH)
H5.1	(M2-12)	GROUNDING IMPROVEMENT ASSEMBLY – PLATE TYPE
H5.2 H5.3	(M2-12A)	GROUNDING IMPROVEMENT ASSEMBLY – WRAP-AROUND TYPE

CONSTRUCTION SPECIFICATIONS FOR GROUNDING

Ground rods (item "ai") shall be driven to their full length in undisturbed earth, a minimum of 2 feet from the face of the pole. The tops of the ground rods shall be at least 12 inches below the surface of the earth. The ground wire (item "av") shall be attached to the rod with a ground rod clamp (item "aj") and shall be secured to the pole with staples. The staples on the ground wire shall be spaced 2 feet part, except for the first 8 feet above the ground and the top 8 feet of the ground wire where they shall be spaced 6 inches apart.

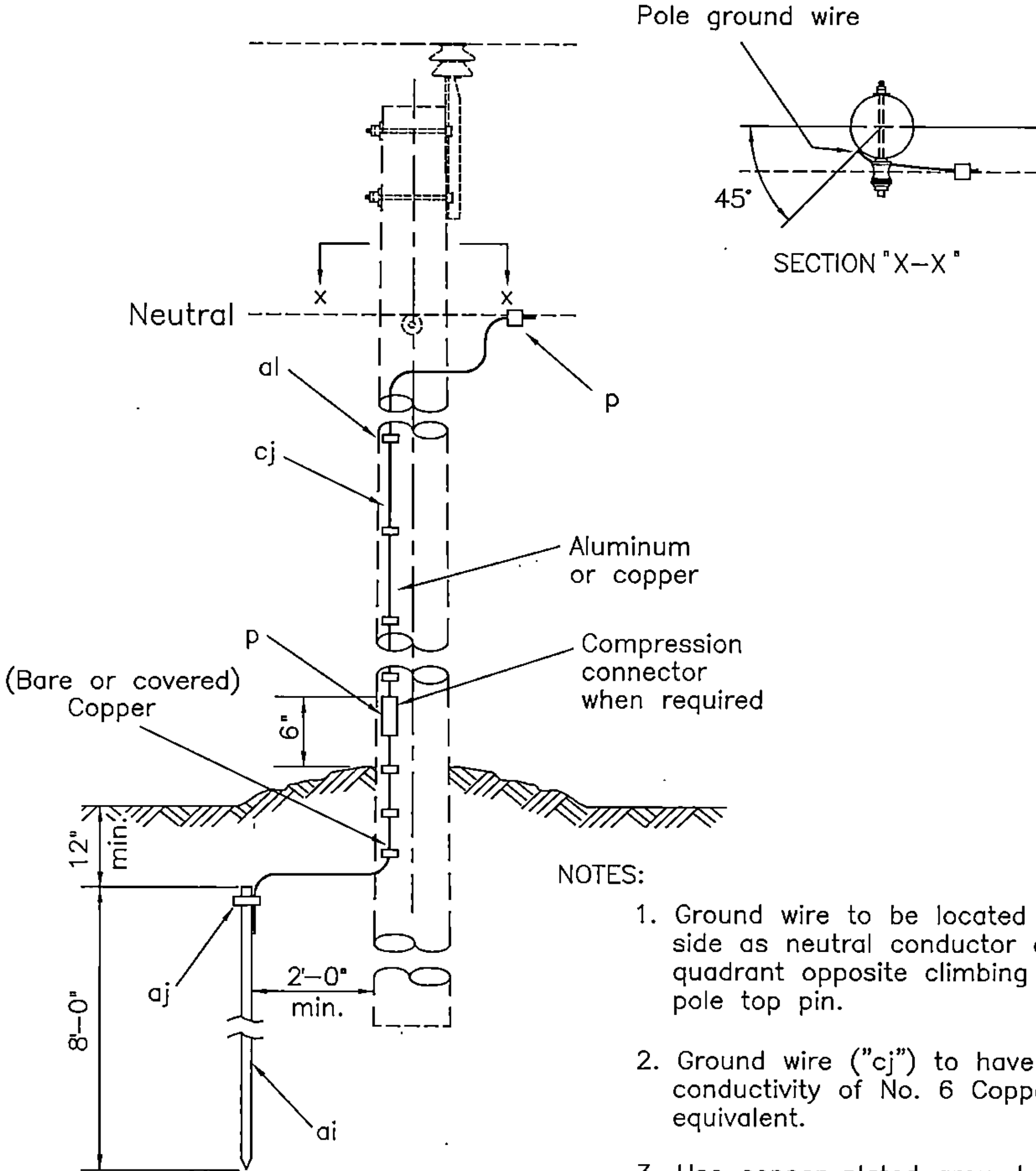
The connection between the ground rod and the system neutral should be made by one continuous piece of conductor (the pole ground wire), and shall be installed in the shortest and most direct path according to the construction drawings. Splices, if required, shall be made using a compression type connector and shall be installed a minimum of 6 inches above the ground line. The pole ground wire shall be connected to the system neutral using a compression type connector.

All equipment shall have at least 2 connections from the frame, case, or tank to the multi-grounded system neutral conductor as shown on the construction drawings. The pole ground wire may be used for one or both of these connections.

All neutral conductors on the pole shall be bonded directly to each other, and connected to the pole ground wire if present. All equipment ground wires, neutral conductors, downguys, messenger wires, and surge-protection ground wires shall be interconnected and attached to a common (pole) ground wire in accordance with the requirements of the National Electrical Safety Code (NESC).

Borrowers shall install effectively grounded driven ground rods (assembly H1.1) or trench type grounding assemblies (assembly H2.1) a maximum of 1,320 feet (433 meters) apart along overhead distribution lines. Customer-owned or other installed electric service grounds shall not be counted in the above minimum grounding assembly requirement.

Whereas under certain circumstances, plate type and wrap-around type grounding improvement assemblies (assemblies H5.1 and H5.2, respectively) may meet the grounding electrode requirements of Rule 094B4 of the NESC, RUS does not allow these types of grounding assemblies to be used to meet the NESC requirement of 4 grounds per mile because the effectiveness of these types of grounds in "disturbed" earth is often questionable. However, RUS encourages the installation of these grounding improvement assemblies to augment and improve the overall grounding of the distribution system that in turn generally improves the performance of line protection devices and improves safety.



NOTES:

1. Ground wire to be located on same side as neutral conductor and in quadrant opposite climbing space or pole top pin.

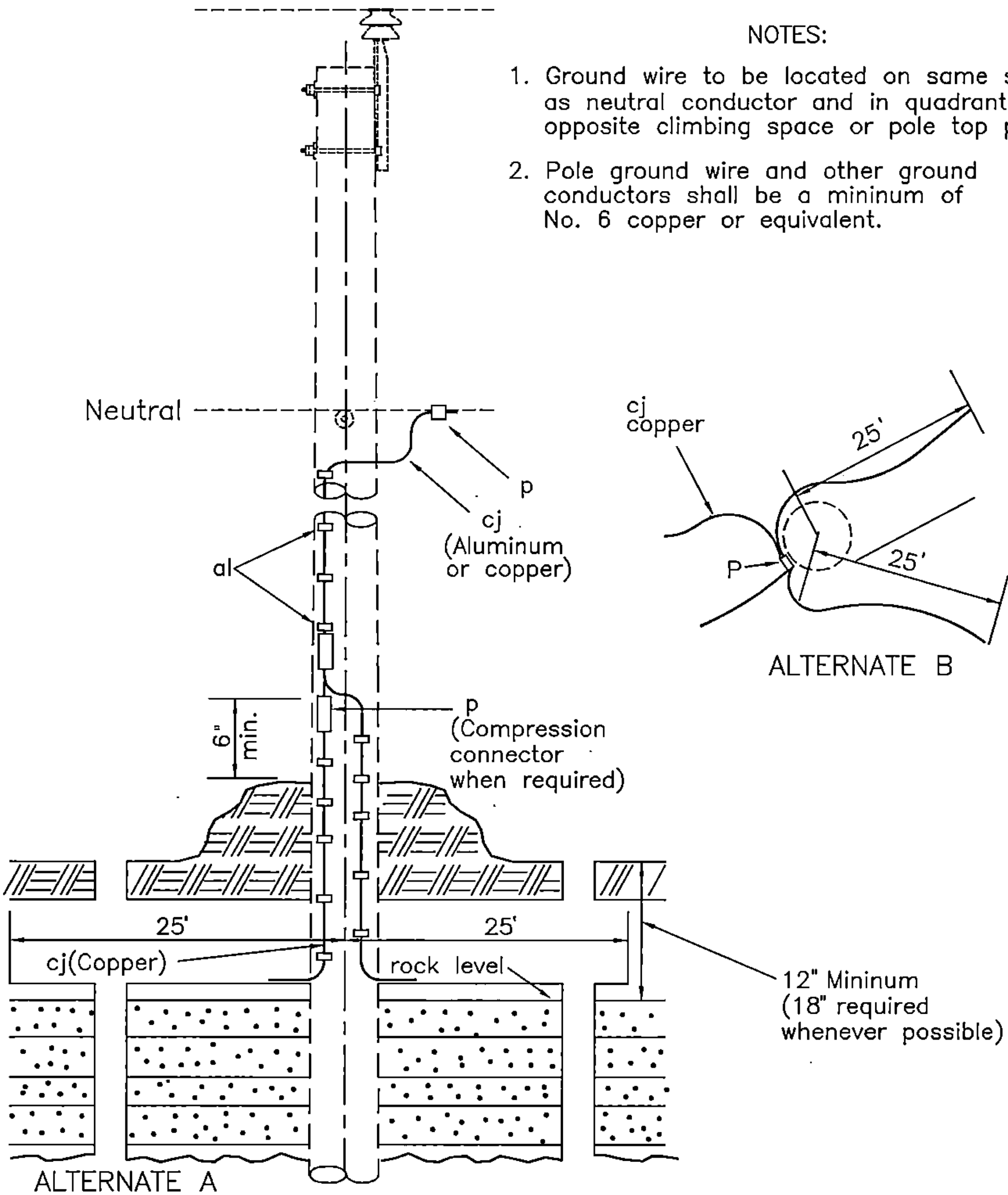
2. Ground wire ("cj") to have minimum conductivity of No. 6 Copper or equivalent.

3. Use copper plated ground rod and copper ground wire and staples, or use galvanized steel ground rod, staples and soft annealed iron, 3-strand, 5/16" ground wire with class C galvanizing.

ITEM	QTY	MATERIAL
p		Connector, compression, as req'd
ai	1	Rod, ground, 5/8" min. diameter
aj	1	Clamp, ground rod
al		Staple, ground wire, as req'd
cj		Wire, pole ground, as req'd

GROUNDING ASSEMBLY – GROUND ROD TYPE

APRIL 2005		H1.1
RUS		(M2–11)



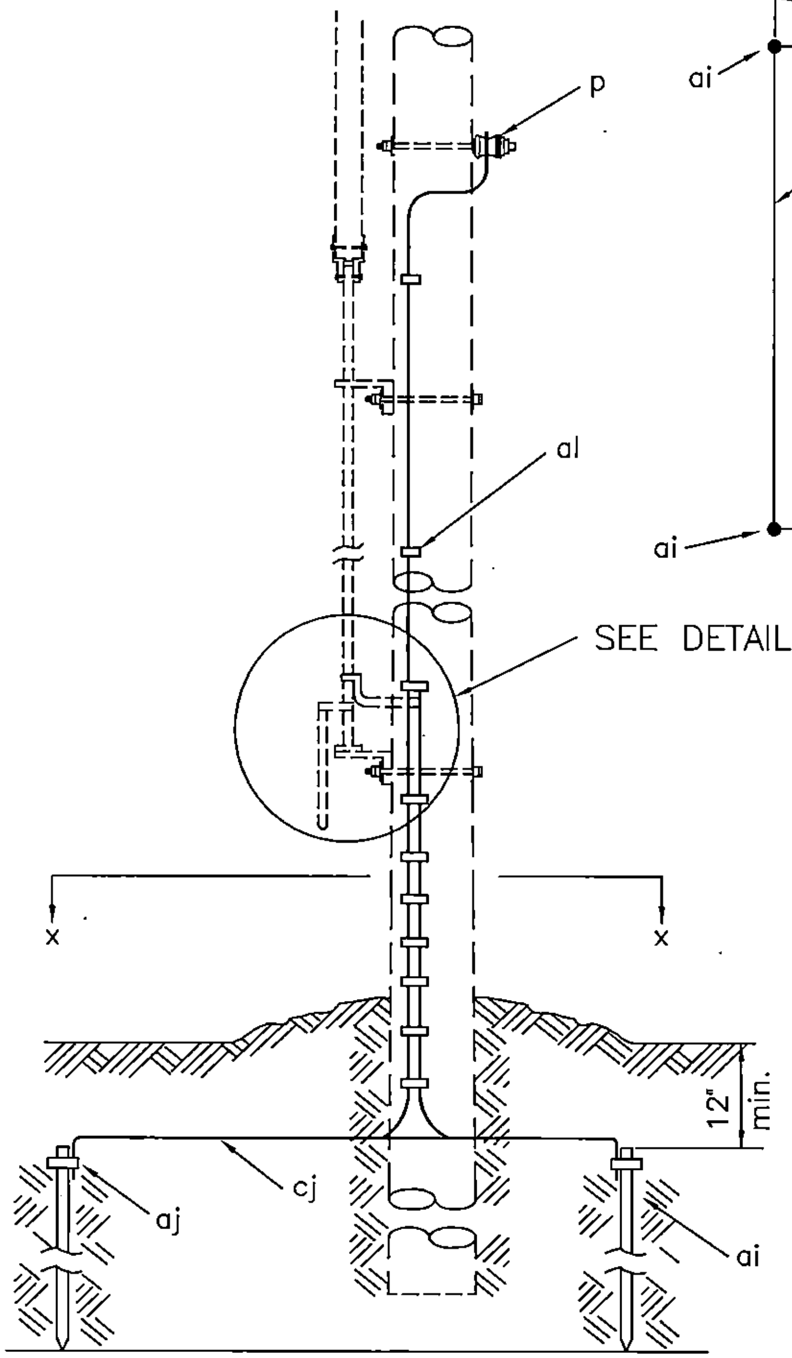
NOTES:

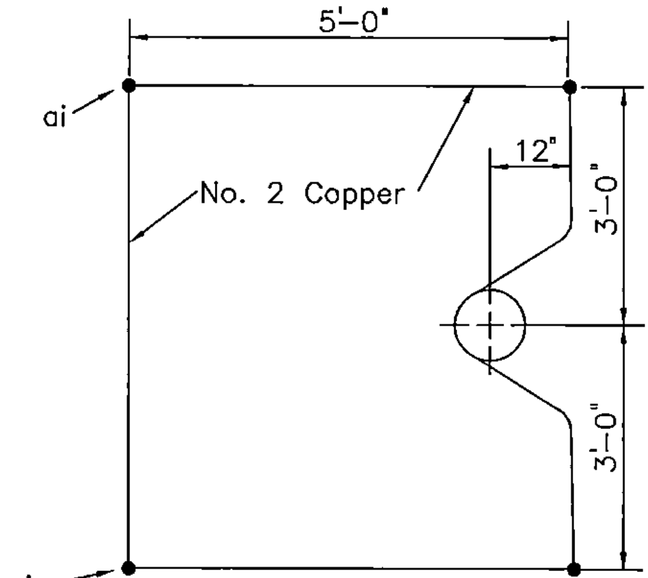
1. Ground wire to be located on same side as neutral conductor and in quadrant opposite climbing space or pole top pin.
2. Pole ground wire and other ground conductors shall be a mininum of No. 6 copper or equivalent.

ITEM	QTY	MATERIAL
p		Connector, compression, as req'd
al		Staple, ground wire, as req'd
cj		Wire pole ground as req'd See Note 3 on Drawing H1.1

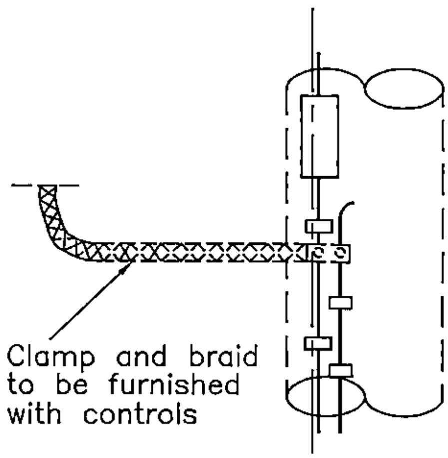
GROUNDING ASSEMBLY — TRENCH TYPE

APRIL 2005 RUS		H2.1 (M2–13)





SECTION X–X
(Detail of ground Grid)



DETAIL

ITEM	QTY	MATERIAL
p		Connector, compression, as req'd
ai	4	Rod, ground, 5/8" min. dia., copper covered
aj	4	Clamp, ground rod
al		Staple, ground wire, (copper),as req'd
cj		Wire, pole ground, #2 S.D. Copper, as req'd

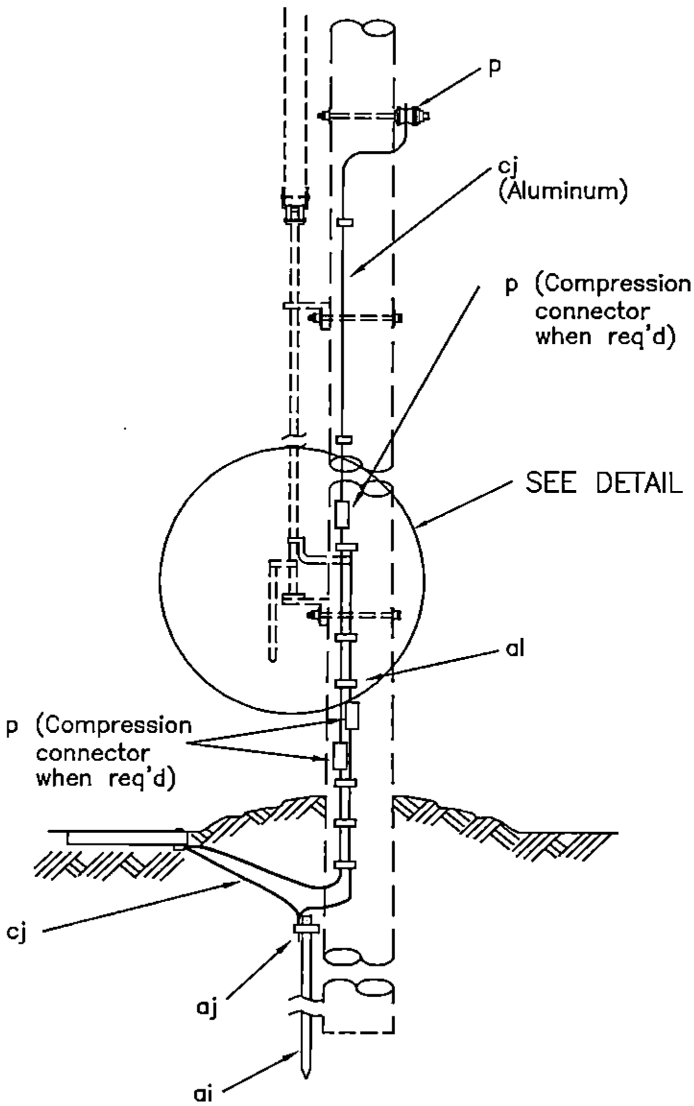
CAUTION: Rubber gloves should be worn when operating switch.

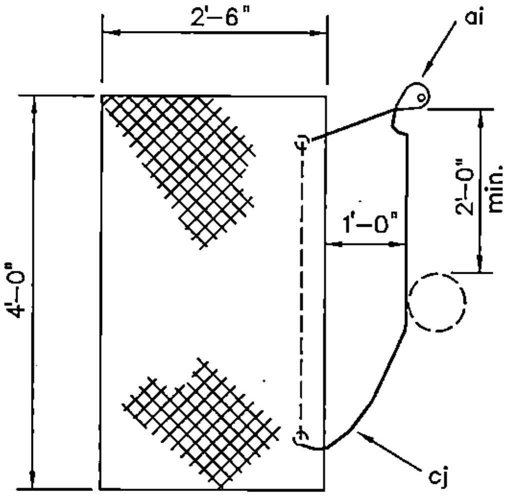
GROUNDING ASSEMBLY – GROUND ROD TYPE
(FOR SECTIONALIZING AIRBREAK SWITCH)

APRIL 2005

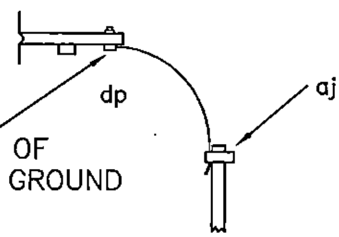
RUS

H3.1
(M2–15)

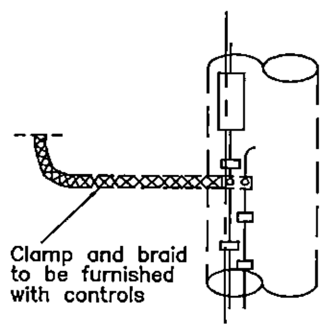




DETAIL OF PLATFORM



DETAIL OF PLATFORM GROUND



DETAIL

ITEM	QTY	MATERIAL
p		Connector, compression, as req'd
ai	1	Rod, ground, 5/8 min. dia., (galv.)
aj	1	Clamp, ground rod, (galvanized steel)
al		Staple, ground wire, (galv.), as req'd
cj		Wire pole ground, as req'd Soft annealed iron, 5/16" with class C galvanizing
dp	2	Clamp, ground wire, with lock washer
	1	Platform, grounding plate, galv. iron

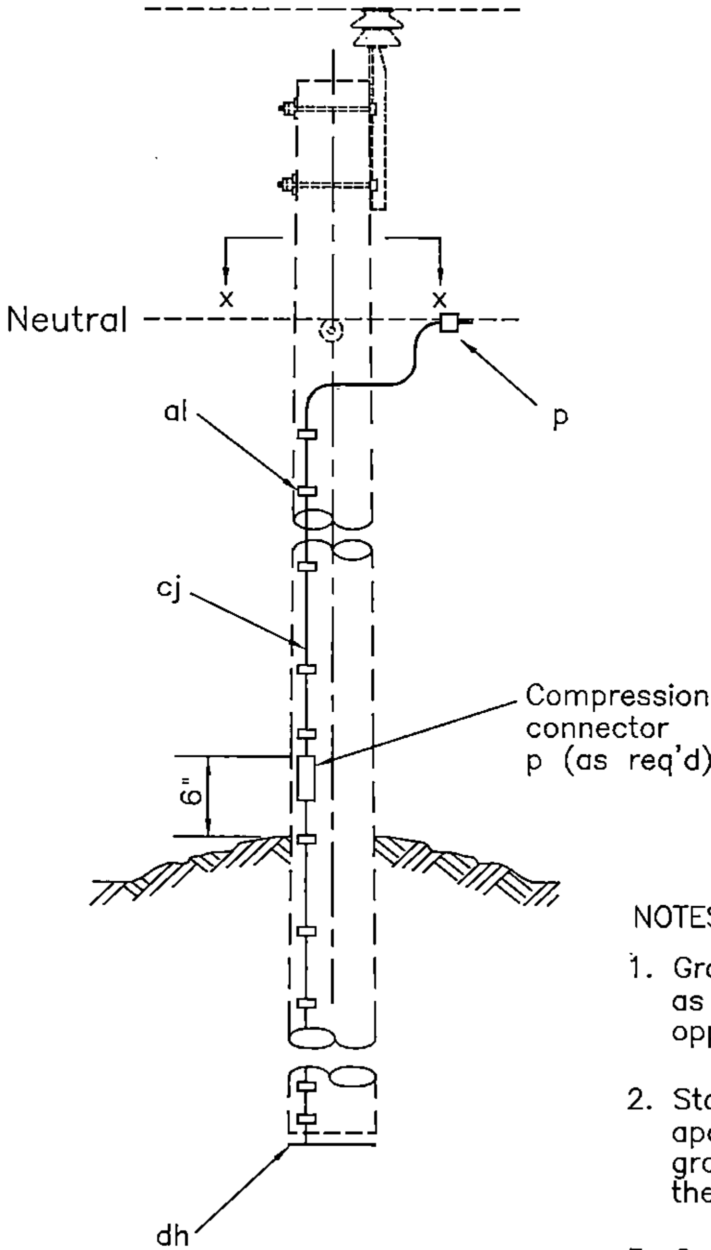
NOTE: Wear rubber gloves when operating switch.

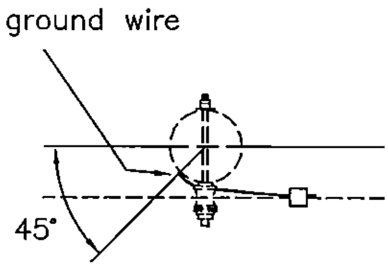
GROUNDING ASSEMBLY — PLATFORM TYPE
(FOR SECTIONALIZING AIRBREAK SWITCH)

APRIL 2005

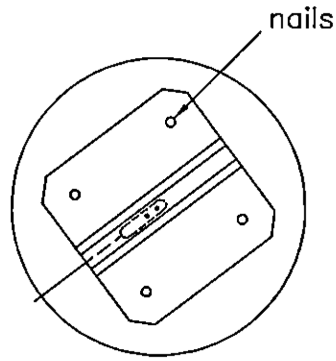
RUS

H4.1
(M2–15A)





SECTION "X–X"



Plan View
Grounding plate (dh)

NOTES:

1. Ground wire to be located on same side as neutral conductor and in quadrant opposite climbing space or pole top pin.

2. Staples on ground wire shall be 2'–0" apart except for a distance of 8' above ground and 8' from top of pole where they shall be 6" apart.

3. Copper ground wire ("cj") to have a minimum conductivity of No. 6 Copper or equivalent.

ITEM	QTY	MATERIAL
p		Connector, compression, as req'd
al		Staple, ground wire, as reg'd
cj		Wire, pole ground, as req'd
dh	1	Plate, grounding, butt type
	4	Nails, 1", galvanized, roofing

DESIGN PARAMETERS:

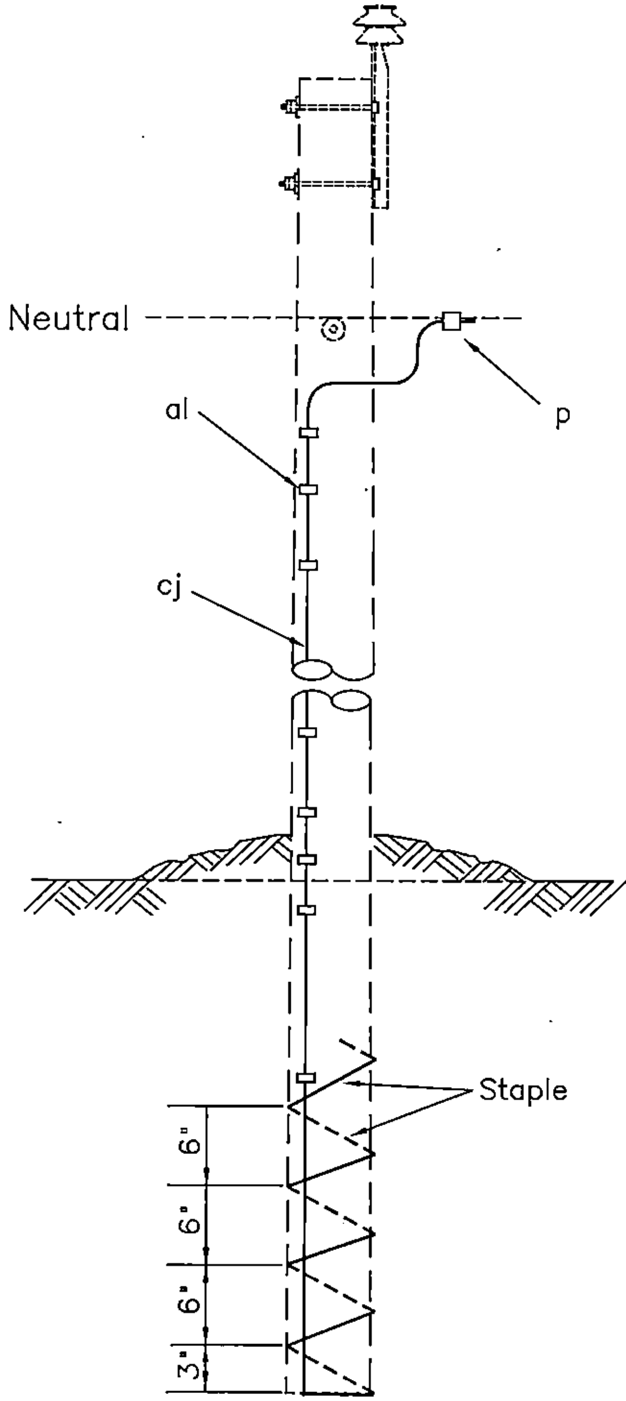
RUS SPECIFIES THAT THIS ASSEMBLY CAN NOT BE COUNTED AS A SYSTEM GROUNDING ELECTRODE REQUIRED BY THE NESC BUT RECOMMENDS ITS USE FOR OVERALL SYSTEM GROUNDING IMPROVEMENT.

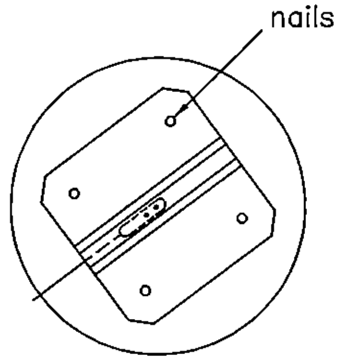
GROUNDING IMPROVEMENT ASSEMBLY – PLATE TYPE

APRIL 2005

RUS

H5.1
(M2–12)





Plan View
Grounding plate (dh)

Designate assembly with grounding plate as "H2.3"

NOTES:

1. Ground wire to be located on same side as neutral conductor and in quadrant opposite climbing space or pole top pin.

2. Staples on ground wire shall be 2'–0" apart except for a distance of 8' above ground and 8' from top of pole where they shall be 6" apart.

3. Copper ground wire ("cj") to have a minimum conductivity of No. 6 Copper or equivalent.

	ASSEMBLY:	H2.2	H2.3
ITEM	MATERIAL	QTY	QTY
p	Connector, compression, as req'd		
al	Staples, ground wire, as req'd		
cj	Wire, pole ground, as req'd		
dh	Plate, grounding, butt type		1
	Nails, 1", galvanized, roofing		4

DESIGN PARAMETERS:

RUS SPECIFIES THAT THIS ASSEMBLY CAN NOT BE COUNTED AS A SYSTEM GROUNDING ELECTRODE REQUIRED BY THE NESC BUT RECOMMENDS ITS USE FOR OVERALL SYSTEM GROUNDING IMPROVEMENT.

GROUNDING IMPROVEMENT ASSEMBLY – WRAP–AROUND TYPE

APRIL 2005

RUS

H5.2,H5.3
(M2–12A)

SECONDARY ASSEMBLY UNITS

DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804 (New)	**Bulletin 50-3** (Old)	
J1.1	(J8)	SECONDARY ASSEMBLIES - (SMALL ANGLE)
J1.2	(J5)	
J2.1	(J10)	SECONDARY ASSEMBLIES - (LARGE ANGLE)
J2.2	(J7), (J7C)	
J3.1	(J6), (J11)	SECONDARY ASSEMBLIES - (DEADEND, MISC.)
J4.1	(J12)	

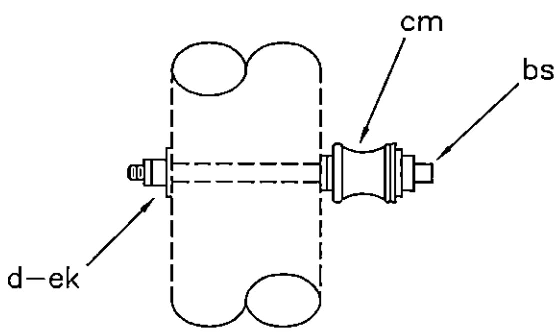
CONSTRUCTION SPECIFICATIONS FOR SECONDARY CONDUCTORS AND SERVICE DROPS

Secondary conductors may be bare or covered wires or multi-conductor service cable. The conductors shall be sagged in accordance with the manufacturer's recommendations.

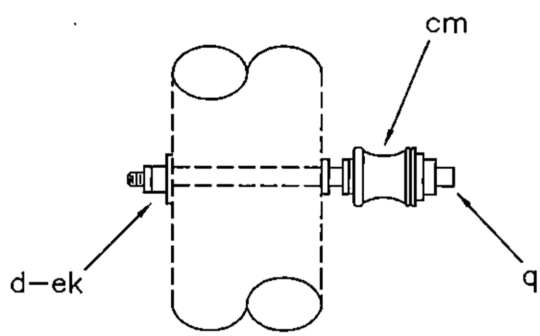
Conductors for secondary underbuild on primary lines may be bare wires, except in those circumstances where conditions may necessitate that covered wires or service cable be used. Service drop conductors shall be covered wires or service cable in accordance with NESC Rule 234C3.

Secondary and service drop conductors shall be installed such that the climbing space on poles is not obstructed. For new construction there shall not be more than one splice per conductor in any span, and splices shall be located at least 10 feet from the conductor support. Covered conductors or service cables used for both the secondary and service drop may be installed in one continuous run.

The "permitted longitudinal loadings" shown on the assembly drawings are based on 50 percent of the mechanical-electrical ratings of the insulators. ***All applied loads must be multiplied by the appropriate NESC overload factors when applicable.***



J1.1



J1.2

		J1.1	J1.2
ITEM	MATERIAL	QTY	QTY
d	Washer, 2 1/4" square	1	1
q	Bolt, double upset		1
bs	Bolt, single upset	1	
cm	Insulator, spool	1	1
ek	Locknuts	1	1

DESIGN PARAMETERS:
MAXIMUM LINE ANGLES

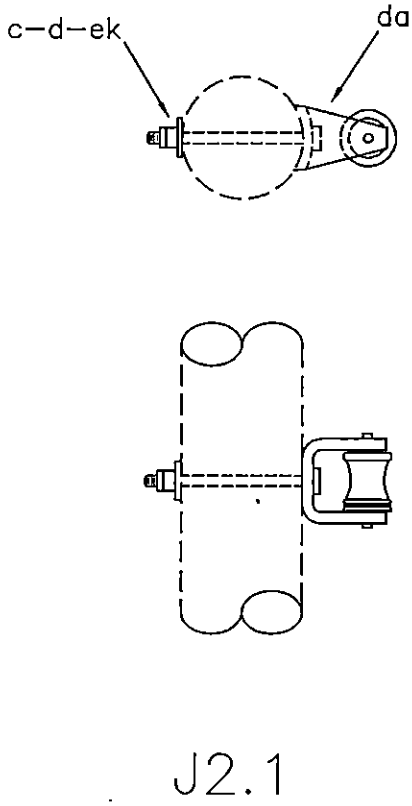
5° – Small Conductors
2° – Larger than #1/0

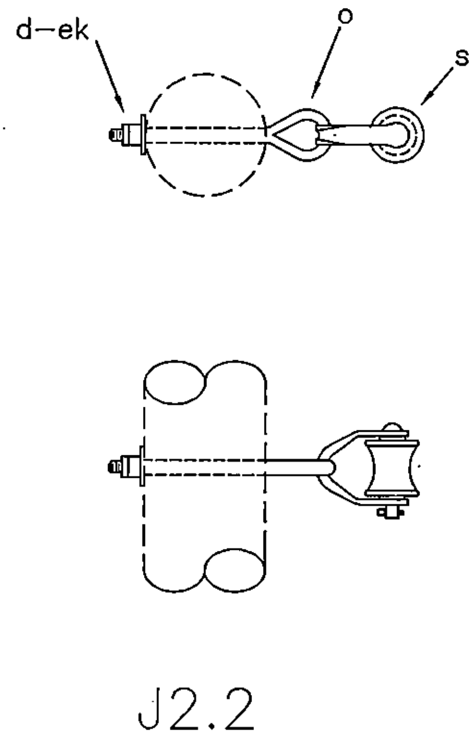
SECONDARY ASSEMBLIES
(SMALL ANGLE)

APRIL 2005

RUS

J1.1,J1.2
(J8),(J5)





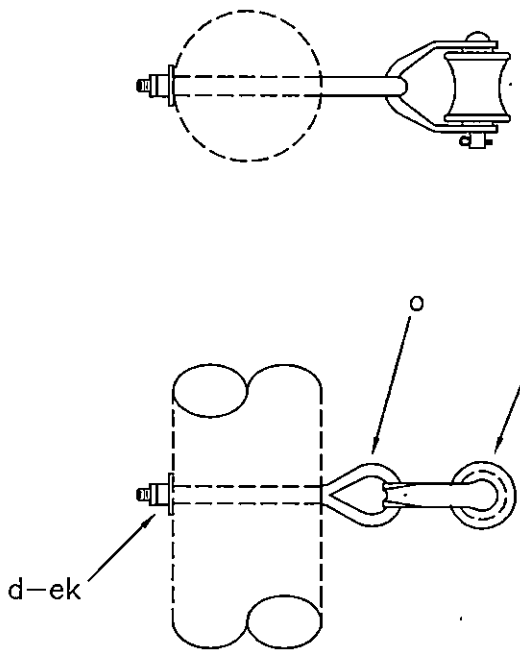
ITEM	MATERIAL	J2.1 QTY	J2.2 QTY
c	Bolt, machine, 5/8" X req'd length	1	
d	Washer, 2 1/4" square	1	1
o	Bolt, eye, 5/8" X req'd length		1
s	Clevis, secondary, swinging, insulated		1
da	Bracket, insulated	1	
ek	Locknuts	1	1

DESIGN PARAMETERS:
MAXIMUM LINE ANGLES

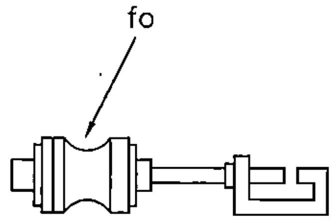
J2.1: 60°
J2.2: 60°

SECONDARY ASSEMBLIES
(LARGE ANGLE)

APRIL 2005		J2.1,J2.2
RUS		(J10),(J7,J7C)



J3.1



J4.1

		J3.1	J4.1
ITEM	MATERIAL	QTY	QTY
d	Washer, 2 1/4" square	1	
o	Bolt, eye, 5/8" x req'd length	1	
s	Clevis, secondary, swinging, insulated	1	
fo	Bracket, transformer secondary		1
ek	Locknuts	1	1

DESIGN PARAMETERS: (J3.1)

PERMITTED LONGITUDINAL LOADING:
1,500 lbs. (ANSI Class 53–2 Insulator)
2,250 lbs. (ANSI Class 53–4 Insulator)

SECONDARY ASSEMBLIES
(DEADEND, MISC.)

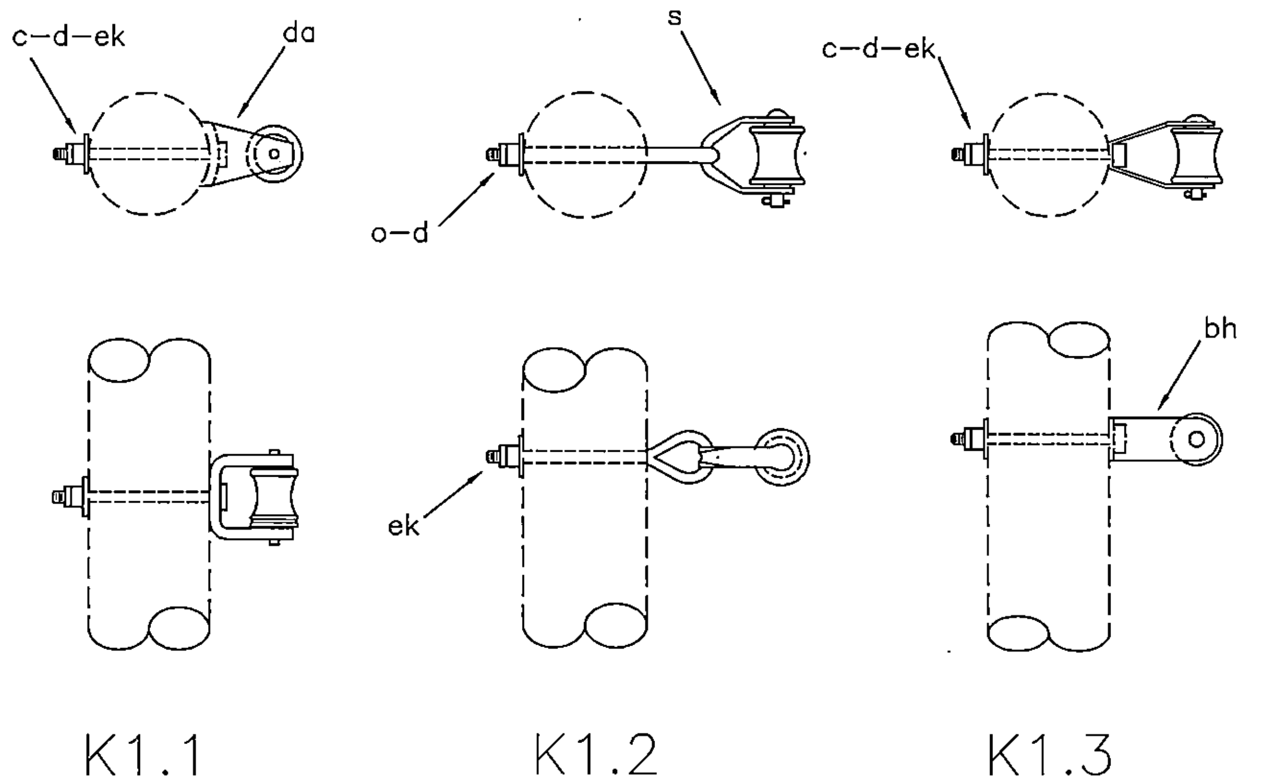
APRIL 2005

RUS

J3.1,J4.1
(J6,J11),(J12)

SERVICE ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
K1.1	(K14C)	SECRVICE ASSEMBLIES - (POLE MOUNTED)
K1.2	(K11C)	
K1.3	(K14), (K14L)	
K1.4	(K11), (K11L)	SECRVICE ASSEMBLIES - (POLE MOUNTED)
K1.5	(K15C)	
K2.1	(K10), (K10L)	SERVICE ASSEMBLIES
K2.2	(K10C)	
K2.3	(K10C)	
K3.1	(K17), (K17L)	SERVICE ASSEMBLIES - (MAST TYPE)
K3.2	(K16C)	
K4.1G	(M24)	CABLE SERVICE ASSEMBLY GUIDE
K4.2G	(M24-10)	MAST TYPE SERVICE ASSEMBLY GUIDE



		ASSEMBLY: K1	.1	.2	.3
ITEM	MATERIAL		QTY	QTY	QTY
c	Bolt, machine, 5/8" X req'd length		1		1
d	Washer, 2 1/4" square		1	1	1
o	Bolt, eye, 5/8" X req'd length			1	
s	Clevis, secondary, swinging, insulated			1	
bh	Clevis, service, deadend, insulated				1
ek	Locknuts		1	1	1
da	Bracket, insulated		1		

ASSEMBLY NUMBERS	
NEW	(OLD)
K1.1	(K14C)
K1.2	(K11C)
K1.3	(K14)
	(K14L)

DESIGN PARAMETERS:

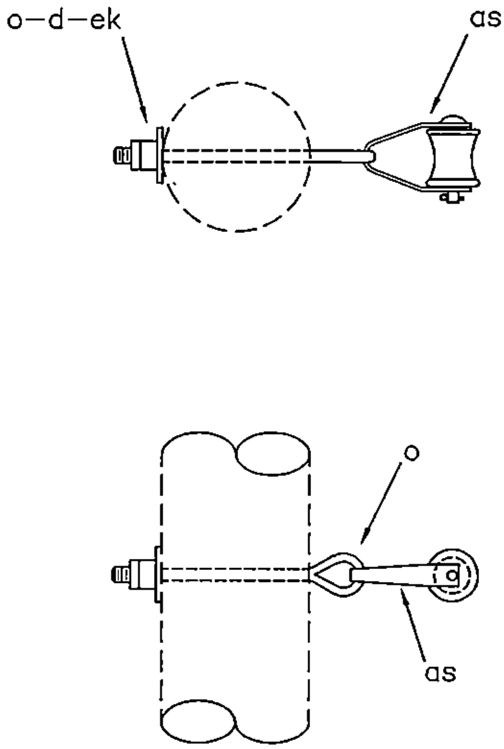
PERMITTED LONGITUDINAL LOADING:
1,500 lbs. (ANSI Class 53–2 Insulator)
2,250 lbs. (ANSI Class 53–4 Insulator)

SERVICE ASSEMBLIES
(POLE MOUNTED)

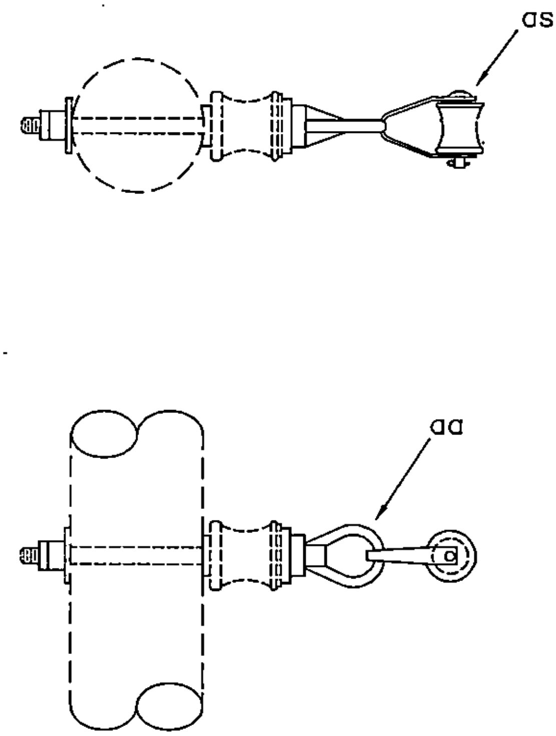
APRIL 2005

RUS

K1.1,K1.2,K1.3



K1.4



K1.5

ITEM	MATERIAL (ASSEMBLY: K1)	.4 QTY	.5 QTY
d	Washer, 2 1/4" square	1	
o	Bolt, eye, 5/8" X req'd length	1	
aa	Nut, eye		1
as	Clevis, service, swinging, insulated	1	1
ek	Locknuts	1	

DESIGN PARAMETERS:

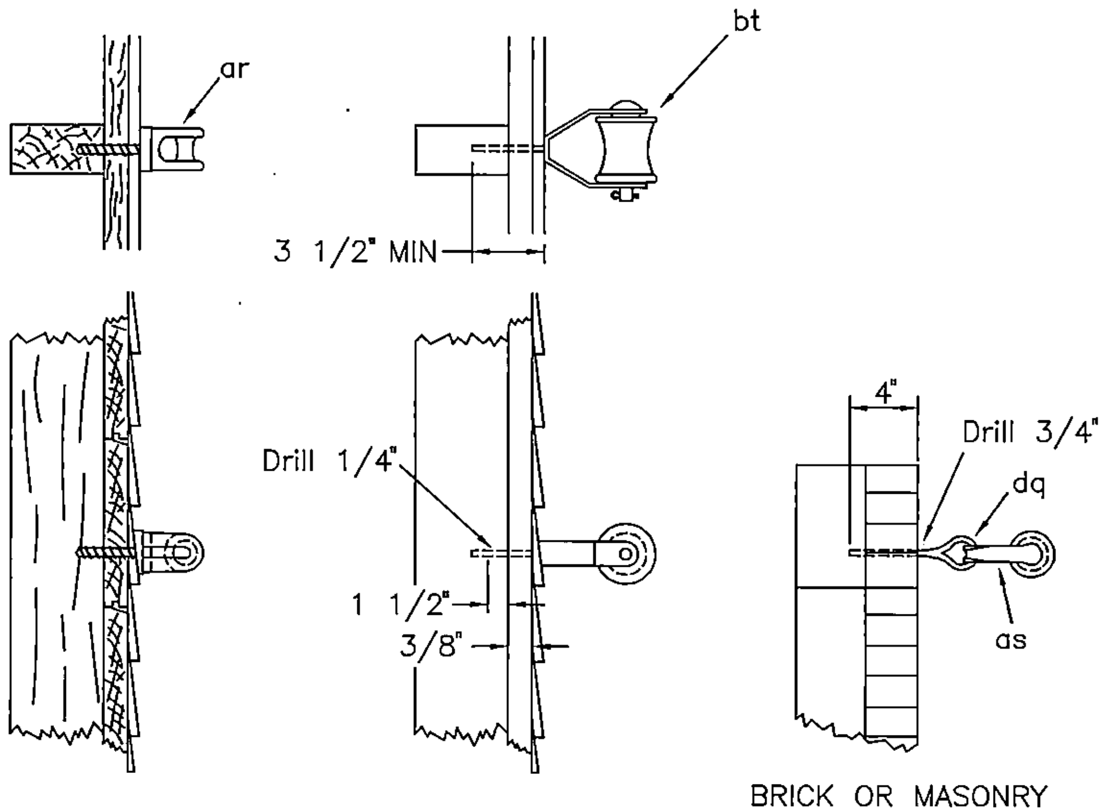
PERMITTED LONGITUDINAL LOAD:
1,500 lbs. (ANSI Class 53-2 Insulator)
2,250 lbs. (ANSI Class 53-4 Insulator)

SERVICE ASSEMBLIES
(POLE MOUNTED)

APRIL 2005

RUS

K1.4,K1.5
(K11,K11L),(K15C)



K2.1 K2.2 K2.3

NOTE: Assembly K2.1 not suitable for large conductors or cable services.

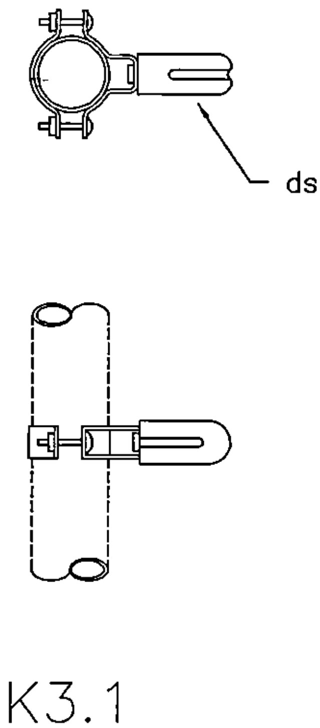
	ASSEMBLY: K2	.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
ar	Wireholder	1		
as	Clevis, secondary, swinging, insulated			1
bt	Wireholder, clevis type insulated, #24 Woodscrew		1	
dq	Eye, screw, elliptical, 1/2" X 6"			1
	3/4" x 3 1/2" expansion shield			1

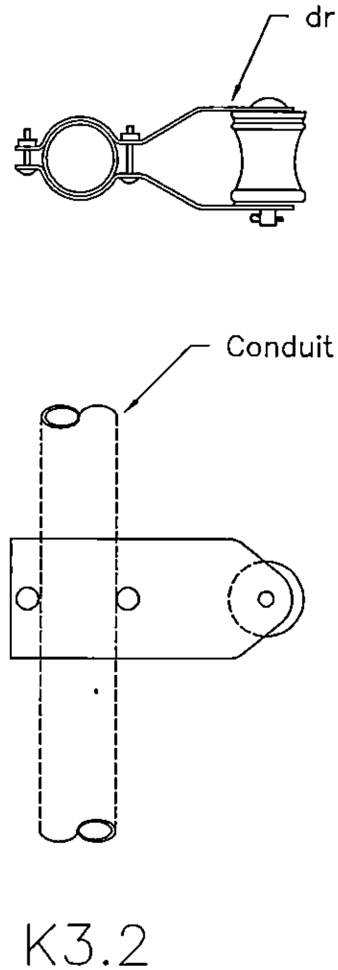
SERVICE ASSEMBLIES

APRIL 2005

RUS

K2.1,K2.2,K2.3
(K10,K10L),(K10C)





NOTE: Assembly K3.1 not suitable for loarge conductors or cable services.

ITEM	MATERIAL (ASSEMBLY: K3)	.1 QTY	.2 QTY
dr	Clevis, conduit, insulated		1
ds	Wireholder, conduit	1	

DESIGN PARAMETERS:

PERMITTED LOADING (lbs)

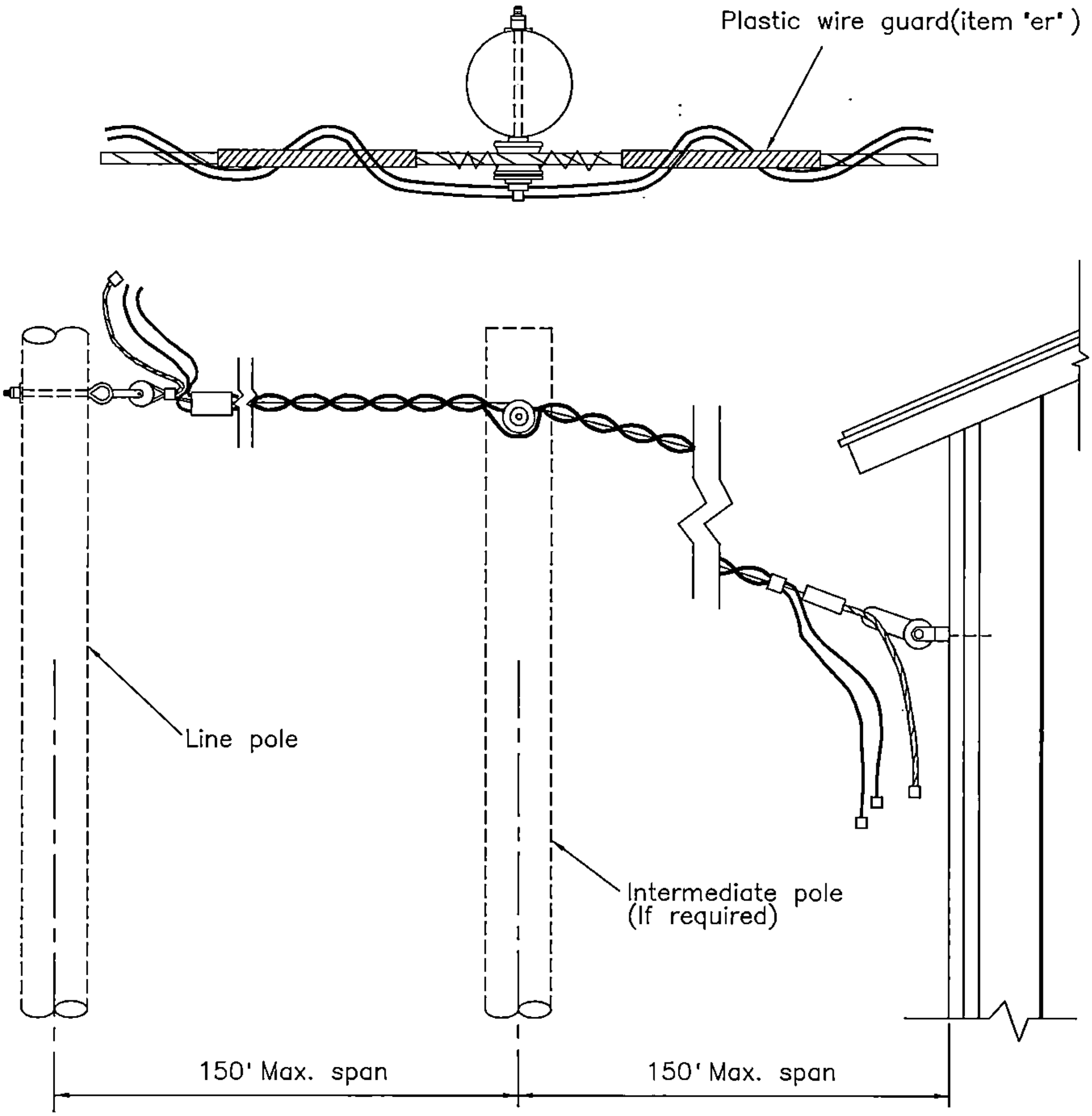
	Deadend	Cantilever
K3.1	1500	800
K3.2	1500	400

SERVICE ASSEMBLIES
(MAST TYPE)

APRIL 2005

RUS

K3.1,K3.2
(K17,K17L),(K16C)

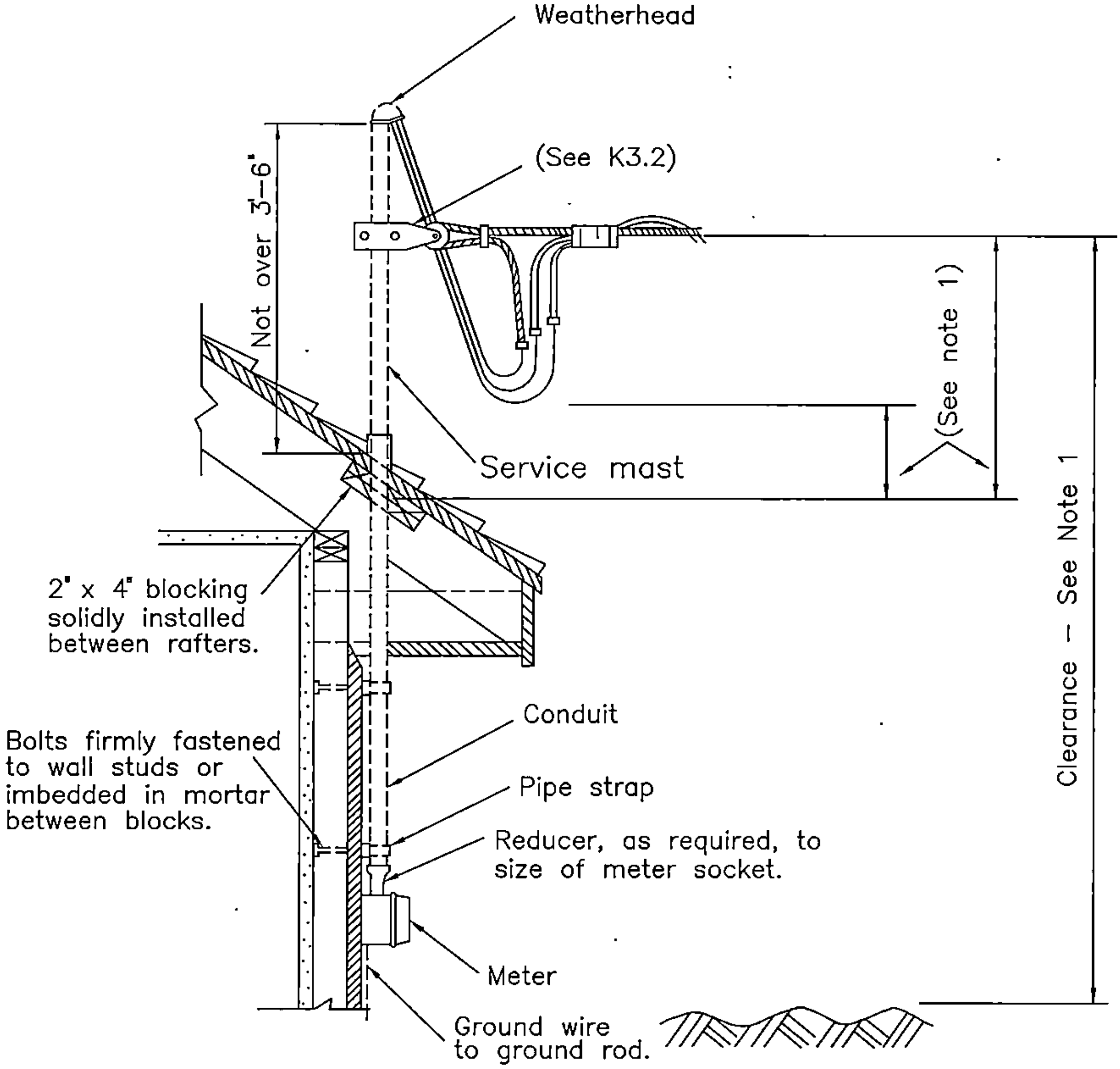


NOTES:

1. Services as short as possible are preferred.
2. See NESC Table 232-1 for minimum ground clearances.
3. Refer to secondary and service assemblies for construction details.
4. Service connectors to be insulated compression type.

CABLE SERVICE ASSEMBLY GUIDE

APRIL 2005		K4.1G
RUS		(M24)



NOTES:

1. All clearances to be in conformance to the most stringent requirements of the NESC, NEC or other codes of governmental or regulating authorities as applicable.

2. If length of conduit exceeds 10 feet, coupling is permitted on end adjacent to meter.

MAST TYPE SERVICE ASSEMBLY GUIDE		
APRIL 2005		K4.2G
RUS		(M24-10)

TYING ASSEMBLIES

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
L1.1	(M41-1)	PRIMARY ANGLE TYING ASSEMBLIES
L1.2	(M41-10)	
L1.3	(M42-3)	PRIMARY DEADEND TYING ASSEMBLIES
L1.4	(M42-21)	
L1.5	(M42-11)	
L2.1		NEUTRAL ANGLE TYING ASSEMBLIES
L2.2		
L2.3		NEUTRAL DEADEND TYING ASSEMBLIES
L2.4		
L2.5	(M42-13)	
L3.1	(M41-1)	NEUTRAL & SECONDARY ANGLE TYING ASSEMBLIES
L3.2	(M41-10)	
L3.3	(M42-21)	NEUTRAL & SECONDARY DEADEND TYING ASSEMBLIES -
L3.4	(M42-3)	(COPPER)
L3.5	(M42-11)	NEUTRAL & SECONDARY DEADEND TYING ASSEMBLIES -
L3.6		(ACSR)
L4.1		TYING ASSEMBLIES, SERVICES
L4.2		TYING ASSEMBLIES, CABLE SERVICES
L4.3		
L4.4		

CONSTRUCTION SPECIFICATIONS FOR CONNECTORS, STIRRUPS, CLAMPS, TAPS, AND JUMPERS

Jumpers and other leads connected to line conductors shall have sufficient slack to allow free movement of the conductors without causing the jumpers to be pulled from their connectors. Even if not shown on the drawings, jumpers shall have at least two bends in a vertical plane, or one in a horizontal plane, or the equivalent.

All leads on equipment, such as transformers and reclosers, shall be a minimum of #6 copper conductivity. Where aluminum jumpers are used, a connection to unplated bronze terminals shall be made by splicing a short stub of copper to the aluminum jumpers using a compression connector suitable for the bimetallic connection.

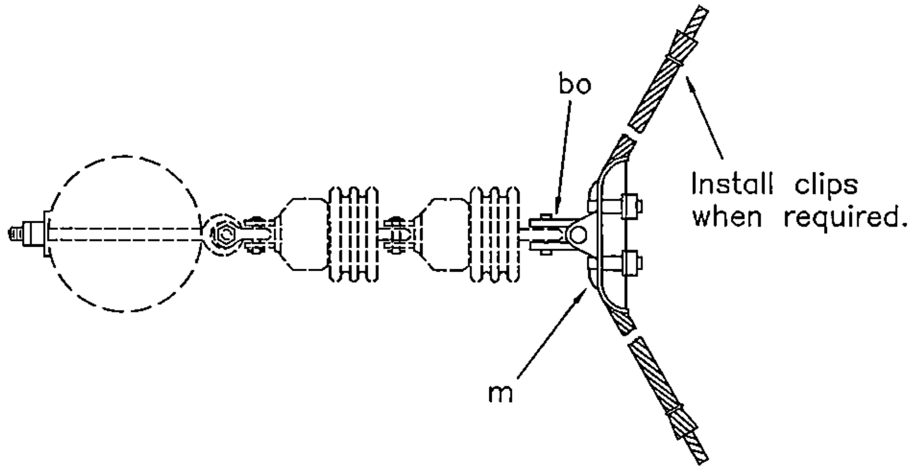
Connectors and hot-line clamps suitable for the purpose shall be installed as shown on the drawings and also in accordance with the manufacturer's specifications and recommendations. On all hot-line clamp installations, the clamp and jumper shall be installed so that they are permanently bonded to the load side of the line, allowing the jumper to be de-energized when the clamp is disconnected.

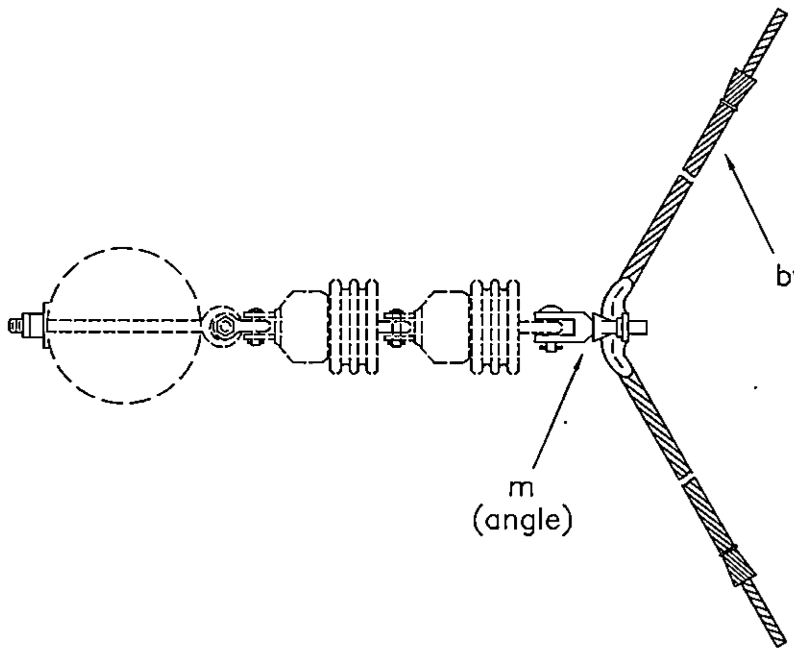
Stirrups may be used to connect tap conductors (jumper wires) to primary conductors if the following criteria are met:

- The stirrup and hot line clamp are sized to meet or exceed the current carrying capacity of the tap conductor or equipment jumper;
- All stirrup conductors are made of copper or bronze;
- All stirrup conductors are made of #2 copper equivalent conductivity or larger;
- All-purpose or aluminum hot line clamps are not used with stirrups;
- All stirrups, connectors, and clamps are installed in accordance with the manufacturer's specifications;
- Stirrups with two compression connectors are not used in areas prone to aeolian vibration;
- Stirrups are not used to connect main lines together or to connect heavily loaded tap lines to main lines.

Stirrups are not recommended to be used to connect reclosers, autotransformers, or line regulators to primary conductors. Stirrups and hot line clamps shall not be used for sectionalizing taps nor taps for main lines for operational or maintenance purposes. Permanent compression or bolted type connectors shall be used because of their better current carrying capabilities and reliability. Line switches, fused cutouts, or solid blade cutouts should be used at line locations where occasional line sectionalizing may be required.

At locations where permanent connections using compression or bolted type connectors are not desired, and where the installation of sectionalizing equipment is also not desired, hot line clamps (over armor rod on aluminum conductors) shall be installed.

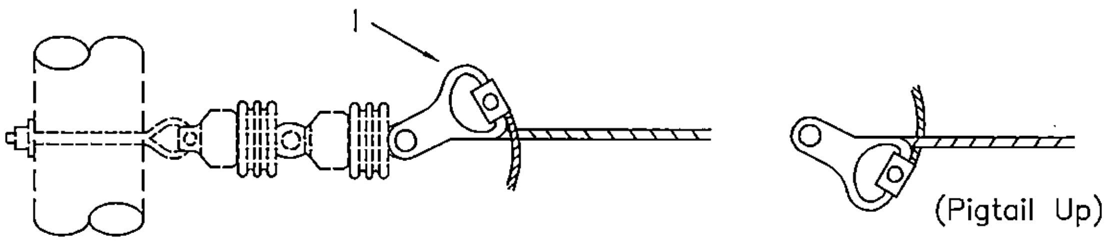




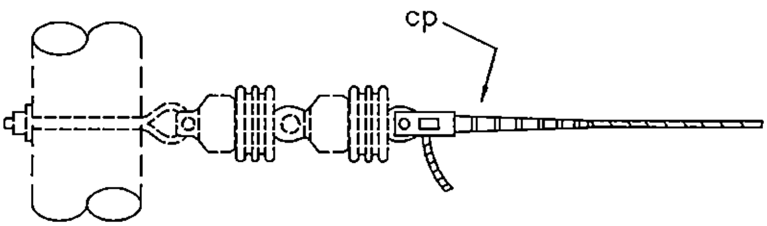
NOTES:
1. ACSR conductors require armor rods and clips (as shown).
2. Use angle suspension clamp with #2 or #4 ACSR only.

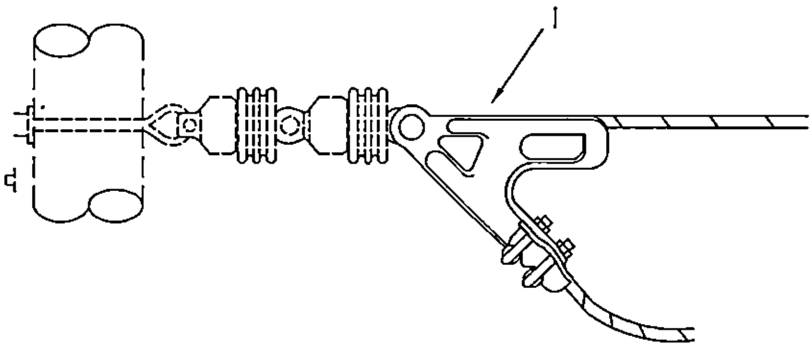
ITEM	MATERIAL (ASSEMBLY: L1)	.1 QTY	.2 QTY
m	Clamp, 2 bolt, suspension (distribution)	1	
m	Clamp, angle, suspension (distribution)		1
bo	Shackle, anchor	1	1
bv	Rods, armor (as req'd)		

DESIGN PARAMETERS: 30° to 60° Line Angles	PRIMARY ANGLE TYING ASSEMBLIES		
	APRIL 2005	12.47/7.2 kV	L1.1,L1.2
	RUS		(M41-1),(M41-10)



NOTE: For use with copper or copperweld–copper conductors only.





NOTES:

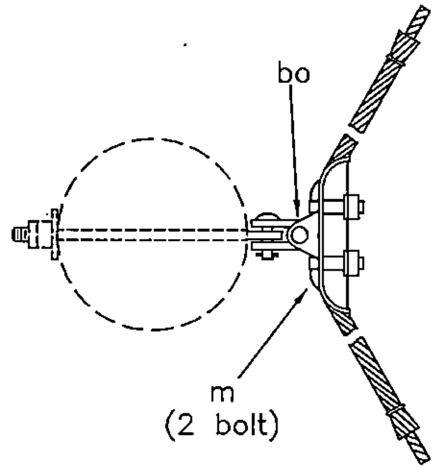
1. Item "by" may be substituted for item "cp" shown.
2. Specify "ej" clamp instead of "l" clamp for conductors larger than #4/0 ACSR.
3. Armor tape required for conductors in galvanized fittings not having aluminum liners.
4. Bend pigtails away from line conductors to avoid chafing.

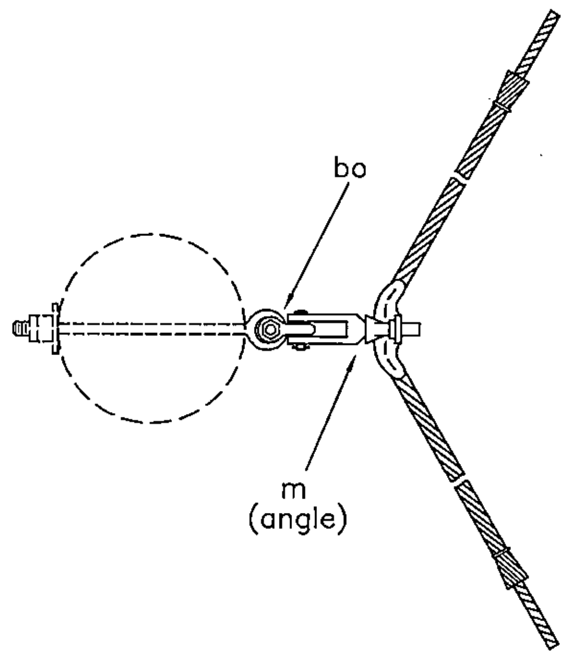
ASSEMBLY NUMBERS	
NEW	(OLD)
L1.3	(M42–3)
L1.4	(M42–21)
L1.5	(M42–11)

	ASSEMBLY: L1	.3	.4	.5	
ITEM	MATERIAL	QTY	QTY	QTY	
l	Clamp, deadend (distribution)	1		1	
by	Deadend, automatic or formed type				(Not Shown)
cp	Deadend, compression type		1		

PRIMARY DEADEND TYING ASSEMBLIES

APRIL 2005	12.47/7.2 kV	L1.3,L1.4,L1.5
RUS		





NOTES:
1. ACSR conductors require armor rods and clips (as shown).
2. Use angle suspension clamp with #2 or #4 ACSR only.

	ASSEMBLY: L2	.1	.2
ITEM	MATERIAL	QTY	QTY
m	Clamp, 2 bolt, suspension (distribution)	1	
m	Clamp, angle, suspension (distribution)		1
bo	Shackle, anchor	1	1
bv	Rods, armor (as req'd)		

DESIGN PARAMETERS:

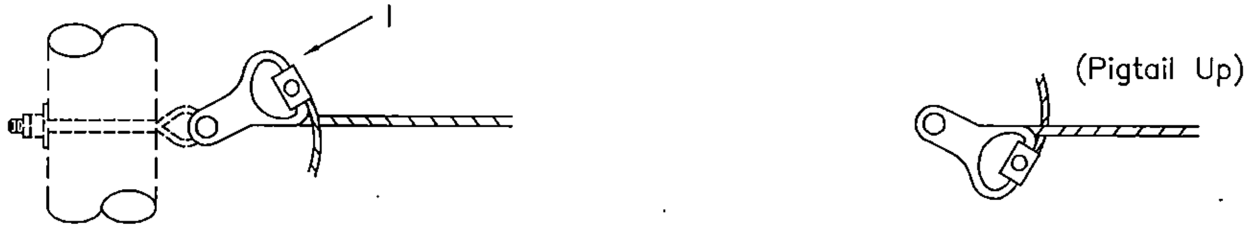
30° to 60° Line Angles

NEUTRAL ANGLE TYING ASSEMBLIES

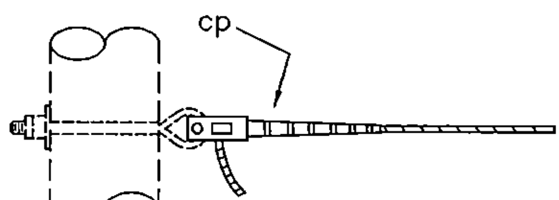
APRIL 2005

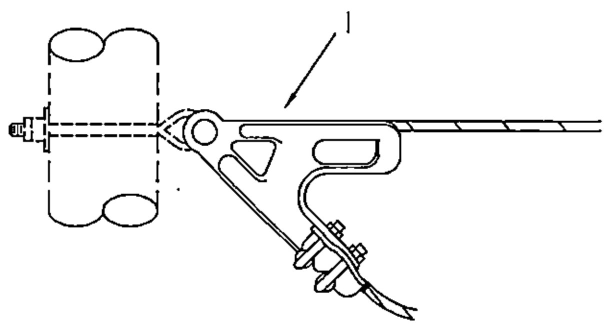
RUS

L2.1,L2.2



NOTE: For use with copper or copperweld–copper conductors only.



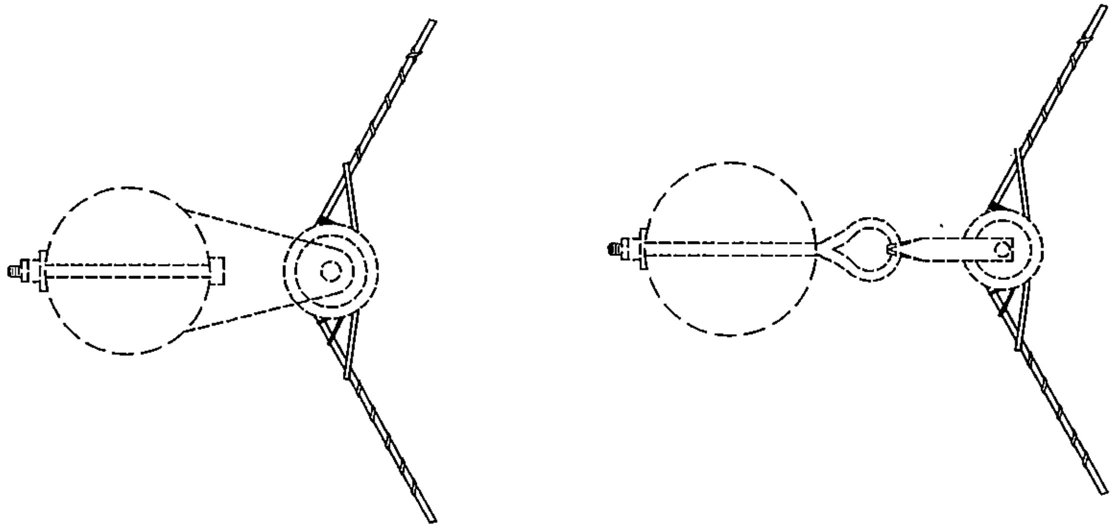


NOTES:

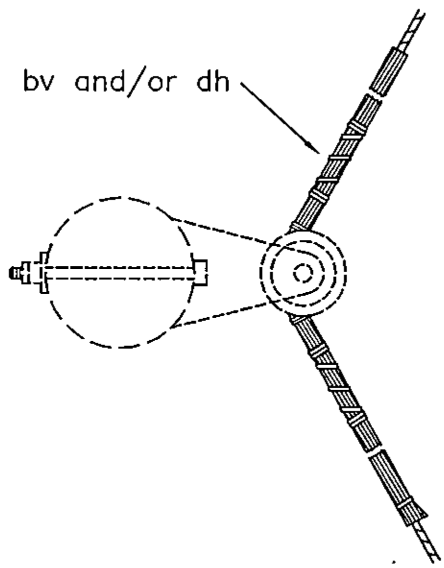
1. Item "by" may be substituted for item "cp" shown.
2. Specify "ej" clamp instead of "I" clamp for conductors larger than #4/0 ACSR.
3. Armor tape required for conductors in galvanized fittings not having aluminum liners.
4. Bend pigtails away from line conductors to avoid chafing.

	ASSEMBLY: L2	.3	.4	.5	
ITEM	MATERIAL	QTY	QTY	QTY	
I	Clamp, deadend (distribution)	1		1	
by	Deadend, automatic or formed type				(Not Shown)
cp	Deadend, compression type		1		

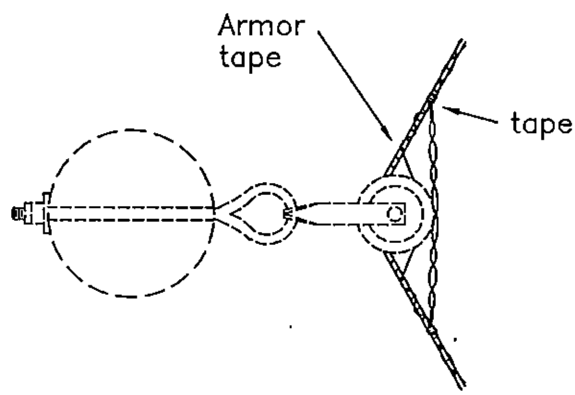
NEUTRAL DEADEND TYING ASSEMBLIES	
APRIL 2005	L2.3,L2.4,L2.5
RUS	(M42–13)



For use with copper or copperweld–copper conductors.



ACSR Conductors

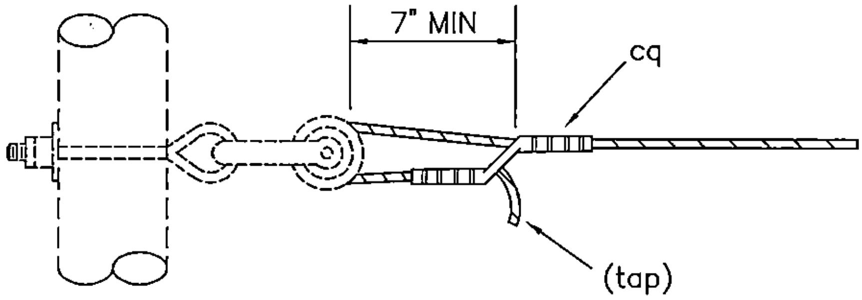


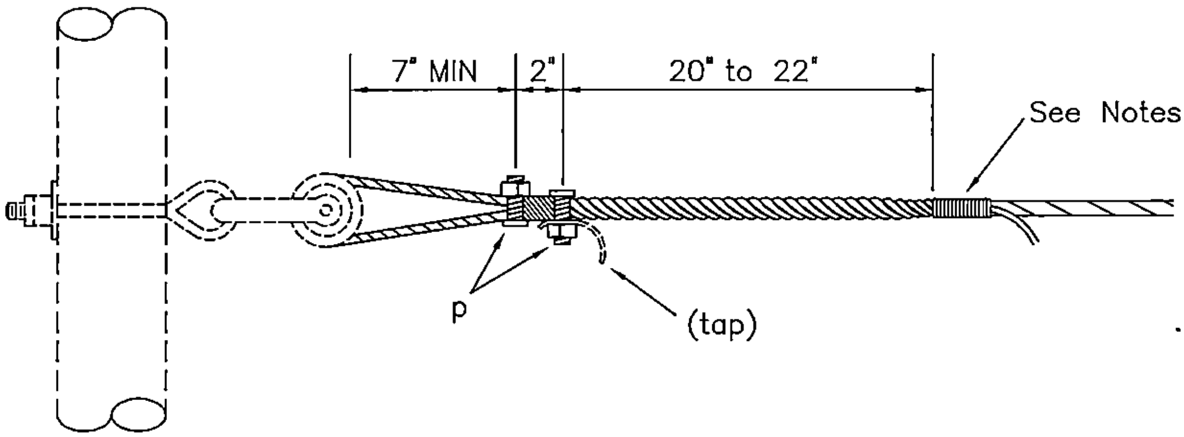
Self Supporting
Cable Conductors

ITEM	MATERIAL
bv	Rod, armor (formed type)
dh	Tie, insulator (formed type)

NEUTRAL & SECONDARY
ANGLE TYING ASSEMBLIES

APRIL 2005		L3.1,L3.2
RUS		(M41–1),(M41–10)





NOTES:

1. Bend all pigtails away from line conductor to avoid chafing.

2. Extend one strand of free end (the copperweld strand of copperweld–copper conductor) against line conductor. Wrap free ends of conductor along line conductor using same lay. Serve copper strands six turns each and then cut off.

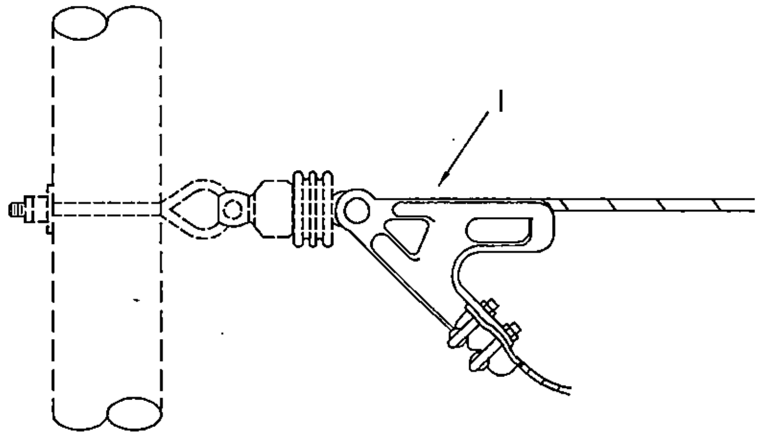
3. For solid conductors, use same dimensions and install third connector "p" in lieu of serving.

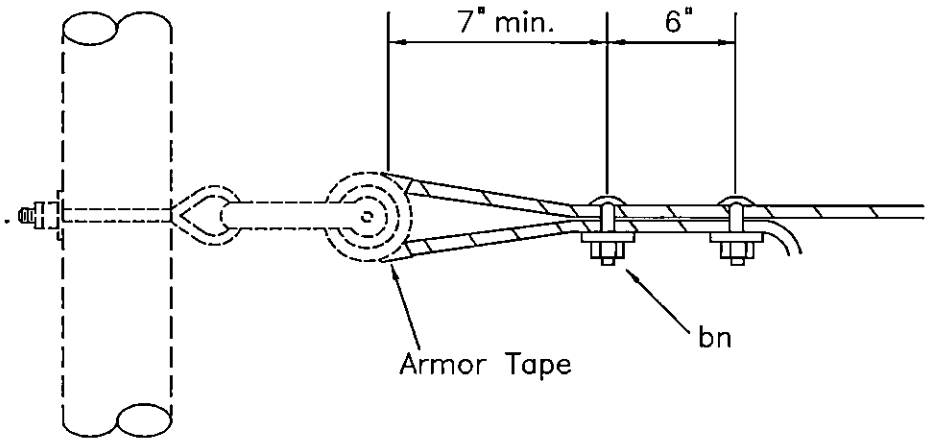
	ASSEMBLY: L3	.3	.4
ITEM	MATERIAL	QTY	QTY
p	Connectors, as req'd		
cq	Deadend, secondary	1	

NEUTRAL & SECONDARY
DEADEND TYING ASSEMBLIES (COPPER)

APRIL 2005
RUS

L3.3,L3.4
(M42–21),(M42–3)





NOTES:

1. Armor tape wrapping to extend not more than two wraps beyond the mouth of deadend clamp or spool insulator.

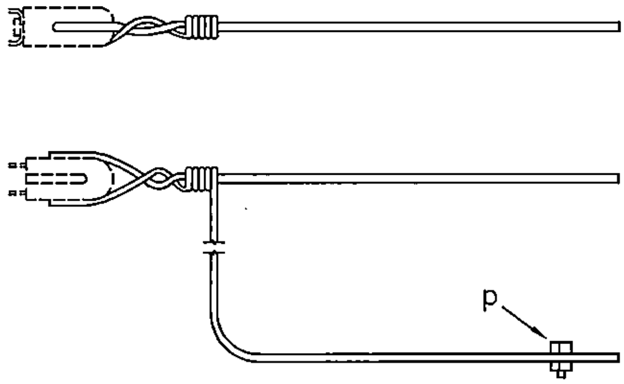
2. For #1/0 and larger, use spool with 3" minimum groove diameter.

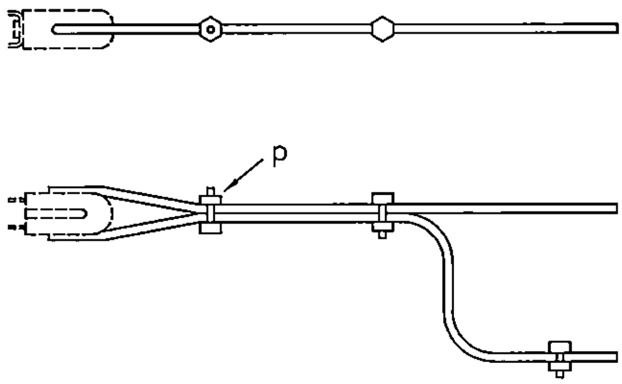
	ASSEMBLY: L3	.5	.6
ITEM	MATERIAL	QTY	QTY
i	Clamp, deadend	1	
bn	Clamp, loop deadend		2

NEUTRAL & SECONDARY
DEADEND TYING ASSEMBLIES (ACSR)

APRIL 2005
RUS

L3.5,L3.6
(M42–11,13)





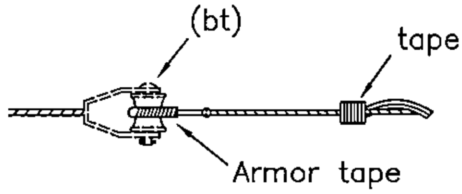
This type of construction should be used for small, aluminum covered conductors.

NOTE: Service connectors (p) to be applied over bare wire and then taped as required.

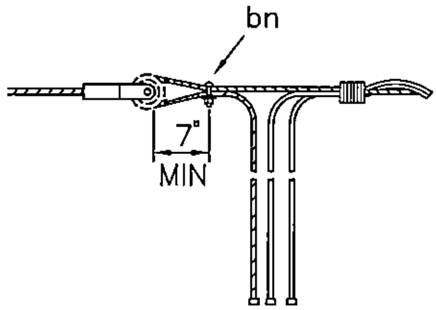
ITEM	MATERIAL
p	Connectors, as req'd

TYING ASSEMBLY, SERVICES

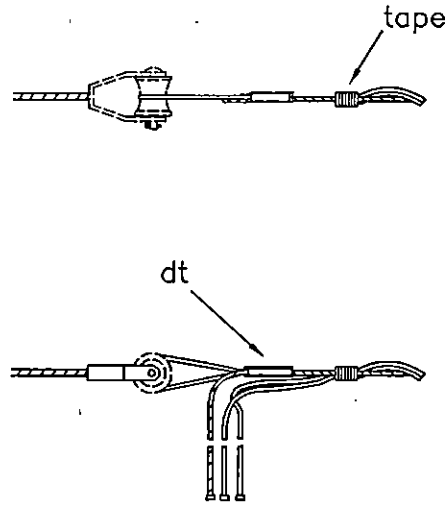
APRIL 2005		
RUS		L4.1



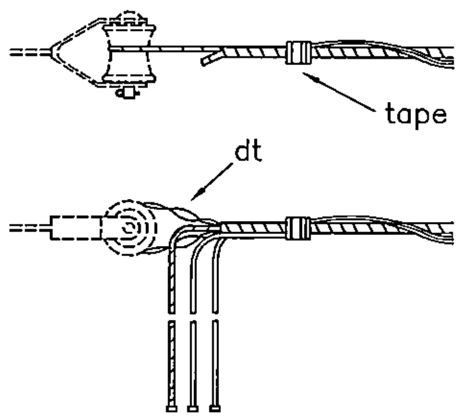
NOTE:
Groove diameter of insulator 1 3/4" min.



LOOP TYPE



WEDGE TYPE



PREFORMED TYPE

NOTES:

1. This type of construction should be for 3 or 4 conductor service cables with bare ACSR neutral.
CAUTION: Not suitable for K2.1 or K3.1 Service Assemblies.

2. Service connectors (p) to be insulated, compression type.

	ASSEMBLY: L4	.2	.3	.4
ITEM	MATERIAL	QTY	QTY	QTY
dt	Service deadend, wedge type			1
dt	Service deadend, preformed type		1	
bn	Clamp, loop deadend	1		

TYING ASSEMBLIES, CABLE SERVICES

APRIL 2005

RUS

L4.2,L4.3,L4.4

MISCELLANEOUS ASSEMBLY UNITS AND GUIDES

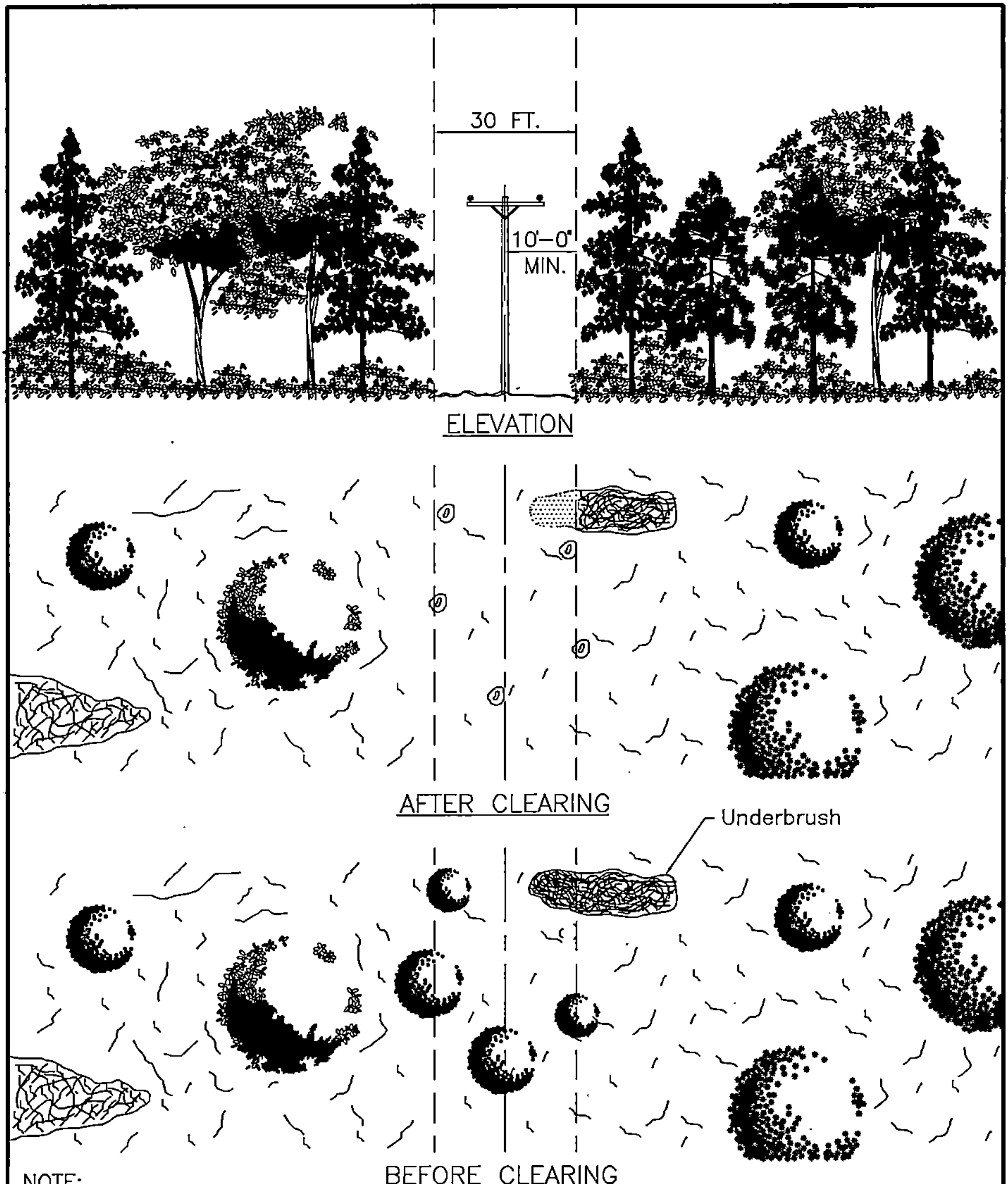
DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804 (New)	**Bulletin 50-3** (Old)	
M1.30G	(R1)	RIGHT-OF-WAY CLEARING GUIDE

SPECIFICATIONS FOR RIGHT-OF-WAY CLEARING

The right-of-way shall be prepared by removing trees, clearing underbrush, and trimming trees so that the right-of-way is cleared close to the ground and to the width specified. However, low growing shrubs, which will not interfere with the operation or maintenance of the line, can be left undisturbed if so directed by the property owner. Slash may be chipped and blown on the right-of-way if so allowed. Trim, but do not remove shade, fruit, or ornamental trees unless otherwise authorized.

All trimming shall be done using good arboricultural practices.

The landowner's written permission is usually required prior to cutting trees outside of the right-of-way. Trim trees fronting each side of the right-of-way symmetrically unless otherwise specified. Remove dead trees beyond the right-of-way which would strike the line in falling. Also, either remove or top leaning trees beyond the right-of-way that would strike the line in falling.

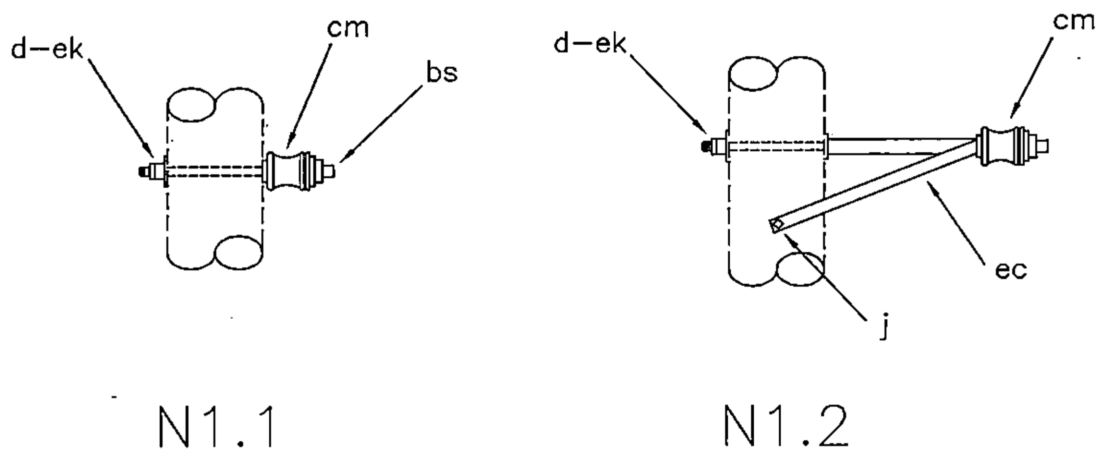


NOTE:
Change suffix of drawing number to designate clearing width. (e.g. M1.30G specifies 30 foot wide clearing).

	RIGHT-OF-WAY CLEARING GUIDE	
APRIL 2005 RUS		M1.30G (R1)

NEUTRAL ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	 Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
N1.1		NEUTRAL ASSEMBLIES - TANGENT
N1.2	(M5-19)	
N1.11		NEUTRAL SUPPORTS ON CROSSARMS
N2.21		
N2.1		NEUTRAL ASSEMBLIES - LARGE ANGLE
N2.1L		
N5.1	(M5-25)	NEUTRAL ASSEMBLIES - (SINGLE DEADENDS)
N5.2		
N5.3	(M5-26)	
N6.1		NEUTRAL ASSEMBLY - DOUBLE DEADEND
N6.21		NEUTRAL ASSEMBLY - DOUBLE DEADEND ON CROSSARMS



	ASSEMBLY:	N1.1	N1.2
ITEM	MATERIAL	QTY	QTY
d	Washer, 2 1/4" square	1	1
j	Screw, lag, 1/2" x 4"		2
bs	Bolt, single, upset	1	
cm	Insulator, spool, 3"	1	1
ec	Bracket, offset neutral		1
ek	Locknuts	1	1

DESIGN PARAMETERS:

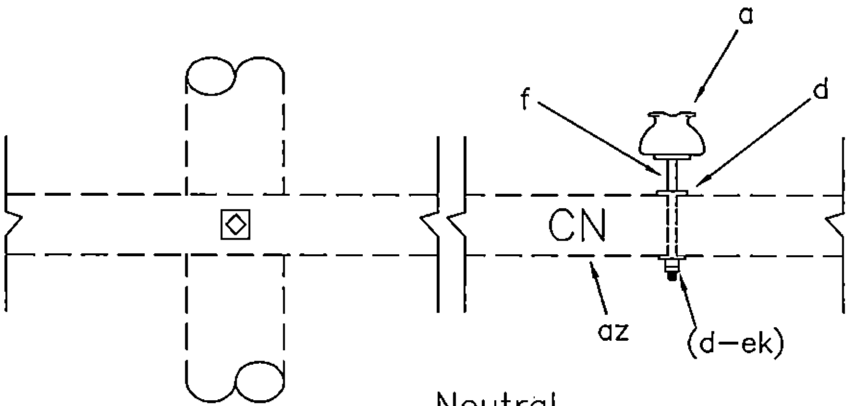
MAXIMUM LINE ANGLES:
5° – Small Conductors
2° – Larger than #1/0

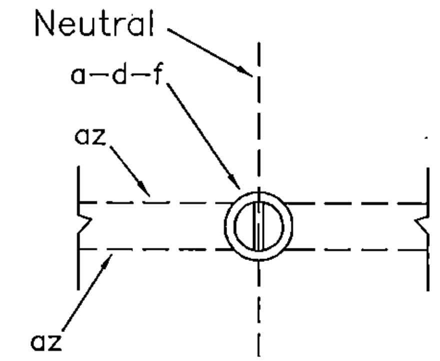
NEUTRAL ASSEMBLIES – TANGENT

APRIL 2005

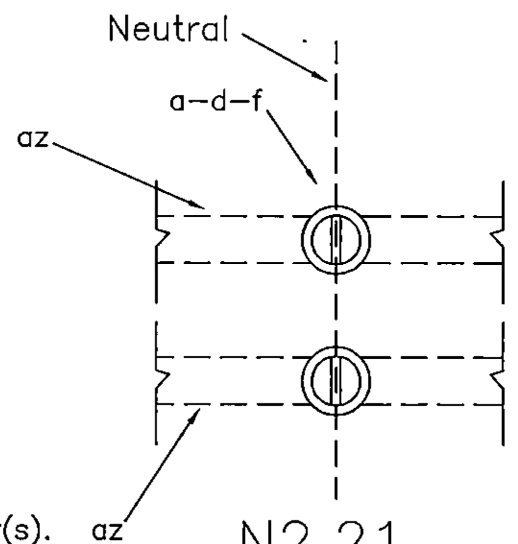
RUS

N1.1,
N1.2 (M5–19)





N1.11



N2.21

NOTE: Install either identification letters (az) or white insulator(s).

		ASSEMBLY: N1.11	N2.21
ITEM	MATERIAL	QTY	QTY
a	Insulator, pin type, 15 kV, white	1	2
d	Washer, 2 1/4" square	1	2
f	Pin, crossarm, steel, 5/8" x 10 3/4"	1	2
az	Letters, 2" C, 2" N, with 1" nails	4	4

DESIGN PARAMETERS:

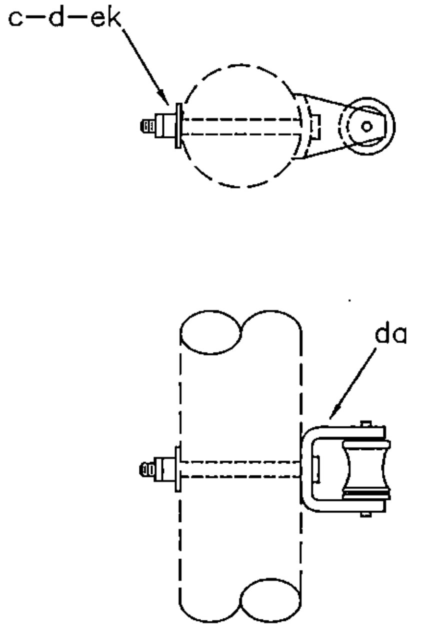
N1.11: See TABLE II
N2.21: See TABLE IV

NEUTRAL SUPPORTS ON CROSSARMS

APRIL 2005

RUS

N1.11, N2.21



N2.1
(ANSI Class 53–2 Insulator)
N2.1L
(ANSI Class 53–4 Insulator)

	ASSEMBLY: N2	.1	.1L
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8" X req'd length	1	1
d	Washer, 2 1/4" square	1	1
o	Bolt, eye, 5/8" X req'd length		
s	Clevis, secondary, swinging, insulated		
da	Bracket, with 3" x 1 3/4" spool insulator	1	
da	Bracket, with 3" x 3" spool insulator		1
ek	Locknuts	1	1

DESIGN PARAMETERS:

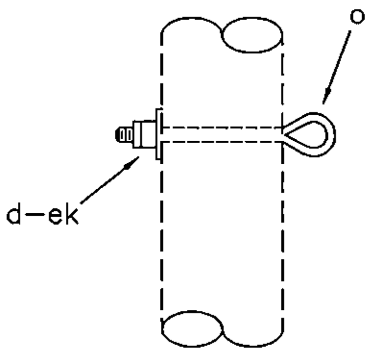
N2.1: See TABLE VI
N2.1L: See TABLE VII

NEUTRAL ASSEMBLIES – LARGE ANGLE

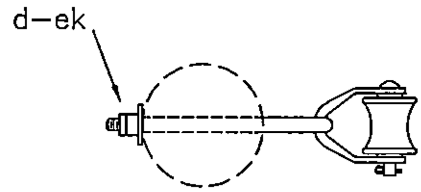
APRIL 2005

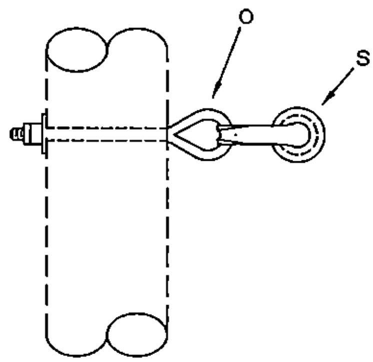
RUS

N2.1, N2.1L

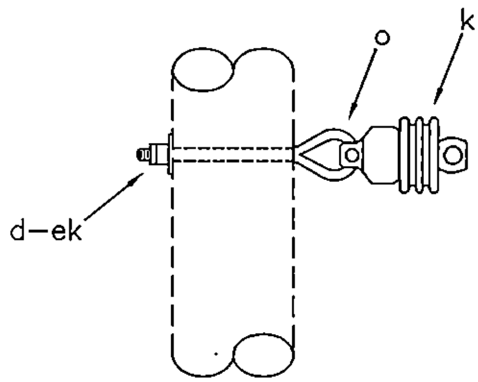


N5.1





N5.2



N5.3

ASSEMBLY: N5		.1	.2	.3
ITEM	MATERIAL	QTY	QTY	QTY
d	Washer, square 3" curved	1	1	1
k	Insulator, suspension, 4 1/4"			1
o	Bolt, eye, 5/8" X req'd length	1	1	1
s	Clevis, secondary, swinging, insulated		1	
ek	Locknuts	1	1	1

ASSEMBLY NUMBERS

NEW	(OLD)
N5.1	(M5—25)
N5.2	
N5.3	(M5—26)

DESIGN PARAMETERS:

PERMITTED LONGITUDINAL LOADING:

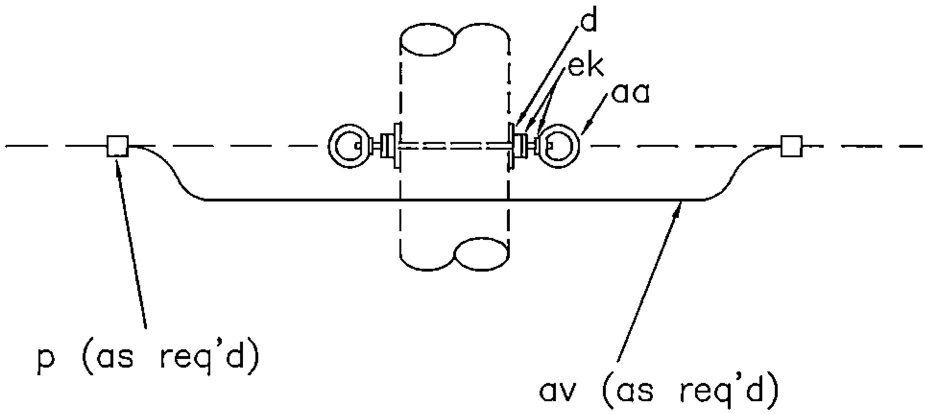
N5.1,N5.3 = 5,000 lbs.
N5.2 = 1,500 lbs.
(ANSI Class 53—2 Insulator)
N5.2 = 2,250 lbs.
(ANSI Class 53—4 Insulator)

NEUTRAL ASSEMBLIES
(SINGLE DEADENDS)

APRIL 2005

RUS

N5.1,N5.2,N5.3



ITEM	QTY	MATERIAL
d	2	Washer, square 3" curve
n	1	Bolt,double arming,5/8" x req'd length
p		Connectors, as req'd
aa	2	Nut, eye, 5/8"
av		Jumpers, as req'd
ek	4	Locknuts

DESIGN PARAMETERS:

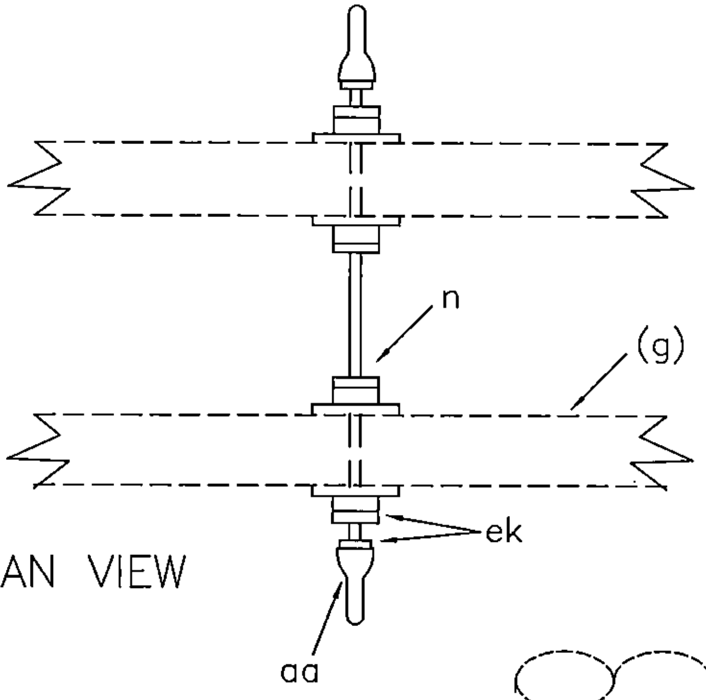
PERMITTED LONGITUDINAL
LOADING: 5,000 lbs.

NEUTRAL ASSEMBLY – DOUBLE DEADEND

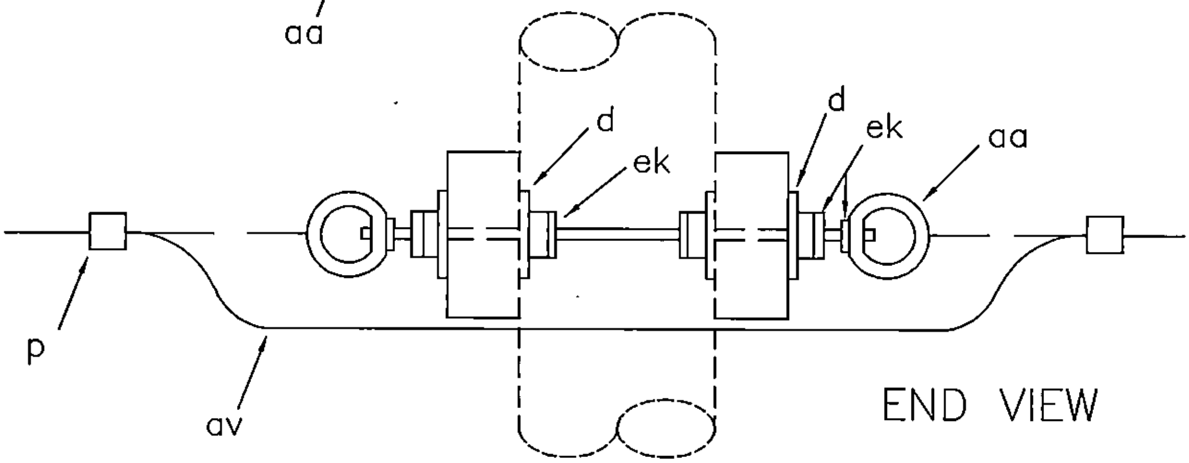
APRIL 2005

RUS

N6.1



PLAN VIEW



END VIEW

NOTES:

1. Doubling arming bolt, item "n" and eye nut, item "aa," may be replaced with doubling arming eye bolt, item "dy."
2. Maximum line angle may be increased to 15° by installing anchor shackles, item "bo" to (horizontally mounted) eye nuts and installing side guys.

ITEM	QTY	MATERIAL
d	4	Washer, square, 2 1/4"
n	1	Bolt,double arming,5/8" x req'd length
p		Connectors, as req'd
aa	2	Nut, eye, 5/8"
av		Jumpers, as req'd
ek	6	Locknuts

DESIGN PARAMETERS:

PERMITTED UNBALANCED TENSION:
(See drawings where assembly used)

ALLOWABLE LINE ANGLE = 5°
(See Note 2)

NEUTRAL ASSEMBLY –
DOUBLE DEADEND ON CROSSARMS

APRIL 2005

RUS

N6.21

INDEX P

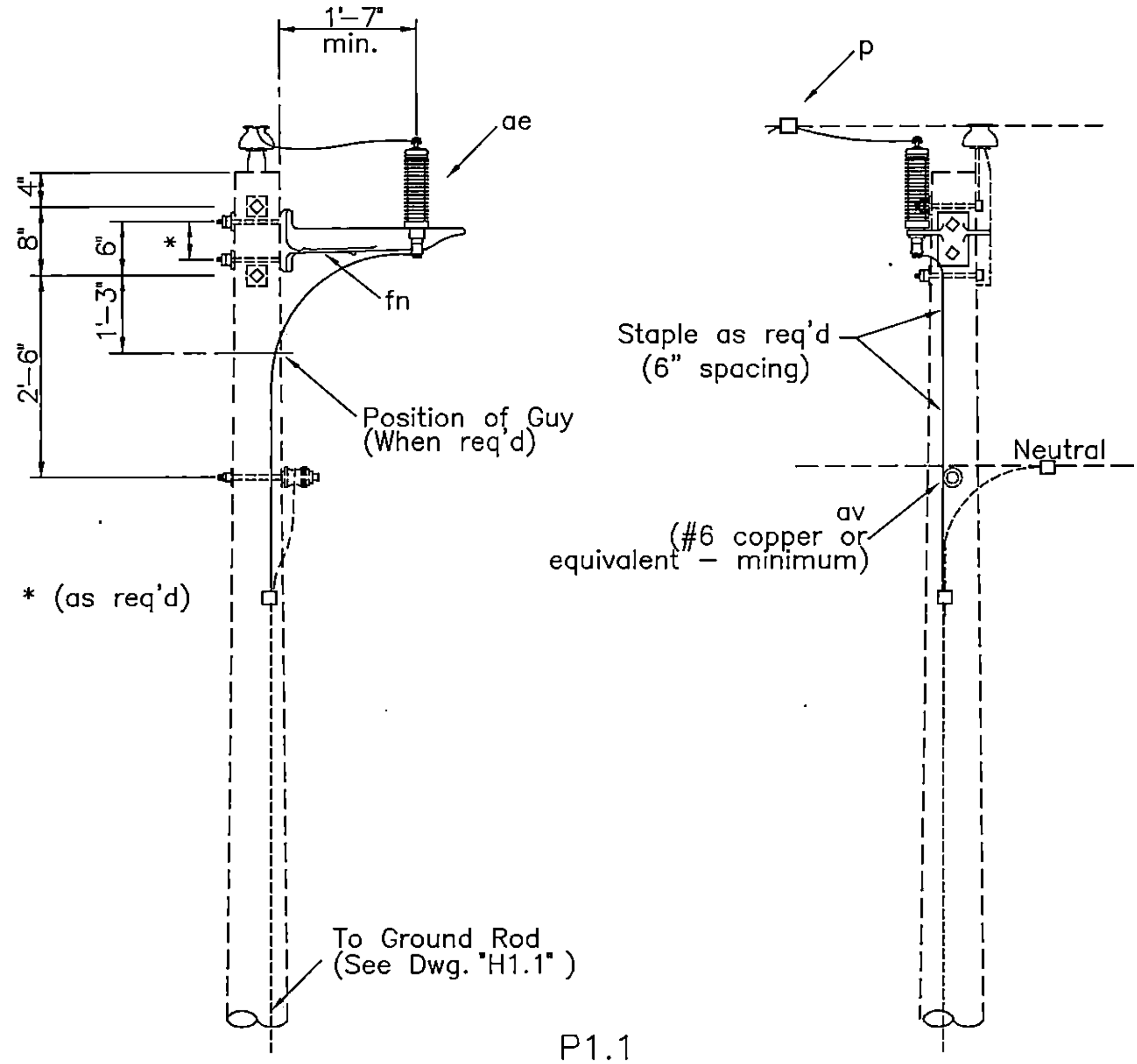
PROTECTION ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
P1.01 P1.1	(M5-6)	SURGE ARRESTERS - SINGLE PHASE
P1.1NG		SURGE ARRESTER GUIDE - NARROW PROFILE
P1.3		SURGE ARRESTERS - 3 SINGLE PHASE
P3.1G		RAPTOR PROTECTION ASSEMBLY GUIDE SUPPORT ON 8-FOOT CROSSARMS (TANGENT)
P3.2G		RAPTOR PROTECTION ASSEMBLY GUIDE SUPPORT ON 10-FOOT CROSSARMS (TANGENT)
P3.3G		RAPTOR PROTECTION, PERCH GUARDS - GUIDE
P3.4G		RAPTOR PROTECTION, SINGLE-PHASE, CSP TRANSFORMER (TANGENT POLE)
P3.5G		RAPTOR PROTECTION ASSEMBLY GUIDE THREE-PHASE TRANSFORMER BANK

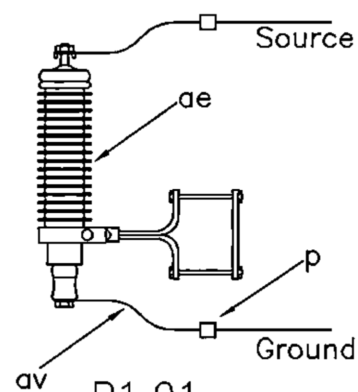
CONSTRUCTION SPECIFICATIONS FOR RAPTOR PROTECTION

Raptor injury and electrocution around power lines are major wildlife concerns of the U.S. Fish and Wildlife Service. Raptors are protected by the Endangered Species Act, the Eagle Protection Act, and the Migratory Bird Treaty Act. The electrocution issue may be a problem especially on lines with voltages of 69 kV or less. Reports indicate that raptor concerns exist primarily on distribution lines in western and southwestern states; however, hazards can exist anywhere in the United States where large birds are present.

The provisions included on the "P3" series of construction drawings will help to minimize or eliminate bird electrocutions. This construction should be used in areas where raptors or other large birds are present. It may be prudent to adopt these designs for all new construction.



P1.1



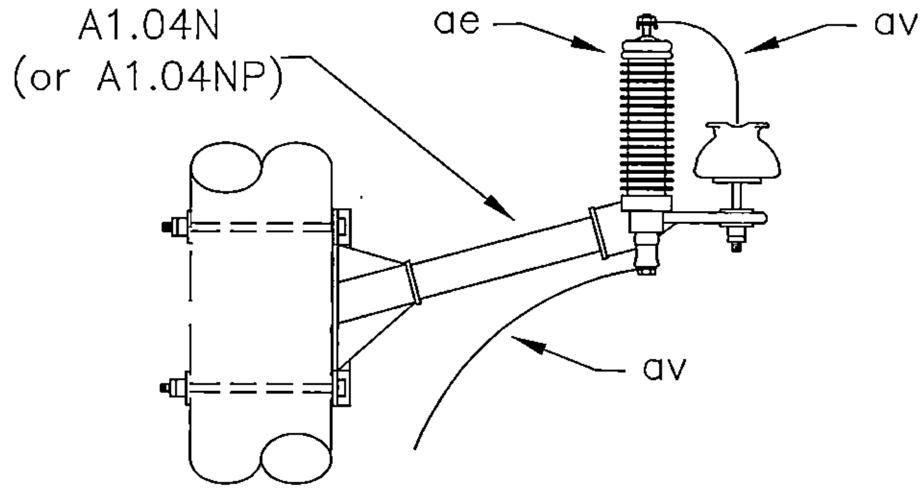
P1.01

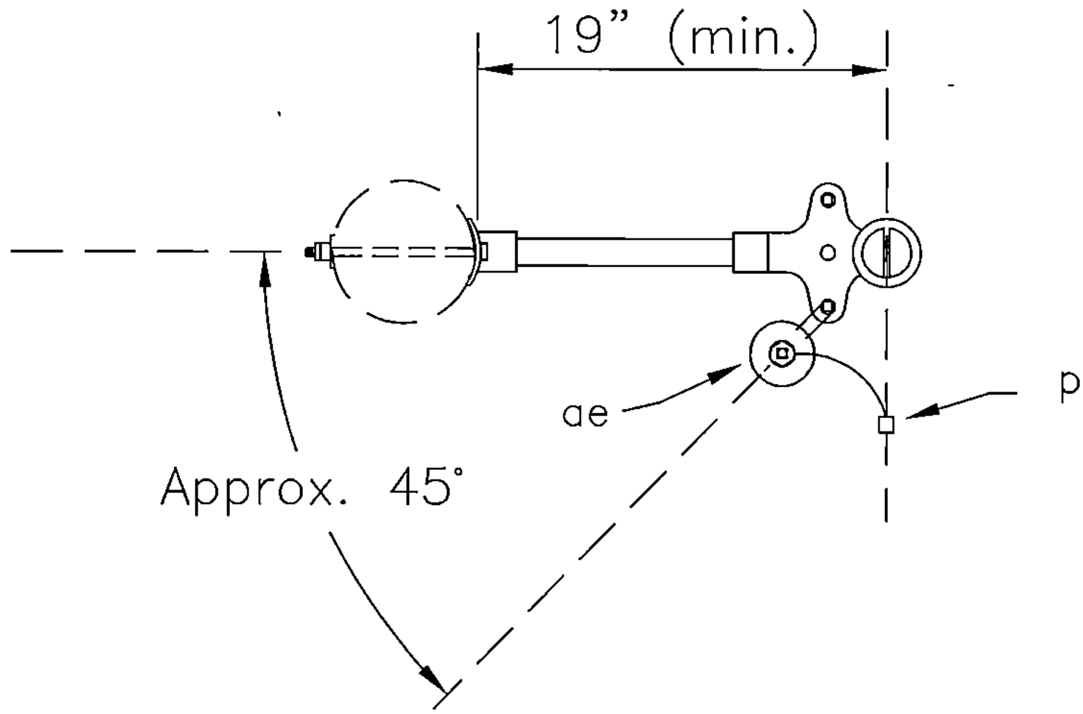
NOTE: Use "P1.01" on existing arm, a minimum of 19" from face of pole.

	ASSEMBLY: P1	.01	.1
ITEM	MATERIAL	QTY	QTY
c	Bolt, machine, 5/8 x req'd length		2
d	Washer, square, 2 1/4		2
p	Connectors, as req'd		
ae	Arrester, surge, (9 kV)	1	1
av	Jumpers, as req'd		
fn	Bracket, cutout extension		1
ek	Locknuts		2

SURGE ARRESTERS – SINGLE PHASE

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	P1.01, (M5–6) P1.1





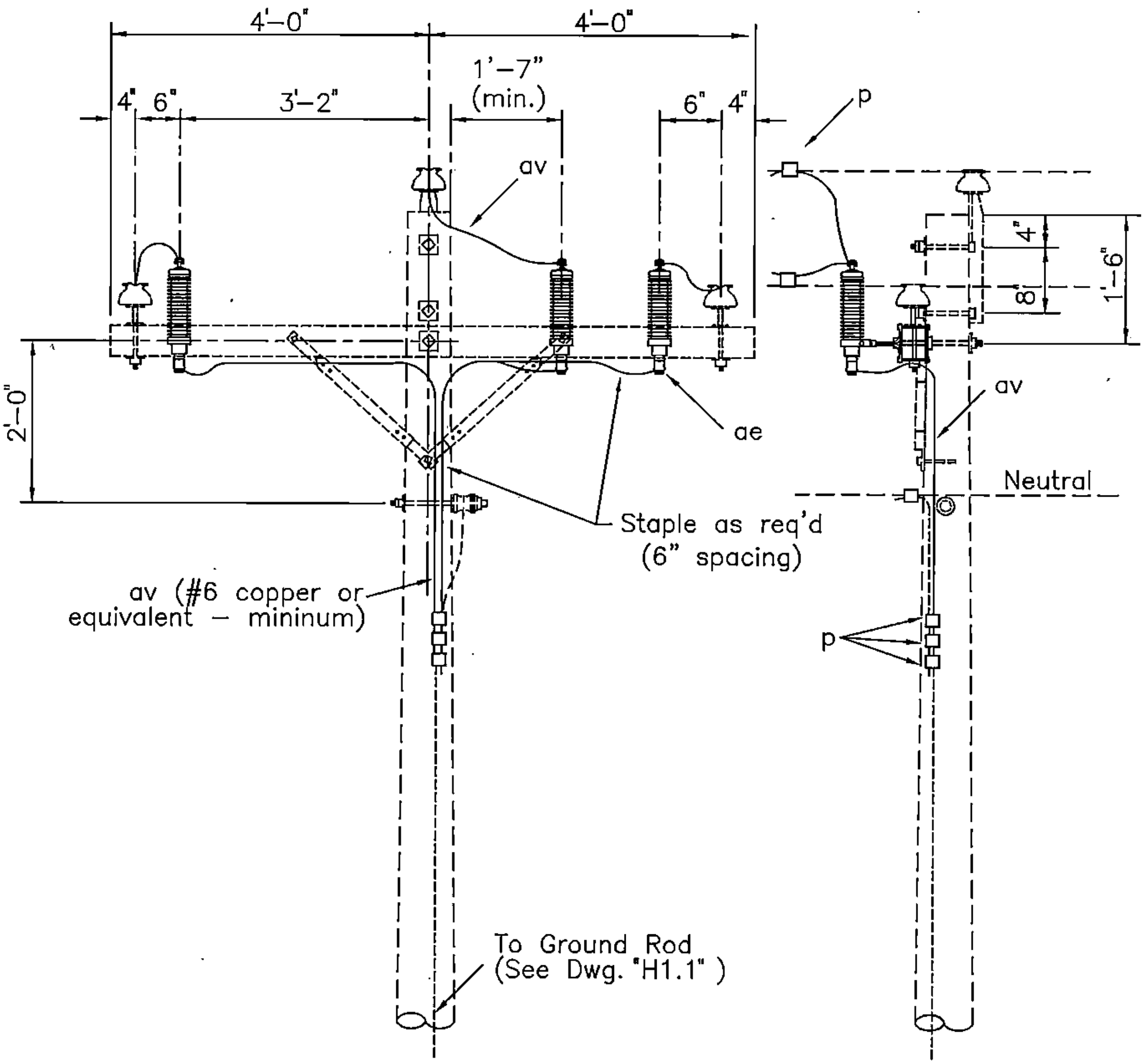
NOTE: May be used on an apparatus mounting bracket (item "fm") of any 1, 2 or 3–phase narrow profile assembly. Specify quantity of surge arresters (item "ae").

ITEM	MATERIAL
	Assembly A1.04N or A1.04NP
ae	Arrester, surge (9kV)
av	Jumpers, as req'd
p	Connectors, as req'd

Design Parameters:

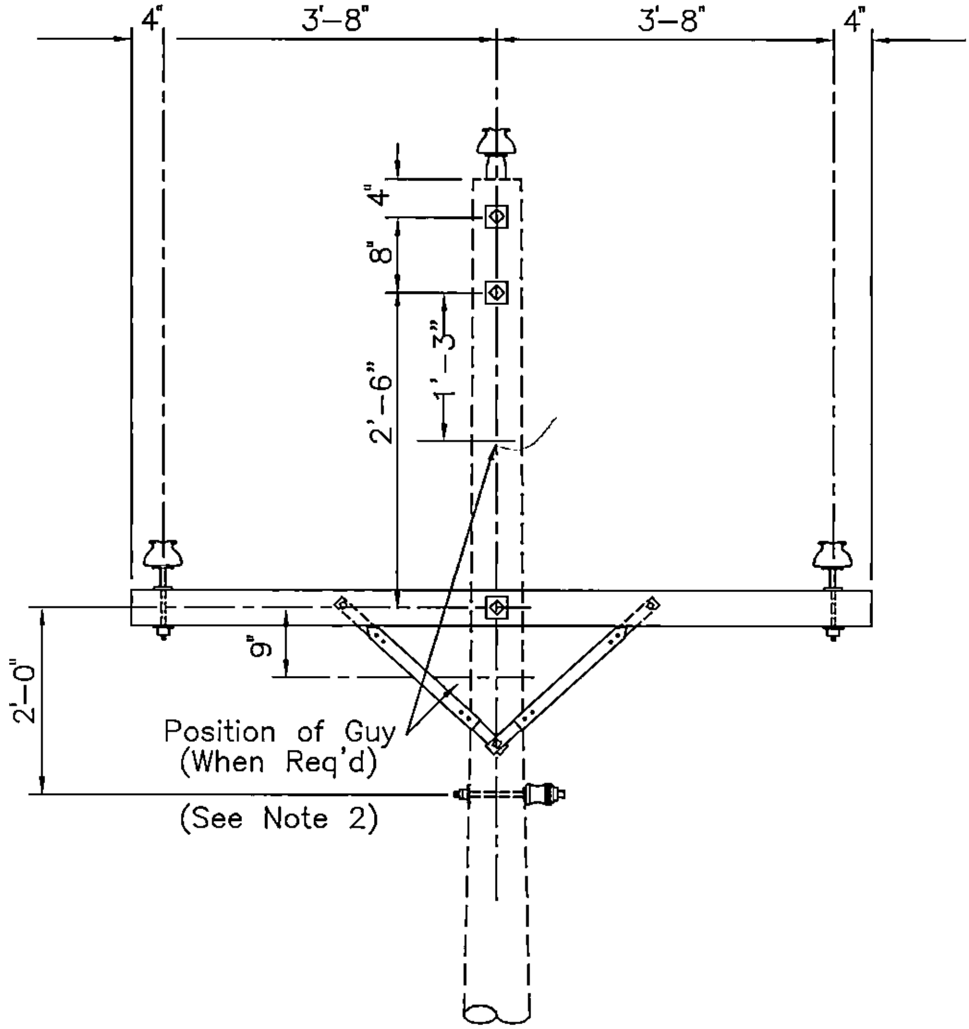
SURGE ARRESTER GUIDE–NARROW PROFILE

APRIL 2005	1 – PHASE PRIMARY	P1.1NG
RUS	12.47/7.2 kV	



ITEM	QTY	MATERIAL
p		Connectors, as req'd
ae	3	Arrester, surge, (9 kV)
av		Jumpers, as req'd

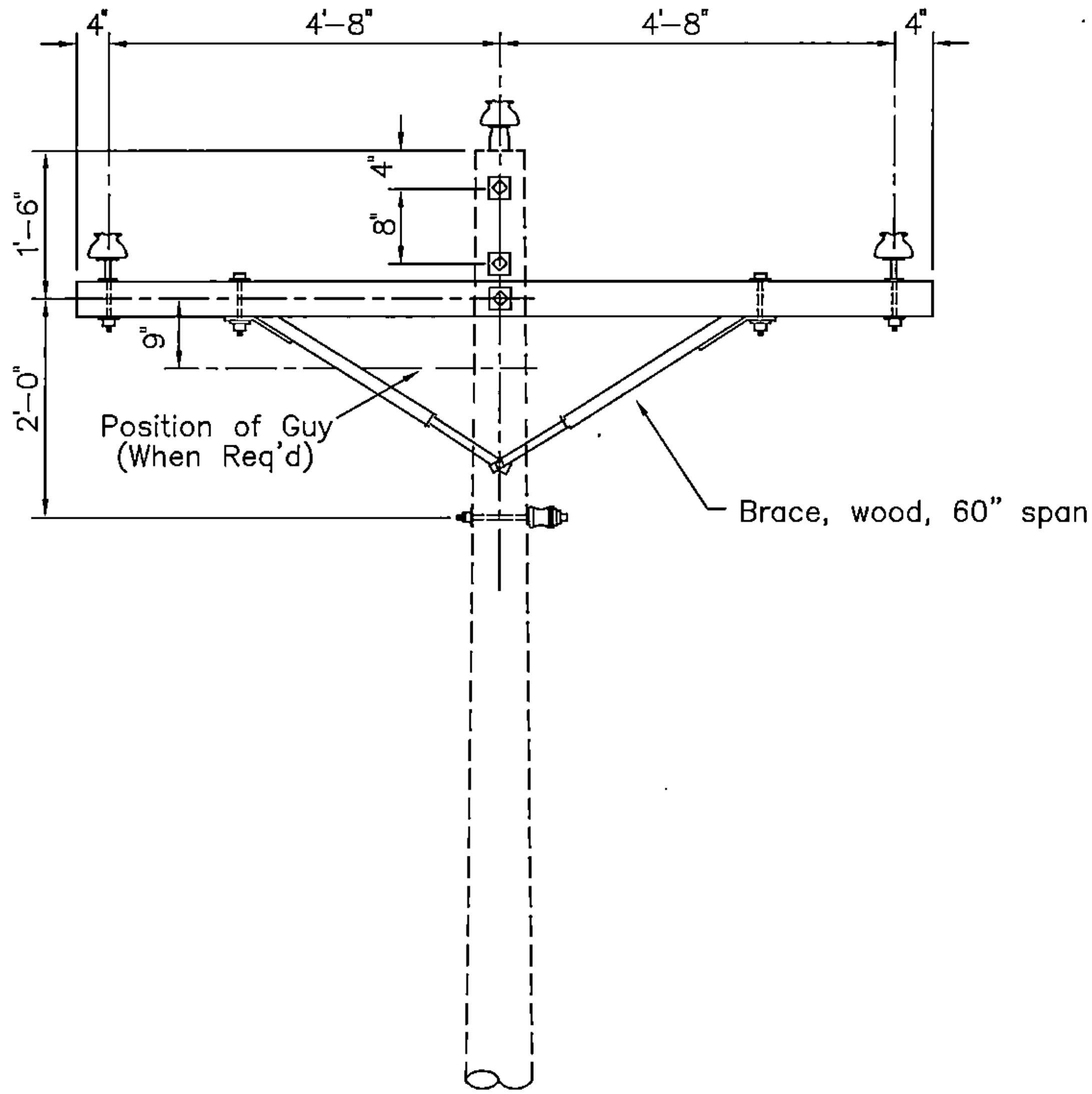
SURGE ARRESTERS – 3 SINGLE PHASE		
APRIL 2005	3 – PHASE PRIMARY 12.47/7.2 kV	P1.3
RUS		



NOTES:

1. See "C1.11" and "C2.21" drawings for additional construction details and materials.
2. All down guys must be insulated at top of pole.

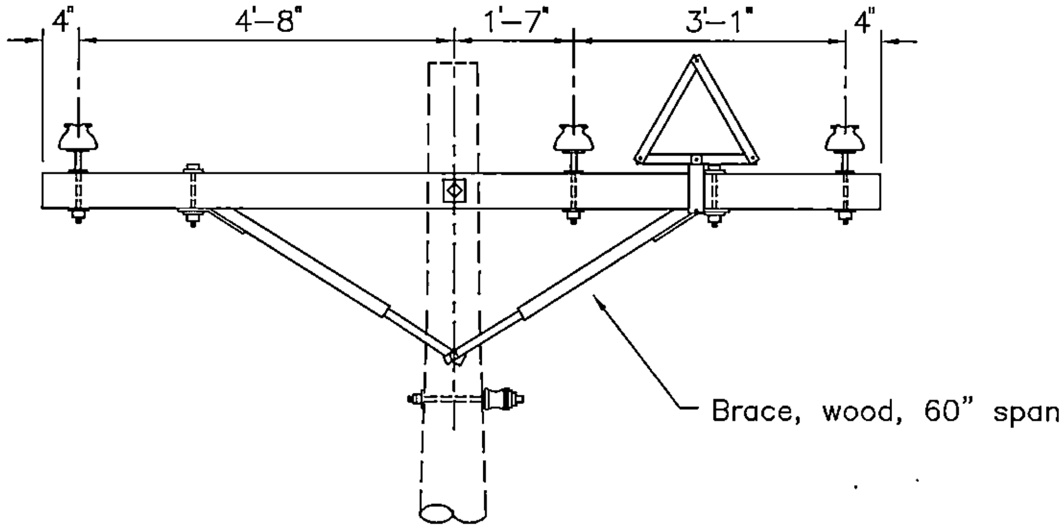
DESIGN PARAMETERS:	RAPTOR PROTECTION ASSEMBLY GUIDE SUPPORT ON 8 FOOT CROSSARMS (TANGENT)		
	APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	P3.1G

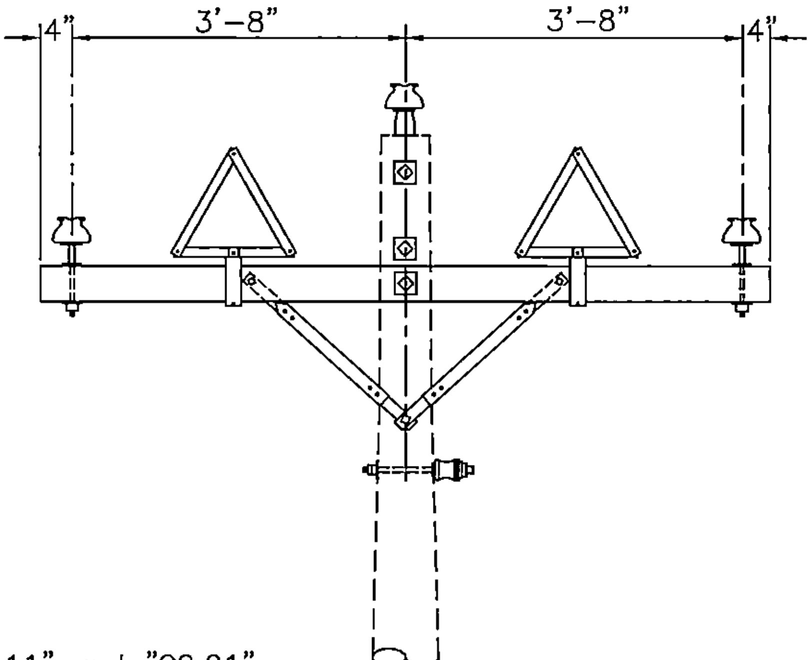


NOTE:

1. See "C1.11" and "C2.21" drawings for additional construction details and materials.

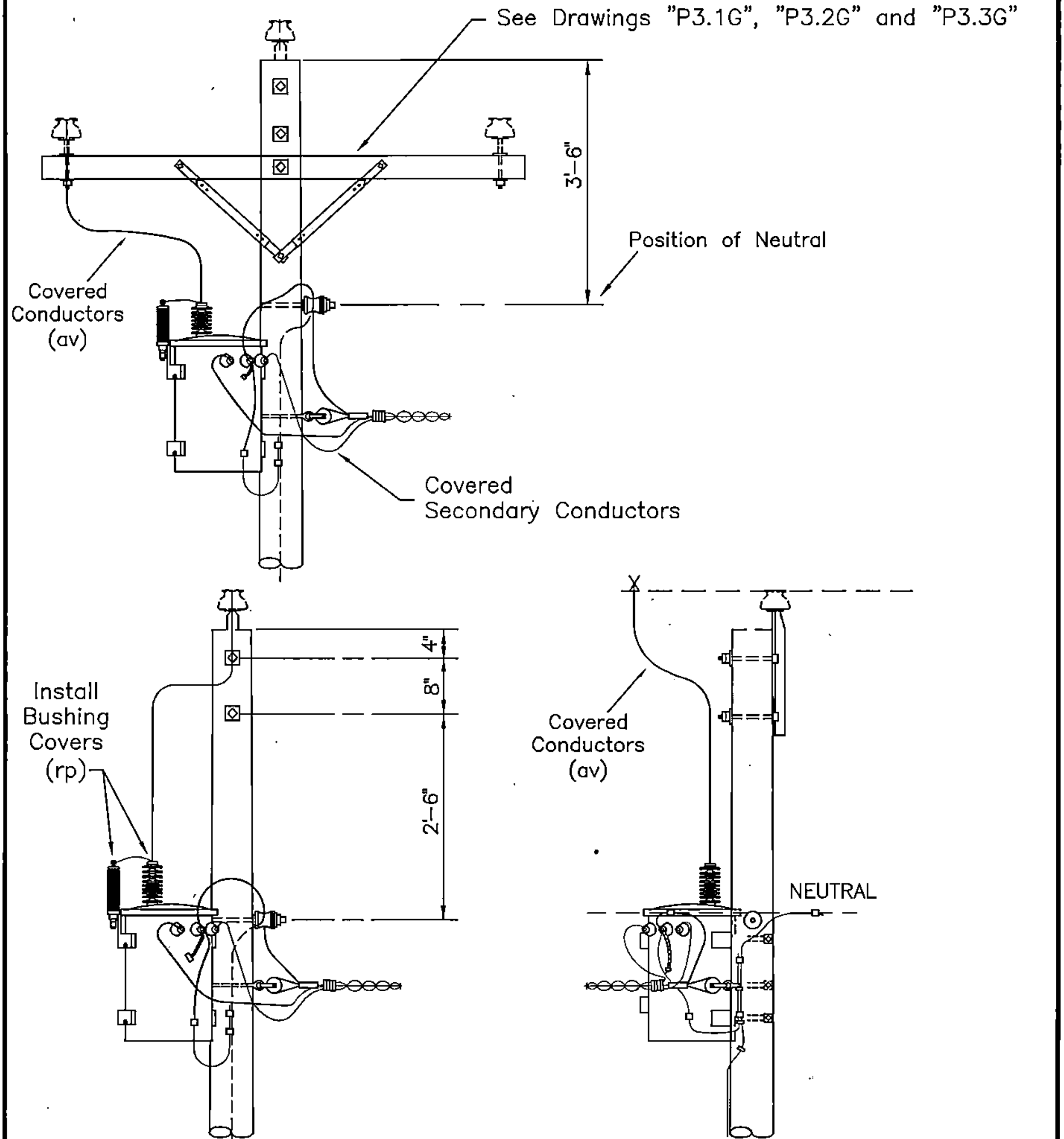
DESIGN PARAMETERS:	RAPTOR PROTECTION ASSEMBLY GUIDE SUPPORT ON 10 FOOT CROSSARMS (TANGENT)	
APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	P3.2G





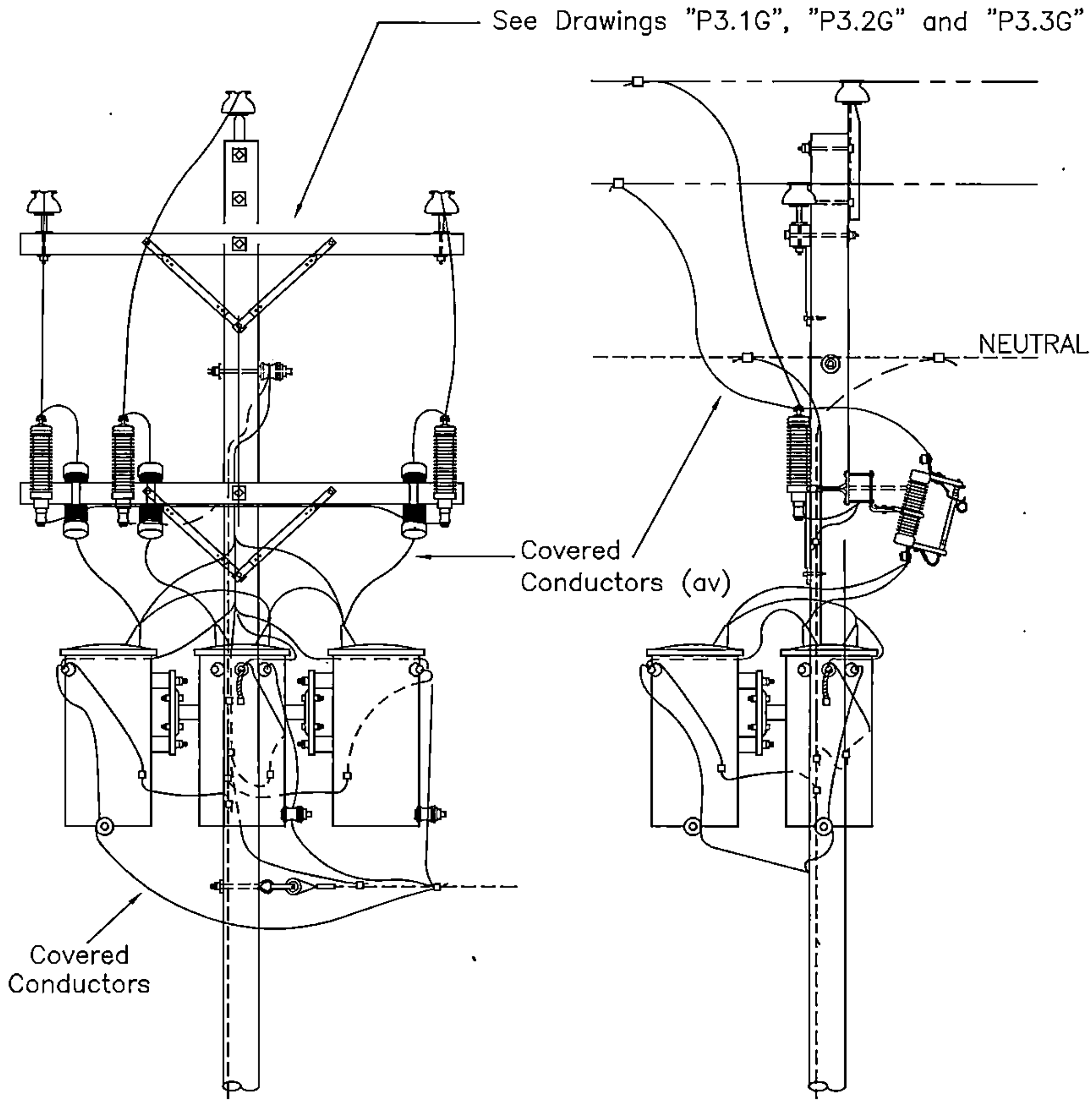
NOTE: See "C1.11" and "C2.21" drawings for additional construction details and materials.

DESIGN PARAMETERS:	RAPTOR PROTECTION PERCH GUARDS–GUIDE	
	APRIL 2005 RUS	3–PHASE PRIMARY 12.47/7.2 kV	P3.3G



Note: Specify Insulated Transformer Covers (Lids); Minimum Dielectric Strength=15kV

DESIGN PARAMETERS: See Assembly "G1.2"	RAPTOR PROTECTION SINGLE–PHASE, CSP TRANSFORMER (TANGENT POLE)	
APRIL 2005		
RUS	12.47/7.2 kV	P3.4G



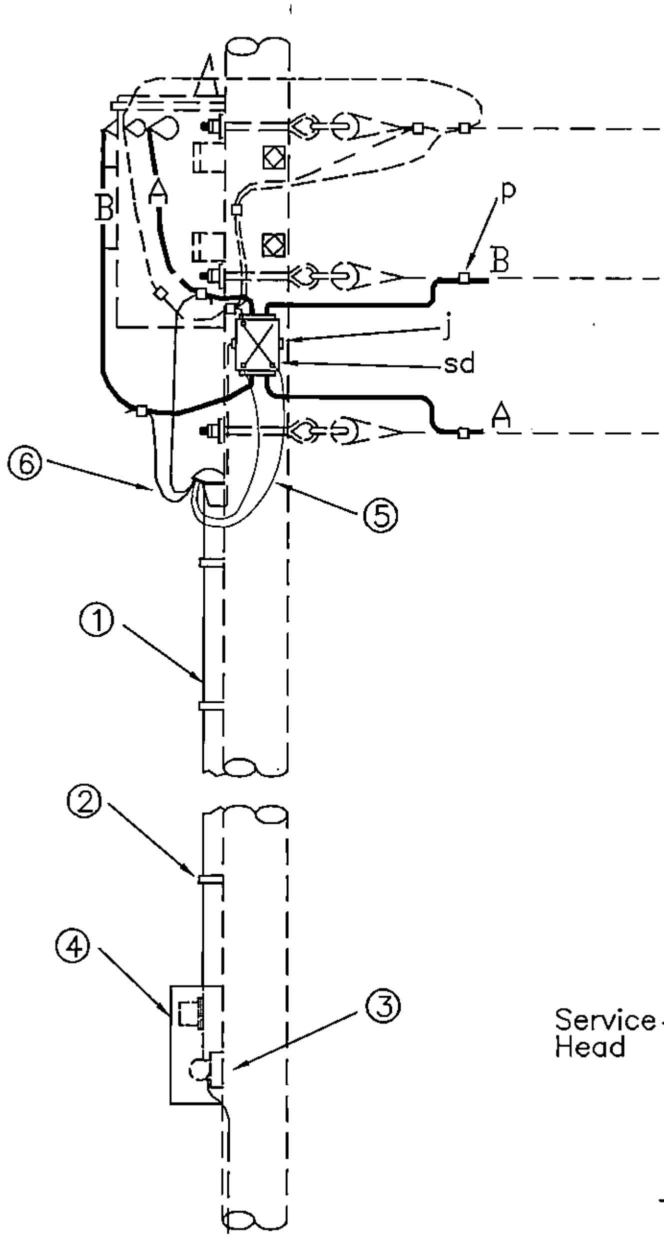
Notes: 1. Specify Insulated Transformer covers (lids); Minimum Dielectric Strength 15kV
2. Install bushing covers (rp) on all surge arresters and transformer bushings.

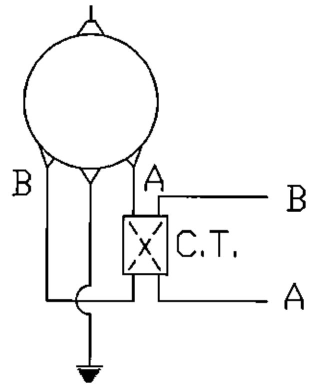
DESIGN PARAMETERS:	RAPTOR PROTECTION ASSEMBLY GUIDE THREE–PHASE TRANSFORMER BANK		
See Assembly "G3.3"	APRIL 2005	3 – PHASE PRIMARY	
	RUS	12.47/7.2 kV	P3.5G

INDEX Q

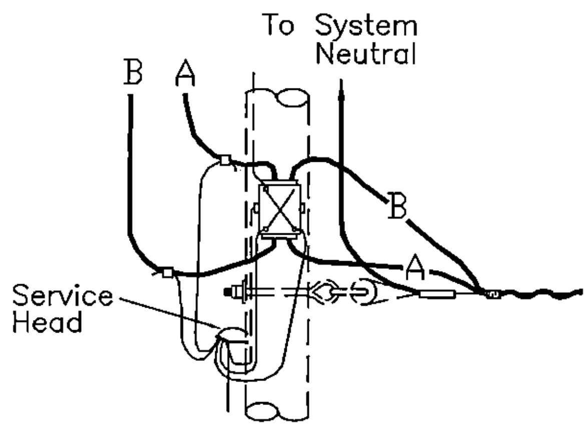
METERING ASSEMBLY UNITS

DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804 (New)	**Bulletin 50-3** (Old)	
Q1.1	(M8)	SECONDARY METERING - SINGLE-PHASE, 120/240 VOLTS
Q2.1G	(M8-10)	POLE TYPE SERVICE ASSEMBLY GUIDE
Q2.2G	(M8-9)	YARD POLE METER INSTALLATION GUIDE
Q3.1	(M8-6)	SECONDARY METERING - THREE-PHASE, 120/240 VOLTS (4 WIRE DELTA)
Q3.2	(M8-12)	SECONDARY METERING - THREE-PHASE, 240 OR 480 VOLTS (3 WIRE CORNER GROUNDED DELTA)
Q3.3	(M8-11)	SECONDARY METERING - THREE-PHASE, 120/208 VOLTS (4 WIRE GROUNDED WYE)
Q4.1	(M8-15)	PRIMARY METERING, THREE-PHASE (4 WIRE GROUNDED WYE)





WIRING DIAGRAM



TRIPLEX SERVICE

NOTE: Customer owned, installed and maintained equipment, including "point of attachment" shall be located a minum of 5 feet away from this assembly.

ITEM	QTY	MATERIAL
j	2	Screw, lag, 1/2" x 4"
p		Connectors, as required
sd	1	Transformer, Current
①		Conduit, 1 1/4" as required
②		Straps, conduit, as required
③	1	Condulet, type LB
④	1	Meter box, meter and test block
⑤		Wire, No. 12, insulation for current
⑥		Wire, No. 14, insulation for potential

SECONDARY METERING
SINGLE PHASE, 120/240 VOLTS

APRIL 2005

RUS

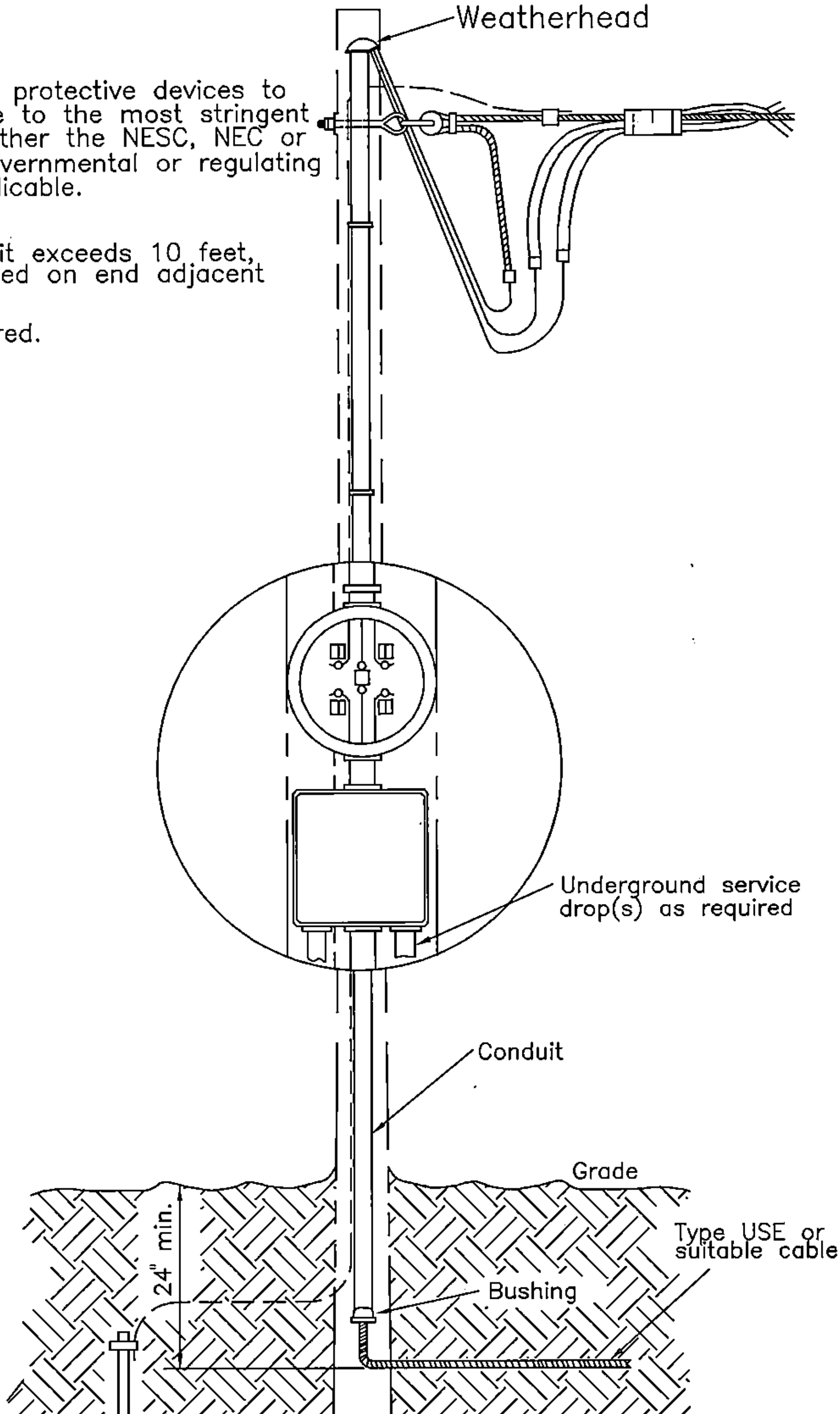
Q1.1
(M8)

NOTES:

1. All Clearances and protective devices to be in conformance to the most stringent requirements of either the NESC, NEC or other codes of governmental or regulating authorities as applicable.

2. If length of conduit exceeds 10 feet, coupling is permitted on end adjacent to meter.

3. Guy pole as required.



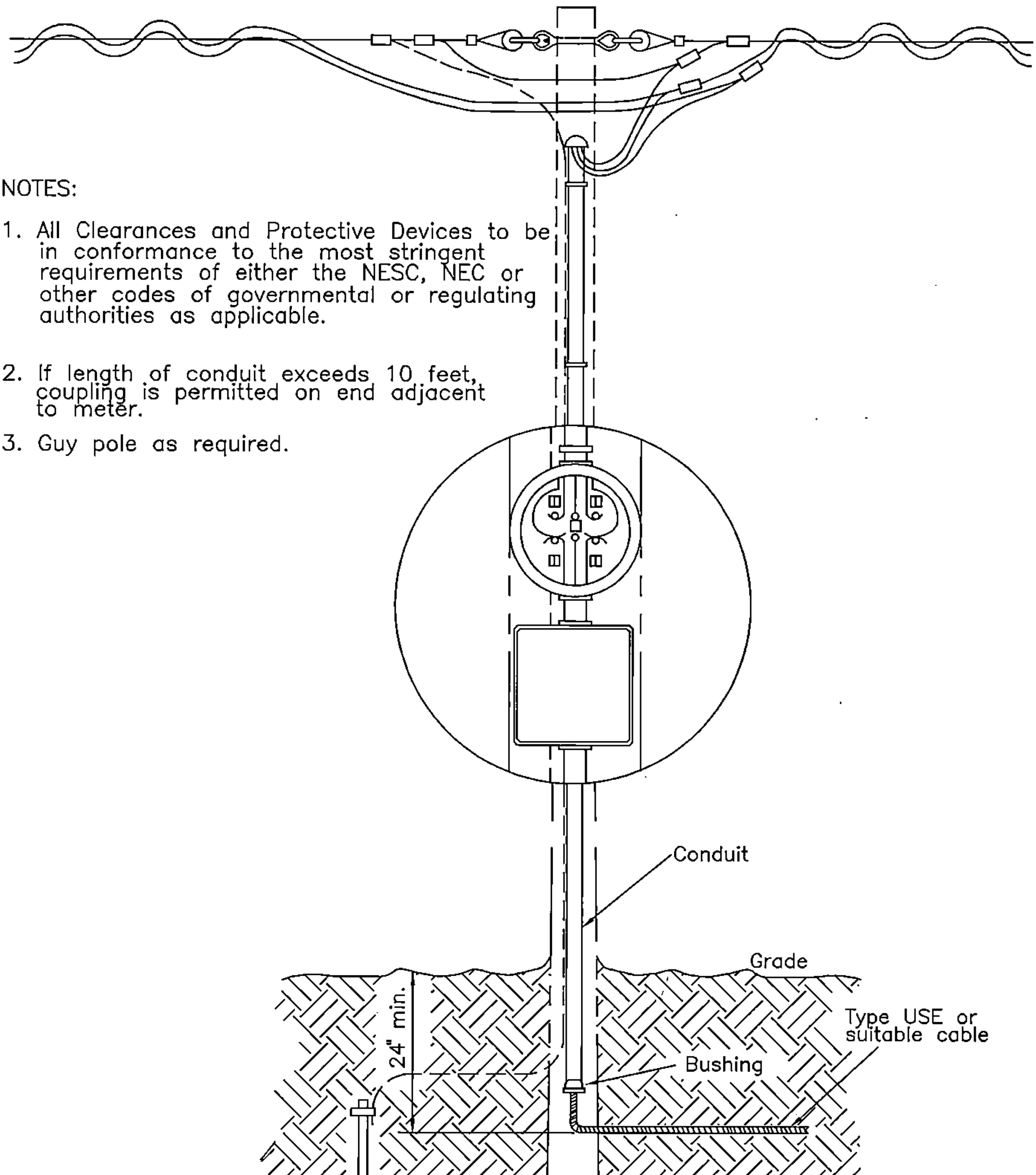
DESIGN PARAMETERS: (See NOTE 1)	POLE TYPE SERVICE ASSEMBLY GUIDE		
	APRIL 2005		Q2.1G
	RUS		(M8-10)

NOTES:

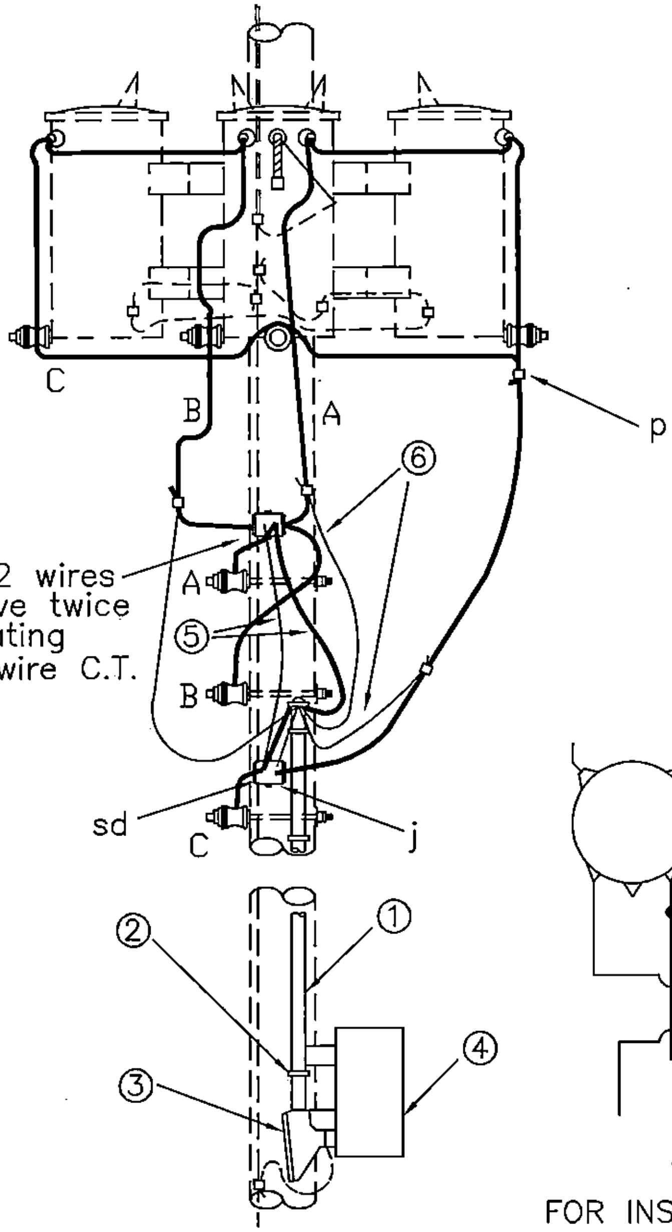
1. All Clearances and Protective Devices to be in conformance to the most stringent requirements of either the NESC, NEC or other codes of governmental or regulating authorities as applicable.

2. If length of conduit exceeds 10 feet, coupling is permitted on end adjacent to meter.

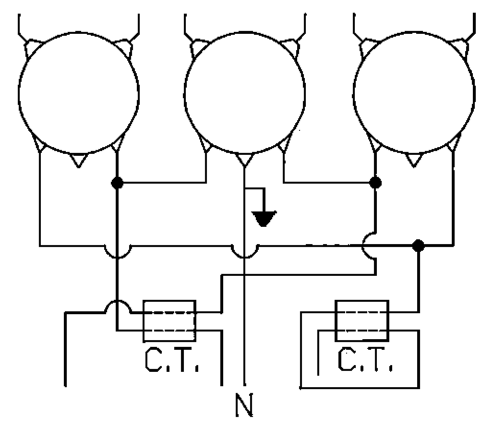
3. Guy pole as required.



DESIGN PARAMETERS: (See NOTE I)	YARD POLE METER INSTALLATION GUIDE	
	APRIL 2005 / RUS	Q2.2G (M8–9)



Note:
C.T. with 2 wires should have twice primary rating of single wire C.T.



WIRING DIAGRAM
FOR INSTRUMENT TRANSFORMERS

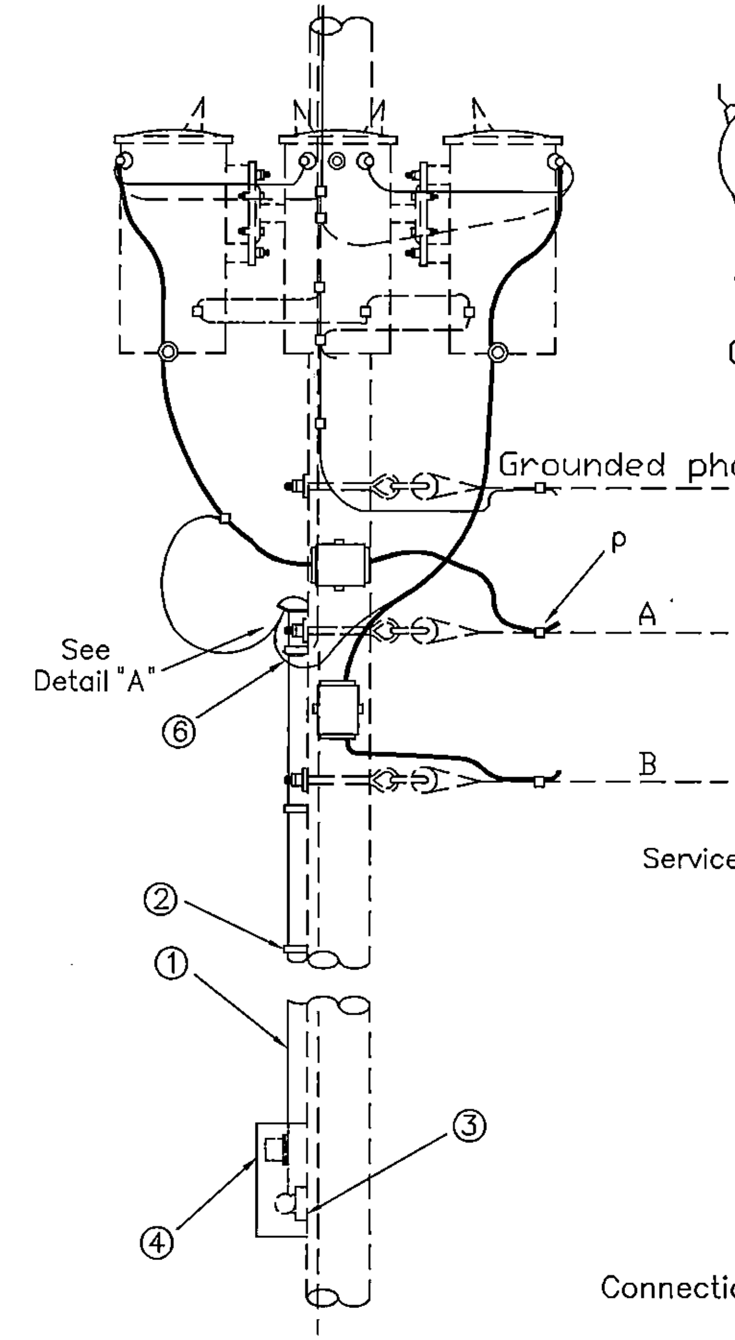
NOTE: Customer owned, installed and maintained equipment, including "point of attachment" shall be located a minum of 5 feet away from this assembly.

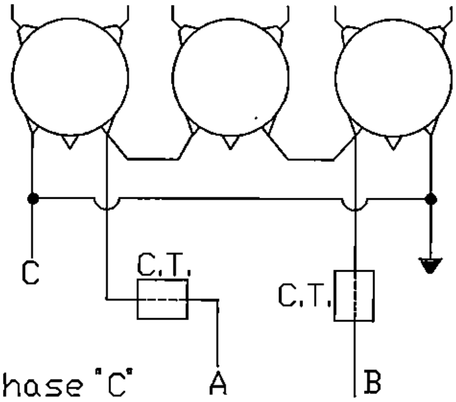
ITEM	QTY	MATERIAL
j	4	Screw, lag, 1/2" x 4"
p		Connectors, as required
sd	2	Transformer, Current
①		Conduit, 1 1/4" as required
②		Straps, conduit, as required

ITEM	QTY	MATERIAL
③	1	Condulet, type "LB"
④	1	Meter box, meter and test block
⑤		Wire, No. 12, insulation for current
⑥		Wire, No. 14, insulation for potential

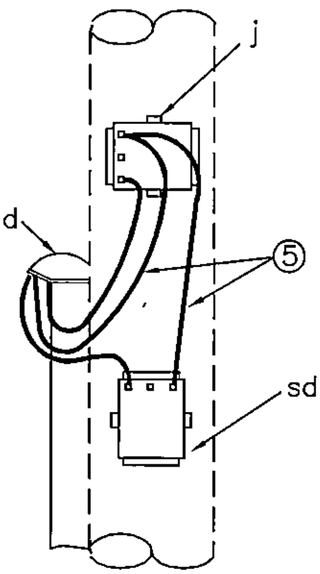
SECONDARY METERING
THREE PHASE, 120/240 VOLTS
(4 WIRE DELTA)

APRIL 2005		Q3.1
RUS		(M8-6)





WIRING DIAGRAM



DETAIL "A"
Connections from C.T.'s to Service Head

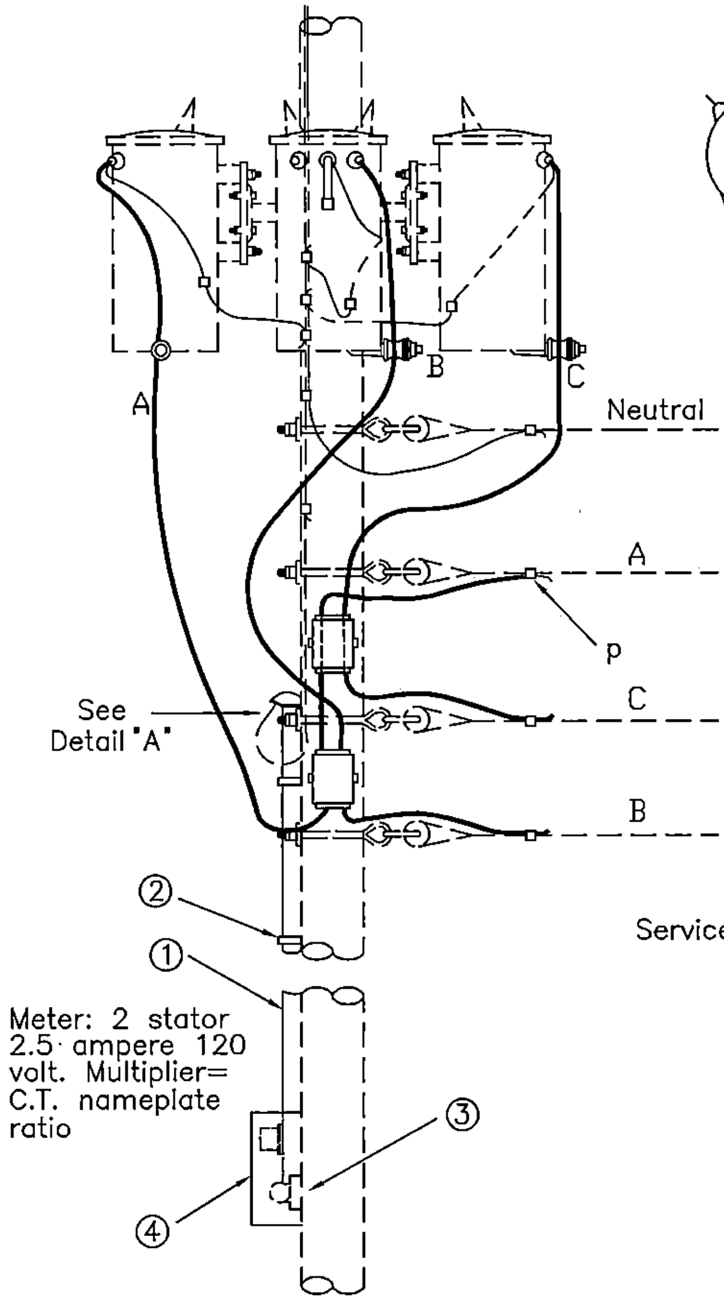
NOTES: PT metering is recommended for 480 volt service.
Customer owned, installed and maintained equipment, including "point of attachment" shall be located a minimum of 5 feet away from this assembly.

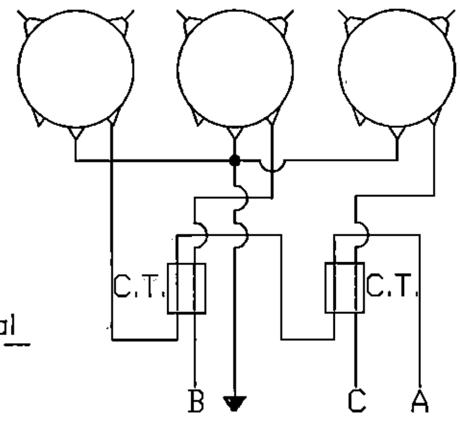
ITEM	QTY	MATERIAL
j	4	Screw, lag, 1/2" x 4"
p		Connectors, as required
sd	2	Transformer, Current
①	.	Conduit, 1 1/4" as required
②		Straps, conduit, as required

ITEM	QTY	MATERIAL
③	1	Condulet, type "LB"
④	1	Meter box, meter and test block
⑤		Wire, No. 12, insulation for current
⑥		Wire, No. 14, insulation for potential

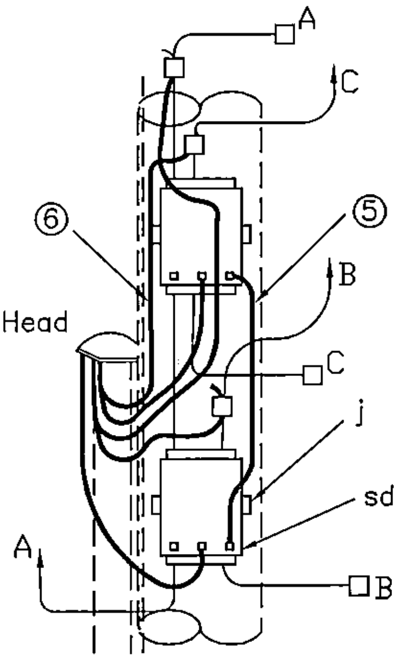
SECONDARY METERING THREE PHASE, 240 or 480 VOLTS (3 WIRE CORNER GROUNDED DELTA)

APRIL 2005		Q3.2
RUS		(M8–12)





WIRING DIAGRAM



DETAIL "A"
Connections from C.T.'s to Service Head

NOTES: Ground current transformers as required (not shown)
Customer owned, installed and maintained equipment, including "point of attachment" shall be located a minimum of 5 feet away from this assembly.

ITEM	QTY	MATERIAL
j	4	Screw, lag, 1/2" x 4"
p		Connectors, as required
sd	2	Transformer, Current
①		Conduit, 1 1/4" as required
②		Straps, conduit, as required

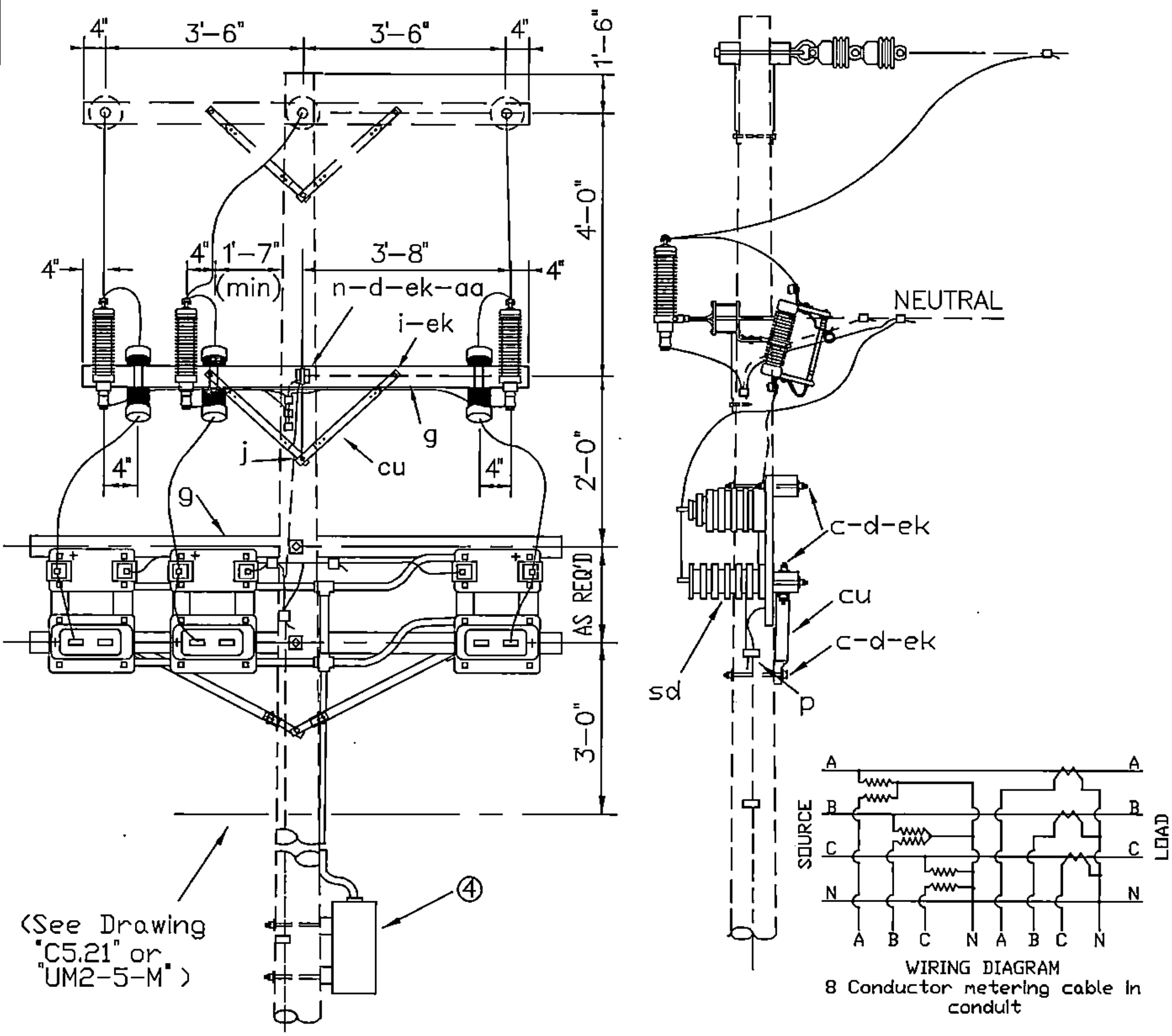
ITEM	QTY	MATERIAL
③	1	Condulet, type "LB"
④	1	Meter box, meter and test block
⑤		Wire, No. 12, insulation for current
⑥		Wire, No. 14, insulation for potential

SECONDARY METERING
THREE PHASE, 120/208 VOLTS
(4 WIRE GROUNDED WYE)

APRIL 2005

RUS

Q3.3
(M8–11)



WIRING DIAGRAM
8 Conductor metering cable in conduit

ITEM	QTY	MATERIAL
c	5	Bolt, machine, 5/8"x req'd length
c	26	Bolt, machine, 1/2"x req'd length
d	33	Washer, 2 1/4" square
d	2	Washer, round, 1 3/8" dia.
g	1	Crossarm, 3 5/8"x 4 5/8"x 8'-0"
g	2	Crossarm, 3 5/8"x 4 5/8"x 10'-0"
i	2	Bolt, carriage, 3/8"x 4 1/2"
j	1	Screw, lag, 1/2"x 4"
n	1	Bolt,double arming,5/8"x req'd length
p		Connectors, as required
aa	1	Nut, eye, 5/8"
av		Jumper, primary, bare, as required

ITEM	QTY	MATERIAL
ae	3	Arrester, surge (9 kV)
af	3	Cutout, dist. open (15 kV)
cu	2	Brace, 28"
cu	1	Brace, wood, 60" span
④		Meter box, meter on test block
		Condulets, as required
sd	3	Transformer, current
se	3	Transformer, potential
ek	34	Locknuts
*	6	Mounting brackets
		Metering cable, as req'd

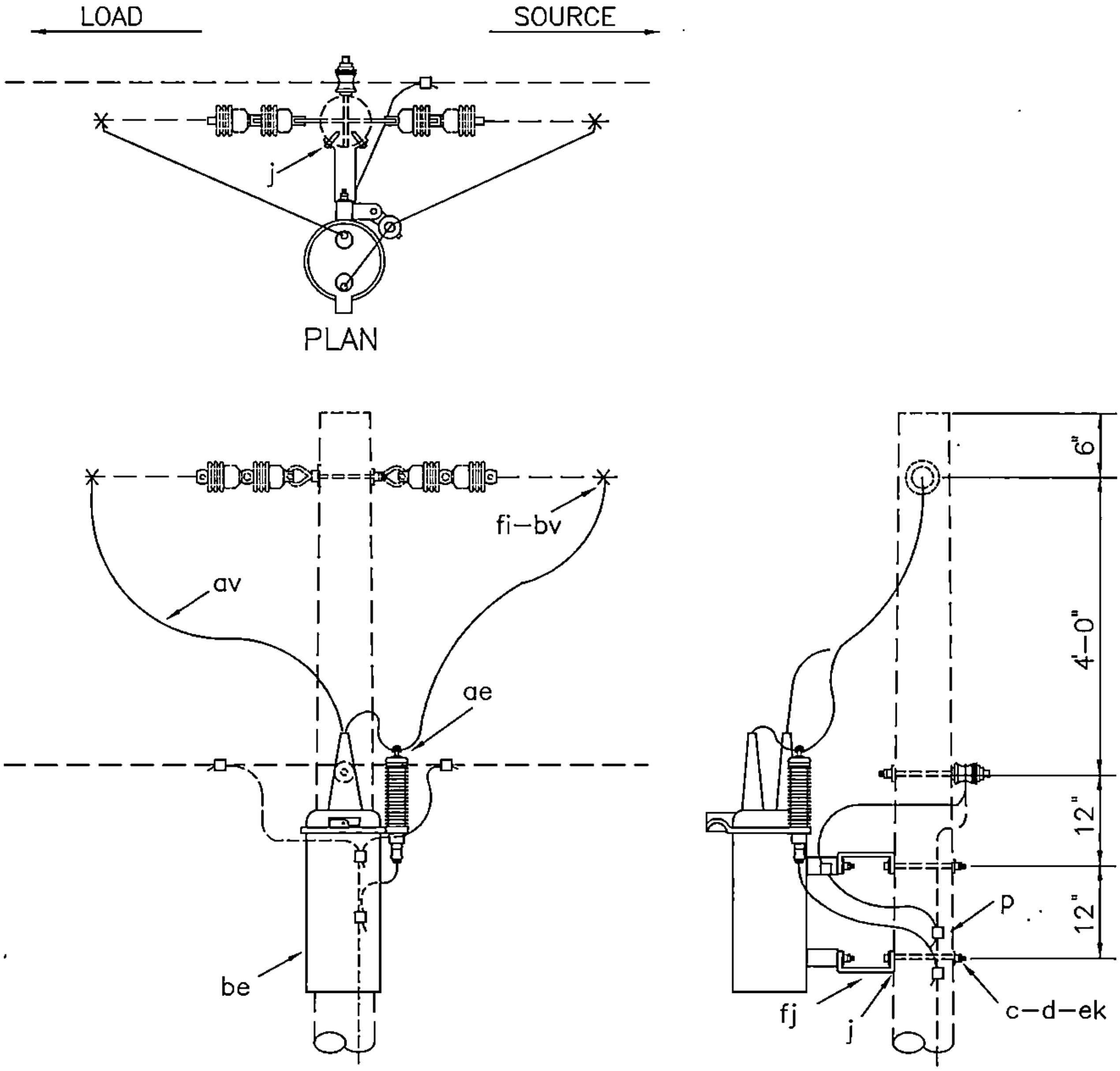
*Specify this item to be furnished by the transformer manufacturer.

PRIMARY METERING THREE PHASE (4 WIRE GROUNDED WYE)

APRIL 2005		Q4.1
RUS	12.47/7.2 kV	(M8-15)

OIL CIRCUIT RECLOSER ASSEMBLY UNITS

DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804 (New)	**Bulletin 50-3** (Old)	
R1.1	(M3-10)	OIL CIRCUIT RECLOSER
R1.2	(M3-23A)	OIL CIRCUIT RECLOSER - (WITH BYPASS CUTOUT)
R2.1 R3.1	(M3-11A) (M3-12A)	(THREE) OIL CIRCUIT RECLOSERS
R2.2 R3.2	(M3-24A) (M3-25A)	(THREE) OIL CIRCUIT RECLOSERS (WITH BYPASS SWITCHES)
R3.3	(M3-30)	THREE-PHASE OIL CIRCUIT RECLOSER WITH BY-PASS SWITCHES



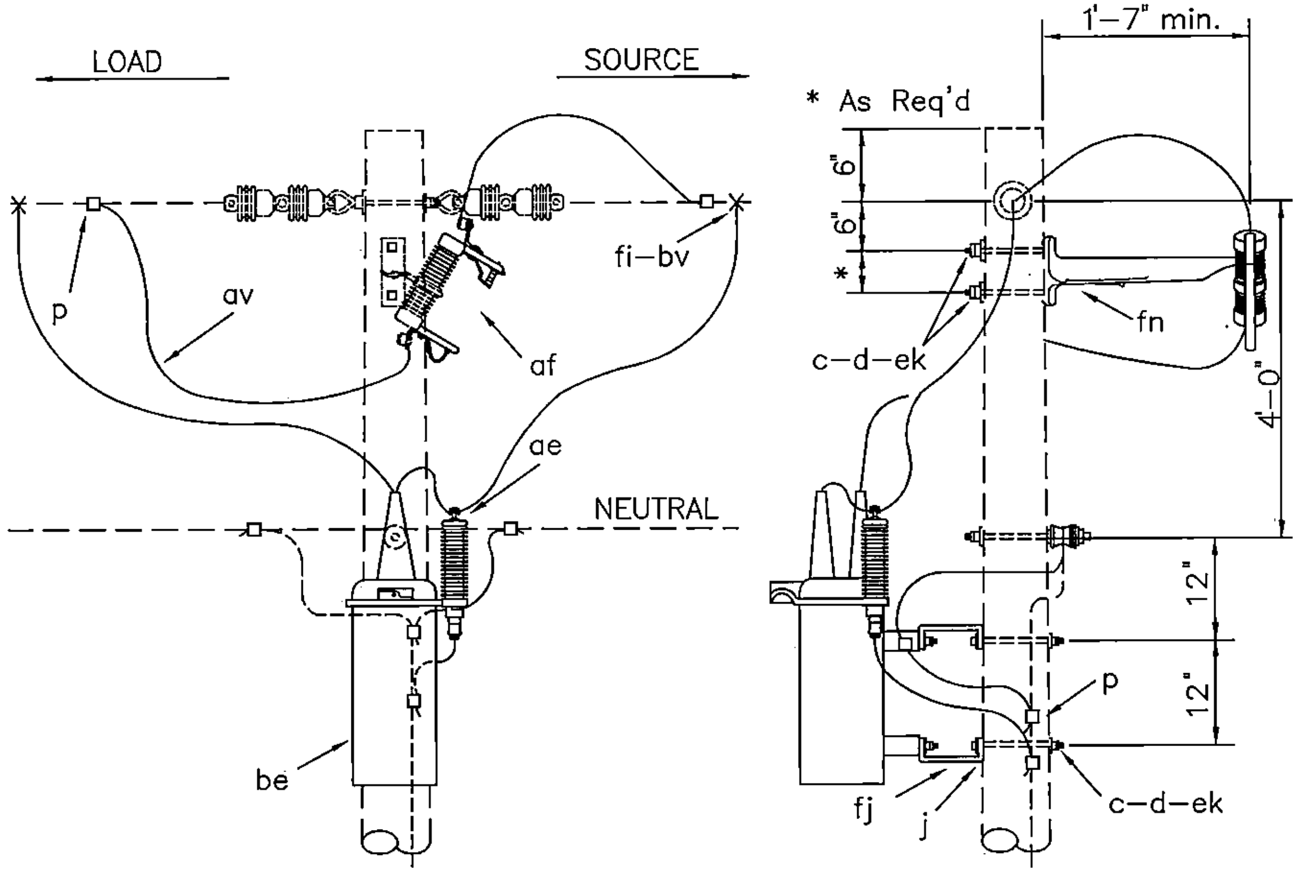
NOTE: The recloser terminal bushing connected to the coil should be connected to the source.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
j	4	Screw, lag, 1/2" x 4"
p		Connector, as required
ae	1	Arrester, surge (9 kV)
av		Jumpers, stranded, as required

ITEM	QTY	MATERIAL
be	1	Recloser, oil circuit (12.47 kV)
bv		Rod, armor, as req'd
ek	2	Locknuts
fi	2	Connector, hot line
fj	2	Brackets, extension, 9" long

OIL CIRCUIT RECLOSER

APRIL 2005	1 – PHASE PRIMARY	R1.1
RUS	12.47/7.2 kV	(M3–10)



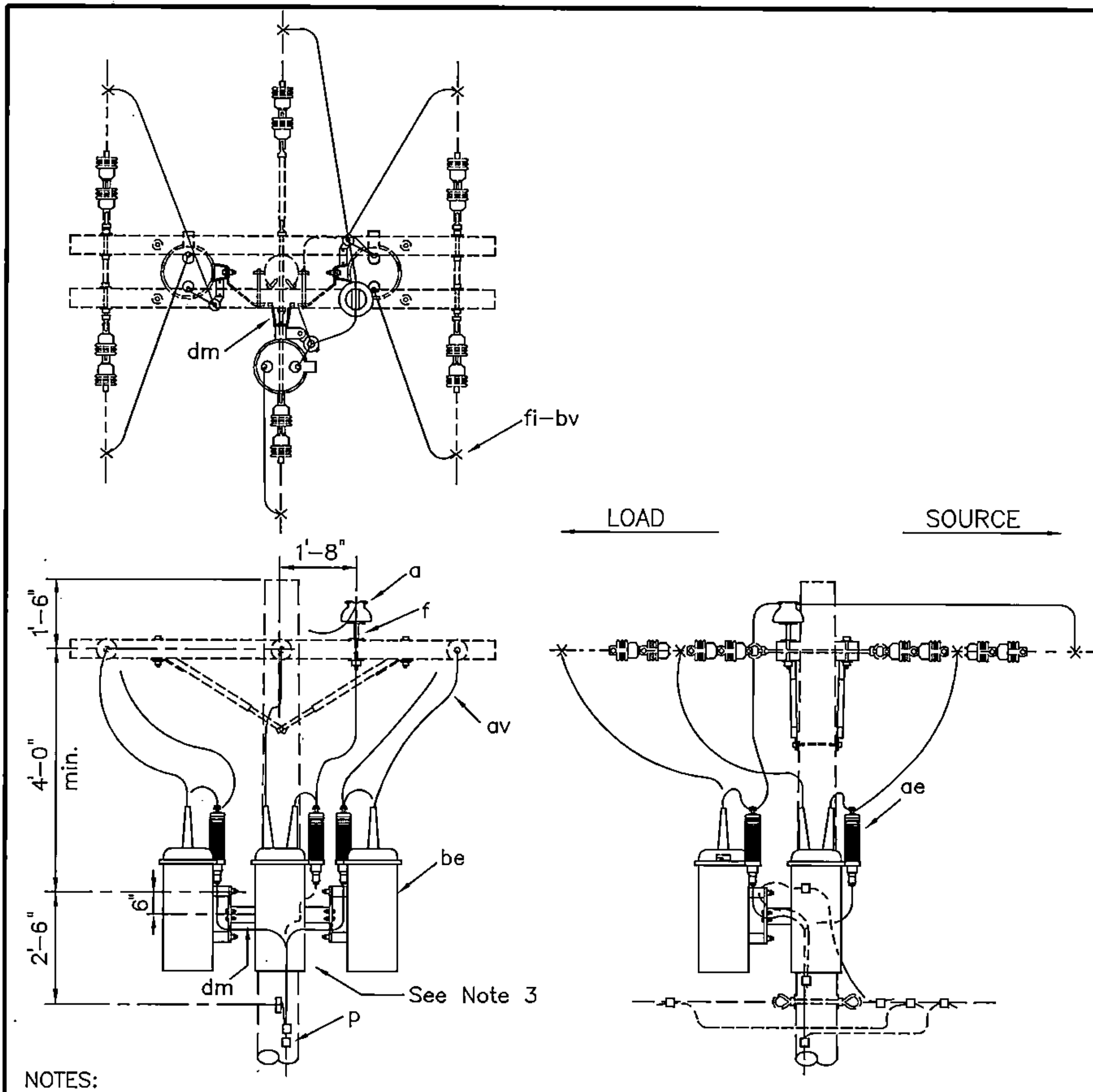
NOTE: The recloser terminal bushing connected to the coil should be connected to the source.

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
j	4	Screw, lag, 1/2" x 4"
p		Connector, as required
ae	1	Arrester, surge (9 kV)
af	1	Cutout, distribution, open (15 kV)
av		Jumpers, stranded, as required

ITEM	QTY	MATERIAL
be	1	Recloser, oil circuit (12.47 kV)
bv		Rod, armor, as req'd
ek	4	Locknuts
fi	2	Connector, hot line
fj	2	Brackets, extension, 9" long
fn	1	Bracket, extension

OIL CIRCUIT RECLOSER
(WITH BYPASS CUTOUT)

APRIL 2005	1 — PHASE PRIMARY	R1.2
RUS	12.47/7.2 kV	(M3—23A)



NOTES:

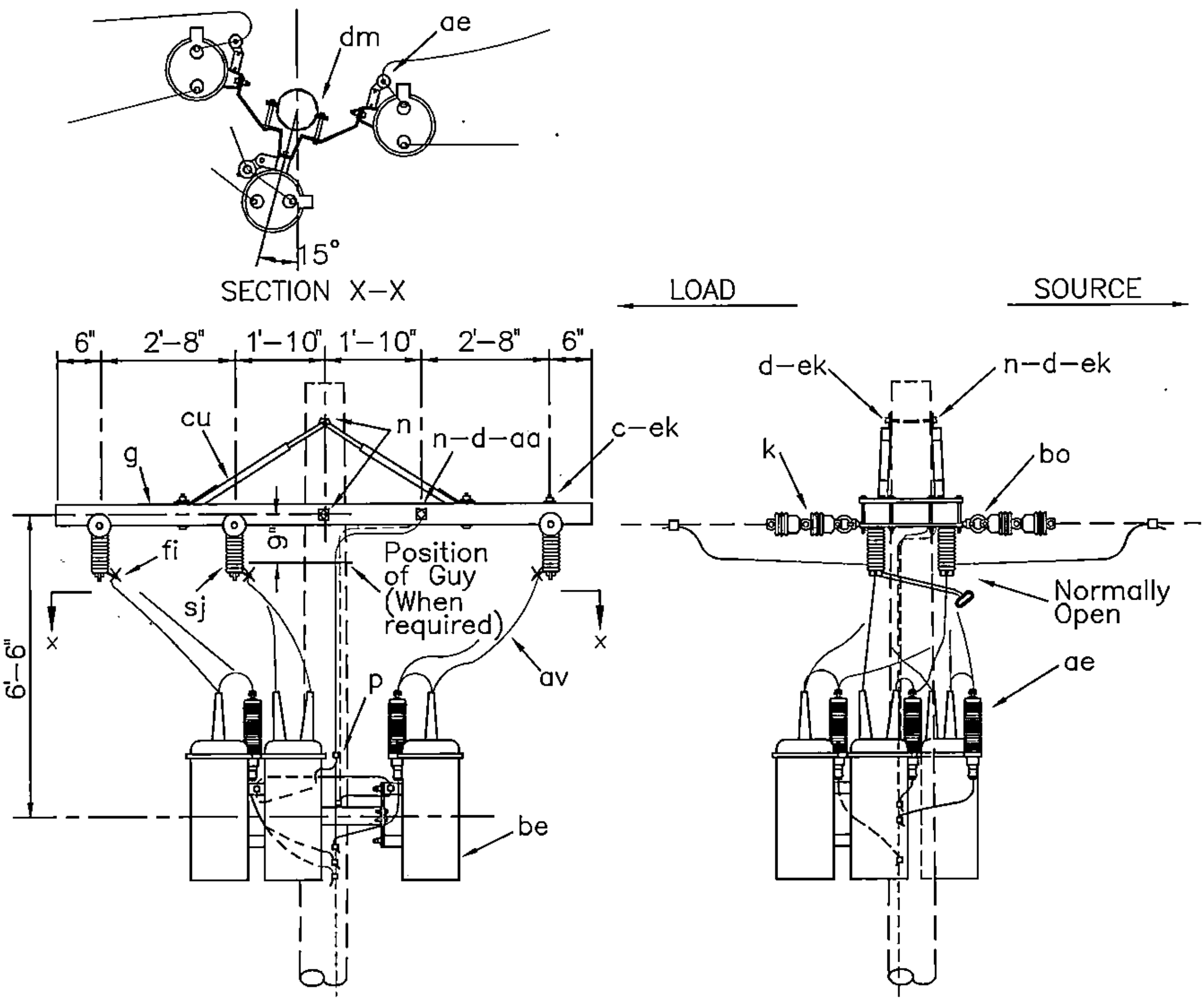
1. The recloser terminal bushing connected directly to the coil should be connected to the source.
2. For 2–phase installations, omit recloser and related items on center phase and designate as R2.1.
3. Each recloser tank shall have two connections to ground.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
a	1	Insulator, pin type, (12.47/7.2 kV)
f	1	Pin, crossarm, steel, 5/8" x 10 3/4"
p		Connector, as required
ae	3	Arrester, surge (9 kV)
av		Jumpers, stranded, as required

ITEM	QTY	MATERIAL
be	3	Recloser, oil circuit (12.47 kV)
bv	6	Rod, armor, as req'd
ek	2	Locknuts
fi	6	Connector, hot line
dm	1	Bracket, cluster type, with 14" adapter plate

(THREE) OIL CIRCUIT RECLOSERS

APRIL 2005 RUS	3 – PHASE PRIMARY 12.47/7.2 kV	R2.1,R3.1 (M3–11A),(M3–12A)



NOTES:

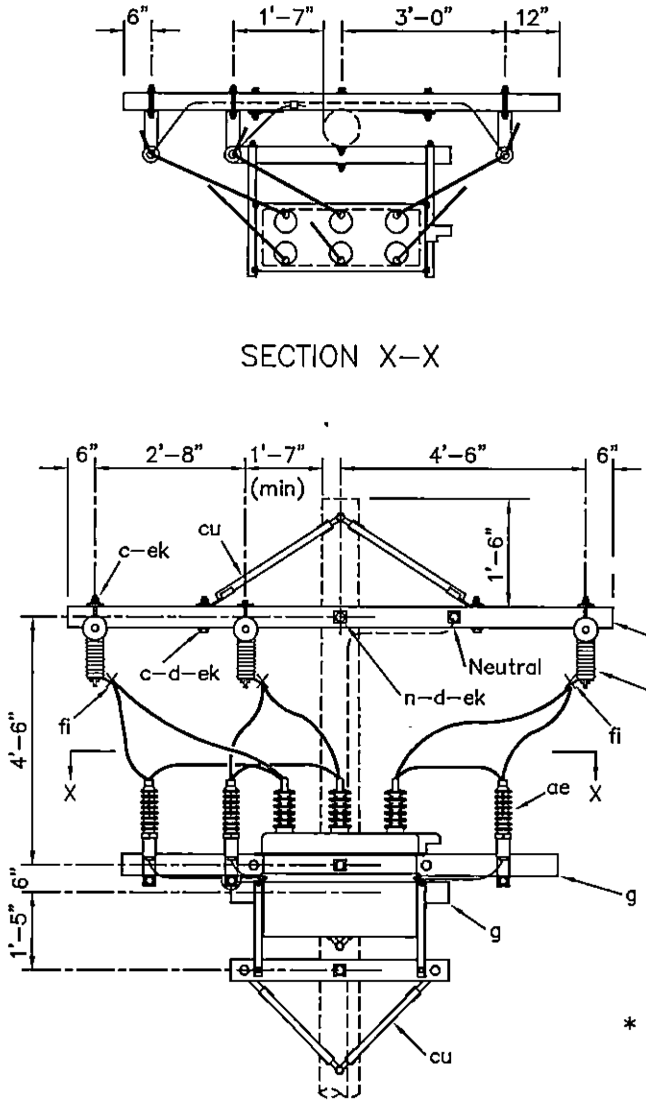
1. The recloser terminal bushing connected directly to the coil should be connected to the source.
2. For 2-phase installations, omit recloser and related items on center phase and designate as "R2.2."
3. Each recloser tank shall have two connections to ground.

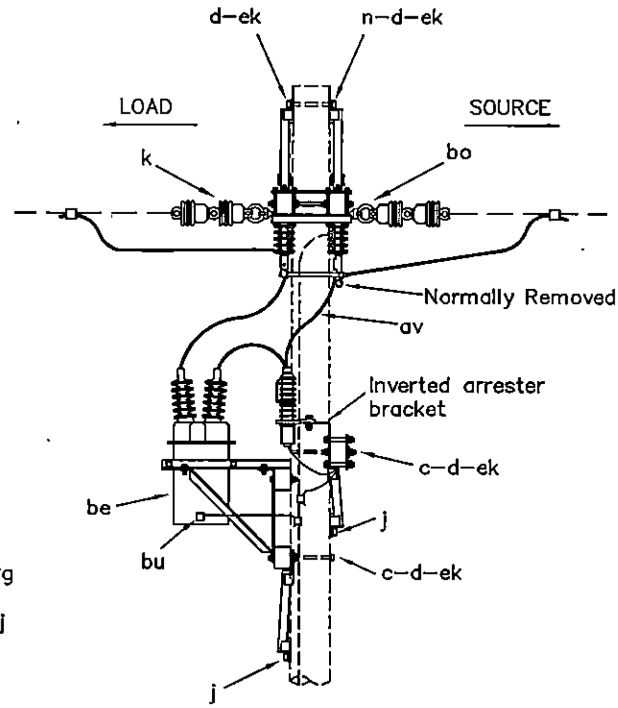
ITEM	QTY	MATERIAL
c	4	Bolt, machine, 1/2" x req'd length
c	14	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	10	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
k	12	Insulator, suspension, 4 1/4"
n	3	Bolt, double arm, 5/8" x req'd length
p		Connectors, as required
aa	2	Nut, eye, 5/8"
ae	3	Arresters, surge, (9 kV)

ITEM	QTY	MATERIAL
av		Jumpers, stranded, as req'd
be	3	Recloser, oil circuit (12.47 kV)
bo	6	Shackle, anchor
cu	2	Brace, wood, 60" span
dm	1	Bracket, cluster type with 14" adapter
		plate
ek	28	Locknuts
fi	6	Connector, hot line
sj	3	Switch, OCR, by-pass, (15 kV)

(THREE) OIL CIRCUIT RECLOSERS
(WITH BYPASS SWITCHES)

APRIL 2005	3 - PHASE PRIMARY	R2.2,R3.2
RUS	12.47/7.2 kV	(M3-24A),(M3-25A)





* Specify this item to be furnished by recloser manufacturer.

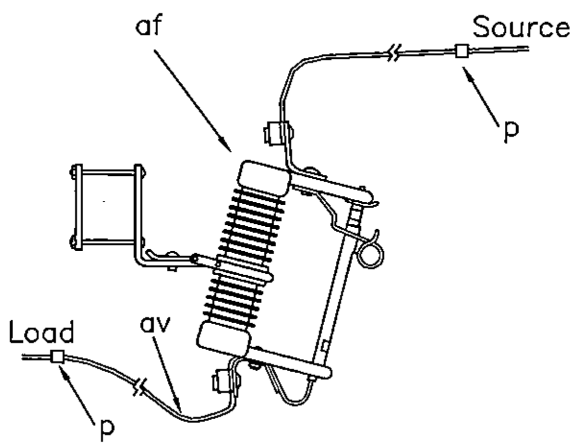
ITEM	NO.	MATERIAL	ITEM	NO.	MATERIAL
c	3	Bolt, machine, 5/8"x req'd length	aa	2	Nut, eye, 5/8"
c	4	Bolt, machine, 1/2"x req'd length	ae	3	Surge arrester
d	12	Washer, sq. 2-1/4"x 3/16", 13/16"hole	av	–	Jumpers, stranded, as req'd
d	4	Washer, rd. 1-3/8" dia., 9/16" hole	be	1	Recloser, oil circuit – 3 phase
g	2	Crossarm, 3-5/8"x 4-5/8"x 10'-0"	*	1	Mounting bracket for 3 phase recloser
g	1	Crossarm, 3-5/8"x 4-5/8"x 8'-0"	bo	6	Shackle, anchor
g	2	Crossarm, 3-5/8"x 4-5/8"x 4'-0"	bu	1	Connector, solderless
j	2	Screw, lag, 5/8"x req'd length	cu	2	Brace, crossarm, wood, 60" span
k	12	Insulator, suspension	cu	4	Brace, crossarm, wood, 28"
l	6	Clamp, deadend	ek	–	Locknuts, as req'd
n	3	Bolt, double arming, 5/8"x req'd length	fi	6	Connector, hot line
p	–	Connectors, as req'd	sj	3	Switch, recloser by-pass

THREE-PHASE OIL CIRCUIT RECLOSER WITH BY-PASS SWITCHES

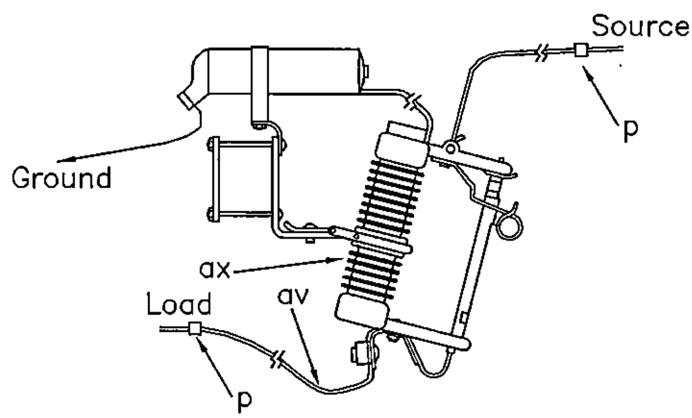
APRIL 2005	3 – PHASE PRIMARY	R3.3
RUS	12.47/7.2 kV	(M3-30)

SECTIONALIZING ASSEMBLY UNITS

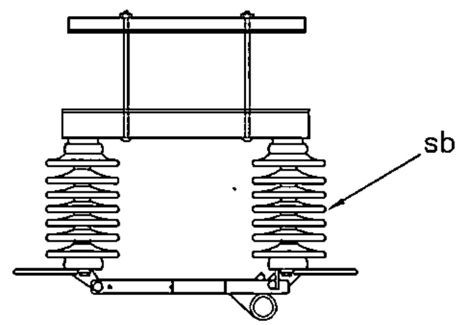
DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
S1.01 S1.02 S2.01	(M5-9) (M5-10)	MISCELLANEOUS CUTOUTS AND DISCONNECT SWITCH
S1.1	(M3-4)	CUTOUT - SINGLE PHASE
S1.1N		CUTOUT GUIDE - NARROW PROFILE
S1.3		COUTOUTS - (THREE SINGLE-PHASE)
S2.3	(M3-3B)	LINE TENSION SWITCHES – (THREE SINGLE-PHASE)
S2.21 S2.31	(M3-2A) (M3-3A)	DISCONNECT SWITCHES - (TWO OR THREE SINGLE-PHASE)
S2.32	(M3-15)	GROUP-OPERATED AIRBREAK SWITCH - (THREE-PHASE)
S3.1	(M3-41)	SECTIONALIZER
S3.2		SECTIONALIZER (WITH BYPASS CUTOUT)



S1.01



S1.02



S2.01

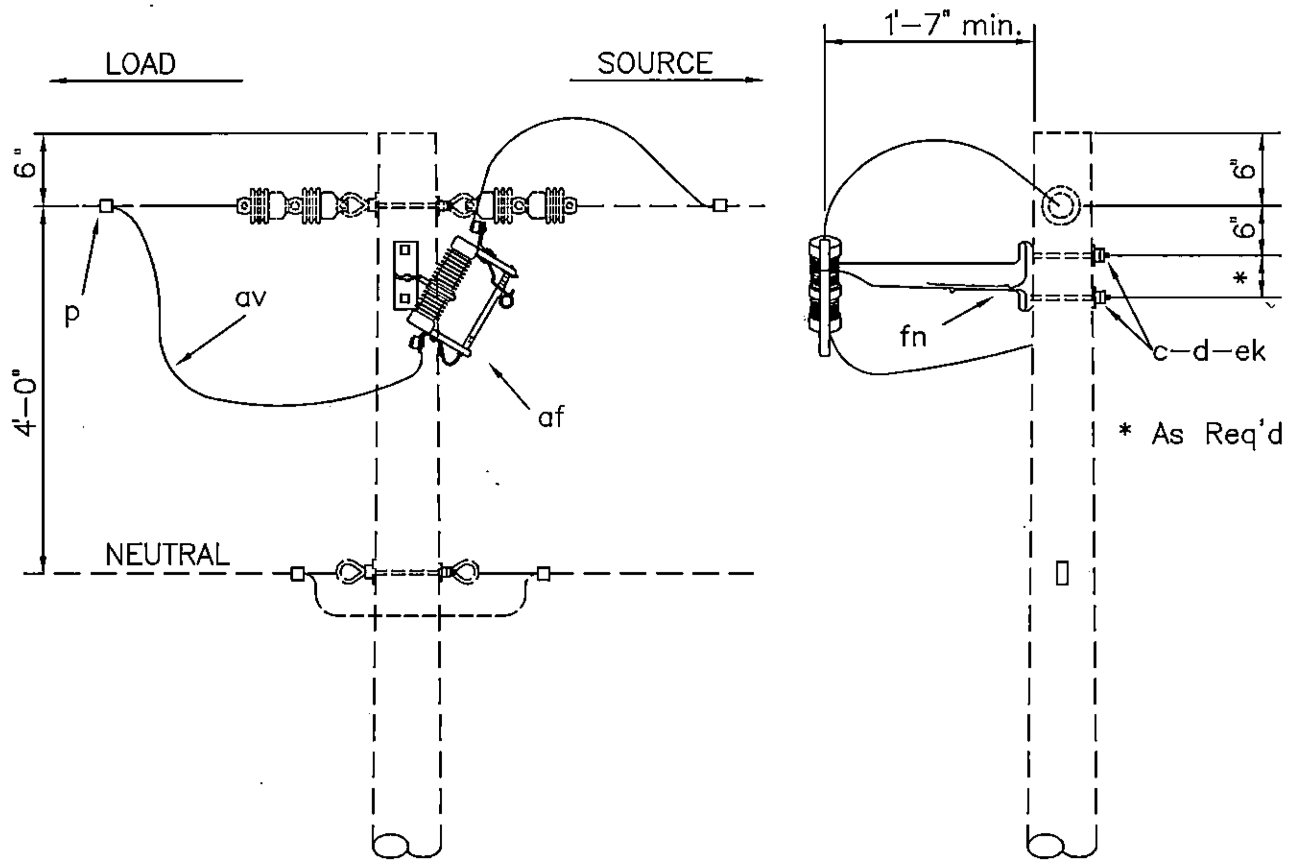
NOTES: Specify cutouts to be furnished with fuse tube or switch blade.

"S2.01" may be used with assembly "C6.21" (mount braces above crossarm). See "S2.32".

	ASSEMBLY: S	1.01	1.02	2.01
ITEM	MATERIAL	QTY	QTY	QTY
p	Connector, as req'd			
af	Cutout, dist., open (15 kV)	1		
ax	Cutout, & Arrester Comb. (9 kV)		1	
av	Jumpers, as req'd			
sb	Switch, disconnect (15 kV)			1

MISCELLANEOUS CUTOUTS AND DISCONNECT SWITCH

APRIL 2005		S1.01,S1.02,S2.01
RUS	12.47/7.2 kV	(M5–9),(M5–10)

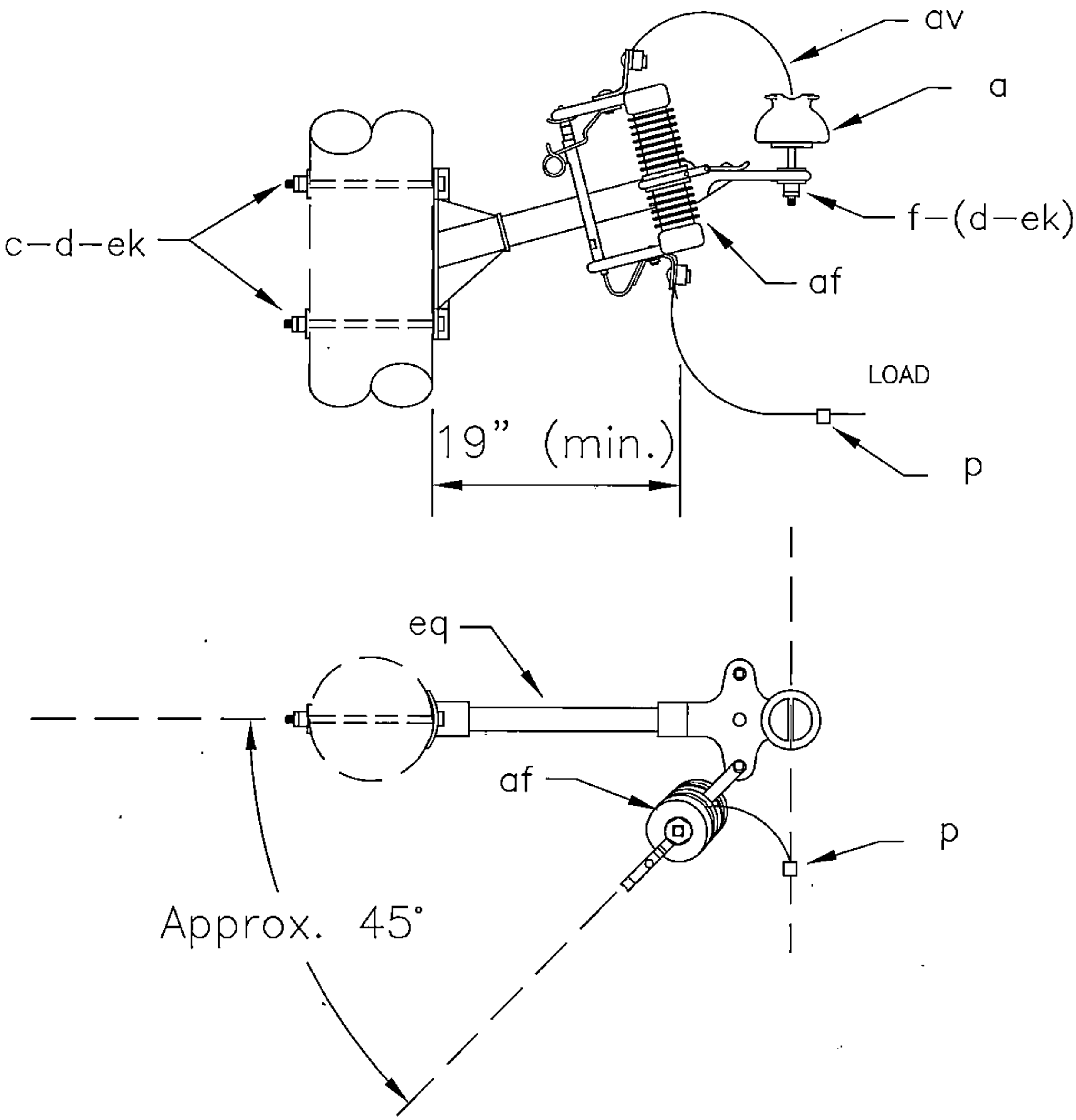


NOTE: Specify fuse size or solid blade

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
p	2	Connector, compression type
af	1	Cutout, distribution, open (15 kV)
av		Jumpers, as required
ek	2	Locknuts
fn	1	Bracket, extension

CUTOUT – SINGLE PHASE

APRIL 2005		S1.1
RUS	12.47/7.2 kV	(M3–4)



ITEM	MATERIAL	QTY
a	Insulator, pin type (12.47/7.2 kV)	1
c	Bolt, machine, 5/8" x req'd length	2
d	Washer, square 2 1/4"	2
f	Pin, crossarm, 5/8" x 6 1/2"	1
af	Cutout, distribution, open (15kV)	1
av	Jumpers, as required	
ek	Locknuts	2
eq	Bracket, insulator/equipment	1

NOTE: Also see "A5.4NG".

Design Parameters:

Maximum Line Angles:
See Table II

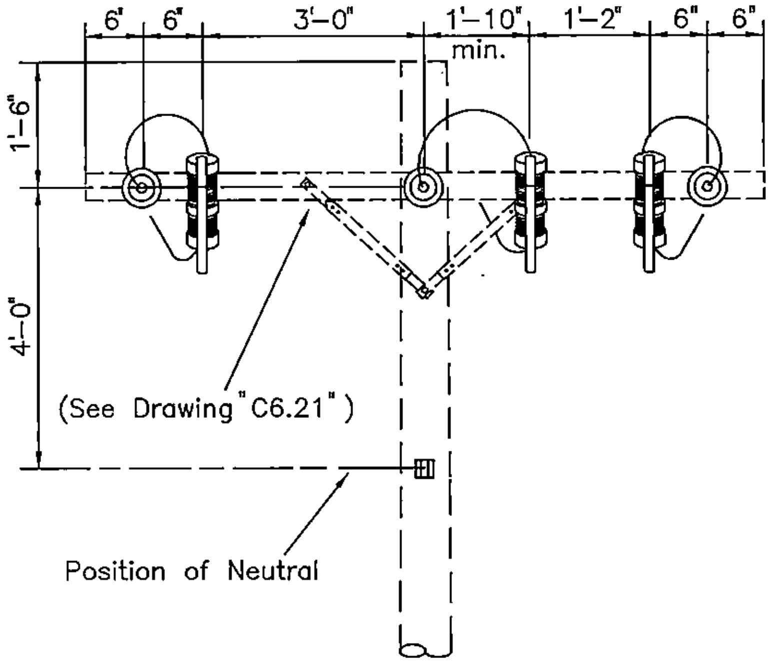
CUTOUT–NARROW PROFILE

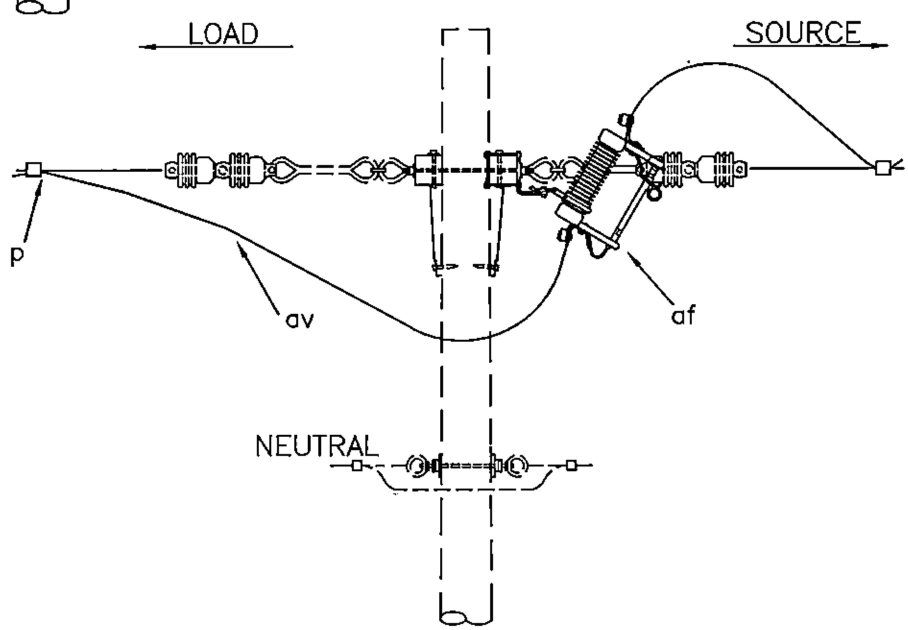
APRIL 2005

RUS

1 – PHASE PRIMARY
12.47/7.2 kV

S1.1N



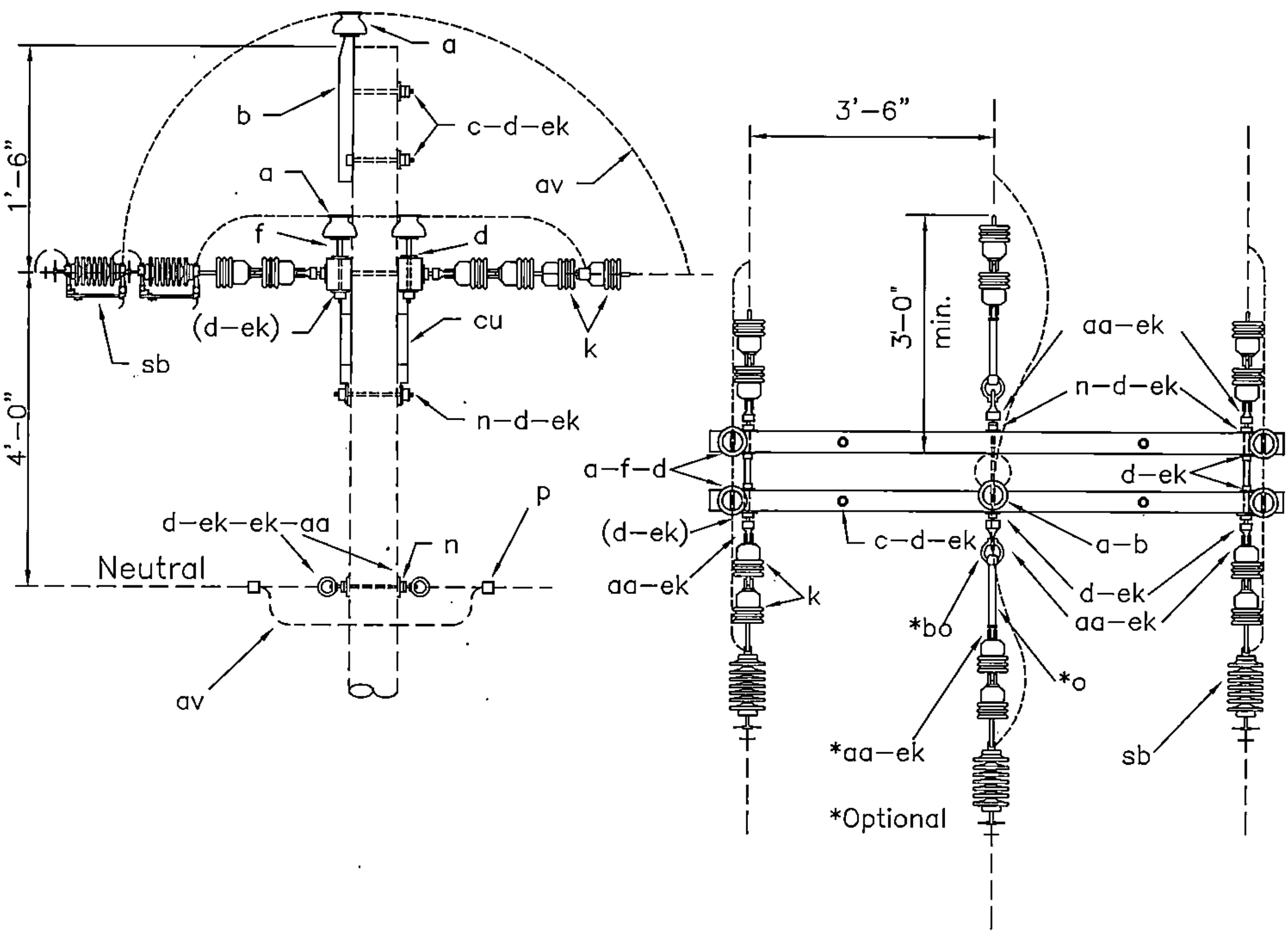


NOTES:
1. Specify fuse size or solid blade.
2. Mount cutouts so that blades face climbing face of pole.

ITEM	QTY	MATERIAL
p	6	Connector, compression type
af	3	Cutout, distribution open (15 kV)
av		Jumpers, as req'd

CUTOUTS
(THREE SINGLE-PHASE)

APRIL 2005		
RUS	12.47/7.2 kV	S1.3



NOTE:
See Assembly C6.21 for additional details.

ITEM	QTY	MATERIAL	ITEM	QTY	MATERIAL
a	5	Insulator, pin type	o	2	Bolt, eye, 5/8"x req'd length
b	1	Pin, pole top, 20"	p		Connectors, as required
c	4	Bolt, machine, 1/2" x req'd length	aa	10	Nut, eye, 5/8"
c	2	Bolt, machine, 5/8" x req'd length	av		Jumpers and leads as req'd
d	20	Washer, square, 2 1/4"	bo	2	Shackle, anchor
d	4	Washer, round, 1 3/8"	cu	2	Brace, wood, 60" span
f	4	Pin, crossarm, steel, 5/8"x10 3/4"	ek	30	Locknuts
g	2	Crossarm, 3 5/8"x4 5/8"x8'–0"	sb	3	Switch, line tension
k	12	Insulators, suspension			
n	5	Bolt,double arming,5/8"x req'd length			

DESIGN PARAMETERS:

PERMITTED UNBALANCED
CONDUCTOR TENSION:

See Table A (Exhibit 2)

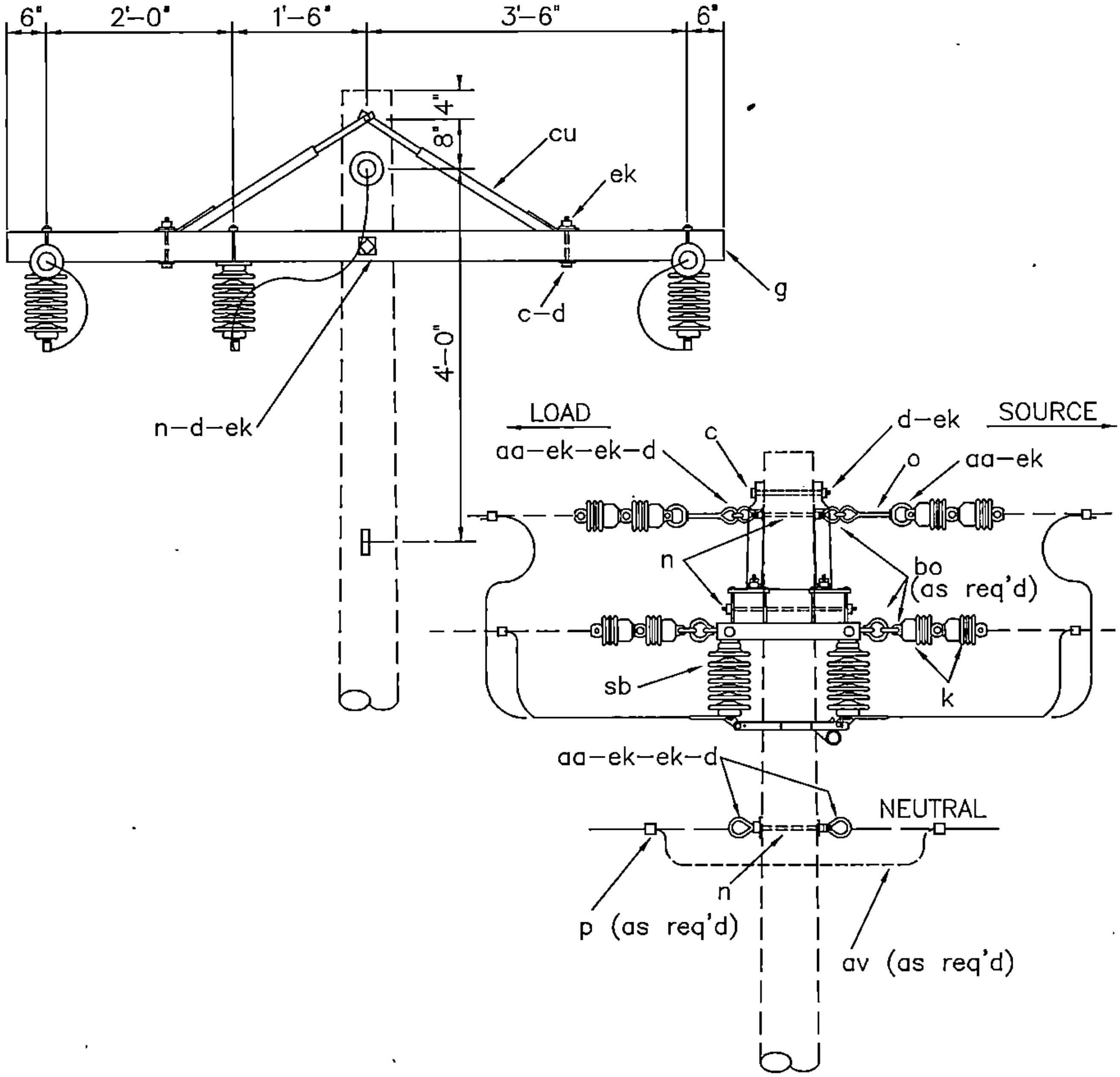
LINE TENSION SWITCHES
(THREE SINGLE–PHASE)

APRIL 2005

RUS

3 – PHASE PRIMARY
12.47/7.2 kV

S2.3 (M3–3B)



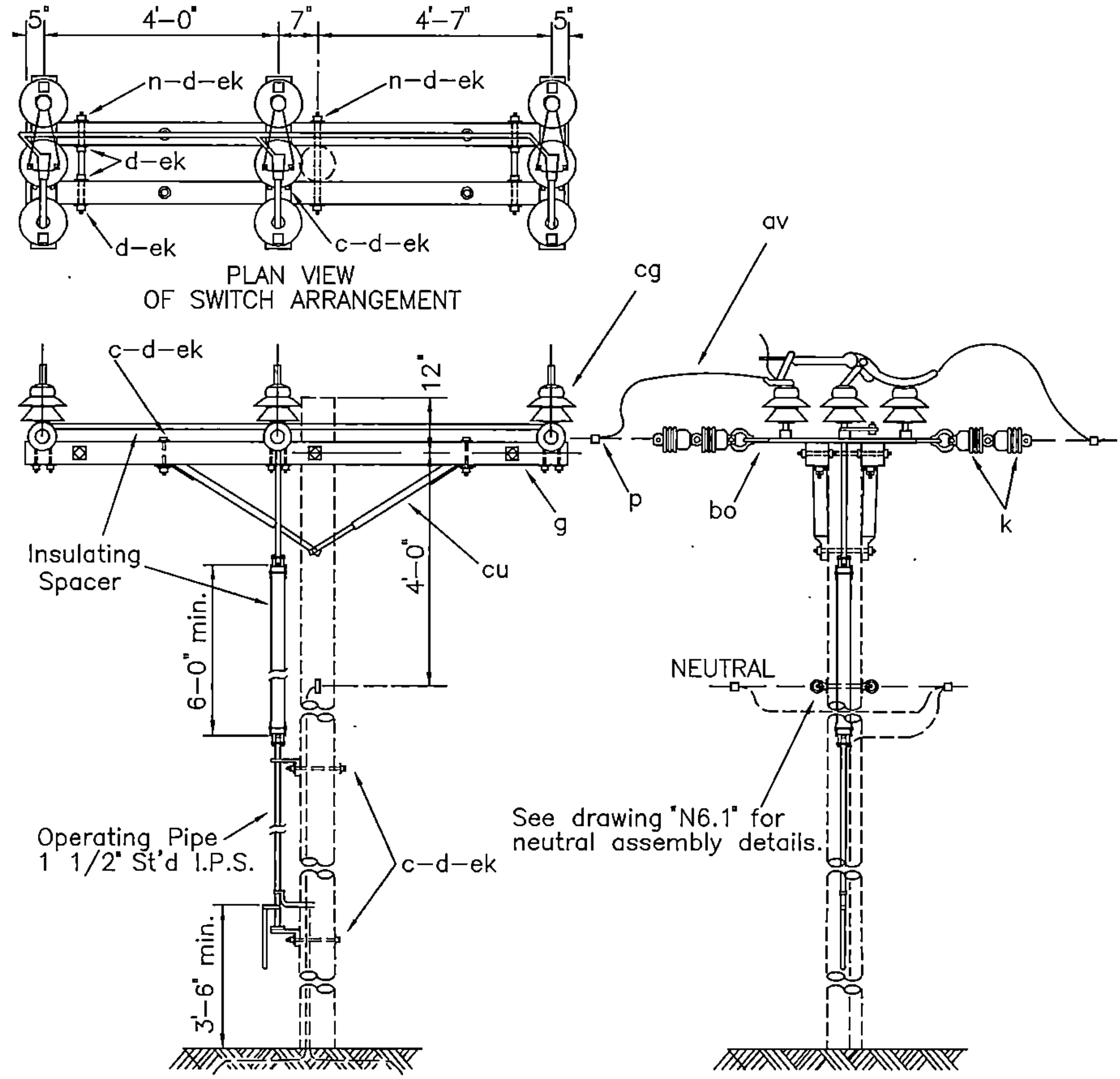
NOTE: For 2-phase installations, omit switch and related items on center phase and designate as "S2.21."

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 1/2" x req'd length
c	1	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	11	Washer, square, 2 1/4"
d	4	Washer, square, 3", curved
g	2	Crossarm, 3 5/8" x 4 5/8" x 8'-0"
k	12	Insulator, suspension, 4 1/4"
n	5	Bolt, double arm, 5/8" x req'd length

ITEM	QTY	MATERIAL
o	2	Bolt, eye, 5/8" x req'd length
p		Connectors, compression as required
aa	6	Nut, eye, 5/8"
av		Jumpers, as required
bo	6	Shackle, anchor
cu	2	Brace, wood, 60" span
sb	3	Switch, disconnect, 15 kV,
		with mounting hardware

DISCONNECT SWITCHES
(TWO or THREE SINGLE-PHASE)

APRIL 2005		S2.21,S2.31
RUS	12.47/7.2 kV	(M3-2A),(M3-3A)



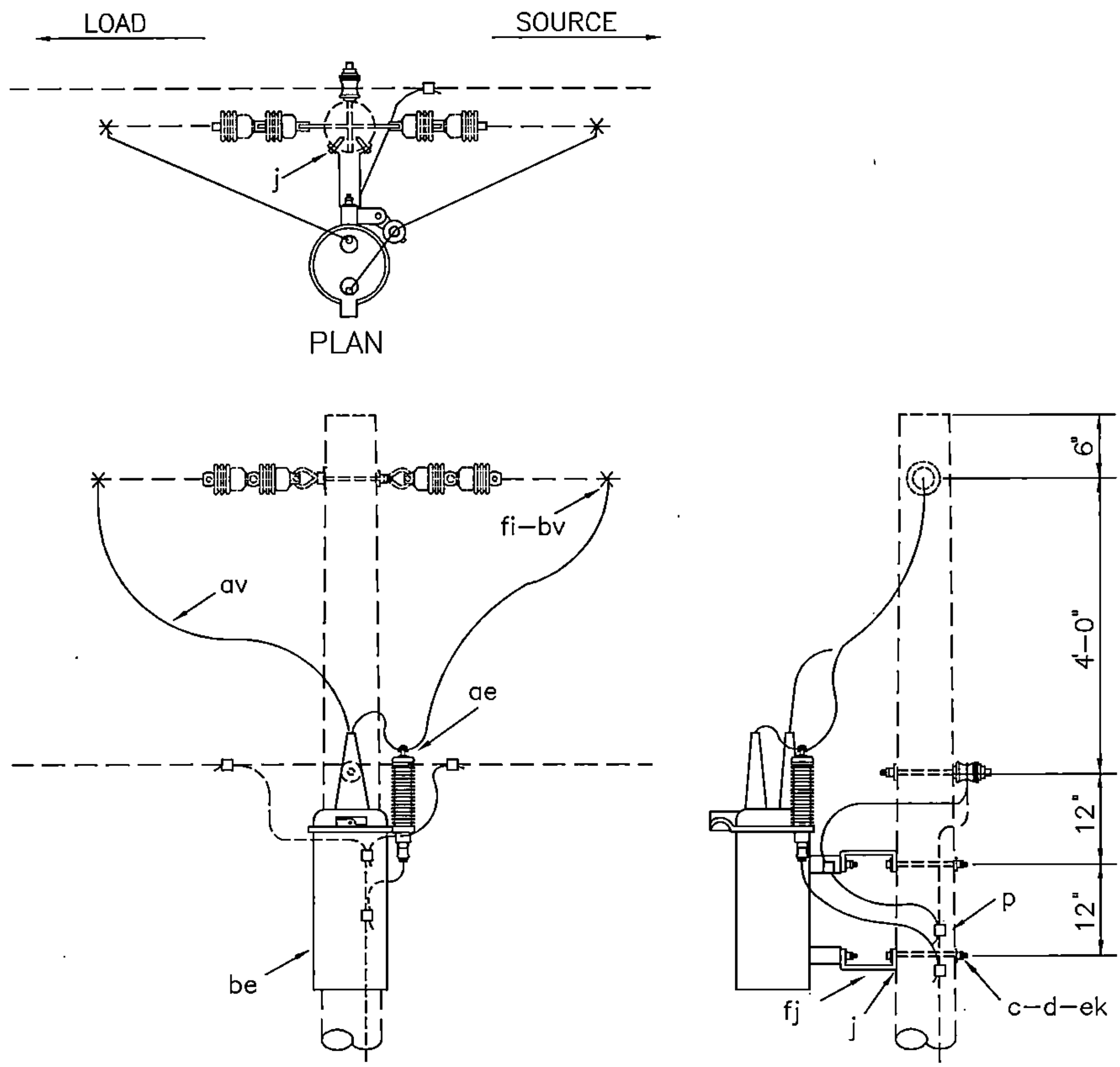
NOTES: See Dwg. "H4.1" (Preferred) or "H3.1" for required grounding assembly.
RUS accepted pre-assembled, group operated, airbreak switches may be used. Install according to manufacturer's instructions.

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 1/2" x req'd length
c	15	Bolt, machine, 5/8" x req'd length
d	4	Washer, round, 1 3/8"
d	25	Washer, square, 2 1/4"
d	2	Washer, square, 3"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
k	12	Insulator, suspension, 4 1/4"
n	4	Bolt, double arm, 5/8" x req'd length
p		Connectors, as required

ITEM	QTY	MATERIAL
aa	2	Nut, eye, 5/8"
av		Jumpers, as required
bo	6	Shackle, anchor
cg	1	Switch, airbreak, group operated
		15 kV, w/ operating mechanism
cu	2	Brace, wood, 60" span
ek	33	Locknuts

GROUP-OPERATED AIRBREAK SWITCH
(THREE-PHASE)

APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	S2.32 (M3-15)



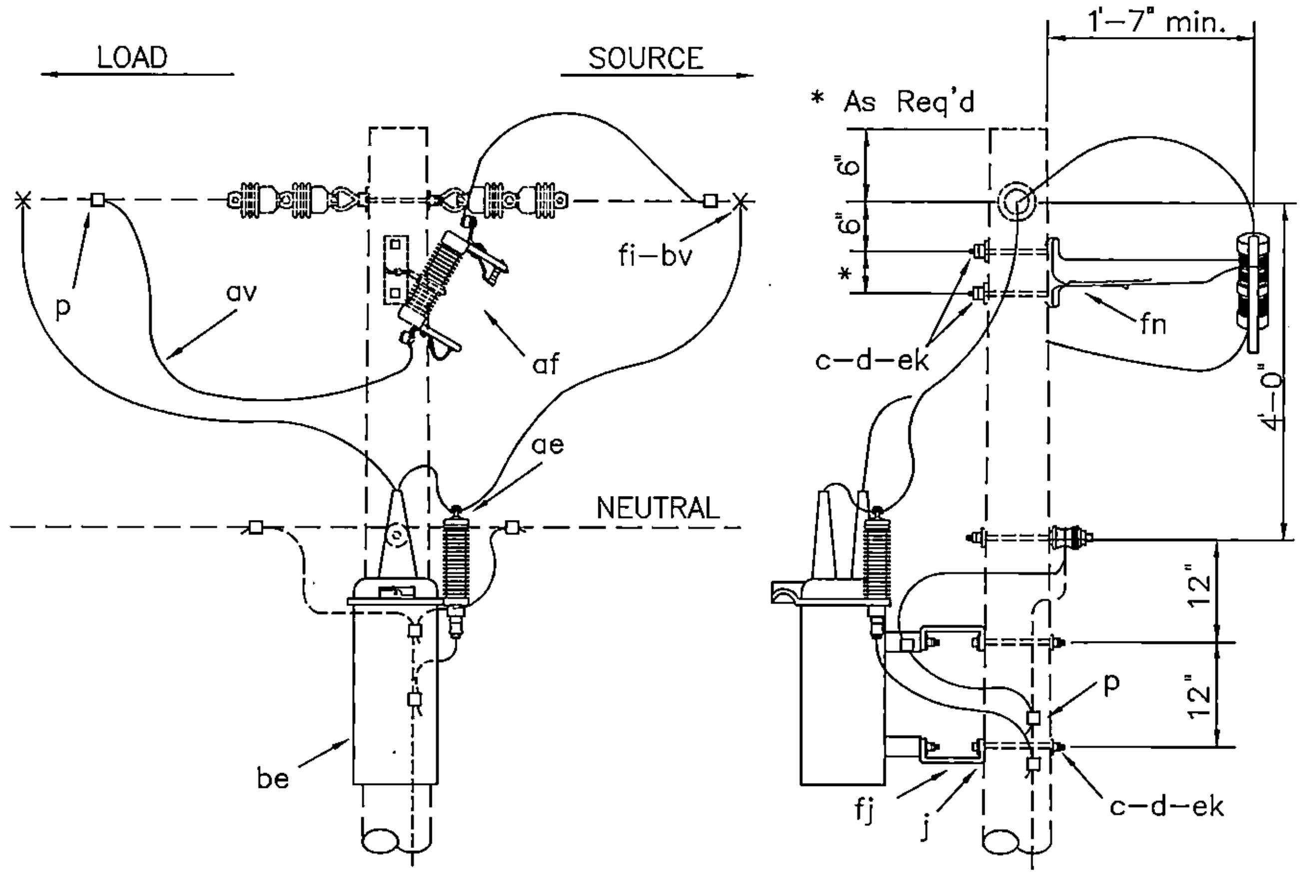
NOTE: The sectionalizer terminal bushing connected to the coil should be connected to the source.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
d	2	Washer, square, 2 1/4"
j	4	Screw, lag, 1/2" x 4"
p		Connector, as required
ae	1	Arrester, surge (9 kV)
av		Jumpers, stranded, as required

ITEM	QTY	MATERIAL
el	1	Sectionalizer (12.47 kV)
bv		Rod, armor, as req'd
ek	2	Locknuts
fi	2	Connector, hot line
fj	2	Brackets, extension, 9" long

SECTIONALIZER

APRIL 2005	1 – PHASE PRIMARY	S3.1
RUS	12.47/7.2 kV	(M3–41)



NOTE: The sectionalizer terminal bushing connected to the coil should be connected to the source.

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
j	4	Screw, lag, 1/2" x 4"
p		Connector, as required
ae	1	Arrester, surge (9 kV)
af	1	Cutout, distribution, open (15' kV)
av		Jumpers, stranded, as required

ITEM	QTY	MATERIAL
el	1	Sectionalizer (12.47kV)
bv		Rod, armor, as req'd
ek	4	Locknuts
fi	2	Connector, hot line
fj	2	Brackets, extension, 9" long
fn	1	Bracket, extension

SECTIONALIZER

APRIL 2005	1 – PHASE PRIMARY	S3.2
RUS	12.47/7.2 kV	

WOOD POLES, CROSSARMS AND BRACES

DRAWING NUMBERS		DRAWING TITLE (DESCRIPTION)
1728F-804 (New)	**Bulletin 50-3** (Old)	
W1.1G	(M20)	POLE FRAMING GUIDE
W2.1G	(M19)	DISTRIBUTION CROSSARM DRILLING GUIDE
W3.1	(M5-17)	CROSSARM BRACES
W3.2	(M5-13)	

CONSTRUCTION SPECIFICATIONS FOR POLES AND CROSSARMS

Large, dense poles that have no serious defects shall be used at transformer, deadend, angle, and corner locations.

Poles shall be set so that the crossarm gains face in opposite directions on every other pole. However at line deadends, the last two poles shall be set so that the pole gains face the deadend. On unusually long spans, the poles shall be set so that the crossarm is located on the side of the pole away from the long span. On lines that curve, the crossarms shall be installed on the side of the pole that faces the midpoint of the curve. On sloping terrain, the crossarms shall be installed on the uphill side of the pole. Pole top insulator brackets and pole top pins shall be installed on the opposite side of the pole from the gain.

At line angles and deadends, poles shall be set such that they lean away from the strain of the primary conductors. They shall be set such that the final rake is not less than 1 inch for each 10 feet of pole height above ground after the conductors are installed at the required tension.

Newly set poles shall be backfilled and tamped to the full depth. Excess dirt shall be banked around the base of the pole.

POLE SETTING DEPTHS

The minimum depth for setting poles is:

Length of Pole (Feet)	Setting in Soil (Feet)	Setting in All Solid Rock (Feet)
20	4.0	3.0
25	5.0	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0
60	8.0	5.0

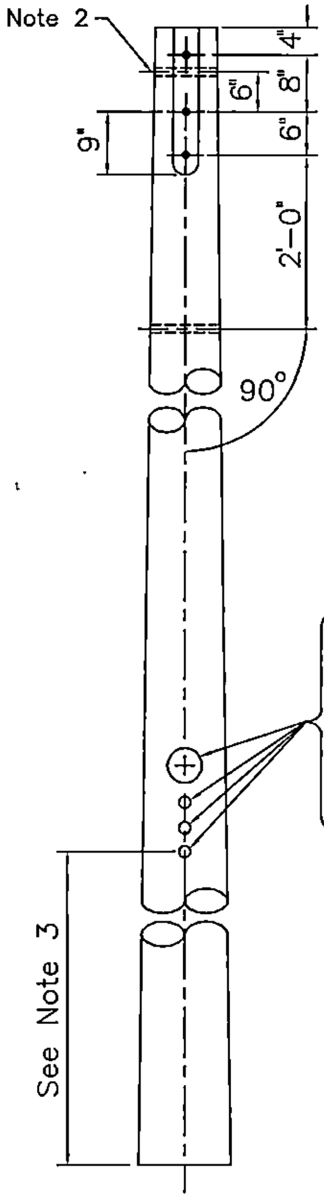
"Setting in Soil" depths apply where:

- Poles are set in soil;
- There is a layer of soil of more than two (2) feet in depth over solid rock; or
- The hole in solid rock is not substantially vertical or the diameter of the hole at the surface of the rock exceeds approximately twice the diameter of the pole at the same level.

"Setting in All Solid Rock" depths shall apply where poles are set in solid rock and where the hole is substantially vertical, approximately uniform in diameter and large enough to permit the use of tamping bars the full depth of the hole.

Where there is a layer of soil two (2) feet or less in depth over solid rock, the depth of the hole shall be the depth of the soil in addition to the depth specified under "Setting in All Solid Rock" provided. However, this depth shall not exceed the depth specified under "Setting in Soil."

On sloping ground, the depth of the hole shall be measured from the low side of the hole.

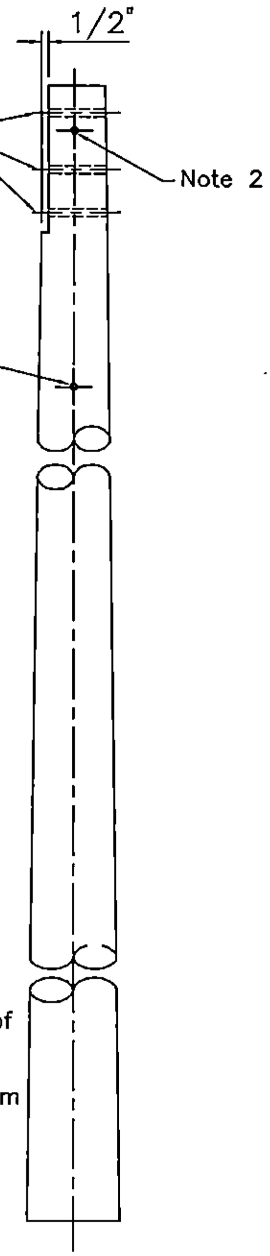


Through-bolt holes must be parallel and in the same plane

HOLES: Drill 11/16" diameter

GAINS: Gains are to be flat with plane at right angles to the bolt holes

Neutral bolt hole must be at 90° angle with through-bolt holes

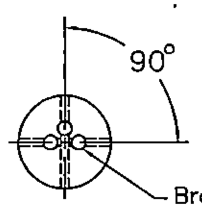


- Supplier's code or Trademark
- Insured warranty or Quality Assurance Mark
- Plant location, month and year of treatment
- Species, preservation code and retention
- Size or designation

TOLERANCES

HOLES:
- On the gain: ±1/8" from the centerline of the holes.
- On the side opposite the gain: ±1/4" from the centerlines of the holes.
- Location (measured from the roof):
  - Gain side ±1/4"
  - Opposite side ±1/2"
- Diameter: ±1/16"

GAINS: out of parallel ±1/2"



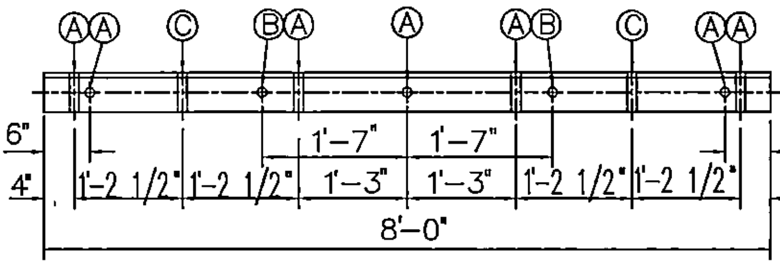
Brand butt with proper length and class

NOTES:

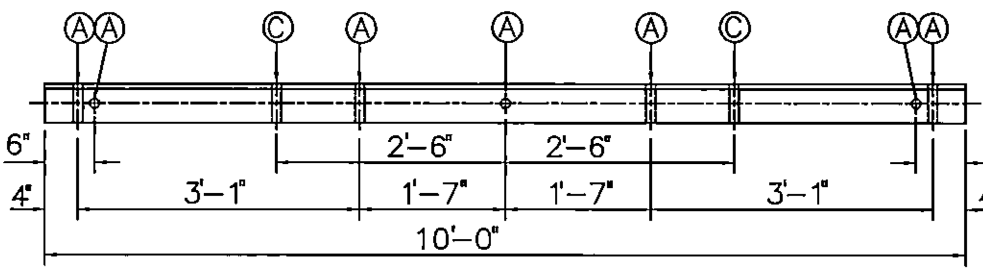
1. All poles shorter than 50 feet must be bored, roofed and gained before treatment, except that Class 7 and smaller poles need not be gained unless requested by purchaser. Roofs may be flat or at a 15° angle at the producer's option.
2. Anti-split bolt hole is optional and is to be drilled only when so specified by the purchaser.
3. Bottom of brand or center of metal disk shall be 10' ±2" from the pole butt for poles less than 55' in length; 14' ±2" for poles 55' and longer.

POLE FRAMING GUIDE		
APRIL 2005		W1.1G
RUS		(M20)

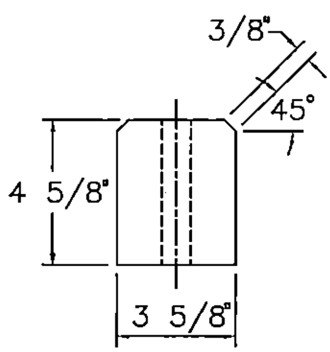
TOLERANCES AND SIZES OF HOLES			
NOMINAL		GO	NO GO
Ⓐ	11/16"	5/8"	3/4"
Ⓑ	7/16"	3/8"	1/2"
Ⓒ	9/16"	1/2"	5/8"



TYPE 04



TYPE 05M



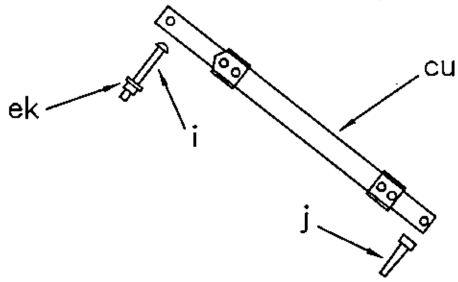
TYPICAL END SECTION

NOTES:

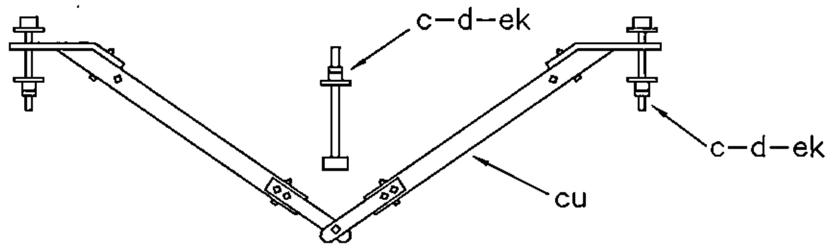
1. Holes are to be located within ±1/8"
2. Length of the crossarm is to be within ±1/4"
3. The tolerance of the cross section is +1/8" and −0" at time of manufacture.
4. All holes are to be drilled on centerlines of crossarm faces.

DISTRIBUTION CROSSARM DRILLING GUIDE

APRIL 2005	W2.1G
RUS	(M19)



W3.1



W3.2

ITEM	MATERIAL	W3.1 QTY	W3.2 QTY
c	Bolt, machine, 1/2" x req'd length		2
c	Bolt, machine, 5/8" x req'd length		1
d	Washer, round, 1 3/8"		2
d	Washer, square, 2 1/4"		1
i	Bolt, carriage, 3/8" x 4 1/2"	1	
j	Screw, lag, 1/2" x 4"	1	
cu	Brace, 28", wood (or fiberglass)	1	
cu	Brace, wood, 60"		1
ek	Locknuts	1	3

CROSSARM BRACES

APRIL 2005

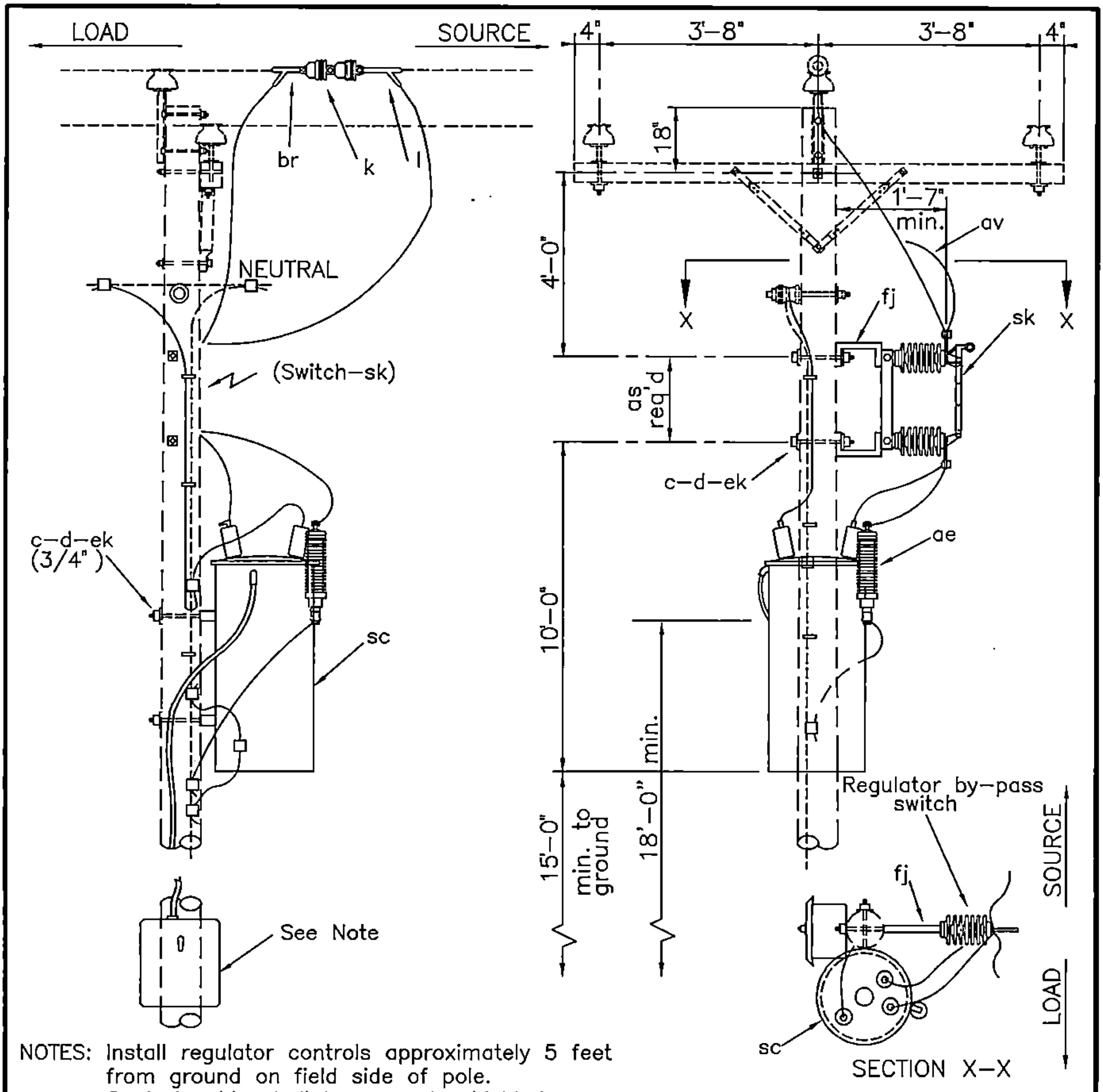
RUS

W3.1,W3.2

(M5–17),(M5–13)

VOLTAGE ALTERATION EQUIPMENT ASSEMBLY UNITS

DRAWING NUMBERS 1728F-804 (New)	Bulletin 50-3 (Old)	DRAWING TITLE (DESCRIPTION)
Y1.1	(M7-11)	VOLTAGE REGULATOR, POLE MOUNTED (ONE SINGLE-PHASE)
Y1.3	(M7-13)	VOLTAGE REGULATOR, PLATFORM MOUNTED (THREE SINGLE-PHASE)
Y2.1 Y2.2		AUTOTRANSFORMER, POLE MOUNTED (ONE SINGLE-PHASE, STEP-DOWN)
Y3.1	(M9-11)	SINGLE-PHASE CAPACITOR BANK
Y3.2 Y3.3	(M9-12) (M9-13)	THREE-PHASE CAPACITOR BANK
Y3.4		SWITCHED CAPACITOR BANK - THREE-PHASE



NOTES: Install regulator controls approximately 5 feet from ground on field side of pole.
Control cable shall be properly shielded or installed in suitable conduit.

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 5/8" x req'd length
c	2	Bolt, machine, 3/4" x req'd length
d	2	Washer, square, 2 1/4"
d	2	Washer, square, 3," curved
k	2	Insulator, suspension, 4 1/4
l	2	Clamp, deadend
p		Connectors, compression, as req'd
ae	1	Arrester, surge (9 kV)

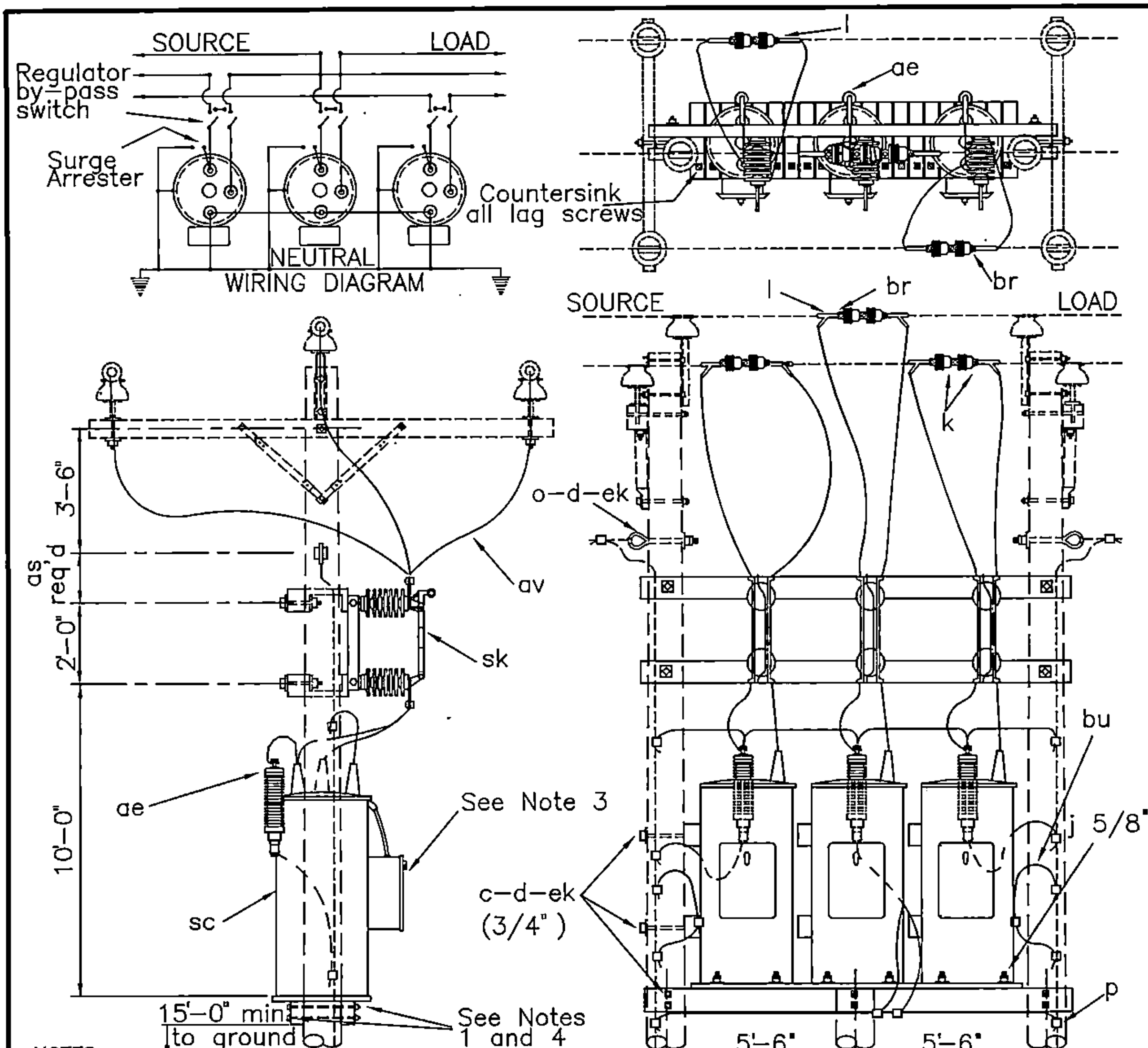
ITEM	QTY	MATERIAL
av		Jumpers, bare, stranded, as req'd
br	1	Chain link
bu		Connector, grounding
fj	2	Bracket, extension, 9"
sc	1	Regulator, voltage, step-type
		12.47/7.2 kV
sk	1	Switch, regulator by-pass
ek	4	Locknuts

VOLTAGE REGULATOR, POLE MOUNTED
(ONE SINGLE-PHASE)

APRIL 2005
RUS

12.47/7.2 kV

Y1.1
(M7-11)



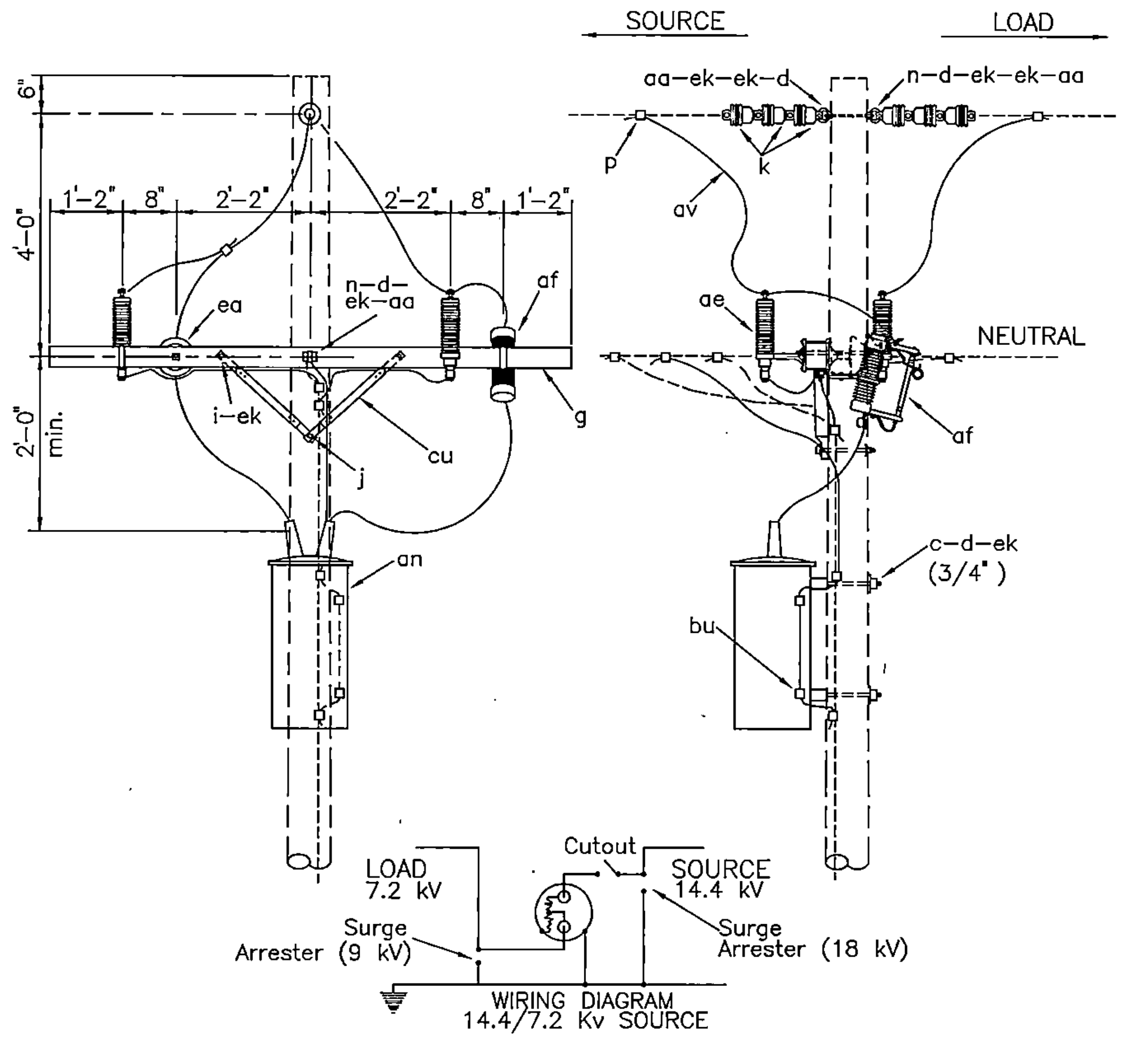
NOTES:
1. All structural timbers and planks to be treated as per RUS specifications.
2. Each regulator must be bolted to platform or pole.
3. Control boxes may be installed on poles below regulators, (Specify additional control cable).
4. 4 x 6.25 /ft. channel steel or 6 x 2.91#/ft. channel aluminum may be substituted for structural timbers.

ITEM	QTY	MATERIAL
c	12	Bolt, machine, 1/2" x req'd length
c	6	Bolt, machine, 5/8" x req'd length
c	6	Bolt, machine, 3/4" x req'd length
d	12	Washer, round, 1 3/8" diam.
d	24	Washer, square, 2 1/4"
j		Screw, lag, 1/2" x 5", as req'd
j	8	Screw, lag, 5/8" x 6"
k	6	Insulator, suspension, 4 1/4"
l	6	Clamp, deadend
o	2	Bolt, eye, 5/8" x req'd length
p		Connectors, compression, as req'd
ae	3	Arrester, surge (9 kV)

ITEM	QTY	MATERIAL
ae	3	Arrester, by-pass (furnished
		by manufacturer)
av		Jumpers, bare, stranded, as req'd
br	3	Chain link
bu	3	Connector, grounding
ek	26	Locknuts
sc	3	Regulator, voltage, step-type
		12.47/7.2 kV
sk	3	Switch, regulator by-pass
	2	Structural timber, 4" x 12" x 12'
		Planks, 2" or 3" thick -
-		length and number as req'd

VOLTAGE REGULATORS, PLATFORM MOUNTED (THREE SINGLE-PHASE)

APRIL 2005	3 - PHASE PRIMARY	Y1.3
RUS	12.47/7.2 kV	(M7-13)



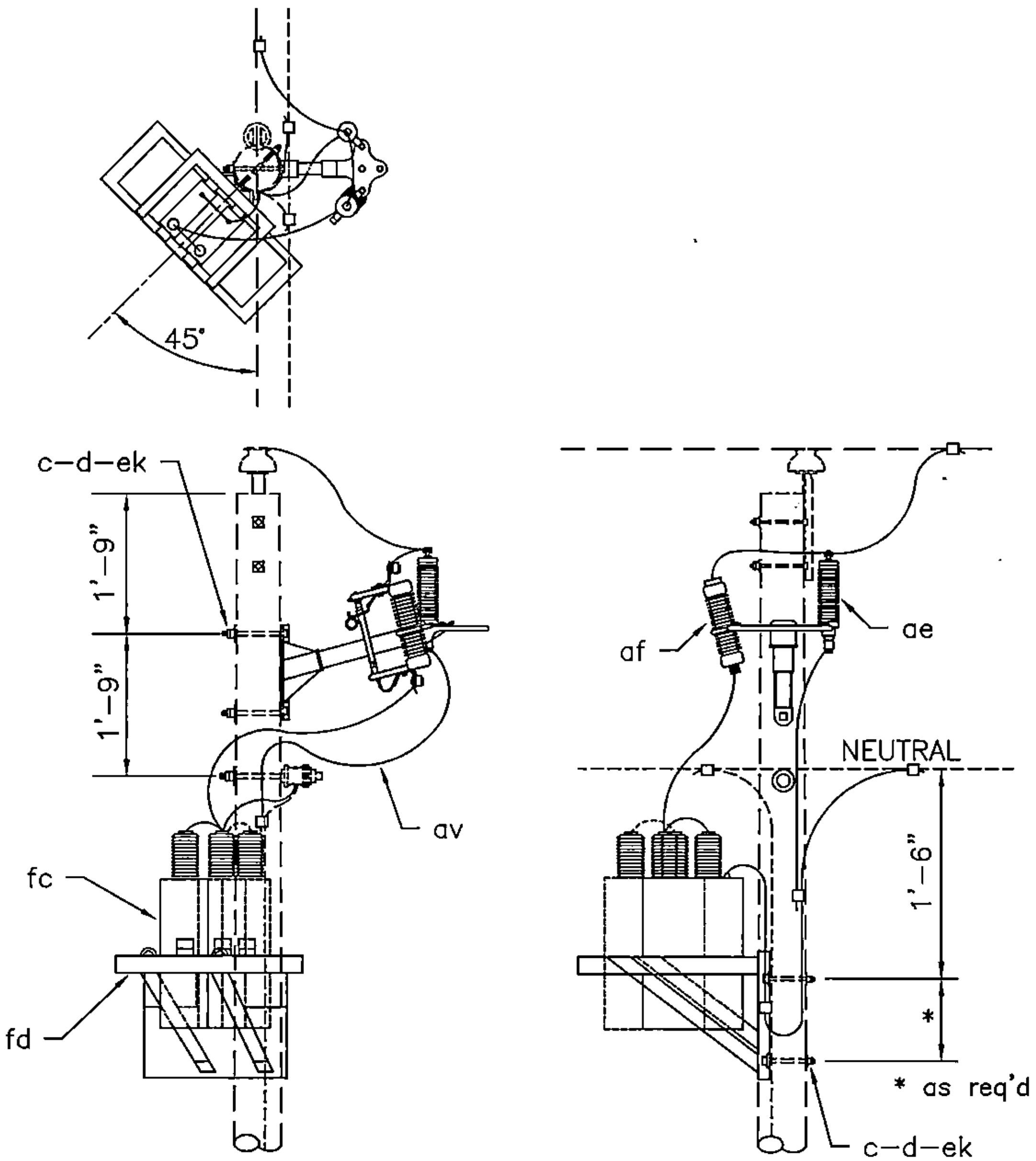
NOTE: For step–up operation, (7.2 kV source; 14.4 kV load), interchange the surge arrester locations, make autotransformer connections as required, and designate assembly as "Y2.2."

ITEM	QTY	MATERIAL
c	2	Bolt, machine, 3/4" x req'd length
d	1	Washer, square, 2 1/4"
d	5	Washer, square, 3," curved
g	1	Crossarm, 3 5/8" x 4 5/8" x 8'–0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
k	6	Insulator, suspension, 4 1/4"
n	2	Bolt, dbl arm, 5/8" x req'd length
p		Connectors, compression, as req'd

ITEM	QTY	MATERIAL
aa	4	Nut, eye, 5/8"
ae	1	Arrester, surge (9 kV)
ae	1	Arrester, surge (18 kV)
af	1	Cutout, dist. open (27 kV)
an	1	Transformer, auto, 14.4 kV 7.2 kV
av		Jumpers, bare, stranded, as req'd
bu	2	Connector, grounding
cu	2	Brace, 28"
ea	1	Insulator, post type, (25 kV)
ek	12	Locknuts

AUTOTRANSFORMER, POLE MOUNTED
(ONE SINGLE–PHASE, STEP–DOWN)

APRIL 2005	1 – PHASE PRIMARY	
RUS	(14.4 kV to 7.2 kV)	Y2.1, Y2.2



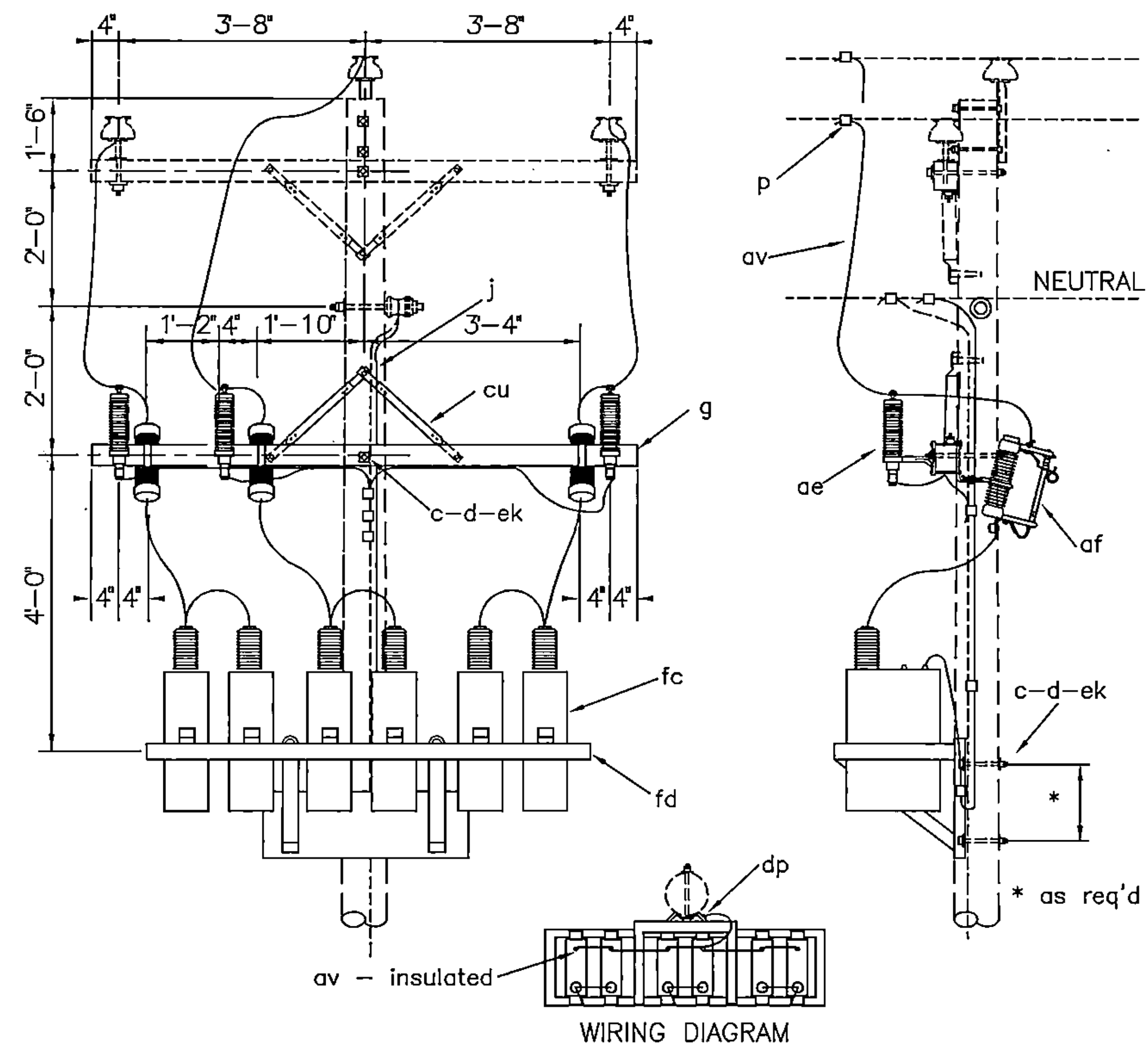
NOTES:
1. Specify number and kVAr required.
2. Load break cutouts for installations over 75 kVAr.
3. Specify insulating caps for primary terminal bushings.

ITEM	QTY	MATERIAL
c	4	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
p		Connectors, as req'd
ae	1	Arrester, surge (9 kV)
af	1	Cutout, dist., loadbreak, (15 kV)
av		Jumpers, bare, stranded, as req'd
av		Jumpers, insulated, as req'd

ITEM	QTY	MATERIAL
dp	1	Clamp, ground wire
ek	4	Locknuts
eq	1	Bracket, insulator/equipment
fc		Capacitor, shunt, 12.47/7.2 kV
		(specify number and kVAR)
fd	1	Hanger, capacitor

SINGLE PHASE CAPACITOR ASSEMBLY

APRIL 2005 RUS	1 – PHASE PRIMARY 12.47/7.2 kV	Y3.1 (M9–11)



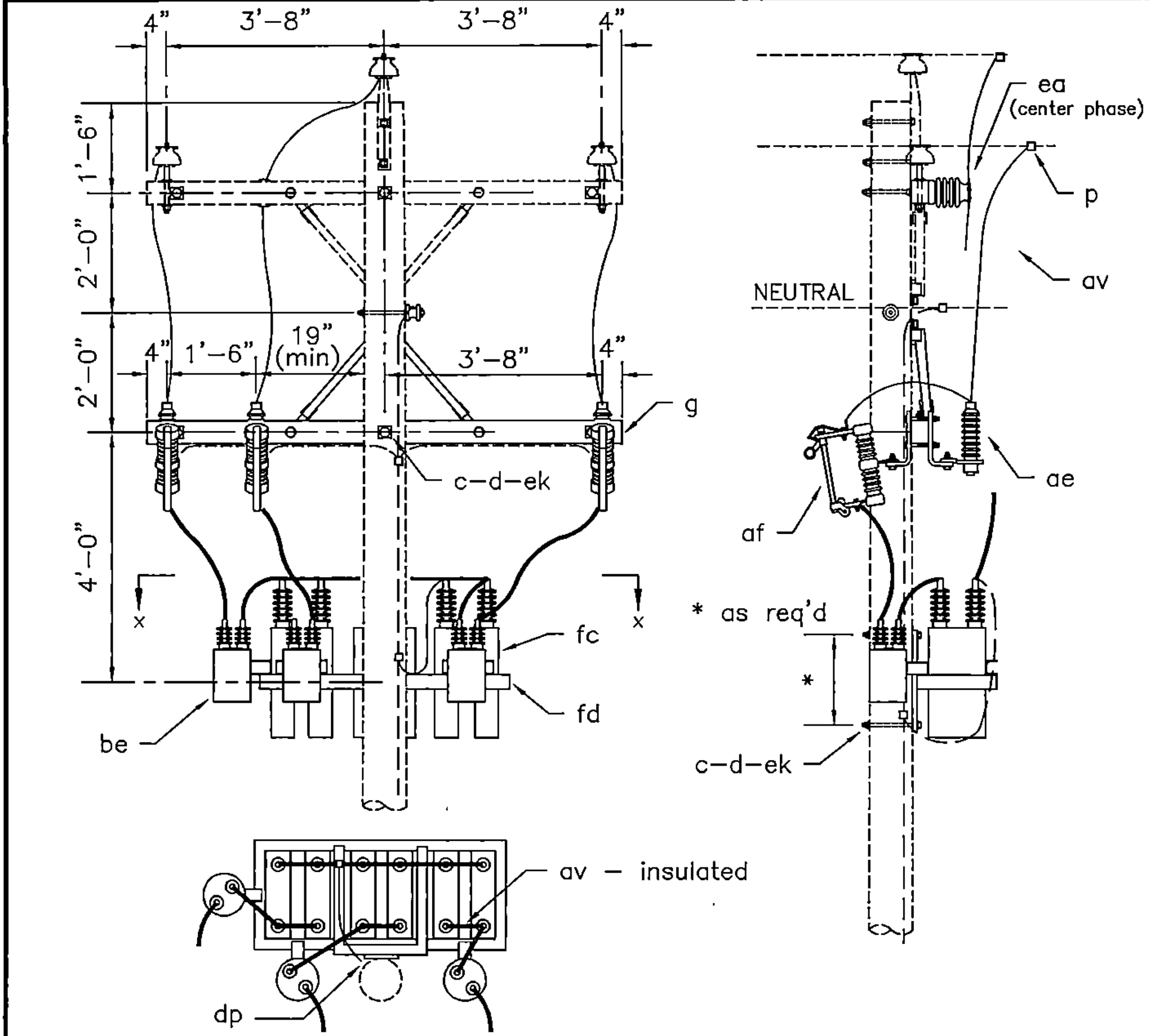
NOTE:
1. Specify insulating caps for primary terminal bushings.
2. For two-phase assemblies, omit capacitors and other material on center phase; designate assembly as "Y3.2."

ITEM	QTY	MATERIAL
c	3	Bolt, machine, 5/8" x req'd length
d	4	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" X 4 5/8" X 8-0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
p		Connectors, as req'd
p		Connectors, compression, as req'd
ae	3	Arrester, surge (9 kV)
af	3	Cutout, dist., loadbreak, (15 kV)

ITEM	QTY	MATERIAL
av		Jumpers, bare, stranded, as req'd
av		Jumpers, insulated, as req'd
cu	2	Brace, 28"
dp	1	Clamp, ground wire
ek	5	Locknuts
fc		Capacitor, shunt, 12.47/7.2 kV
		(specify number and kVAR)
fd	1	Hanger, capacitor

THREE PHASE CAPACITOR BANK

APRIL 2005	3 - PHASE PRIMARY	Y3.2,Y3.3
RUS	12.47/7.2 kV	(M9-12),(M9-13)



SECTION X-X

NOTE:

1. Specify insulating caps for primary terminal bushings.

ITEM	QTY	MATERIAL
c	3	Bolt, machine, 5/8" x req'd length
d	3	Washer, square, 2 1/4"
g	1	Crossarm, 3 5/8" X 4 5/8" X 8-0"
i	2	Bolt, carriage, 3/8" x 4 1/2"
j	1	Screw, lag, 1/2" x 4"
p		Connectors, as req'd
ae	3	Arrester, surge (9 kV)
af	3	Cutout, dist., loadbreak, (15 kV)
av		Jumpers, bare, stranded, as req'd

ITEM	QTY	MATERIAL
av		Jumpers, insulated, as req'd
be	3	Switch, oil, with controls
cu	2	Brace, 28
dp	1	Clamp, ground wire
ea	1	Insulator, post type (15kv)
ek	5	Locknuts
fc		Capacitor, shunt, 12.47/7.2 kV
		(specify number and kVAR)
fd	1	Hanger, capacitor

THREE-PHASE SWITCHED CAPACITOR BANK

APRIL 2005 RUS	3 - PHASE PRIMARY 12.47/7.2 kV	Y3.4

Calculation of Maximum Line Angles

The following formula and the data tabulated below were used to calculate the maximum line angles on pin and spool insulator assemblies:

$$Sin(\theta/2) = \frac{P-(Fw\times Sw\times Ww)}{2\times Ft\times T} \qquad \theta = 2\times Arc\sin\left[\frac{P-(Fw\times Sw\times Ww)}{2\times Ft\times T}\right]$$

Where:

θ = Maximum Line Angle (calculated): [Degrees]
P = Designated Maximum Transverse Load (allowed on pin or insulator): [lbs]
Fw = Wind Overload Factor for Transverse Loads
Ft = Wire Tension Overload Factor for Transverse Loads
Sw = Wind Span (equals ½ sum of adjacent spans): [ft]
Ww = Wind Load on Conductor: [lbs/ft] *(See Table Below)*
T = Design Tension of Conductor: [lbs] *(See Table Below)*

From NESC Table 253-1 for Grade C Construction:

Fw = 1.75 for non-crossing spans (Footnote 4 to Table 253-1)
= 2.20 for crossing spans
Ft = 1.30

CONDUCTOR SIZE & TYPE	Strength	Maximum Tension	Design Tension *(T)(lbs)*
4 ACSR (7/1)	2360	60%	1416
2 ACSR (6/1)	2850	60%	1710
2 ACSR (7/1)	3640	60%	2184
1/0 ACSR (6/1)	4380	60%	2628
123.3 AAC (7)	4460	60%	2676
2/0 ACSR (6/1)	5310	50%	2655
3/0 ACSR (6/1)	6620	50%	3310
4/0 ACSR (6/1)	8350	40%	3340
246.9 AAC (7)	8560	40%	3424
336.4 ACSR (18/1)	8680	40%	3472
336.4 ACSR (26/7)	14100	35%	4935

	WIND LOAD *(Ww) (lbs/ft)* by NESC Loading District		
	LIGHT	MEDIUM	HEAVY
4 ACSR (7/1)	0.1928	0.2523	0.4190
2 ACSR (6/1)	0.2370	0.2720	0.4387
2 ACSR (7/1)	0.2438	0.2750	0.4417
1/0 ACSR (6/1)	0.2985	0.2993	0.4660
123.3 AAC (7)	0.2985	0.2993	0.4660
2/0 ACSR (6/1)	0.3353	0.3157	0.4823
3/0 ACSR (6/1)	0.3765	0.3340	0.5007
4/0 ACSR (6/1)	0.4223	0.3543	0.5210
246.9 AAC (7)	0.4223	0.3543	0.5210
336.4 ACSR (18/1)	0.5130	0.3947	0.5613
336.4 ACSR (26/7)	0.5408	0.4070	0.5737

TABLE I

MAXIMUM LINE ANGLES (Degrees)
PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

Designated Maximum Transverse Load = 500 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE			LIGHT LOADING DISTRICT			
4 ACSR (7/1)	14	13	13	12	12	11
2 ACSR (6/1)	11	11	10	10	9	9
2 ACSR (7/1)	9	8	8	8	7	7
1/0 ACSR (6/1)	7	7	6	6	5	5
123.3 AAAC (7)	7	7	6	6	5	5
2/0 ACSR (6/1)	7	6	6	5	5	4
3/0 ACSR (6/1)	5	5	4	4	4	3
4/0 ACSR (6/1)	5	5	4	4	3	3
246.9 AAAC (7)	5	5	4	4	3	3
336.4 ACSR (18/1)	5	4	3	3	2	2
336.4 ACSR (26/7)	3	3	2	2	2	1
			MEDIUM LOADING DISTRICT			
4 ACSR (7/1)	14	13	12	11	11	10
2 ACSR (6/1)	11	10	10	9	9	8
2 ACSR (7/1)	9	8	8	7	7	6
1/0 ACSR (6/1)	7	7	6	6	5	5
123.3 AAAC (7)	7	7	6	6	5	5
2/0 ACSR (6/1)	7	6	6	6	5	5
3/0 ACSR (6/1)	5	5	5	4	4	4
4/0 ACSR (6/1)	5	5	5	4	4	3
246.9 AAAC (7)	5	5	4	4	4	3
336.4 ACSR (18/1)	5	5	4	4	3	3
336.4 ACSR (26/7)	4	3	3	3	2	2
			HEAVY LOADING DISTRICT			
4 ACSR (7/1)	12	11	10	9	8	6
2 ACSR (6/1)	10	9	8	7	6	5
2 ACSR (7/1)	8	7	6	5	5	4
1/0 ACSR (6/1)	6	6	5	4	4	3
123.3 AAAC (7)	6	6	5	4	4	3
2/0 ACSR (6/1)	6	6	5	4	3	3
3/0 ACSR (6/1)	5	4	4	3	3	2
4/0 ACSR (6/1)	5	4	4	3	2	2
246.9 AAAC (7)	5	4	4	3	2	2
336.4 ACSR (18/1)	4	4	3	3	2	1
336.4 ACSR (26/7)	3	3	2	2	1	1

TABLE II

MAXIMUM LINE ANGLES (Degrees)
PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction (Re-calculate for NESC Grade B)

Designated Maximum Transverse Load = 750 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE			LIGHT LOADING DISTRICT			
4 ACSR (7/1)	22	21	21	20	20	19
2 ACSR (6/1)	18	17	17	16	16	15
2 ACSR (7/1)	14	13	13	13	12	12
1/0 ACSR (6/1)	11	11	10	10	10	9
123.3 AAAC (7)	11	11	10	10	9	9
2/0 ACSR (6/1)	11	11	10	10	9	9
3/0 ACSR (6/1)	9	8	8	7	7	6
4/0 ACSR (6/1)	8	8	7	7	6	6
246.9 AAAC (7)	8	8	7	7	6	6
336.4 ACSR (18/1)	8	7	7	6	6	5
336.4 ACSR (26/7)	5	5	5	4	4	3
			MEDIUM LOADING DISTRICT			
4 ACSR (7/1)	21	21	20	19	19	18
2 ACSR (6/1)	18	17	16	16	15	14
2 ACSR (7/1)	14	13	13	12	12	11
1/0 ACSR (6/1)	11	11	10	10	10	9
123.3 AAAC (7)	11	11	10	10	9	9
2/0 ACSR (6/1)	11	11	10	10	9	9
3/0 ACSR (6/1)	9	8	8	8	7	7
4/0 ACSR (6/1)	9	8	8	7	7	7
246.9 AAAC (7)	8	8	8	7	7	6
336.4 ACSR (18/1)	8	8	7	7	6	6
336.4 ACSR (26/7)	6	5	5	5	4	4
			HEAVY LOADING DISTRICT			
4 ACSR (7/1)	20	19	18	17	15	14
2 ACSR (6/1)	16	15	14	13	12	11
2 ACSR (7/1)	13	12	11	10	10	9
1/0 ACSR (6/1)	11	10	9	8	8	7
123.3 AAAC (7)	10	10	9	8	8	7
2/0 ACSR (6/1)	10	10	9	8	8	7
3/0 ACSR (6/1)	8	8	7	6	6	5
4/0 ACSR (6/1)	8	7	7	6	6	5
246.9 AAAC (7)	8	7	7	6	6	5
336.4 ACSR (18/1)	8	7	6	6	5	5
336.4 ACSR (26/7)	5	5	4	4	4	3

TABLE III

MAXIMUM LINE ANGLES (Degrees)

PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

Designated Maximum Transverse Load = 1,000 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE			LIGHT LOADING DISTRICT			
4 ACSR (7/1)	30	29	29	28	28	27
2 ACSR (6/1)	24	24	23	23	22	22
2 ACSR (7/1)	19	19	18	18	17	17
1/0 ACSR (6/1)	16	15	15	14	14	13
123.3 AAAC (7)	15	15	14	14	13	13
2/0 ACSR (6/1)	15	15	14	14	13	13
3/0 ACSR (6/1)	12	12	11	11	10	10
4/0 ACSR (6/1)	12	11	11	10	10	9
246.9 AAAC (7)	11	11	11	10	10	9
336.4 ACSR (18/1)	11	10	10	9	9	8
336.4 ACSR (26/7)	8	7	7	6	6	6
			MEDIUM LOADING DISTRICT			
4 ACSR (7/1)	29	29	28	27	27	26
2 ACSR (6/1)	24	23	23	22	22	21
2 ACSR (7/1)	19	18	18	17	17	16
1/0 ACSR (6/1)	16	15	15	14	14	13
123.3 AAAC (7)	15	15	14	14	13	13
2/0 ACSR (6/1)	15	15	14	14	13	13
3/0 ACSR (6/1)	12	12	11	11	11	10
4/0 ACSR (6/1)	12	12	11	11	10	10
246.9 AAAC (7)	12	11	11	10	10	10
336.4 ACSR (18/1)	11	11	11	10	10	9
336.4 ACSR (26/7)	8	8	7	7	7	6
			HEAVY LOADING DISTRICT			
4 ACSR (7/1)	28	27	26	24	23	22
2 ACSR (6/1)	23	22	21	20	19	18
2 ACSR (7/1)	18	17	16	16	15	14
1/0 ACSR (6/1)	15	14	13	13	12	11
123.3 AAAC (7)	14	14	13	12	12	11
2/0 ACSR (6/1)	15	14	13	12	12	11
3/0 ACSR (6/1)	12	11	10	10	9	9
4/0 ACSR (6/1)	11	11	10	10	9	8
246.9 AAAC (7)	11	11	10	9	9	8
336.4 ACSR (18/1)	11	10	10	9	8	8
336.4 ACSR (26/7)	8	7	7	6	6	5

TABLE IV

MAXIMUM LINE ANGLES (Degrees)

PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

Designated Maximum Transverse Load = 1,500 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE			LIGHT LOADING DISTRICT			
4 ACSR (7/1)	46	46	45	45	44	44
2 ACSR (6/1)	38	37	37	36	35	35
2 ACSR (7/1)	29	29	28	28	28	27
1/0 ACSR (6/1)	24	24	23	23	22	22
123.3 AAAC (7)	24	23	23	22	22	21
2/0 ACSR (6/1)	24	23	23	22	22	21
3/0 ACSR (6/1)	19	18	18	17	17	17
4/0 ACSR (6/1)	18	18	17	17	16	16
246.9 AAAC (7)	18	17	17	17	16	16
336.4 ACSR (18/1)	17	17	16	16	15	15
336.4 ACSR (26/7)	12	12	11	11	10	10
			MEDIUM LOADING DISTRICT			
4 ACSR (7/1)	46	45	44	44	43	42
2 ACSR (6/1)	37	37	36	36	35	34
2 ACSR (7/1)	29	29	28	28	27	27
1/0 ACSR (6/1)	24	24	23	23	22	22
123.3 AAAC (7)	24	23	23	22	22	21
2/0 ACSR (6/1)	24	23	23	22	22	21
3/0 ACSR (6/1)	19	18	18	18	17	17
4/0 ACSR (6/1)	19	18	18	17	17	17
246.9 AAAC (7)	18	18	17	17	17	16
336.4 ACSR (18/1)	18	17	17	16	16	16
336.4 ACSR (26/7)	12	12	12	12	11	11
			HEAVY LOADING DISTRICT			
4 ACSR (7/1)	44	43	42	41	39	38
2 ACSR (6/1)	36	35	34	33	32	31
2 ACSR (7/1)	28	27	27	26	25	24
1/0 ACSR (6/1)	23	23	22	21	20	20
123.3 AAAC (7)	23	22	21	21	20	19
2/0 ACSR (6/1)	23	22	22	21	20	19
3/0 ACSR (6/1)	18	18	17	17	16	15
4/0 ACSR (6/1)	18	17	17	16	16	15
246.9 AAAC (7)	18	17	16	16	15	15
336.4 ACSR (18/1)	17	17	16	15	15	14
336.4 ACSR (26/7)	12	12	11	11	10	10

TABLE V

MAXIMUM LINE ANGLES (Degrees)
PIN and POST TYPE INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

Designated Maximum Transverse Load = 2,000 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE			LIGHT LOADING DISTRICT			
4 ACSR (7/1)	60	60	60	60	60	60
2 ACSR (6/1)	52	51	50	50	49	49
2 ACSR (7/1)	40	39	39	38	38	38
1/0 ACSR (6/1)	33	32	32	31	31	30
123.3 AAAC (7)	32	32	31	31	30	30
2/0 ACSR (6/1)	32	32	31	31	30	30
3/0 ACSR (6/1)	26	25	25	24	24	23
4/0 ACSR (6/1)	25	25	24	24	23	23
246.9 AAAC (7)	25	24	24	23	23	22
336.4 ACSR (18/1)	24	23	23	22	22	21
336.4 ACSR (26/7)	17	16	16	15	15	15
			MEDIUM LOADING DISTRICT			
4 ACSR (7/1)	60	60	60	60	60	59
2 ACSR (6/1)	51	51	50	49	49	48
2 ACSR (7/1)	40	39	39	38	38	37
1/0 ACSR (6/1)	33	32	32	31	31	30
123.3 AAAC (7)	32	32	31	31	30	30
2/0 ACSR (6/1)	32	32	31	31	30	30
3/0 ACSR (6/1)	26	25	25	24	24	24
4/0 ACSR (6/1)	25	25	25	24	24	23
246.9 AAAC (7)	25	24	24	24	23	23
336.4 ACSR (18/1)	24	24	23	23	22	22
336.4 ACSR (26/7)	17	17	16	16	16	15
			HEAVY LOADING DISTRICT			
4 ACSR (7/1)	60	60	59	58	57	55
2 ACSR (6/1)	50	49	48	47	46	45
2 ACSR (7/1)	39	38	37	36	35	35
1/0 ACSR (6/1)	32	31	30	30	29	28
123.3 AAAC (7)	31	31	30	29	29	28
2/0 ACSR (6/1)	31	31	30	29	29	28
3/0 ACSR (6/1)	25	24	24	23	23	22
4/0 ACSR (6/1)	25	24	24	23	22	22
246.9 AAAC (7)	24	24	23	22	22	21
336.4 ACSR (18/1)	24	23	22	22	21	21
336.4 ACSR (26/7)	17	16	16	15	15	14

TABLE VI

MAXIMUM LINE ANGLES (Degrees) ON SPOOL INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***
(ANSI Clss 53-2 Spool Insulator)

Designated Maximum Transverse Load = 1,500 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE			LIGHT LOADING DISTRICT			
4 ACSR (7/1)	46	46	45	45	44	44
2 ACSR (6/1)	38	37	37	36	35	35
2 ACSR (7/1)	29	29	28	28	28	27
1/0 ACSR (6/1)	24	24	23	23	22	22
123.3 AAAC (7)	24	23	23	22	22	21
2/0 ACSR (6/1)	24	23	23	22	22	21
3/0 ACSR (6/1)	19	18	18	17	17	17
4/0 ACSR (6/1)	18	18	17	17	16	16
246.9 AAAC (7)	18	17	17	17	16	16
336.4 ACSR (18/1)	17	17	16	16	15	15
336.4 ACSR (26/7)	12	12	11	11	10	10
			MEDIUM LOADING DISTRICT			
4 ACSR (7/1)	46	45	44	44	43	42
2 ACSR (6/1)	37	37	36	36	35	34
2 ACSR (7/1)	29	29	28	28	27	27
1/0 ACSR (6/1)	24	24	23	23	22	22
123.3 AAAC (7)	24	23	23	22	22	21
2/0 ACSR (6/1)	24	23	23	22	22	21
3/0 ACSR (6/1)	19	18	18	18	17	17
4/0 ACSR (6/1)	19	18	18	17	17	17
246.9 AAAC (7)	18	18	17	17	17	16
336.4 ACSR (18/1)	18	17	17	16	16	16
336.4 ACSR (26/7)	12	12	12	12	11	11
			HEAVY LOADING DISTRICT			
4 ACSR (7/1)	44	43	42	41	39	38
2 ACSR (6/1)	36	35	34	33	32	31
2 ACSR (7/1)	28	27	27	26	25	24
1/0 ACSR (6/1)	23	23	22	21	20	20
123.3 AAAC (7)	23	22	21	21	20	19
2/0 ACSR (6/1)	23	22	22	21	20	19
3/0 ACSR (6/1)	18	18	17	17	16	15
4/0 ACSR (6/1)	18	17	17	16	16	15
246.9 AAAC (7)	18	17	16	16	15	15
336.4 ACSR (18/1)	17	17	16	15	15	14
336.4 ACSR (26/7)	12	12	11	11	10	10

TABLE VII

MAXIMUM LINE ANGLES (Degrees) ON SPOOL INSULATOR ASSEMBLIES

NESC Grade C Construction ***(Re-calculate for NESC Grade B)***

(ANSI Clss 53-4 Spool Insulator)

Designated Maximum Transverse Load = 2,250 Lbs./Conductor

Note: Decrease line angle by 1 degree for poles adjacent to a crossing span.

WIND SPAN (feet)	150	200	250	300	350	400
CONDUCTOR SIZE			LIGHT LOADING DISTRICT			
4 ACSR (7/1)	60	60	60	60	60	60
2 ACSR (6/1)	59	58	58	57	57	56
2 ACSR (7/1)	45	45	44	44	43	43
1/0 ACSR (6/1)	37	37	36	36	35	35
123.3 AAAC (7)	36	36	35	35	35	34
2/0 ACSR (6/1)	37	36	35	35	34	34
3/0 ACSR (6/1)	29	28	28	28	27	27
4/0 ACSR (6/1)	29	28	28	27	27	26
246.9 AAAC (7)	28	27	27	26	26	25
336.4 ACSR (18/1)	27	27	26	25	25	24
336.4 ACSR (26/7)	19	18	18	18	17	17
			MEDIUM LOADING DISTRICT			
4 ACSR (7/1)	60	60	60	60	60	60
2 ACSR (6/1)	59	58	57	57	56	55
2 ACSR (7/1)	45	45	44	44	43	42
1/0 ACSR (6/1)	37	37	36	36	35	35
123.3 AAAC (7)	36	36	35	35	35	34
2/0 ACSR (6/1)	37	36	36	35	35	34
3/0 ACSR (6/1)	29	29	28	28	27	27
4/0 ACSR (6/1)	29	28	28	27	27	27
246.9 AAAC (7)	28	28	27	27	26	26
336.4 ACSR (18/1)	28	27	27	26	26	25
336.4 ACSR (26/7)	19	19	19	18	18	18
			HEAVY LOADING DISTRICT			
4 ACSR (7/1)	60	60	60	60	60	60
2 ACSR (6/1)	57	56	55	54	53	52
2 ACSR (7/1)	44	43	42	42	41	40
1/0 ACSR (6/1)	36	36	35	34	33	33
123.3 AAAC (7)	36	35	34	34	33	32
2/0 ACSR (6/1)	36	35	34	34	33	32
3/0 ACSR (6/1)	29	28	27	27	26	26
4/0 ACSR (6/1)	28	28	27	26	26	25
246.9 AAAC (7)	27	27	26	26	25	24
336.4 ACSR (18/1)	27	26	26	25	24	24
336.4 ACSR (26/7)	19	18	18	17	17	17

LONGITUDINAL LOADING ON CROSSARM ASSEMBLIES

Applied vertical loads need to be considered when determining the permitted longitudinal loading of crossarm deadend assemblies. The following mathematical relationship, which relate vertical and longitudinal loading, has to be satisfied to avoid overstressing the wood fibers of crossarms:

$$\frac{\sum \textit{Applied Vertical Moments}}{\textit{Permitted Vertical Moment (Capacity)}} + \frac{\sum \textit{Applied Longitudinal Moments}}{\textit{Permitted Longitudinal Moment (Capacity)}} \leq 1$$

The following applies to RUS standard distribution, deadend, crossarm assemblies:

- *Permitted Vertical Moment (Capacity) of Assembly* = $N \times M_v \times F_s$
- *Permitted Longitudinal Moment (Capacity) of Assembly* = $N \times M_h \times F_s$
- Σ *Applied Vertical Moments* =

  $$D_1 \times [(S_{in} \times W_1) + (S_{out} \times W_2)] \times F_{OLV} + D_2 \times [(S_{in} \times W_3) + (S_{out} \times W_4)] \times F_{OLV} + M_{LW}$$

- Σ *Applied Longitudinal Moments* =

  $$[D_1 \times (L_{1-in} - L_{1-out}) + D_2 \times (L_{2-in} - L_{2-out})] \times F_{OLL}$$

The units of measure of the above four groups of terms are "ft-lbs." Note that all of the calculations apply to one-half of the crossarm assembly (on either the right or left side of the pole looking parallel to the line). Each conductor attachment location, at a distance D_1 or D_2 from the center of the assembly, has either one conductor attached ("into" the assembly) or has two back-to-back conductors attached (one "into" and one "out from" the assembly).

Following are the definitions and values of the variables in the above equations:

M_v	=	7,650	Vertical crossarm moment (capacity) (ft-lbs)
M_h	=	5,060	Longitudinal crossarm moment (capacity) (ft-lbs)
M_{LW}	=	1,000	Load moment attributed to weight of lineworker (ft-lbs)
F_s	=	0.85	Strength Factor (2002 NESC Table 261-1A) - Grade C
	=	0.65	" " " " " " - Grade B
F_{OLV}	=	1.90	Overload factor - Vertical (2002 NESC Table 253-1) - Grade C
	=	1.50	" " " " " " " - Grade B
F_{OLL}	=	1.30	Overload factor - Longitudinal (2002 NESC Table 253-1) - Grade C
	=	1.65	" " " " " " " - Grade B
D_1	=	1.75	Distance to nearest conductors on 10-foot crossarm assemblies (ft)
D_2	=	4.50	Distance to farthest conductors on 10-foot crossarm assemblies (ft)
D_1	=	3.50	Distance to conductor(s) on 8-foot crossarm assemblies (ft)
W_i	=		Vertical unit weight of conductor plus NESC ice and wind loads (lbs/ft)
S_{in}	=		One-half of the total span length "into" the assembly (ft)

S_{out}	=	One-half of the total span length "out from" the assembly (ft)
N	=	Number of crossarms
L_{in}	=	Tension of each conductor "into" the assembly (lbs)
L_{out}	=	Tension of each conductor "out from" the assembly (lbs)

For purposes of simplifying mechanical loading calculations, the following assumptions and approximations are made:

- All of the conductor spans "into" a crossarm assembly have the same length; all of the conductor spans "out from" a crossarm assembly have the same length. The length "S," where $S = S_{in} + S_{out}$, is called a "*weight span.*"

- The tensions of all of the conductors into the crossarm assembly (L_{in}) are the same; the tensions of all of the conductors out from the crossarm assembly (L_{out}) are the same. "L" is the difference of the conductor tensions ($L = L_{in} - L_{out}$) at each (phase) conductor attachment location on the assembly.

- All of the conductors attached to the crossarm assembly are the same type and size as the largest conductor. Thus in the above equation: $W_1 = W_2 = W_3 = W_4 = W$.

- A load moment (M_{LW}) of 250 pounds (which might be attributed to a lineworker, materials or equipment) times 2 feet and times a constant overload factor of 2.0 (the product equals 1,000 ft-lbs) is added to the applied vertical load moments to satisfy NESC Rule 261D4b requirements. ***(Note: Standard construction practices and RUS discourage lineworkers from standing on crossarms.)***

After applying the above assumptions and substitutions, the equation can be simplified and re-written as:

$$\frac{(D_1 + D_2)\times(W \times S)\times F_{OLV} + 1{,}000}{N \times M_v \times F_s} + \frac{(D_1 + D_2)\times L \times F_{OLL}}{N \times M_h \times F_s} \leq 1 \quad \text{(ft-lbs)}$$

This equation can be solved for "L" as a function of all of the other variables in the equation. Tables A and B show the calculated *permitted unbalanced conductor tensions* ("L") for several commonly used distribution conductors versus three different weight spans ("S"), for standard RUS crossarm deadend assemblies and NESC Grade C construction.

TABLE A

PERMITTED UNBALANCED CONDUCTOR TENSION (Lbs / Phase)*

SINGLE and DOUBLE DEADEND ASSEMBLIES; 1 PHASE EACH SIDE OF POLE- NESC Grade C

CONDUCTOR SIZE	Vertical Loading (lbs/ft)	2 CROSSARMS WEIGHT SPANS** (feet) 200	300	400	3 CROSSARMS WEIGHT SPANS** (feet) 200	300	400
		NESC LIGHT LOADING DISTRICT (0.00" Ice; 9 lb Wind)					
4 ACSR (7/1)	0.0670	1,730	1,720	1,710	2,670	2,670	2,660
2 ACSR (6/1)	0.0913	1,720	1,710	1,700	2,670	2,660	2,650
123.3 AAAC (7)	0.1157	1,720	1,710	1,700	2,660	2,650	2,640
1/0 ACSR (6/1)	0.1452	1,710	1,700	1,680	2,660	2,640	2,630
2/0 ACSR (6/1)	0.1831	1,700	1,690	1,670	2,650	2,630	2,610
3/0 ACSR (6/1)	0.2309	1,700	1,670	1,650	2,640	2,620	2,600
246.9 AAAC (7)	0.2318	1,700	1,670	1,650	2,640	2,620	2,600
4/0 ACSR (6/1)	0.2911	1,680	1,660	1,630	2,630	2,600	2,570
312.8 AAAC (19)	0.2936	1,680	1,650	1,630	2,630	2,600	2,570
336.4 ACSR (18/1)	0.3653	1,670	1,630	1,600	2,610	2,580	2,540
		NESC MEDIUM LOADING DISTRICT (0.25" Ice; 4 lb Wind)					
4 ACSR (7/1)	0.2247	1,700	1,670	1,650	2,640	2,620	2,600
2 ACSR (6/1)	0.2673	1,690	1,660	1,640	2,630	2,610	2,580
123.3 AAAC (7)	0.3172	1,680	1,650	1,620	2,620	2,590	2,560
1/0 ACSR (6/1)	0.3467	1,670	1,640	1,610	2,620	2,580	2,550
2/0 ACSR (6/1)	0.3998	1,660	1,620	1,590	2,610	2,570	2,530
3/0 ACSR (6/1)	0.4647	1,650	1,610	1,560	2,600	2,550	2,510
246.9 AAAC (7)	0.4846	1,650	1,600	1,550	2,590	2,540	2,500
4/0 ACSR (6/1)	0.5439	1,630	1,580	1,530	2,580	2,530	2,470
312.8 AAAC (19)	0.5709	1,630	1,570	1,520	2,570	2,520	2,460
336.4 ACSR (18/1)	0.6557	1,610	1,550	1,490	2,560	2,490	2,430
		NESC HEAVY LOADING DISTRICT (0.50" Ice; 4 lb Wind)					
4 ACSR (7/1)	0.5379	1,640	1,580	1,530	2,580	2,530	2,480
2 ACSR (6/1)	0.5989	1,620	1,570	1,510	2,570	2,510	2,450
123.3 AAAC (7)	0.6741	1,610	1,540	1,480	2,550	2,490	2,420
1/0 ACSR (6/1)	0.7036	1,600	1,540	1,470	2,550	2,480	2,410
2/0 ACSR (6/1)	0.7719	1,590	1,520	1,440	2,540	2,460	2,390
3/0 ACSR (6/1)	0.8539	1,570	1,490	1,410	2,520	2,440	2,350
246.9 AAAC (7)	0.8927	1,570	1,480	1,390	2,510	2,430	2,340
4/0 ACSR (6/1)	0.9520	1,560	1,460	1,370	2,500	2,410	2,320
312.8 AAAC (19)	1.0037	1,550	1,450	1,350	2,490	2,390	2,300
336.4 ACSR (18/1)	1.1015	1,530	1,420	1,310	2,470	2,370	2,260

NOTES: ***Reduce tabulated tensions by 40% for NESC Grade B construction.***

**(Lbs/Phase) means tension difference at each point on crossarms where conductors are attached.*

**** ***Weight span*** *equals 1/2 span length into assembly plus 1/2 span length out from assembly.*

Weight Span for ***single deadend assemblies*** *only equals 1/2 span length into assembly.*

Last 3 notes at end of TABLE B also apply to TABLE A.

TABLE B

PERMITTED UNBALANCED CONDUCTOR TENSION (Lbs / Phase)*

DOUBLE DEADEND ASSEMBLIES - 2 PHASES EACH SIDE OF POLE - NESC Grade C

CONDUCTOR SIZE	Vertical Loading (lbs/ft)	2 CROSSARMS WEIGHT SPANS** (feet) 200	300	400	3 CROSSARMS WEIGHT SPANS** (feet) 200	300	400
		NESC LIGHT LOADING DISTRICT (0.00" Ice; 9 lb Wind)					
4 ACSR (7/1)	0.0670	960	950	950	1,490	1,480	1,480
2 ACSR (6/1)	0.0913	950	950	940	1,480	1,480	1,470
123.3 AAAC (7)	0.1157	950	940	930	1,480	1,470	1,460
1/0 ACSR (6/1)	0.1452	940	930	920	1,470	1,460	1,450
2/0 ACSR (6/1)	0.1831	940	920	900	1,470	1,450	1,430
3/0 ACSR (6/1)	0.2309	930	910	880	1,460	1,440	1,410
246.9 AAAC (7)	0.2318	930	900	880	1,460	1,430	1,410
4/0 ACSR (6/1)	0.2911	920	890	860	1,450	1,420	1,390
312.8 AAAC (19)	0.2936	920	890	860	1,450	1,420	1,390
336.4 ACSR (18/1)	0.3653	900	870	830	1,430	1,400	1,360
		NESC MEDIUM LOADING DISTRICT (0.25" Ice; 4 lb Wind)					
4 ACSR (7/1)	0.2247	930	910	890	1,460	1,440	1,420
2 ACSR (6/1)	0.2673	920	890	870	1,450	1,420	1,400
123.3 AAAC (7)	0.3172	910	880	850	1,440	1,410	1,380
1/0 ACSR (6/1)	0.3467	900	870	840	1,430	1,400	1,370
2/0 ACSR (6/1)	0.3998	890	860	820	1,420	1,390	1,350
3/0 ACSR (6/1)	0.4647	880	840	790	1,410	1,370	1,320
246.9 AAAC (7)	0.4846	880	830	780	1,410	1,360	1,310
4/0 ACSR (6/1)	0.5439	870	810	760	1,400	1,340	1,290
312.8 AAAC (19)	0.5709	860	810	750	1,390	1,340	1,280
336.4 ACSR (18/1)	0.6557	850	780	720	1,380	1,310	1,250
		NESC HEAVY LOADING DISTRICT (0.50" Ice; 4 lb Wind)					
4 ACSR (7/1)	0.5379	870	820	760	1,400	1,350	1,290
2 ACSR (6/1)	0.5989	860	800	740	1,390	1,330	1,270
123.3 AAAC (7)	0.6741	840	780	710	1,370	1,310	1,240
1/0 ACSR (6/1)	0.7036	840	770	700	1,370	1,300	1,230
2/0 ACSR (6/1)	0.7719	820	750	670	1,350	1,280	1,200
3/0 ACSR (6/1)	0.8539	810	720	640	1,340	1,250	1,170
246.9 AAAC (7)	0.8927	800	710	630	1,330	1,240	1,160
4/0 ACSR (6/1)	0.9520	790	700	600	1,320	1,230	1,130
312.8 AAAC (19)	1.0037	780	680	580	1,310	1,210	1,110
336.4 ACSR (18/1)	1.1015	760	650	550	1,290	1,180	1,080

NOTES: ***Reduce tabulated tensions by 40% for NESC Grade B construction.***

**(Lbs/Phase) means tension difference at each point on crossarms where conductors are attached.*
*** **Weight span** equals 1/2 span length into assembly plus 1/2 span length out from assembly.*
Calculations assume all conductors same size and type as largest conductor and level spans.
Assemblies have been multiplied by strength factor of 0.85 (2002 NESC Table 261-1A).
Applied loads have been multiplied by overload factors (2002 NESC Table 253-1).

Disposition of Assemblies in Bulletin 50-3 (D 804)

Old Assembly Number (Bulletin 50-3)	New Assembly Number (1728F-804)	Material Changes and Comments
A1	A1.1	No material changes
A1A	A1.2	No material changes
A1-1	A2.1	No material changes
A1-1A	A2.2	No material changes
A1P	A1.1P	No material changes
A1AP	A1.2P	No material changes
A1-1AP	A2.2P	No material changes
A1-1P	A2.1P	No material changes
A2	A2.3	No material changes
A2P	A2.3P	No material changes
A3	A3.1	Replace 2 washers abutting pole
A4	A4.1	Replace 4 washers abutting pole
A5	A5.1	Replace 2 washers abutting pole
A5-1		Discontinued *(Material same as A5.1; Replaced with A5.2G)*
A5-2	A5.2	Replace 2 washers abutting pole
A5-2A		Discontinued *(Same as A5.2 and note)*
A5-3		Discontinued *(Same as A5.1 and note)*
A5-4		Discontinued *(Combination of A5.1, A1.1 and A5.2G)*
A6	A6.1	Replace 4 washers abutting pole
A7	A5.21	No material changes
A7-1	A5.31	No material changes
A8	A6.21	No material changes
A9	A2.21	Add 4 washers under crossarm pins
A9P	A2.21P	Add 2 washers under crossarm pins
A9-1	A1.11	Add 2 washers under crossarm pins
A9-1P	A1.11P	Add 1 washer under crossarm pin
A22		Discontinued *(Combination of A1.11, A1.11 and A1.12G)*
A22P		Discontinued *(Combination of A1.11P, A1.1 and A1.12G)*
B1	B1.11	Add 2 washers under crossarm pins
B1A	B1.12	Add 2 washers under crossarm pins
B1P	B1.11P	No material changes
B1AP	B1.12P	No material changes
B1-1	B2.24	Add 4 washers under crossarm pins
B1-1A	B2.25	Add 4 washers under crossarm pins
B1-1P	B2.24P	No material changes
B1-1AP	B2.25P	No material changes
B2	B2.21	Add 4 washers under crossarm pins
B2P	B2.21P	No material changes
B3	B3.1	Replace 2 washers abutting pole and slight material changes

Disposition of Assemblies in Bulletin 50-3 (D 804)

Old Assembly Number (Bulletin 50-3)	**New Assembly Number** (1728F-804)	**Material Changes and Comments**
B3A		Discontinued *(Similar to B3.1)*
B4-1		Discontinued *(Replaced with guide B4.1G)*
B4-1A		Discontinued *(Replaced with guide B4.1G)*
B5-1	B5.1	Replace 3 washers abutting pole and slight material changes
B5-1A		Discontinued *(Similar to B5.1)*
B7	B5.21	Neutral position and material slightly different
B7-1	B5.31	Neutral position and material slightly different
B8	B6.21	Neutral and material slightly different
B9	B2.22	Add 6 washers under crossarm pins
B9-1	B1.14	Add 3 washers under crossarm pins
B9-2		Discontinued *(Same as B2.22 except for 10-foot crossarms)*
B9-3		Discontinued *(Same as B1.14 except for 10-foot crossarms)*
B9P	B2.22P	Add 2 washers under crossarm pins
B9-1P	B1.14P	Add 1 washer under crossarm pin
B9-2P		Discontinued *(Same as B2.22P except for 10-foot crossarms)*
B9-3P		Discontinued *(Same as B1.14P except for 10 foot crossarms)*
B22		Discontinued *(Same as two B1.11s)*
B22P		Discontinued *(Same as two B1.11Ps)*
C1	C1.11	Add 2 washers under crossarm pins
C1A	C1.12	Add 2 washers under crossarm pins
C1P	C1.11P	No material changes
C1AP	C1.12P	No material changes
C1PL		Discontinued *(Same as C1.11P except crossarm braces)*
C1-1	C2.24	Add 4 washers under crossarm pins
C1-1A	C2.25	Add 4 washers under crossarm pins
C1-1AP	C2.24P	No material changes
C1-1P	C2.25P	No material changes
C1-3P	C2.21P	No material changes
C1-4PL		Discontinued *(Second center insulator not needed)*
C1-2	C1.11L	No material changes
C1-3	C2.21L	No material changes
C1-4	C1.13L	No material changes
C2	C2.21	Add 4 washers under crossarm pins
C2-1	C2.52	Add 6 washers under crossarm pins
C2-2	C2.52L	No material changes
C2-2PL	C2.52P	2 fewer double arming bolts – optional
C3	C3.1	Replace 4 washers abutting pole; add neutral eyebolt
C3-1	C3.1L	Replace 8 washers abutting pole
C4-1		Discontinued *(Replaced with guide C4.1G)*

Disposition of Assemblies in Bulletin 50-3 (D 804)

Old Assembly Number (Bulletin 50-3)	**New Assembly Number** (1728F-804)	**Material Changes and Comments**
C5-1	C5.2	Replace 4 washers abutting pole
C7	C5.21	Replace 1 washer abutting pole
C7-1	C5.31	Replace 1 washer abutting pole
C7A	C5.71L	Replace 1 washer abutting pole
C7-2	C5.22	Slight material changes
C8	C6.21	Different neutral and crossarm brace materials
C8-1		Discontinued *(Replaced with C6.51)*
C8-2		Discontinued *(Similar to C5.21)*
C8-3	C6.31L	Different neutral position and materials
C9	C2.51	Add 8 washers under crossarm pins and anti-split bolt
C9-1	C1.41	Add 4 washers under crossarm pins
C9-2	C2.51L	Replace 2 crossarm pins with clamp-type
C9-3	C1.41L	Replace 1 crossarm pin with clamp-type
C9-1P	C1.41P	Add 1 washer under crossarm pin
C9-2PL	C2.51P	Add 2 washers under crossarm pins; 2 fewer double arming bolts – optional
C9-3PL		Discontinued *(Nearly same as C9-1P)*
C22		Discontinued *(Combination of C1.11, A1.11 and C6.91G)*
C24		Discontinued *(Replaced with C6.91G)*
DC-C1	D1.81	Add 6 washers under crossarm pins
DC-C1A		Discontinued
DC-C1-1A		Discontinued
DC-C1PL		Discontinued *(Replaced with D1.81P)*
DC-C1-3PL		Discontinued *(Replaced with D2.91P)*
DC-C2		Discontinued *(Wrong neutral for line angle)*
DC-C2-1	D2.91	Add 12 washers under crossarm pins
DC-C3		Discontinued *(Replaced by two C3's and D3.1G)*
DC-C4-1		Discontinued *(Replaced by four C3's and D4.1G)*
DC-C8	D6.91	Slightly different neutral and other material.
DC-C25		Discontinued *(Replace with guide drawing D5.91G)*
E1-1		Discontinued *(See E1.1)*
E1-2	E1.1	Add Guy Marker
E1-3	E1.1L	Add Guy Marker
E2-1		Discontinued
E2-2	E1.4	Different guy strand wire *(Different permitted loads)*
E2-3	E1.4L	Replace 5/8" thimble eye bolt and nut with 3/4"
E3-2		Discontinued
E3-3	E1.2	Add Guy Marker *(Different permitted loads)*
E3-10		Discontinued

Disposition of Assemblies in Bulletin 50-3 (D 804)

Old Assembly Number (Bulletin 50-3)	New Assembly Number (1728F-804)	Material Changes and Comments
E4-2		Discontinued *(See note 3 on E1.4)*
E4-3		Discontinued *(See note 3 on E1.4)*
E5-1		Discontinued
E5-2		Discontinued
E6-2		Discontinued *(See E2.1G)*
E6-3		Discontinued *(See E2.1G)*
E7-2		Discontinued *(See E3.1LG)*
E7-3		Discontinued *(See E3.1LG)*
E8-2		Discontinued *(See E4.3LG)*
E8-3		Discontinued *(See E4.3LG)*
E11		Discontinued *(See E1.2)*
E12		Discontinued *(See E1.2)*
F1-1	F1.6	No material changes
F1-2	F1.8	No material changes
F1-3	F1.10	No material changes
F1-4	F1.12	No material changes
F1-1C		Discontinued *(Not in List of Materials)*
F1-2C		Discontinued *(Not in List of Materials)*
F1-3C		Discontinued *(Not in List of Materials)*
F1-1P	F3.6	No material changes
F1-2P	F3.8	No material changes
F1-3P	F3.10	No material changes
F1-4P	F3.12	No material changes
F1-1S	F2.6	No material changes
F1-2S	F2.8	No material changes
F1-3S	F2.10	No material changes
F1-4S	F2.12	No material changes
F2-1		Discontinued
F2-2		Discontinued
F2-3		Discontinued
F2-4		Discontinued
F4-1E	F4.1	No material changes
F4-1S	F4.2	No material changes
F5-1	F5.1	No material changes
F5-2	F5.2	No material changes
F5-3	F5.3	No material changes
F6-1	F6.6	No material changes
F6-2	F6.8	No material changes
F6-3	F6.10	No material changes

Disposition of Assemblies in Bulletin 50-3 (D 804)

Old Assembly Number (Bulletin 50-3)	New Assembly Number (1728F-804)	Material Changes and Comments
G9-	G1.7	No material changes
G65-		Discontinued
G105-	G1.2	No material changes
G10-	G1.8	No material changes
G66-		Discontinued
G106-	G1.3	No material changes
G39-		Discontinued - *Same as G9-*
G67-		Discontinued
G136-		Discontinued - *Same as G105-*
G210-	G2.1	No material changes *(Drawing modified)*
G310-	G3.1	No material changes *(Drawing modified)*
G311-	G3.2	No material changes *(Drawing modified)*
G312-	G3.3	No material changes *(Drawing modified)*
J5	J1.2	No material changes
J6	J3.1	No material changes
J7	J2.2	No material changes
J7C		Discontinued - *Same as J7*
J8	J1.1	No material changes
J10	J2.1	No material changes
J11		Discontinued - *Same as J6*
J12	J4.1	No material changes
K10	K2.1	No material changes
K11	K1.4	No material changes
K14	K1.3	No material changes
K10C	K2.2	No material changes
(K10C)	K2.3	No material changes
K10L		Discontinued - *Same as K10*
K11L		Discontinued - *Same as K11*
K14L		Discontinued - *Same as K14*
K11C	K1.2	No material changes
K14C	K1.1	No material changes
K15C	K1.5	No material changes
K16C	K3.2	No material changes
K17	K3.1	No material changes
K17L		Discontinued - *Same as K17*
M2-1		Discontinued
M2-11	H1.1	No material changes
M2-2		Discontinued
M2-12	H5.1	No material changes

Disposition of Assemblies in Bulletin 50-3 (D 804)

Old Assembly Number (Bulletin 50-3)	**New Assembly Number** (1728F-804)	**Material Changes and Comments**
M2-2A		Discontinued
M2-12A	H5.2	No material changes
M2-2A2		Discontinued
M2-12A2		Discontinued
M2-3		Discontinued
M2-13	H2.1	No material changes
M2-7		Discontinued
M2-17		Discontinued
M2-9		Discontinued
M2-15	H3.1	No material changes
M2-15A	H4.1	No material changes
M3-1A		Discontinued
M3-4	S1.1	Replace lag screw with machine bolt and washer
M3-2A	S2.21	Slight material changes
M3-3A	S2.31	Slight material changes
M3-3B	S2.3	No material changes
M3-10	R1.1	Slight material changes *(Add bracket)*
M3-41	S3.1	Slight material changes *(Add bracket)*
M3-11		Discontinued *(See R3.1)*
M3-12		Discontinued *(Replaced with R3.1)*
M3-11A	R2.1	No material changes
M3-12A	R3.1	No material changes
M3-15	S2.32	Slight material changes
M3-23		Discontinued
M3-24		Discontinued
M3-25		Discontinued
M3-23A	R1.2	Slight material changes *(Add bracket)*
M3-24A	R2.2	Slight material changes
M3-25A	R3.2	Slight material changes
M3-30	R3.3	Slight material changes
M5-1		Discontinued
M5-2	A1.01	No material changes
M5-5	A1.011	Add 1 washer under crossarm pin
M5-6	P1.01	No material changes
M5-7	A1.011P	No material changes
M5-8	A5.02	No material changes
M5-9	S1.01	No material changes
M5-10	S1.02	No material changes
M5-11		Discontinued

Disposition of Assemblies in Bulletin 50-3 (D 804)

Old Assembly Number (Bulletin 50-3)	New Assembly Number (1728F-804)	Material Changes and Comments
M5-12		Discontinued
M5-13	W3.2	No material changes
M5-14		Discontinued
M5-16		Discontinued
M5-17	W3.1	No material changes
M5-18	A1.01P	No material changes
M5-19	N1.2	No material changes
M5-20		Discontinued *(See A5.3)*
M5-21		Discontinued
M5-22		Discontinued
M5-23		Discontinued
M5-24	A5.01	No material changes
M5-25	N5.1	Replace 1 washer abutting pole
M5-26	N5.3	Replace 1 washer abutting pole
M7-11	Y1.1	Minor material changes – *replace crossarms with bracket*
M7-13	Y1.3	Minor material changes
M8	Q1.1	Minor material changes
M8-6	Q3.1	No material changes
M8-9	Q2.2G	Modified guide drawing; no material
M8-10	Q2.1G	Modified guide drawing; no material
M8-11	Q3.3	Minor material changes
M8-12	Q3.2	Minor material changes
M8-15	Q4.1	Minor material changes
M9-11	Y3.1	No material changes
M9-12	Y3.2	Minor material changes
M9-13	Y3.3	Minor material changes
M19	W2.1G	Modified guide drawing; no material
M20	W1.1G	Modified guide drawing; no material
M21		Discontinued *(Guide drawing)*
M22-1		Discontinued *(Guide drawing)*
M22-2		Discontinued *(Guide drawing)*
M24	K4.1G	Modified guide drawing; no material
M24-1		Discontinued *(Guide drawing)*
M24-10	K4.2G	Modified guide drawing; no material
M26-5		Discontinued *(Guide drawing)*
M27		Discontinued *(Guide drawing)*
M27-1		Discontinued *(Guide drawing)*
M27-1A	G1.1G	Modified guide drawing; no material
M27-2		Discontinued *(Guide drawing)*

Disposition of Assemblies in Bulletin 50-3 (D 804)

Old Assembly Number (Bulletin 50-3)	**New Assembly Number** (1728F-804)	**Material Changes and Comments**
M28		Discontinued *(See G1.1G)*
M29-1		Discontinued *(See guide drawings in Sections A and C)*
M29-2		Discontinued *(See guide drawings in Sections A and C)*
M30-1		Discontinued *(Guide drawing)*
M30-2		Discontinued *(Guide drawing)*
M40-11		Discontinued *(Guide drawing)*
M41-1		Discontinued *(Replaced assemblies L1.1 and L3.1)*
M41-10		Discontinued *(Replaced assemblies L1.2 and L3.2)*
M42-3		Discontinued *(Replaced assemblies L1.3 and L3.4)*
M42-11		Discontinued *(Replaced assemblies L1.5 and L3.5)*
M42-13		Discontinued *(Replaced assembly L2.5)*
M42-21		Discontinued *(Replaced assemblies L1.4 and L3.3)*
M43-4		Discontinued *(Guide drawing)*
M43-10		Discontinued *(Guide drawing)*
M52-3		Discontinued *(Guide drawing)*
M52-4		Discontinued *(Guide drawing)*
R1	M1.30G	Modified guide drawing; no material

249 Total Assemblies *(257 – 8 discontinued duplicates)*

82 Discontinued

94 Re-used: No material changes
37 Re-used: Washer changes only
36 Re-used: Other slight material changes
167 Total assemblies re-used

32 Total Guide Drawings
24 Discontinued
8 Re-used

180 Total pages

Bulletin 1728F-804: New Assemblies and Guide Drawings	
NUMBER	**ASSEMBLY / GUIDE DRAWING DESCRIPTION**

NEW SINGLE-PHASE PRIMARY POLE TOP ASSEMBLIES	
A1.011L	SINGLE SUPPORT - PRIMARY
A1.04N A1.04NP	SINGLE SUPPORT – NARROW PROFILE
A1.3	SINGLE SUPPORT
A1.3P	SINGLE SUPPORT (POST INSULATORS)
A1.4N A1.5N	SINGLE SUPPORT – NARROW PROFILE (TANGENT)
A1.4NP A1.5NP	SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
A1.6N	SINGLE SUPPORT - NARROW PROFILE
A1.6NP	SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
A1.12G	SINGLE PHASE JUNCTION GUIDE
A2.01 A2.01P A2.021 A2.021P	DOUBLE SUPPORT - PRIMARY
A2.04N A2.04NP	DOUBLE SUPPORT – NARROW PROFILE
A2.4N A2.5N	DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
A2.4NP A2.5NP	DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
A2.6N	DOUBLE SUPPORT - NARROW PROFILE
A2.6NP	DOUBLE SUPPORT – NARROW PROFILE (POST INSULATORS)
A3.2 A3.3	SUSPENSION ANGLE
A3.4 A3.5 A3.6 A3.7 A3.8 A3.9	SUSPENSION ANGLE
A4.2	DEADEND ANGLE (15° - 90°)
A5.03	SINGLE DEADENDS
A5.3	SINGLE DEADENDS

A5.4 A5.5 A5.6 A5.7 A5.8 A5.9	SINGLE DEADENDS
A5.2G	SINGLE PHASE TAP GUIDE
A5.3NG	SINGLE PHASE TAP GUIDE - NARROW PROFILE
A5.4NG	SINGLE PHASE TAP GUIDE - NARROW PROFILE (WITH CUTOUT AND ARRESTER)
A6.2	DOUBLE DEADEND (FEED THROUGH)
A6.22G	DOUBLE DEADEND GUIDE (FEED THROUGH ON CROSSARMS)
	NEW TWO-PHASE PRIMARY POLE TOP ASSEMBLIES
B1.1N B1.2N	SINGLE SUPPORT - NARROW PROFILE (TANGENT)
B1.1NP B1.2NP	SINGLE SUPPORT - NARROW PROFILE (TANGENT) (POST INSULATORS)
B1.3N	SINGLE SUPPORT - NARROW PROFILE
B1.3NP	SINGLE SUPPORT – NARROW PROFILE (POST INSULATORS)
B1.4N B1.5N	SINGLE SUPPORT - NARROW PROFILE (TANGENT)
B1.4NP B1.5NP	SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B1.6N	SINGLE SUPPORT - NARROW PROFILE
B1.6NP	SINGLE SUPPORT - NARROW PROFILE (POST INSULATORS)
B1.7N B1.8N	SINGLE SUPPORT - NARROW PROFILE (TANGENT)
B1.7NP B1.8NP	SINGLE SUPPORT - NARROW PROFILE (TANGENT) (POST INSULATORS)
B1.9N	SINGLE SUPPORT - NARROW PROFILE
B1.9NP	SINGLE SUPPORT - NARROW PROFILE (POST INSULATORS)
B1.13	SINGLE SUPPORT ON CROSSARM
B1.13P	SINGLE SUPPORT ON CROSSARM (POST INSULATORS)
B2.1N B2.2N	DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
B2.1NP B2.2NP	DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B2.3N	DOUBLE SUPPORT - NARROW PROFILE
B2.3NP	DOUBLE SUPPORT - NARROW PROFILE (POST INSULATORS)
B2.4N B2.5N	DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
B2.4NP	DOUBLE SUPPORT – NARROW PROFILE (TANGENT)

B2.5NP	(POST INSULATORS)
B2.6N	DOUBLE SUPPORT - NARROW PROFILE
B2.6NP	DOUBLE SUPPORT - NARROW PROFILE (POST INSULATORS)
B2.7N B2.8N	DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
B2.7NP B2.8NP	DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
B2.9N	DOUBLE SUPPORT - NARROW PROFILE
B2.9NP	DOUBLE SUPPORT - NARROW PROFILE (POST INSULATORS)
B3.2 B3.3	SUSPENSION ANGLE
B3.4 B3.5 B3.6 B3.7 B3.8 B3.9	SUSPENSION ANGLE
B4.1G	DEADEND ANGLE GUIDE ($90^0 – 150^0$)
B4.2G	DEADEND ANGLE GUIDE ($15^0 – 90^0$)
B5.2 B5.3	SINGLE DEADENDS
B5.4 B5.5 B5.6 B5.7 B5.8 B5.9	SINGLE DEADENDS
NEW THREE-PHASE PRIMARY POLE TOP ASSEMBLIES	
C1.1N C1.2N	SINGLE SUPPORT – NARROW PROFILE (TANGENT)
C1.1NP C1.2NP	SINGLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
C1.3N	SINGLE SUPPORT - NARROW PROFILE
C1.3NP	SINGLE SUPPORT - NARROW PROFILE (POST INSULATORS)
C1.4N C1.5N	SINGLE SUPPORT - NARROW PROFILE (TANGENT
C1.4NP C1.5NP	SINGLE SUPPORT - NARROW PROFILE (TANGENT) (POST INSULATORS)
C1.6N	SINGLE SUPPORT - NARROW PROFILE
C1.6NP	SINGLE SUPPORT - NARROW PROFILE (POST INSULATORS)
C1.7N C1.8N	SINGLE SUPPORT - NARROW PROFILE (TANGENT)
C1.7NP C1.8NP	SINGLE SUPPORT - NARROW PROFILE) (TANGENT) (POST INSULATORS)

C1.9N	SINGLE SUPPORT - NARROW PROFILE
C1.9NP	SINGLE SUPPORT - NARROW PROFILE (POST INSULATORS)
C1.12L	SINGLE SUPPORT ON CROSSARM – (TANGENT) (LARGE CONDUCTORS)
C1.13	SINGLE SUPPORT ON CROSSARM
C1.13P	SINGLE SUPPORT ON CROSSARM (POST INSULATORS)
C1.81G	THREE-PHASE JUNCTION GUIDE
C2.1N C2.2N	DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
C2.1NP C2.2NP	DOUBLE SUPPORT – TANGENT (POST INSULATORS) (NARROW PROFILE)
C2.3N	DOUBLE SUPPORT - NARROW PROFILE
C2.3NG	DOUBLE SUPPORT – NARROW PROFILE (ALTERNATIVE GUYING GUIDE
C2.3NP	DOUBLE SUPPORT - NARROW PROFILE (POST INSULATORS)
C2.4N C2.5N	DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
C2.4NP C2.5NP	DOUBLE SUPPORT – NARROW PROFILE TANGENT (POST INSULATORS)
C2.6N	DOUBLE SUPPORT - NARROW PROFILE
C2.6NP	DOUBLE SUPPORT - NARROW PROFILE (POST INSULATORS)
C2.7N C2.8N	DOUBLE SUPPORT – NARROW PROFILE (TANGENT)
C2.7NP C2.8NP	DOUBLE SUPPORT – NARROW PROFILE (TANGENT) (POST INSULATORS)
C2.9N	DOUBLE SUPPORT - NARROW PROFILE
C2.9NP	DOUBLE SUPPORT - NARROW PROFILE (POST INSULATORS)
C3.2 C3.3	SUSPENSION ANGLE
C3.4 C3.5 C3.6 C3.7 C3.8 C3.9	SUSPENSION ANGLE
C4.1G	DEADEND GUIDE ($90^{O} – 150^{O}$)
C4.2G	DEADEND GUIDE ($15^{O} – 90^{O}$)
C5.1 C5.3	SINGLE DEADENDS - VERTICAL
C5.4 C5.5 C5.6 C5.7 C5.8	SINGLE DEADENDS - VERTICAL

C5.9	
C5.11G	SINGLE PHASE TAP GUIDE
C5.21L C5.31L	SINGLE DEADEND ON CROSSARMS (LARGE CONDUCTORS)
C5.32	SINGLE DEADEND ON CROSSARMS - ALTERNATIVE
C5.82G	THREE PHASE HORIZONTAL TAP GUIDE
C6.31	DOUBLE DEADEND ON CROSSARMS
C6.21L	DOUBLE DEADEND ON CROSSARMS (LARGE CONDUCTORS)
C6.52 C6.53	DOUBLE DEADEND ON 10-FOOT CROSSARMS
C6.52G	DOUBLE DEADEND ON 10-FOOT CROSSARMS (FEEDTHROUGH GUIDE)
C6.91G	DOUBLE DEADENDS (BUCKARMS) GUIDE
NEW DOUBLE CIRCUIT PRIMARY POLE TOP ASSEMBLIES	
D1.4N D1.4NP D1.5N D1.5NP	SINGLE SUPPORT - NARROW PROFILE – (TANGENT) (and POST INSULATORS
D1.82	SINGLE SUPPORT ON CROSSARMS – (TANGENT)
D1.81L D1.82L	SINGLE SUPPORT ON CROSSARMS – (TANGENT) (LARGE CONDUCTORS)
D1.81P D1.82P	SINGLE SUPPORT ON CROSSARMS - (TANGENT) (POST INSULATORS)
D1.83	SINGLE SUPPORT ON CROSSARMS
D1.83L	SINGLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)
D1.83P	SINGLE SUPPORT ON CROSSARMS (POST INSULATORS)
D2.9N D2.9NP	DOUBLE SUPPORT - NARROW PROFILE (and POST INSULATORS
D2.91L	DOUBLE SUPPORT ON CROSSARMS (LARGE CONDUCTORS)
D2.91P	DOUBLE SUPPORT ON CROSSARMS (POST INSULATORS)
D3.1G	SUSPENSION ANGLE GUIDE
D4.1G	DEADEND ANGLE GUIDE
D5.91G	THREE PHASE TAP GUIDE
NEW GUYING ASSEMBLIES	
E1.3L	SINGLE DOWN GUY - LARGE CONDUCTORS (POLE BAND TYPE)
E1.5	GUY STRAIN INSULATOR
E2.1G	DOUBLE DOWN GUY GUIDE - (THROUGH BOLT TYPE)
E3.1LG	THREE DOWN GUY GUIDE - HEAVY DUTY (THROUGH BOLT TYPE)
E4.3LG	FOUR DOWN GUY GUIDE - LARGE CONDUCTORS (POLE BAND TYPES)

NEW TRANSFORMER ASSEMBLIES	
G1.2G	POLE TYPE TRANSFORMER LOCATION GUIDE
G1.4 G1.5	SINGLE-PHASE, CONVENTIONAL TRANSFORMER (TANGENT POLE)
G1.6	SINGLE-PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)
G2.1G	TRANSFORMER / METER CONNECTION GUIDE THREE-PHASE, OPEN-WYE - OPEN DELTA FOR 120/240 VOLT POWER LOADS
G3.1G	TRANSFORMER / METER CONNECTION GUIDE UNGROUNDED WYE - CENTER TAP GROUNDED DELTA FOR 120/240 VOLT POWER LOADS
G3.2G	TRANSFORMER / METER CONNECTION GUIDE UNGROUNDED WYE - CORNER GROUNDED DELTA FOR 240 OR 480 VOLT POWER LOADS
G3.3G	TRANSFORMER / METER CONNECTION GUIDE GROUNDED WYE - GROUNDED WYE FOR 120/208 VOLT POWER LOADS
NEW GROUNDING ASSEMBLIES	
H5.3	GROUNDING IMPROVEMENT ASSEMBLIES - WRAP-AROUND TYPE
NEW TYING ASSEMBLIES	
L1.1 L1.2	PRIMARY ANGLE TYING ASSEMBLIES
L1.3 L1.4 L1.5	PRIMARY DEADEND TYING ASSEMBLIES
L2.1 L2.2	NEUTRAL ANGLE TYING ASSEMBLIES
L2.3 L2.4 L2.5	NEUTRAL DEADEND TYING ASSEMBLIES
L3.1 L3.2	NEUTRAL & SECONDARY ANGLE TYING ASSEMBLIES
L3.3 L3.4	NEUTRAL & SECONDARY DEADEND TYING ASSEMBLIES - (COPPER)
L3.5 L3.6	NEUTRAL & SECONDARY DEADEND TYING ASSEMBLIES - (ACSR)
L4.1	TYING ASSEMBLIES, SERVICES
L4.2 L4.3 L4.4	TYING ASSEMBLIES, SERVICES

NEW NEUTRAL ASSEMBLIES	
N1.1	NEUTRAL ASSEMBLIES - TANGENT
N1.11 N2.21	NEUTRAL SUPPORTS ON CROSSARMS
N2.1 N2.1L	NEUTRAL ASSEMBLIES - LARGE ANGLE
N5.2	NEUTRAL ASSEMBLIES - (SINGLE DEADENDS)
N6.1	NEUTRAL ASSEMBLY - DOUBLE DEADEND
N6.21	NEUTRAL ASSEMBLY - DOUBLE DEADEND ON CROSSARMS
NEW PROTECTION ASSEMBLIES	
P1.1	SURGE ARRESTERS - SINGLE PHASE
P1.1NG	SURGE ARRESTER GUIDE - NARROW PROFILE
P1.3	SURGE ARRESTERS - 3 SINGLE PHASE
P3.1G	RAPTOR PROTECTION ASSEMBLY GUIDE SUPPORT ON 8-FOOT CROSSARMS (TANGENT)
P3.2G	RAPTOR PROTECTION ASSEMBLY GUIDE SUPPORT ON 10-FOOT CROSSARMS (TANGENT)
P3.3G	RAPTOR PROTECTION, PERCH GUARDS - GUIDE
P3.4G	RAPTOR PROTECTION, SINGLE-PHASE, CSP TRANSFORMER (TANGENT POLE)
P3.5G	RAPTOR PROTECTION ASSEMBLY GUIDE THREE-PHASE TRANSFORMER BANK
NEW SECTIONALIZING ASSEMBLIES	
S2.01	MISCELLANEOUS CUTOUTS AND DISCONNECT SWITCH
S1.1N	CUTOUT GUIDE - NARROW PROFILE
S1.3	COUTOUTS - (THREE SINGLE-PHASE)
S3.2	SECTIONALIZER (WITH BYPASS CUTOUT)
NEW VOLTAGE ALTERATION EQUIPMENT ASSEMBLIES	
Y2.1 Y2.2	AUTOTRANSFORMER, POLE MOUNTED (ONE SINGLE-PHASE, STEP-DOWN)
Y3.4	SWITCHED CAPACITOR BANK - THREE PHASE
	215 Total new assemblies (95 narrow profile) **32 Total new guide drawings** (4 narrow profile)

RUS Standard Format and Meaning of Overhead Distribution Assembly Numbers

The RUS standard numbering format for overhead distribution assemblies is: $\mathbf{L_1N_1.N_2}$

$\mathbf{L_1}$ is an alphabetic character that represents the *category* or group of similar assemblies that fulfill a similar and specific function in the construction or operation of an overhead distribution line. For example, the assemblies in category "C" are pole top assemblies that support three primary conductors (3-phase) and a neutral conductor.

The following table shows the 19 distribution assembly categories and the letter (L_1) RUS has assigned to represent them.

DESIGNATED MEANINGS of ASSEMBLY CATEGORY NUMBERS (L_1)					
A	1-Phase, pole-top	**H**	Grounds	**Q**	Metering
B	2-Phase, pole-top	**J**	Secondaries	**R**	Reclosers
C	3-Phase, pole-top	**K**	Services	**S**	Sectionalizing
D	Double Circuit, pole-top	**L**	Conductor Tying	**W**	Poles, Crossarms
E	Guys	**M**	Miscellaneous	**Y**	Volt. Alteration Equip.
F	Anchors	**N**	Neutrals		
G	Transformers	**P**	Protection		

$\mathbf{N_1}$ is a numeric character that represents a *subcategory* or group of similar assemblies within a category. The different assemblies in a subcategory all fulfill the same specific functional purpose, but their function is somewhat different than the other assemblies within their associated assembly category (L_1). For example, within categories "A" through "D" the subcategory "1" assemblies are all *tangent or small angle* pole top assemblies that (only) support the primary and neutral conductors.

The following table shows the RUS designated meaning of the numbers (N_1) that represent the 6 subcategories within pole-top assembly categories "A" through "D".

DESIGNATED MEANINGS of SUBCATEGORY NUMBERS (N_1) for POLE TOP ASSEMBLIES	
1	Tangent or Small Angles (single pin or post type insulators)
2	Small Angles (double pin or post type insulators)
3	Large Angles (suspension type insulators)
4	Large Angles (double deadends)
5	Single Deadends or Taps
6	Double Deadends

RUS has assigned meanings to the subcategory numbers (N_1) for the remaining 15 (L_1) categories of overhead distribution assemblies, however, the list and meanings of these numbers is long and varied and beyond the scope of this summary exhibit. The remaining subcategory numbers and their assigned meanings are tabulated in RUS

Bulletin 1728F-800, "Construction Assembly Unit Numbers and Format." This bulletin is posted on the RUS website at: http://www.usda.gov/rus/electric/bulletins.htm.

N_2, which is always either a one or two digit number, is defined as the ***assembly identification number***. This number is used to differentiate the similar assemblies in a subcategory (N_1) of assemblies

RUS has assigned assembly identifications numbers from 11 through 99 to pole top assemblies that are constructed with crossarms. Furthermore, the two-digit crossarm assembly identification numbers have been assigned the designated meaning shown in the following table.

DESIGNATED MEANINGS of ASSEMBLY IDENTIFICATION NUMBERS (N_2) for CROSSARM ASSEMBLIES	
11-19	Single 8-foot crossarms
21-29	(1 set of) Double 8-foot crossarms
31-39	(1 set of) Triple 8-foot crossarms
41-49	Single 10-foot crossarms
51-59	(1 set of) Double 10-foot crossarms
61-69	*Not used – Reserved for future*
71-79	(1) Pre-assembled (manufactured) single crossarm assembly (item "gj")
81-89	Multiple crossarm assemblies
91-99	Multiple crossarm assemblies

The ***prefix*** "V" in front of a standard assembly number indicates that the assembly is used for 24.9/14.4 kV line construction. A standard assembly number with no prefix indicates that the assembly is used for 12.47/7.2 kV line construction.

A ***suffix*** is an alphabetic character placed at the end of a standard assembly number. A suffix describes the type of the assembly. Presently, RUS only uses the following 4 suffixes whose designated meanings are shown in parentheses:

G (Guide drawing, not an assembly)
N (Narrow profile construction assembly)
L (Large conductor construction)
P (Assembly with post type insulators)

Not all assembly numbers have suffixes and some may have more than one suffix letter.

TABLE OF SELECTED SI TO METRIC CONVERSIONS

LENGTH

To Convert From	*To*	*Multiply By*	
foot (ft.)	meter (m)	3.048	E-01
inch (in.)	meter (m)	2.540	E-02
kilometer (km)	meter (m)	1.000	E+03
mile (mi.)	meter (m)	1.609344	E+03

AREA

To Convert From	*To*	*Multiply By*	
circular mil (cmil)	square meter	5.067075	E-10
square centimeter	square meter	1.000	E-04
square foot	square meter	9.290304	E-02
square kilometer	square meter	1.000	E+06
square mile	square meter	2.589988	E+06

FORCE

To Convert From	*To*	*Multiply By*	
kilogram force (kgf)	newton (N)	9.806650	
kip	newton (N)	4.448222	E+03
pound force (lbf)	newton (N)	4.448222	

MASS

To Convert From	*To*	*Multiply By*	
pound (avoirdupois) (lb)	kilogram (kg)	4.535924	E-01

Respondent's Cross Exhibit 2

I/A

ACTIVE

CASE LIST

GREGORY L. BOOTH, PE PLS
EXPERT WITNESS

ACTIVE CASES

CASE	
2009 Harold Thurman v. Kansas City Power & Light Company 10 CR-CC00101	(P) (DE)
2010 Tammy Greely Adminstratix of Estate of Ralph Greely v. Verizon Pennsylvanian, Inc.; Verizon Services Corporation; Allegheny Energy, Inc. Civil Division No. 8428 of 2010	(P)
2011 John William Shaw v. Holloman Corporation BCN: 3927593	(P) (DE)

CASE	
2013 Steven Mader v. Duquesne Light Company and Duquesne Light Holdings, Inc. GD 13-6249	(P)
2013 Nga Nguyen v. David Tuyn Pham, Eric Otto, T.J. Laurain, and Zbignew Gawrys and Hoffman Enclosures, Inc., and French-Gerleman Electric Company 13SL-CC04316	(P) (DE)
2013 Sylvia Lambert; Estate of Joseph L. White v. North Florida Tower Service, Inc., James Wilson; Tri-County Electric Coop; Floey Timber and Land Co; Foley Timber Co. 11-435CA	(D)
2014 Lachelle Kemp v. Westar Energy	(P)

CASE	
<u>2014</u> KCP&L v. General Services Administration	**(D)**
<u>2014</u> Troy and Karen Walker v. Laclede Electric Cooperative	**(D)**
<u>2015</u> Jonni Cullison, Individually and as Personal Representative on behalf of the Estate of decedent Jayden Hicks, and Jaymie Hicks v. City of Salina, Kansas, et al. 14CV55	**(P)**
<u>2015</u> Randall W. Foster v. USIC Locating Services, LLC and Kansas City Power & Light Company 2:16-cv-02174-CM-GLR	**(P)**

CASE	
2015 Michelle Morris, Individually and on behalf of her minor children James Morris and Kai Duplichan v. Lafayette Utility System through The Lafayette City-Parishi Consolidated Government, Lafayette City-parish Consolidated Government and Champion Real Estate Services, LLC 2015-1072-K	(D)
2015 Thomas J. Magiera and Michelle A. Magiera v. Modern Forge Services, LLC and Chester Inc. 45DO5-1506CT00,101	(P)
2015 Lisa M. Jones, et. al., v. Ohio Edison, FirstEnergy Corp, et. al. 15 CV 201	(P) (DE)
2015 Jodi Lewis, as Special Administratix of the Estate of Stephen Lewis v. Indiana-American Water Company, Inc., American Infrastructure Technologies, LLC and Northern Indiana Public Service Co. 45D11-1411-CT-00216	(P)

CASE	
2015 Liberty Mutual Fire Insurance Company, as Subrogee of Dietz & Watson, Inc. v. Absolutely Energized Solar Electric, Inc. et al BUR-L-1782-14	**(P)**
2015 Nstar v. Veolia	**(D)**
2016 Edward Kammerer v. Empire District Electric Company and/or City Electric	**(P)**
2016 David Gaiten and Jovany Cortez v. Shereeji Hospitality Investors, LLC and Chandresh Patel	**(P)**

CASE	
2016 Center Mall Ltd. Partnership, Dorchester Insurance Company, Ltd., Ironshore Insurance Ltd., L.S. Holding, Inc. and Munich Reinsurance America, Inc. v. Howard Industries, Inc., and Virgin Islands Water and Power Authority. Civil No ST-15-CV-183	**(P)**
2016 PEPCO v. Continental Associates 2016 CA 007540 B	**(P)**
2016 Lesley Kemp, as Personal Representative of the Estate of Brandon Kemp, Deceased v. Royal Palm Marina, LLC and Pinchers Crab Shack of Downtown Ft. Myers, Inc. d/b/a The Marina At Edison Ford 16-CA-004084	**(P)**
2016 Leesville Road School Fire Investigation v. Engineered Control Systems	**(D)**

CASE	
2016 Thomas Poynton (Deceased) v. Metropolitan Edison, FirstEnergy	**(P)**
2016 Pamela Johnson as Special Administratix of the Estate of Sammie G. Johnson, deceased v. WIN Energy REMC 49D06-1603-CT-010096	**(D)**
2016 Charles S. McCarty, Jr. and Sarah R. McCarty v. Shenandoah Valley Electric Cooperative Civil Action CL15-713	**(D)**
2016 Denise Travis and Reginald Timothy Travis v. Newark Corporation d/b/a Element14, Craig Edward Hahn Cause No. 4:16-cv-00448-SNLJ	**(P)**

CASE	
2016 Thampan Varghese & Shiny Thampan v. PEPCO Energy Company	(P)
2016 Zachary Short v. Westar Energy, Inc. and Great Plains Energy Incorporated Saline County 16 CV 280	(P)
2016 Ryan Gowan v. Victoria Nursing and Rehabilitation Center	(P)
2016 Bruce Lipnick v. The District of Columbia 2016 CA 00119B	(D)

CASE	
2017 Estate of Steven Vance Weaver v. Next Generation Solutions, Overland Contracting, Inc., Black & Veatch, Keegan Electric, Tesla Motors	**(P)**
2017 Kelly v. D.C. and PEPCO	**(D)**

HISTORICAL

CASE LIST

HISTORIC CASE LIST

CASE	
1981 Hulse Brothers Farms v. Steuben REC, Inc.	(D) (DE) (TE)
1982 Joseph M. Phelps v. Duke Power Company	(P) (DE) (TE)
1983 Leonard L. O'Shields, Jr. v. Duke Power Company	(P) (DE) (TE)

CASE	
1983 Roy Marcus Burwell v. VEPCO	(P)
1984 Carr's Truck Lines, Inc. v. Arthure C. Forrester & Community Electric Company	(D)
1984 Z. B. Robinson v. Salem Hilton Inn	(P)
1985 Gary Ray Joyner and Phyllis T. Condrey v. City of Wilson, et. al.	(D) (DE)

CASE	
1985 McFadden et. ux. v. United Electric Cooperative, Inc.	(D)
1986 Estate of Rickey Glenn Bowland v. Duke Power Company	(P)
1986 Steve Brooks v. Duke Power Company	(P) (DE)
1986 Estate of Danny J. Hill v. Pitt & Greene EMC	(D)

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CASE	
1987 Peggy Ann Bradshaw v. Hudson & Lane Electrical Contractors	**(D) (DE)**
1987 Avis Johnson, Admx. Of the estate of Theodore Johnson, Jr. v. Carolina Power & Light	**(P) (DE)**
1988 Edith W. Campbell, Admx. v. The City of Elizabeth City, North Carolina	**(D) (DE)**
1988 Robert Reeves King, Admx. v. Carolina Power & Light	**(P)**

CASE	
1988 John W. Lawson and Lee S. Lawson v. VEPCO	(P) (DE)
1988 James "Ray" Robertson v. Duke Power Company	(P)
1988 Cecil Leroy Rook and Christina Rook v. Carolina Power & Light Company	(P)
1988 James E. Sinclair, Admx. v. Duke Power Company	(P)

CASE	
1989 Sarah O. Banks, Admx. v. Appalachian Power Company	(P)
1989 Linda B. Cobb, Admx. For James Olden Cobb, Jr. v. Carolina Power & Light	(P) (DE)
1989 James O. Cox v. Texas Gulf	(P) (DE)
1989 Laura Ann Porter g/a/l for Andy L. Hernley v. Public Works Commission of the City of Fayetteville	(D) (DE)

CASE	
1989 Nelson v. Duke University	(P)
1989 Estate of Lois Batt Woodard v. Roanoke EMC	(D) (DE)
1990 Charles B. Johnson v. VEPCO	(P)
1991 Reuben Blount v. Wake Electric Membership Corporation	(D)

CASE	
1991 Nathan Thomas Cox and Blue Ridge Tobacco Company, Inc. v. City of Washington	**(D) (DE)**
1991 Cecil L. Davis Jr., Personal Representative of the Estate of Pamela J. Powell v. Talquin Electric Cooperative, Inc.	**(D) (DE)**
1991 Bart Mattucci v. CP&L	**(P) (DE)**
1992 Sea Ranch Motel v. North Carolina Power (VEPCO)	**(P)**

CASE	
1992 Robin K. White v. R.H. Bouligny, Inc.	(D)
1993 Clarence Gene Leggett v. Carteret Craven EMC 93-CVS-727	(D)
1993 Edward Scott Padgett v. Town of Fountain 93-CVS-756	(D)
1993 Mrs. Lou Pridgett Adms. of Estate of Michael Baker v. Royster-Clark, Inc. City of Wilson 93-CVS-599	(D) (DE)

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CASE	
1993 William Earl Todd III (deceased) and Fred L. Montgomery v. City of Elizabeth City	(D) (DE)
1994 Richard Jerome Guffey And wife, Lori C. Guffey v. City of Monroe, NC 94 CVS-1485	(D) (DE) (TE)
1994 Dannie Lee Ham v. Talquin Electric Cooperative, Inc.	(D)
1994 Juan Hernandez v. Carl H. Boone, Clarence Wiggins, John T. Colley III, A. Ezzell and Carolina Power & Light, Inc.	(D) (DE)

CASE	
1994 Glenn Higgs and Carla Higgs v. Memphis Light, Gas & Water Division and TSE International, Inc.	(P) (DE)
1994 Huntington Park Apartments v. Duke Power Company	(P)
1994 Glenda L. Lambert Estate of Donald L. Lambert v. Monongahela Power Company	(P)
1994 Roger Payne v. Haynes Electric Utility Corporation, Haynes Electrical Utility Corporation and M.B. Haynes Corporation	(D)

CASE	
1994 Lisa Sowards, Administratrix of the Estate of Randy D. Sowards, Deceased v. Harrison-Wright Company, Inc. and Duke Power Company	**(P)**
1994 Donald Ward v. Brunswick EMC 94 CVS 864	**(D) (DE)**
1995 Brunswick EMC Whiteville Substation Accident v. Reliance Insurance Company & Planet Insurance Company	**(P)**
1995 Tammy Stevens Buffkin v. Sumter Builders and Davidson EMC	**(D)**

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CASE	
1995 Emma L. Hill v. Pitt & Greene EMC 4:95-CV-35-H-1	**(D) (DE) (TE)**
1995 Eddie Morris v. IBM, James True, and Marshall Contractors 94 CVS 00319	**(P) (DE)**
1995 Willie O. Powell and Doretha Powell v. Halifax EMC	**(D) (DE)**
1995 Smithfield Carroll Farms, Inc. v. Roanoke EMC 2-95-CV-62-BO(3)	**(D)**

CASE	
1996 Linda Braswell and Bobby Lee Sweat v. Brunswick Electric Membership Corporation 96 CVS 1218	(D) (DE) (TE)
1996 Ronald Dion v. Duke Power Company	(P) (DE)
1996 Kerry Hux v. Dixie Yarns	(P) (DE) (TE)
1996 Leslie C. Murray v. Mallinckrodt 5:96-CV-585-F2	(P) (DE)

CASE	
1996 Estate of Leon Swaim, Jr. v. NC Power (VEPCO)	**(P)**
1996 Estate of Jeffrey Vanasek v. Duke Power Company, et. al.	**(P) (DE)**
1996 John Vastis v. RJ Griffin & Company, et. al.	**(P) (DE) (TE)**
1997 Leslie Adams v. Jones-Onslow EMC	**(D)**

CASE	
1997 Charlotte Sunroofs, Inc. v. Duke Power Company	(P)
1997 Cecile B. Stanley, Jr. v. Brunswick EMC	(D) (DE) (TE)
1997 Vince Kennedy v. Davidson Electric Membership Corporation	(D)
1997 David Tuck v. Wake EMC	(D)

CASE	
1998 Concord Telephone Company, Inc. v. Power & Telephone Supply Company, et. al. 97-CVS-588	**(D) (DE)**
1998 William Johnson v. Florida Power & Light CL 99-007648-AE	**(P) (DE)**
1998 James L. Martishius and Cindy K. Martishius v. Carolina Power & Light Company, Hertz Equipment Rental Corporation, Carolco Studies, Inc., Edward R. Pressman Film Corporation, and Crowvision, Inc.	**(D) (DE) (TE)**
1998 Meredith College v. Jodi Lynn Abbate & Susan Marie Fortunes 98-CVS-01734	**(D)**

CASE	
1998 Damon Shane Perry v. Line Construction Inc. and Carolina Power & Light Company	**(D) (DE)**
1998 W.L. Perry v. Carolina Power & Light	**(D) (DE)**
1998 Stillwell, et. al. v. City of Wheeling, et. al. West Virginia	**(P) (DE) (TE)**
1998 Roberto Castilli Trujillo, and William Lewis King, Administrator of the Estate of Pedro Beltran Borbonio v. Donald Ray Vick, Edgecombe-Martin Co. EMC, Halifax EMC, Melvin O. Harrell, Fay Harrell, and Russell H. Harrell, and Robert T. Harrell, Individually and d/b/a Harrell Farms	**(D) (DE)**

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CASE	
1999 Commission of Labor of the State of North Carolina (OSHA) v. Carolina Power & Light (Cingman Avenue, Asheville, NC)	**(D)**
1999 Cathy Celentano v. Duke Power Company	**(P) (DE)**
1999 Commission of Labor of the State of North Carolina (OSHA) v. Brunswick EMC (Involving the fatality of Harry Jones, A Brunswick EMC employee)	**(D) (TE)**
1999 Gregory Gipson v. Carteret-Craven EMC, et. al	**(D)**

CASE	
1999 Leonard P. Goldman and Jan W. Goldman v. Meridian Management Corporation	(D) (DE)
1999 Isley, Guardian ad litem for Mykal Mclean v. Carolina Power & Light, et. al. 99-CVS 2905	(D)
1999 Ralph Ray v. Duke Power Company	(P)
1999 Edward Sanchez (for the estate of Betty Jean Sanchez) v. The City of Public Service Board of the City of San Antonio, 285th Judicial District; Bexar County, Texas	(P) (DE)

CASE	
1999 Joseph C. Trappler and William J. Trappler v. Steuben Rural Electric Cooperative, Inc.	**(D)**
1999 Charles McDougal v. Central EMC	**(D)**
2000 Consolidated Edison of NY New York County Index No. 110254/93 v. General Electric	**(D) (DE)**
2000 Fairways Apartment Fire v. Duke Power	**(P)**

CASE	
<u>2000</u> Bernell Gamble and Gloria Gamble v. RDH Consultants, Inc.	**(P) (DE)**
<u>2000</u> Cornelius Jenkins (for Daniel Jenkins) v. Duke Power	**(P)**
<u>2000</u> Harry Jones v. Simmons Construction	**(P)**
<u>2000</u> William Jones v. Haynes Electric Company	**(D)**

CASE	
2000 Lilly Sport Boats v. General Electric Company and BG & E	**(D)**
2000 H. Lin v. Commonwealth Edison and General Electric	**(D)**
2000 March, et. al. v. Goerke, et. al. Langlade County Case no. 00-CV-16	**(P) (DE)**
2000 Tyler Rutzen v. Wisconsin Public Service	**(P) (DE)**

CASE	
2000 Via Electric v. Gregory Poole Power Systems	**(D)**
2000 Monte Whitt v. Wisconsin Public Service	**(P) (DE)**
2001 Odele Bethune v. Florida Power Corporation 00-573-CI-20	**(P)**
2001 Deborah Hunt v. The Anderson, Inc., et. al. In the Circuit Court of Montgomery County, Alabama Civil Action No. CV-2000-3177-MC	**(P) (DE)**

CASE	
2001 Mayra I. Cruz Rivera, et. al. v. General Electric Company, Inc., et. al. 00-2353 (CCC)	(D) (DE)
2001 Wake Medical Center v. Gregory Poole Equipment Company	(D)
2001 Bill and Vicky Wallace v. Oakwood Homes	(D)
2002 Scott Cameron, individually and as natural parent and guardian of Suzanne Elizabeth Lucille Cameron, his daughter, and Jackie Cameron, his wife v. Construction Rental, Inc., Florida Power & Light Company 2004 CA 000135 SC	(P) (DE)

CASE	
2002 Kenneth Davis, Donna Davis, George T. Hicks and Mozelle Raye Hicks v. Piedmont EMC and Carolina Power & Light Co. 02 CVS 835/02-CVS-15	**(D) (DE)**
2002 Deaton v. Jefferson Mills	**(P)**
2002 Howell Construction v. Brunswick EMC	**(D)**
2002 McDonald v. Carolina Power & Light	**(D)**

CASE	
2002 Musick/Colvin v. Paccar, Inc. CV-01-J-1050	**(P) (DE)**
2002 Suzanne C. Sifford v. Thompson Heating and Air Conditioning and Becker Electric	**(D)**
2002 Willie Johnson and Evanise Johnson v. Florida Power & Light Company CL 99-007648-AE	**(P) (DE)**
2003 Benjamin Carosella v. FP&L 01-1982-CA Collier Co.	**(P) (DE)**

CASE	
<u>2003</u> Gervacio v. Blue Ridge EMC	**(D)**
<u>2003</u> Barbara Hunter v. Florida Power Corporation	**(P)**
<u>2003</u> Jerry A. Jones v. AAA Electric Company, Inc. 01-CVS 1113	**(D) (DE)**
<u>2003</u> Norma L. Lourenco, Administratix v. City of New Bern, N.C. 04-CVS-4CVS 01163	**(D) (DE)**

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CASE	
2003 Emmanuel Martinez, Donald Weygant, and Sandra Weygant v. Duke Energy Corporation, Camp Dresser & McKee, Anthony Crane Rental, L.P., and Terex Corporation 6-03-0049-20	**(P) (DE)**
2003 James Miller and Kimberly Miller v. Duke Energy Corporation 03-CP-42-0606	**(P) (DE)**
2003 Myrick v. Balmer, Vincent Electric	**(D)**
2003 Randy J. Stephan and Laura L. Stephan v. Wisconsin Energy Power Company and Ricco Properties, LLC 03 CV 008731	**(P) (DE)**

CASE	
2003 Melvin Ernie Whitfield v. Seigler Enterprises, Inc., and Mobile Tool International, Inc., d/b/a AmericaQuip 2002-CP-37-214	**(P) (DE)**
2003 The Travelers Indemnity, et al. v. North Beach Services, Inc., et. al. 2003-CV-37-80	**(D) (DE)**
2003 Joseph Kadjeski, Et. Al. v. Potomac Electric Power Company, Et. Al Civil No. 1:01 CVO 1334	**(D)**
2004 Bennett Truck Transport v. Progress Energy Carolina (CP&L) 03-CVS-683	**(D)**

CASE	
2004 Marty Wayne Brown v. Duke Power Company	(P)
2004 Continental Insurance Company v. G&G Manufacturing LLC, and Home Depot USA, Inc. 7:04-CV-122-F(3)	(D) (DE)
2004 Jeffrey L. Curry v. Coast Electric Power Association A-2401-03-530	(P)
2004 Ray Deloache v. South Carolina Electric and Gas, Cutler-Hammer, et. Al.	(P) (DE)

CASE	
2004 Timothy Gray v. Comcast, United Cable & Berkley E.C. 03-CP-08-1759	(P)
2004 Richard Warren King, et. al. v. American Power Conversion Corporation 5:03-CV-704-BR(3)	(D) (DE)
2004 Kirkland and Carla Hall v. Potomac Electric Power Company	(D) (DE)
2004 National Institute of Science v. General Electric Company	(D) (DE)

CASE	
2004 Gerald Richter v. Anderson Windows	(P)
2004 Sellars (Nationwide) v. Brunswick EMC 03-CVD-404	(D) (DE)
2004 Stephen Shepard v. First Electric Cooperative, et. al. CV-2004-170-2	(P) (DE)
2004 Standard Fire Insurance Company a/s/o Gilberta St. John; Hall et. al. v. Potomac Electric Power Company d/b/a PEPCO, a subsidiary of PEPCO Holdings, Inc., and PEPCO Holdings, Inc. 250018-V	(D) (DE)

CASE	
2004 Shirresse B. Brockington, as Personal Representative of the Estate of Heric Moreno Vallejo, and Fenlx Cardona, Personal Representative of the Estate of Rusbeln Ramlrz Cardona v. Helnsohn Electric Service, Inc., C&W Services Inc., Richard Corbin, Arthur James, Walker Grainger, James R. Harrlson, Jr., and Charles Manlgo 03-CP-15-357	(P) (DE)
2004 Jean Victorin v. Florida Power & Light Company, a Florida corporation, Publix Supermarkets, Inc., a Florida Corporation; and The Forestville Corporation, a Florida Corporation d/b/a Feick Security 00-29976 CA 30	(P) (DE) (TE)
2004 Thomas and Alta Wilson v. Lakewood Industries 1:04-CV-0516-TWT	(P)
2004 Keith Fulbright, Sr., Velma Fulbright v. Lawrence Booth, PACCAR, Inc. 04-CV-229053	(P)

CASE
2004 (P) (DE) Amy Layfield, Individually and as next friend of Richard Powers, III v. Georgia Power Company CAFN: 2004-V-07977-L
2004 (P) (DE) Jose Manuel Ruiz v. South Carolina Electric & Gas Company, Inc. a subsidiary of SCANA Corp., Fletcher Bright Company, DBS Const. Co., JLB Industries, Inc., Lynn Ladders & Scaffolding, Co., Inc., Kohl's Department Stores, Inc., Choate Construction Co., et al. 06-CP-10-3528
2005 (P) Phyllis Absalom v. TECO Energy, Inc., Tampa Electric Company and Southeast Milk, Inc.
2005 (P) (DE) Adam Hall v. Florida Power & Light 50-2005 CA 004853

CASE	
2005 Aaron Cody Hokanson v. Oklahoma Gas and Electric Company, et. al. CJ-2005-116-01	(P) (DE)
2005 Cresencio Mendez, as Personal Representative of the Estate of Regino Perez, descendent v. Florida Power & Light Company, Deborah Hearst, and Asplundh Tree Expert Co., 05-004904 AO	(P) (DE)
2005 Jason Payne v. Surry-Yadkin Electric Membership Corporation 04 CVS 02757	(D)
2005 Doris Santos v. Consolidated Edison Company of New York, Inc. and General Electric, Inc. Supreme Court NY Index No 23105/05	(D) (DE)

CASE

2005 **(P) (DE)**

Marel Trujillo, as Guardian of the person and property of Marvin Trujillo (the Ward), and Sandra Trujillo, as natural parent and Guardian of Carolina Trujillo, a minor

v.

Florida Power & Light Company, a Florida corporation, and Bellsouth Telecommuncations, Inc. a foreign corporation

01-29015CA31

2005 **(P) (DE) (TE)**

Payton Wade Vaught

v.

J. H. Bowman Electric Company, Inc. J. Hyatt Hammond Associates, Inc. Lyon Construction, Inc. and the City of Greensboro, NC

05 CVS 4127

2005 **(P)**

Charles David West and Chastity Dawn West and Jack William Delancey and Donna Darlene Delancey

v.

Northern Tool & Equipment Company, Inc., and S & H Industries, Inc.

2005 **(P) (DE)**

Joseph Williams

v.

Florida Power & Light, a corporation, and City of Miami

05-19806 CA 05

CASE	
2005 Tyrone Williams v. Florida Power & Light Company, M.J.S. Construction, Inc. 04860CA27	**(P) (DE)**
2005 Payton Wade Vaught v. J.H. Bowman Electric Company, Inc., J. Hyatt Hammond Associates, Inc., and Lyon Construction, Inc. 05 CVS 4127	**(P) (DE) (TE)**
2005 Walter Washington v. Square D Company, and Trammell Crow Services, Inc. 760CL04S00672-01	**(P) (DE)**
2005 Estate of Craig Cecere v. Florida Power & Light Company	**(P) (DE)**

CASE	
2005 Donald Addison v. Potomac Electric Power Company (PEPCO) 04-6079	(D) (DE)
2006 Eric Bennett and Pamela Bennett v. Carolina Power & Light Company d/b/a Progress Energy Carolinas, Inc.	(P)
2006 Khadafy Bennett v. City of Warner Robins 06-075	(P)
2006 Hobbs v. General Electric, Westinghouse, and ABB	(D)

CASE		
2006 Lewis v. Carteret-Craven Electric Cooperative	(D)	
2006 Elliott Littlejohn v. Duke Power Company	(P)	
2006 Lilian B. Giraldo, as a personal representative of the Estate of Javier E. Rojas, for the use and benefit of the Estate of Javier E. Rojas, Liliana B. Giraldo and Maria Camilla Rojas v. Stryker Electrical Contracting, Inc. 06-001110 CACE (08)	(P)	
2006 Billy Cambell and Ruth Ross Campbell v. Central Electric Membership Corporation 05 CVS 00775	(D)	(TE)

CASE	
2006 Manuel Salazar, Jr. v. South Carolina Electric & Gas Company, Grove Worldwide, Incorporated, Paul C. Rizzo Associates, Inc., McGriff, Seibels & Williams, Inc., and Liberty Mutual Fire Insurance Company 03-CP-40-5996	**(P) (DE)**
2006 Larry Shifflett v. General Electric Company and Electric Power Systems, Inc. and Electric Power Systems International, Inc. 5:06CV00127	**(P) (DE) (TE)**
2006 Clarence Dale Cooper v. Duke Power Company, LLC., and Waffle House, Inc. 2006-CP-23-5973	**(P)**
2006 Wallace Graham and Dorothy Graham v. Bassett Furniture Industries, Fleetwood Homes of GA, Phillips, Inc., Progress Energy Carolinas, Inc. 4:05-CV-02895-TLW-TER	**(P) (DE)**

CASE	
2006 Parker Liapple v. Square D Company CL04S00672-00	(P)
2006 Javier Rivera, and FCCI Insurance Company v. Tampa Electric Company 04-04622, Division G	(P) (DE)
2006 Rick A. Bentz v. Wisconsin Electric Power Company; Fidelity & Guaranty Ins. Co. and Patrick Cudahy, Inc. 06 CV000060	(P) (DE)
2006 Wanda Gail Brown Estate of Gene Barry Brown v. Duke Energy Corporation C.A. 2007-CP-23-1284, 2007-CP-23-1275	(P) (DE)

CASE	
2007 Mikel Anthony Perry v. Electro-Mechanical Corporation, Therron Joseph and Patrick Smith 0722-CC01010	(P) (DE)
2007 Jason Burden v. Duke Energy Corporation d/d/a Duke Power Company 2009-CP-24-1296	(P) (DE)
2007 Raymond Vasilas v. Florida Power & Light	(P)
2007 Xavier Massey, a minor, by Celeste Massey, His Parent and Natural Guardian v. Duke Power Company, LLC d/b/a/ Duke Energy Carolinas, LLC 2009-CP-23-7220	(P) (DE) (TE)

CASE	
2007 Patricia Vancil; John A. Vancil III, deceased v. Desbuild and Tristate Mechanical	**(P) (DE)**
2007 Estate of Kenneth Heller v. Florida Power	**(P)**
2007 Adrana B. West, Cherylene E. Miller and Jean B. Nichols v. EnergyUnited Electric Membership Corporation 07 CVS 01378	**(D)**
2007 Neil Wolfe and Suzanne Wolfe v. Wisconsin Electric 06-CV-3632	**(P) (DE)**

CASE	
2007 Kim Shade v. Potomac Electric Power Company (PEPCO); District of Columbia 07CA3337	(D) (DE)
2008 Carolyn Hayes Individually and as Administrator of the Estate of John Hayes, Deceased v. Time Warner Cable, Inc., Owner and General Partner of Time Warner Entertainment - Advance/Newhouse Partnership 08 CVS 001889	(P) (DE)
2008 City of South Daytona, Florida v. Florida Power & Light Company 2008-30441-CCICI	(P) (DE) (TE)
2008 Schroeder Brothers Farm, Inc. et al v. Wisconsin Public Service Corporation, et al 09-CV063-30201	(P) (DE)

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2008 William Elder v. Wisconsin Energies	(P) (DE)
2008 Edward Price, Judy Price, and Charles Clanton v. Consolidated Metco, Inc., Thomas Coppedge, Christopher Thomas, and Wayne Duncan 07 CVS 01461	(P) (DE)
2008 Linda Hamilton, Representative of Estate of Herbert Hamilton v. Florida Power & Light Company, Asplundh Tree Expert Company, Boynton Landscape Company, Inc. and Susan Smith 2006 CA 005471 MB AE	(P) (DE)
2008 Annette Rodriguez, Administrator of the Estate of Daniel Rodriguez, Deceased v. Mastec North America, Inc., CP&L Co., Progress Energy 06 CVS 6631	(D) (DE)

CASE	
2008 James Tuck v. Wake EMC	(D)
2008 Deborah Davis Kenemore, Administratix of the Estate of Nathan Davis Kenemore v. EnergyUnited EMC	(D)
2008 Beverly Jean Burgess, and Michelle Mullins, Individually and on behalf of the Estate of Jean Aubrey Smith v. The City of Public Service Board of CPS Energy 2007 CI 03011 (TX)	(P) (DE)
2008 Jose Hernandez v. Duke Energy Corporation, LLC, f/d/b/a Duke Power Company 2010-CP-23-0259	(P)

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<u>2008</u> (P) Linda Robeson; Estate of James L. Robeson; Jennifer Hawker v. PPL Electric Utilities; PPL Corporation 2008-CV-5118
<u>2008</u> (P) (DE) Joseph Hart, Guardian Ad Litem for Jose Guadalupe Vargas Morales v. Greensboro Contracting Corporation, Robert S. Isner, J. Nathan Isner, O'Henry Builders, Inc., Court B Properties, LLC, Duke Energy Carolinas, LLC, Duke Energy Corporation, City of Greensboro, NC, Redevelopment Commission of Greensboro et. al. 08 CVS 9952
<u>2008</u> (D) Richardson, Jon v. City of Monroe
<u>2008</u> (D) The Travelers Insurance v. PEPCO

CASE	
2008 Vicki Addis as personal representative for the Estate of Matthew Addis v. Duke Energy Carolinas, LLC and Chris Madden 09-CP-11-0377	**(P) (DE)**
2008 State Farm Fire and Casualty Company v. Potomac Electric Power Company 2008 CA 006210B	**(D) (DE)**
2008 Washington Baptist Church v. PEPCO	**(D)**
2008 Kembra Eubank, et al., v. Kansas City Power & Light Company 0716-CV07429	**(P) (DE)**

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2009 Vincent P. Nertavich, Jr. v. PPL, PPL Corporation, et al., 090902316	(P)	(TE)
2009 Department of Health and Mental Hygiene, State of Maryland and Department of General Services, State of Maryland v. Baltimore Gas and Electric Company and General Electric 24-C09-001033	(D)	
2009 The Estate of Jeffrey McCall v. Riverland Hedging & Topping, Inc., a Florida Corporation; Florida Power and Light, a Florida Corporation, and Williamson Cattle Company, Inc., a Florida Corporation 2008-1315-CA 11	(P)	(DE)
2009 Carl W. Hibbert, and Margaret T. Hibbert v. The City of Raleigh 07 CV 009258	(D)	

CASE	
2009 Steven J. Smith and Eileen Smith h/w v. General Electric Company, PEPCO Holdings, Inc., et. al. 09C-02-099 CLS	(D)
2009 Brian A. Weber and Kathleen A. Weber v. EnergyUnited EMC 09 CVS 586	(P)
2009 GE Prolec Transformers, Inc. v. North American Substation Services, LLC 10-cv-01746	(P) (DE)
2009 Matthew Burnside v. Georgia Power Corp. 2009-2000478	(P)

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2009 Wes Harrell v. Mid Carolina Electric Coop.	(P)
2009 Joseph & Marylou Moeller and Nationwide Property & Casualty Insurance Company v. Tru-Flex Metal Hose, LLC; Carolina Fireplace Distributors, Inc. 11 CVS 4045	(P)
2009 Marcus Reed and Angel Rigor v. Etimex USA, Inc. and Duke Energy Carolinas, LLC 09-CVS-28476	(P) (DE)
2009 Shirley Lou Ann Williams, as Personal Representative of the Estate of Mark Douglas Williams, Deceased v. Duke Energy Carolinas, LLC and Pike Electric, Inc. 8:10-352-RBH	(P) (DE)

CASE	
2009 Leah Vitrano, as Personal Representative of the Estate of Nicholas Vitrano, deceased v. Florida Power & Light Company 50 2010 CA 2538 MB AL	(P)
2009 Crystal Leeanne Asher as Personal Representative of the Estate of Joseph Bradley Asher v. Duke Energy Carolinas, LLC	(P)
2009 Benjamin Noah Marquardt and Kathy Stahlman v. Nathan Decrow and City of Glenwood Springs G09CV60, DIV. B	(P) (DE) (TE)
2009 Sharod Sellers v. H.G. Reynolds, Co., Inc.; Electric Service of South Carolina, LLC. 3:09-CV-00052	(P) (DE)

CASE	
2009 Lorenzo Catao, Sr. Personal representative of the Estate of Lorenzo Catao, Jr. v. Florida Power & Light Company, a Florida corporation 2009-CA04-3846XXXXMB AI	**(P)**
2010 Crystal Mitchell and Jeff Enriquez, as Co-Personal Representatives of the Estate of Jeffry Raye Enriquez, (a minor) deceased v. Bellsouth Telecommunications, Inc., d/b/a AT&T Florida, a Foreign Corporation; and Florida Power & Light Company, a Florida Corporation 09-48838 CA 20	**(P) (DE)**
2010 Vernessa M. Neamo v. Potomac Electric Power Company 2010 CA 001633 V	**(D)**
2010 Potomac Electric Power Company v. Fort Myer Construction Corporation 2010 CA 001964 B	**(P)**

CASE	
2010 Lennie Hamby v. Electric Service Group, Inc.	(P)
2010 Levina Marie Campbell, as Administrator of the Estate of Durant Charles Campbell, deceased v. New River Electrical Corporation 2:09-cv-1131	(P)
2010 Renee M. Latterner, Administratix of the Estate of Ronald S. Latterner v. The Potomac Edison Company Allegheny Energy, Inc. Shenandoah Network Company Shenandoah Telecommunications Company, and U.S. Utility Contractor Company 09-C-306	(P) (DE)
2010 Debra A. Kelly and Girard Kelly v. Frank Guastella, Individually and D/B/A Frank Guastella Electrician Company 5519-CIVIL-2000	(P)

CASE
<u>2010</u> (P) Eric Friddle v. Pike Electric
<u>2010</u> (P) (DE) Sagraria Pavon v. Bellsouth Telecommunications, Inc. d/b/a AT&T, a foreign Corporation, and Florida Power & Light Company, a Florida Corporation 08-60289 CA 10
<u>2010</u> (P) Estate of Kenneth Allen Close v. Baltimore Gas and Electric
<u>2010</u> (P) Joshua Cortez v. Florida Power & Light Co. 10-47500-12

CASE	
2010 Potomac Electric Power Company v. Berkel & Company Contractors Inc. 2010 CA 000544 B	(P)
2010 Muyiwa Sobo, As Personal Representative of the Estate of Timika Revels, Et Al. v. PEPCO Holdings, Inc. & Light Company PJM-10-1254	(D)
2010 The Federal Reserve Bank of Richmond Baltimore Generator Fire v. Reuter & Hanney, Inc. 3:10CV922-JAG	(P) (DE)
2010 Brent Mell; Jessica Mell v. Madison Gas and Electric Company; ABC Insurance Company, Liberty Insurance Company 11CV1318	(P) (DE)

CASE	
2010 Leo Woelkers v. PPL Corporation	(P)
2010 French Broad EMC v. Verizon South 07 CVS 402	(P) (DE)
2010 Jaine Hartnett, as Legal Guardian of Lawrence Finer v. RBG, Inc., Altec Industries, Inc. and Honeywell International, Inc. 1:10-cv-10514-DPW	(P) (DE)
2010 Farm Family Casualty Insurance Company A/S/O Hionis Nursery and, Spiros Hionis and Hionis Greenhouses, Inc. v. Blackmore Company, Inc. and R. Schrock Company, Brian M. Stagnitti, Family Financial Group LLC and Farm Family Casualty Insurance Company HNT-L-196-09	(P) (DE)

CASE	
2011 Youssouf Kone v. Comcast Corporation, et al. 336771V	(P)
2011 Renee Lempke, Individual and as the Executrix of the Estate of Robert Lempeke, deceased v. First Energy Corporation, et al. 003351	(P)
2011 Potomac Electric Power Company v. District of Columbia Water and Sewer Authority, et al. 2009 CA 005006 B	(P) (DE)
2011 Debra Sumner, as Personal Representative of the Estate of Joshua Lee Sumner, deceased v. Florida Department of Transportation; Strategy Energy Corporation; Strategy Energy Consultants, LLC; Infrastructure Corporation of America; Deangelo Brothers, Inc.; and Strategic Energy Efficiency Associates, Inc. CACE09069887 (12)	(P)

CASE	
2011 Jose De La Cruz v. Virgin Islands Water and Power Authority 1:07-cv-00009	**(P) (DE) (TE)**
2011 Calvin McLeod and Maria McLeod v. Progress Energy Carolinas, Inc. 3:10-cv-03247-JPA	**(D) (DE)**
2011 Steve Baptiste v. VI Water and Power Authority (WAPA) SX-07-CV-0000576	**(P)**
2011 Ludmila Clifton v. Potomac Electric Power Company, Et. Al. 332007-V	**(D) (DE) (TE)**

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2011 Lawrence & Mary Hoagland v. Wisconsin Public Service Corporation	(P)
2011 Sandra Pringle, Individually and as personal representative of the Estate of Jammal Pringle, and as GAL for both Sandquan Pringle and Sandrian Pouge v. Wilma Dargan; Myers Lewis d/b/a Lewis Electrical Service, LLC; Carolina Power and Light d/b/a Progress Energy Carolinas, Inc. City of Lamar, County of Darlington and John Does 1-10 10-CP-16-0834	(D)
2011 James Young v. Virgin Islands Water and Power Authority (WAPA) 183/2007	(P)
2011 Carolyn R. Cunningham personal representative of the estate of Robert Cunningham v. South Carolina Electric & Gas Company 2012-CP-40-5871	(P)

CASE	
2011 Barry Johnston v. Southern Pine Electric	(P)
2011 Cody F. Rector v. Pro Erectors, Inc. CL11-000085-00	(P)
2011 Micheal Smith v. Florida Power & Light	(P)
2011 Jarried Jackson and Quinn Jackson v. William L. Shipley, Jr., Gary Chapman and John Doe 2010-CP-26-6467	(P)

CASE	
2011 Wade L. Madole v. DAVCO Electrical Contractors, Northstar Food Service, ESI Constructor	**(P)**
2011 Oklahoma Gas and Electric Company, an Oklahoma Corporation v. Rex Welch, individually, Welch Roofing & Construction, Inc., and Oklahoma Corporation, Midwest Roofing Supply, Inc. an Oklahoma Corporation, Denis Thompson, individually, d/b/a Dinosaur Construction and Remodeling, CJ-2008-294	**(D) (DE)**
2011 Brain Alvin Edmunds v. ABC Company, a fictitious manufacturer, DEF Company, a fictitious distributor Midwest Aerial Service, Inc., GHI Insurance Company a fictitious insurance corporation, and West Bend Mutual Insurance Company 11 CV 0523	**(P)**
2011 Buddy Evans v. ANEC	**(D)**

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2011 Maria Del Carmen Herrera; Jose Trinidad Herrera; Alberto Herrera; Eduardo Guerra v. Pacific Gas and Electric Company (PG&E) CIVMSC12-00754	**(P) (DE)**
2011 John Carreon v. A. Tobias Hedgepeth and C. Hedgepeth CL11-2745	**(P) (DE)**
2011 Evan Alexander Tucker and Richard Wade Halford v. Wake EMC	**(D)**
2011 Roy John Logan Oberlin; Georgia Ann Mauer Oberlin v. Progress Energy, Inc.; Progress Energy Service Company, LLC 11 CVS 2227	**(D)**

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2012 **(D)**

Woods, D.G.

v.

Georgia Pacific

2012 **(P) (DE)**

Rex Dean Williams, Sophia Williams, Ashley Williams, and Rex Dean Williams II

v.

Altec Industries, Inc., and United Electrical Cooperative Services, Inc.

Cause No. C-2010-00642

2012 **(P)**

Timothy D. Todd, Jr.

v.

Forked Deer Electric Cooperative, Inc.; Char Lisa, Inc.; Countyline Dragway, Inc.; The New Great River Road Motorsports Park, Inc., Anthony Munoz, John Munoz, Barbara Munoz; Chandler Properties, LLC; and Mamie Chandler individually and d/b/a Cybersoundz

2011-CV-52

2012 **(P)**

The Federal Reserve Bank of Richmond UPS Failure

v.

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2012 (P) (DE) Logan L. Fray; Leslie Fray; MCI Broadband Solutions, Inc. v. Virginia Electric and Power Company; Dominion Virginia Power; MCI Broadband Solutions, Inc., Altrex, Inc. CL11-001651-00
2012 (P) William Lawler v. PECO Energy Corp.; Exelon Corp; Matthew Vasaturo; Joseph Vasaturo; Aldente Pizza, Inc.; Tony Roni's of Drexel Hill; Tony Roni Holding Co; Tony Roni's Development Partners; Tony A's Pizza
2012 (P) Melvin L. Cockhren II v. Pacific Gas and Electric Company; Harjindar S. Chima; Margaret M. Chima; Harjindar S. Chima and Margaret M. Chima, Trustees; CGC 13-529137
2012 (D) Cleveland Ellis v. Power Design, Inc., Fortune-Johnson, Inc. 11 CVS 005944

CASE	
2012 Eugenio De La Parra Hernandez v. Timothy Edbrooke, Melissa Edbrooke 12-20605-CIV-MORENO	(P)
2012 David Vales v. Pennsylvania Electric Co. (Penelec) 237-Civil-2011	(P)
2012 Angela Horton, et. al. v. Jacobs Engineering Group, Inc., et. al. 10-CVS-6016	(P) (DE)
2012 Jon Clark v. CW Electric, American Staffing, Eaton Electric, Chesapeake Energy GD-13-006269	(P)

CASE	
2012 Gary Vaughn v. Pike Electric Inc.	(P)
2012 Jason Lawson v. Indian Electric Coop.	(P)
2012 Lisa A. Ward, Individually and as Personal Representative and Next Friend of Christian Caleb Ward and Joshua Seth Ward minors and as Adminsitratrix of the Estate of William Bertt Ward, deceased v. Walter J. Guilfoyle, Jr. 2012-CV-0005	(P)
2012 Amber Leigh Barrett v. Progress Energy Carolinas	(D)

CASE	
2012 Monica Mullins v. Power Source, LLC; Andy Sexton; John Doe and other Unknown Employees of Power Source, Inc. 11 CVS 8133	**(D)**
2012 James and Dawn Salazar v. Ameren Services Company; Cellnet Technology, Inc.; Danny M. Weis; Steven M. Meiners; Henkels & McCoy Inc.; David Wilson; Phillip T. Kallal 10SL-CC03541	**(P) (DE)**
2012 Stephanie Knopick v. Towns of Fremont & Stantonsburg 12 CVS 1919	**(D)**
2012 Katherine L. Waddell v. Old Dominion Freight Line, Inc.; Ricky Wayne Stallings; and Bellsouth Telecommunications, LLC d/b/a AT&T North Carolina 12 CVS 10288	**(P)**

CASE	
2012 AMD Farms, Andy Davis v. Halifax EMC 13 CVS 255	(D)
2012 Kip Warren v. Halifax EMC	(D)
2012 Tony Edward Havner v. Tommie Walker; North Arkansas Electric Coop CV-2011-397-3	(P)
2013 Cincinnati Ins. Co. a/s/o Reuter & Haney, Inc. v. Cummins Power Systems, LLC 1:12-cv-00491-CCB	(D)

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2013 Adyson Vermillion v. Ameren Corporation, Union Electric Company, Ameren Development Company and Ameren Services Company 11CM-CC00358	(P)
2013 Matthew Morton v. Tideland EMC	(D)
2013 Clifton Morgan and Phyllis Morgan v. City Water and Light Plant of the City of Jonesboro, Arkansas, et. al. CV-14-521	(D) (DE)
2013 John Caudle v. City of Rocky Mount 11 CVS 101	(D)

CASE	
2013 Rae Franks as Personal Representative of the Estate of Jorge Carrera Zarate v. Merchant Transport; Palm Beach Trucking Co. CACE 13-022197	(P)
2013 Eva Cuttino and Tamika Hathaway v. Roanoke Electric Membership Corporation	(D)
2013 Teresa Rogers, Aministratix of the Estate of Timothy Cory Rogers, Deceased v. Carolina Power & Light Company d/b/a Progress Energy Carolinas, Inc., Southern Industrial, Constructors, Inc., James G. Bordeaux, Dennis Earp, Teresa Harrison, Roland Riverbark, William "David" Benton, Lawrence "David" Smith, Jr., Thomas Hanes & Luther St 12 CVS 2144	(D)
2013 Rutherford Electric Membership Corporation v. Time Warner Entertainment-Advance/Newhouse Partnership, d/b/a Time Warner Cable 13-CVS-231	(P) (DE) (TE)

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2013 (P) Fujita Property Guam v. Guam Power Authority
2013 (P) Richard Huber v. Locust Point Quarry
2013 (P) Paul Cusin v. Water And Power Authority Virgin Islands
2013 (P) (DE) (TE) Earl Demming v. Virgin Islands Water and Power Authority and Watergate Villas, Section 1 and Watergate Villias, Section 2 aka Regatta Point Villas ST-11-CV-586

CASE	
2013 Bruce Klinger v. PSE&G Power, et. al. MER-L-630-13	(P)
2013 Michael W. McIntyre v. Atlantic Dry Ice, LLC, Siemen's Corporation, Siemens Aktiengesellschaft a/k/a Siemens AG, Siemens Energy, Inc., Siemens Industry, Inc., Siemens Entities 3:13CV538CWR-FKB	(P) (DE)
2013 Rutherford Electric Membership Corporation v. 130 of Chatham, LLC 13-SP-95	(P) (DE)
2013 Casey Cheek, as Personal Representative of the Estate of Jeffrey Cheek v. Marlboro County School District 2013-CP-34-00184	(P) (DE)

CASE	
2013 Thomas Gdovin v. Schneider Electric, et. al. 12-CV-5107	(P) (DE)
2013 Starr Indemnity & Liability Company, A/S/O Pacific Coast Feather Company v. Henderson Daly, LLC, and Wausau Underwriters Insurance Company 11-CVS-403	(P)
2013 Ronald D. Minter v. Ameren Corporation, et. al. 14CN-CV00323	(P) (DE)
2013 Allstate Insurance Company a/s/o Florentina and Bassile Boicu v. LG Electronics, Inc. and Lowe's Companies, Inc. 5:12-cv-01113-LS	(P) (DE)

CASE	
2013 Shiva Ghafoorian, Individually and as the Personal Representative of the Estate of Mohammed Ghafoorian v. Potomac Electrical Power Company 2012 CA 009586-12	**(D) (DE)**
2013 Carole H. Kerns, et. al. v. Potomac Electric Power Company, et. al. 2013 CA 002138B	**(D)**
2013 Liberty Mutual Fire Insurance Company a/s/o Norma E. Mortataya v. Potomac Electric Power Company CAL13-15153	**(D)**
2013 Deanna Duvall v. Euro-Pro Operating LLC, Euro-Pro Management Company; SIP Cinderson Motor Co., Ltd; Big Lots Stores, Inc.; Larry E. Gregg, Jr., and Melissa A. Harner 13 CV 01177	**(D)**

CASE	
2014 Louise Kennedy v. St. Charles Gin Co. and Progress Energy Service Co., Inc. 2012-CP-31-0186	(D)
2014 Alan D. Kritz, M.D. v. Wake Electric Membership Corporation d/b/a Wake Electric, et. al. 14-CVS-15229, 15-CVS-002017	(D) (DE)
2014 Nick Savage v. Kansas City Power & Light 12CY-CV01286 4	(P) (DE) (TE)
2014 Potomac Electric Power Company v. Grade Line Engineering & Construction, LLC 2013 CA 004799 B	(P)

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2014 Mark and Stacey McDermott v. Duquesne Light, Co, et. al. 10255-2013	(P)
2014 Micron Technology, Inc. v. Safway Services, LLC, Misivike Contractors, Inc. and Roberta Aquino CL 12003276	(D) (DE)
2014 Demian Padron v. South Florida Stadium, LLC, South Florida Stadium Corporation, Sun Life Stadium, Inc., Sun Life Stadium, Pro Player Stadium, Aggreko Holdings, Inc. Aggreko Generator Company, National Football League, Inc., National Football League, Inc., and John Lampo 14-001874 CA (01)	(P) (DE)
2014 Willie and Melissa Cardwell v. Southside Electric Cooperative CL14-1117 & CL14-1118	(D)

CASE	
<u>2014</u> Gasis Thomas, Jordan Thomas and Glinda Thomas v. First Energy Corporation, et. al. CV-13-798520	(P) (DE)
<u>2014</u> Estate of Thomas Richard Sheppard and Shirley Sheppard v. Westar Energy, Inc., Scott Trettel d/b/a Trettel Design and G.R.I.A., Inc., and Lawrence Preservation Alliance, Inc. 2015-CV-000068	(P) (DE)
<u>2014</u> Estate of Fernando Melchor v. Peace River Electric Cooperative, Inc.	(P)
<u>2014</u> Jacobs Engineering v. ConAgra CI 14-387	(P)

CASE	
<u>2014</u> Donnie Goins, John Austin, Jackie Knapp v. Frontier Communications of the Carolinas, LLC; Time Warner Cable Southeast, LLC; Wake Electric Membership Corporation d/b/a Wake Electric 14 CVS 015229	**(D) (DE) (TE)**
<u>2014</u> Potomac Electric Power Company v. G.T. Contracting Corporation 2014 CA 003003B	**(P)**
<u>2015</u> CSX Transportation, Inc. v. City of Fayetteville and Public Works Commission of the City of Fayetteville, a/k/a Fayetteville Public Works Commission 14-CVS-1826	**(D) (DE)**
<u>2015</u> Estate of Michael Alfaro v. PSE&G, et. al. MID-L-2356-15	**(P) (DE)**

CASE	
2015 Christensen v. Unified Government of Wyandotte County/BPU	(P)
2015 Shane Jackson v. Empire District Electric Company, et. al. 11AO-CC00130	(P) (DE)
2015 Christine Klingsten, Individually and as Personal Representative of the Estate of John Klingsten v. Alerie Ann Lyons, Norma Lyons, Ruben Rocha and Starfish Yacht Service, Inc. CACE 13 027758 (09)	(P)
2015 Johnny Harness v. Ameren and Utilimap, et. al. 13-L-86	(P)

CASE	
2016 PEPCO v. DCWASA 2015 CA 006145 B	(P) (DE)
2016 Brad E. Gatewood v. Guy M. Turner, Inc. 2015-CP-16-00846	(D)
2016 VML County of Halifax v. JE Burton Construction CL13000375-00	(P)
2016 Potomac Electric Power Company v. F & L Construction, Inc. et al 2015 CA 000598 B	(P)

CASE	
2016 William Fleskes v. Fogelman Realty Group, LLC; Fogelman Management Group, LLC; Country Squire-Brookside, LLC; Country Squire Apartments; Country Squire South, LLC and Higgins Electric, LLC CT-003440-13	**(P) (DE)**
2016 PEPCO v. Utility Systems Construction	**(P)**
2016 Hospira, Inc. v. Lawler Logs, Inc. and B&B 15-CVS-004138	**(D)**

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2017

Investigation into the Designation of Non-Transmission Alternative (NTA) Coordinator

Docket No. 2016-00049

2017

Investigation of Inclusion of Acadia Substation Investment in Rates Pertaining to Emera Maine

Docket No. 2017-00018

Commonwealth of Virginia State Corporation Commission

Rappahannock Electric Cooperative, 247 Industrial Court, Fredericksburg, VA 22408

Case No. PUE-2009-0010 (HE)

2007

Delmarva Power & Light System Acquisition Purchase for A & N Electric Cooperative, Post Office Box 290, 21275 Cooperative Way, Tasley, VA 23441 and Old Dominion Electric Cooperative, 4201 Dominion Boulevard, Glen Allen, VA 23060

Case Nos. PUE-2007-00060, 00061, 00062, 00063, and 00065 (HE)

2009

Potomac Edison/Allegheny Energy System Acquisition Purchase for Shenandoah Valley Electric Cooperative, 147 Dinkel Ave., Hwy 257, Mt. Crawford, VA 22841

Case No. PUE-2009-00101 (HE)

2011

Virginia, Maryland & Delaware Association of Electric Cooperatives Commonwealth of Virginia at the relation of the State Corporation Commission in the Matter of Determining Appropriate Regulation of Pole Attachments and Cost Sharing in Virginia

Case No. PUE-2011-00033 (HE)

2013

Northern Virginia Electric Cooperative Pole Attachment Dispute with ComCast

PUE-2013-00055 (HE)

Delaware Public Service Commission

Delaware Electric Cooperative, Inc., Retail Rate Case and Reliability Cases

(HE)

Federal Energy Regulatory Commission

Public Works Commission of the City of Fayetteville, NC v. Carolina Power & Light Company

ER76-, ER77-, ER78, ER81-344, ER84- (HE)

2000

North Carolina Electric Membership Corporation v. Duke Energy Corporation and Duke Electric Transmission

ER01-282-000 and ER01-283-000 (HE)

2000

North Carolina Electric Membership Corporation v. Virginia Electric Power Company dba North Carolina Power

EL90-26-00-000 (HE)

2015

Application for Authorization Pursuant to Section 203(a)(1)(A) and 203(a)(2) of the Federal Power Act and Request for Waivers of Certain Filing Requirements

Dkt EC15-___-000

Florida Public Service Commission (PSC)

2007

Municipal Utility Underground Consortium Pre-Filed Testimony for Storm Hardening and Undergrounding Assessment

Docket Nos. 07023-EI, 080244-EI, and 080522-EI (HE)

2007

Gulf Power Company's Storm Hardening Plan Pre-filed Testimony on Behalf of City of Panama City Beach, Florida

Florida PSC Docket No. 070299-EI (HE)

Massachusetts Department of Public Utilities

2012

Massachusetts Office of Attorney General Commonwealth of Massachusetts Department of Public Utilities Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid Review for Storm Response and Recovery of 2008 Storm Costs

DPU 11-56 (WT) (HE)

Massachusetts Department of Public Utilities

2012

Massachusetts Office of Attorney General Western Massachusetts Electric Company, Northeast Utilities System, Review for Recovery of Storm Costs

DPU 11-102/DPU 11-102A (WT) (HE)

2013

Massachusetts Office of Attorney General Nstar Review for Recovery of Storm Costs

DPU 13-52 (WT) (HE)

2014

Massachusetts Office of Attorney General National Grid Solar Generation Phase II Program Assessment

D.P.U. 14-01 (WT)

2014

Massachusetts Office of Attorney General Western Massachusetts Electric Company, Review of Storm Recovery Reserve Cost Adjustment "SRRCA"

D.P.U. 13-135 (WT) (HE)

2016

MA Elec. Co. and Nantucket Elec. Co. d/b/a National Grid, Fitchburg Gas and Electric Light Co. d/a/a Unitil and NSTAR Elec. Co. and Western MA Elec. Co. d/b/a Eversource for Approval by the DPU of their Grid Modernization Plan

DPU 120-123

2017

Nstar Electric Company and Western Massachusetts Electric Company d/b/a Eversource Energy Petition for Approval of a Performance-Based Ratemaking Mechanism and General Distribution Revenue Change

DPU 17-05

Minnesota Department of Public Service/Environmental Quality Board

Transmission Line Assessment Minnesota Department of Public Service and Minnesota Environmental Quality Board

(HE)

New Hampshire Public Utilities Commission

2004

City of Bedford v. Public Service of New Hampshire

New Jersey Public Service Commission

Sussex Rural Electric Cooperative Retail Rate Cases

(HE)

2004

New Jersey Board of Public Utilities, Focused audit of the planning, operations and maintenance practices, policies and procedures of Jersey Central Power & Light Company

Docket No. EX02120950 (HE)

2015

Jersey Central Power & Light Company ("JCP&L") and Mid-Atlantic Interstate Transmission, LLC ("MAIT") FERC 7 Factor Test Evaluation

BPU Docket No. EM15060733 (WT)

2016

Atlantic City Electric Company for Approval of Amendments to its Tariff to Provide for an Increase in Rates and Charges For Electric Service Pursuant to NJSA 48:2-21 and JJSA 48:2-21.1

DPU Docket No. ER16030252 OAL Docket No. PUC 5556-16

North Carolina Utilities Commission

Larry Eaves, et. al. v. Town of Clayton

(HE)

Poly-Loc v. Town of Tarboro

(HE)

1990

Delora Dennis, et. al. v. Haywood EMC

E-7, Sub 474, EC-10, Sub 37, E013, Sub 151 (HE)

2001

Wake EMC Right of Way Acquisition

(TE)

North Carolina Utilities Commission

2002

Progress Energy Carolinas, Inc.,
Siler City Transmission Line Issues

General Court of Justice Superior Court Division, File No. 03 CVS SP 251, 252, 253, 254, 255 (WT) (HE)

2004

John Wardlaw, et. al. Interveners v. Progress Energy Carolinas

Docket No. E-2, Sub 855 (HE)

2011

Frontier Communications of the Carolinas, Inc.

11-CVS-17175

2017

Time Warner Cable Southeast LLC

NCUC Docket Nos. EC-43 5888, EC-49 555, EC55 570 and EC-39 S44

2017

Blue Ridge Electric Membership Corporation

Docket No EC-23, SUB 50

Pennsylvania Public Utility Commission

2004

Investigation regarding the Metropolitan Edison Company Pennsylvania Electric Company and Pennsylvania Power Company Reliability Performance

Docket No. I-00040102 (WT) (HE)

2006

Investigation regarding Pennsylvania Rural Electric Association / Allegheny Electric Cooperative Rates

Docket Nos. R-00061366, R-0061367, et. al. (WT) (HE)

2007

Wellsboro Electric Company participants Included C&T Enterprises, Inc., comprised of Wellsboro Electric Company, Claverack Rural Electric Cooperative, Inc., Tri-County Rural Electric Cooperative, Inc., and Citizens Electric

Docket No. P-2008-2020257 (WT) (HE)

Pennsylvania Public Utility Commission

2014

PREA 2014 Intervention Assistance, Analysis of Service Reliability Concerns Regarding West Pennsylvania Power Company, Pennsylvania Electric Company, Metropolitan Edison Company (First Energy Company)

Docket Nos. R-2014-2428742, -2428743, -2428744, -248745 (WT)

2014

Pennsylvania Rural Utility Commission

R-2014-2428742, R-2014-2428743, R-2014-2428744, R-2014-2428745 (WT)

2015

MAIT and PENELEC for Authorizing the Transfer of Certain Transmission Assets from MET-Ed & PENELEC to MAIT

A-2015-2488903 (cons.)

Rhode Island Public Utilities Commission

1997

Testimony before the Rhode Island Utilities Commission, on behalf of Rhode Island Division of Public Utilities and Carriers, May 15, 1997

Docket No. 2489 (WT) (HE)

2003

Testimony before the Rhode Island Utilities Commission on behalf of Rhode Island Division of Public Utilities and Carriers, December 2003

Docket No. 2930 (WT) (HE)

2004

Issuance of Advisory Opinion to Energy Facility Siting Board Regarding The Narragansett Electric Company's Application to Relocate Transmission Lines Between Providence and East Providence, 2004

Docket No. 3564 (WT) (HE)

2006

Issuance of Advisory Opinion to Energy Facility Siting Board Regarding the Narragansett Electric Company d/b/a National Grid's Application to Construct and Alter Major Energy Facilities, 2006

Docket No. 3732 (WT) (HE)

2007

Issuance of Advisory Opinion to RIDPUC in the Matter of the Joseph Allard Fatality Involving Verizon and National Grid

Rhode Island Public Utilities Commission

2008

Issuance of Advisory Opinion to Energy Facility Siting Board Regarding the Narragansett Electric Company d/b/a National Grid's Application to Construct and Alter Major Energy Facilities, 2008

Docket No. 4029 (WT) (HE)

2010

Rhode Island Division of Public Utilities and Carriers Narragansett Tariff Investigation

Docket No. R.I.P.U.C. 4065

2010

National Grid Proposed Electric Infrastructure, Safety and Reliability Plan for FY 2012 Submitted Pursuant to R.I.G.L. § 39-1-27.7.1

Docket No. 4218 (WT) (HE)

2012

National Grid Electric FY 2013 Electric Infrastructure, Safety and Reliability Plan

Docket No. 4307 (WT) (HE)

2012

National Grid Hurricane Irene Response Assessment, 2012

Docket No. D-11-94 (WT) (HE)

2012

Public Utilities Commission Review of Storm Contingency Funds of Electric Utilities

Docket No. 2509 (WT) (HE)

2012

Commission's Investigation Relating to Stray and Contact Voltage

Docket No. 4237 (WT)

2012

Rhode Island Public Utilities Commission Interstate Reliability Assessment

Docket No. 4360 (WT) (HE)

2012

National Grid Electric Infrastructure, Safety, and Reliability Plan for 2014

Docket No. 4382 (WT) (HE)

Rhode Island Public Utilities Commission

2014

National Grid Electric Infrastructure, Safety, and Reliability Plan 2015 Proposal

Docket No. 4473 (WT) (HE)

2014

National Grid's FY 2016 Electric Infrastructure, Safety and Reliability Plan

Docket No. 4539 (WT) (HE)

2015

Division's Investigation into Verizon's Vegetation Management Practices

2015

Wind Energy Development, LLC (WED) and ACP Land, LLC Petition for Dispute Resolution Relating to Interconnection

Docket No. 4483 (WT)

2015

National Grid Electric Infrastructure, Safety, and Reliability Plan FY 2017

Docket No. 4592 (WT) (HE)

2016

PUC Advisory Opinion Regarding Need of The Narragansett Electric Co. d/b/a National Grid to Construct and Alter Certain Transmission Components in the Towns of Portsmouth and Middletown (Aquidneck Island Reliability Project)

Docket No. 4614

2016

National Grid Electric Infrastructure, Safety, and Reliability Plan FY 2018

Docket No. 4682 (WT)

State of Maine Public Advocate

2016

Efficiency Maine Trust Request for Examination of Voltage Optimization Pilot Program Docket No. 2016-00162

Dkt. 2016-00162

Respondent's Cross Exhibit 3
I/A

Section 2.
Definitions of special terms

The following definitions are for use with the National Electrical Safety Code. For other use, and for definitions not contained herein, the *IEEE Standards Dictionary Online* should be referenced.

NOTE: IEEE Standards Dictionary Online is available at: http://ieeexplore.ieee.org/xpls/dictionary.jsp.

administrative authority. The governmental authority exercising jurisdiction over application of this Code.

ampacity. The current-carrying capacity, expressed in amperes, of an electric conductor under stated thermal conditions.

anchorage. A secure point of attachment to which the fall protection system is connected.

area lighting. An electrical installation that provides lumens on public or private property.

NOTE: Area lighting installations under the exclusive control of a utility are covered by the NESC. All other area lighting installations are covered by the NEC.

authorized person. A person who has been authorized by the controlling utility or its designated representative to perform specified duties in, on, or in the vicinity of utility facilities, as applicable.

automatic. Self-acting, operating by its own mechanism when actuated by some impersonal influence—as, for example, a change in current strength; not manual; without personal intervention. Remote control that requires personal intervention is not automatic, but manual.

backfill (noun). Materials such as sand, crushed stone, or soil, that are placed to fill an excavation.

ballast section (railroads). The section of material, generally trap rock, that provides support under railroad tracks.

bonding. The electrical interconnecting of conductive parts, designed to maintain a common electrical potential.

cable. A conductor with insulation, or a stranded conductor with or without insulation and other coverings (single-conductor cable), or a combination of conductors insulated from one another (multiple-conductor cable).

cable jacket. A protective covering over the insulation, core, or sheath of a cable.

cable sheath. A conductive protective covering applied to cables.

NOTE: A cable sheath may consist of multiple layers, of which one or more is conductive.

cable terminal. A device that provides insulated egress for the conductors. *Syn:* **termination.**

circuit. A conductor or system of conductors through which an electric current is intended to flow.

circuit breaker. A switching device capable of making, carrying, and breaking currents under normal circuit conditions and also making, carrying for a specified time, and breaking currents under specified abnormal conditions such as those of short circuit.

clearance. The clear distance between two objects measured surface to surface, and usually filled with a gas such as air.

climbing. The vertical movement (ascending and descending) and horizontal movement to access or depart the worksite.

common use. Simultaneous use by two or more utilities of the same kind.

communication equipment. Equipment that produces, modifies, regulates, or controls communication signals. This equipment may also produce, modify, or safeguard a supply of electric energy for the exclusive use of communication devices as long as the equipment and communication devices being served are owned and operated by the same party. *See:* **electric supply equipment.**

communication lines. *See:* **lines.**

communication space. The space on joint-use structures where communication facilities are separated from the supply space by the communication worker safety zone. See Figure D-1.

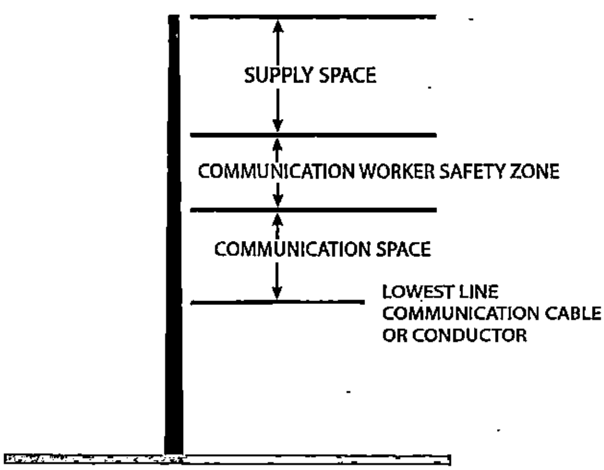


Figure D-1—Communication space

conductor.

1. A material, usually in the form of a wire, cable, or bus bar, suitable for carrying an electric current.
2. **bare conductor.** A metallic conductor without a covering.
3. **bundled conductor.** An assembly of two or more conductors used as a single conductor and employing spacers to maintain a predetermined configuration. The individual conductors of this assembly are called *subconductors*.
4. **covered conductor.** A conductor covered with a dielectric having no rated insulating strength or having a rated insulating strength less than the voltage of the circuit in which the conductor is used.
5. **fiber-optic conductor.** *See:* **fiber-optic cable—communication** or **fiber-optic cable—supply.**
6. **grounded conductor.** A conductor that is intentionally grounded, either solidly or through a noninterrupting current-limiting device.
7. **grounding conductor.** A conductor that is used to connect the equipment or the wiring system with a grounding electrode or electrodes.
8. **insulated conductor.** A conductor covered with a dielectric (other than air) having a rated insulating strength equal to or greater than the voltage of the circuit in which it is used.
9. **lateral conductor.** A wire or cable entirely supported on one structure and extending in a general horizontal, vertical, or diagonal direction to make connections to line conductors, service drops, equipment, or other facilities supported on the same structure. Lateral conductors may be attached directly to the structure or supported away from the structure.

10. **line conductor.** (Overhead supply or communication lines.) A wire or cable intended to carry electric currents, extending along the route of the line, supported by poles, towers, or other structures, but not including vertical or lateral conductors.
11. **open conductor.** A type of electric supply or communication line construction in which the conductors are (a) bare, covered, or insulated, (b) do not have grounded shielding, and (c) are individually supported at the structure either directly or with insulators. *Syn:* **open wire.**
12. **vertical conductor.** Either a wire or cable riser attached to a pole or a vertical portion of a lateral conductor.

conductor shielding. An envelope that encloses the conductor of a cable and provides an equipotential surface in contact with the cable insulation.

conduit. A structure containing one or more ducts.

> *NOTE:* Conduit may be designated as iron-pipe conduit, tile conduit, etc. If it contains only one duct, it is called *single-duct conduit;* if it contains more than one duct, it is called *multiple-duct conduit,* usually with the number of ducts as a prefix, e.g., *two-duct multiple conduit.*

conduit system. Any combination of duct, conduit, conduits, manholes, handholes, and/or vaults joined to form an integrated whole.

current-carrying part. A conducting part intended to be connected in an electric circuit to a source of voltage. Non-current-carrying parts are those not intended to be so connected.

de-energized. Disconnected from all sources of electrical supply by open switches, disconnectors, jumpers, taps, or other means.

> *NOTE:* De-energized conductors or equipment could be electrically charged or energized through various means, such as induction from energized circuits, portable generators, lightning, etc.

delivery point. The point at which one utility delivers energy or signals to another utility.

designated person. A qualified person designated to perform specific duties under the conditions existing. *Syn:* **designated employee.**

disconnecting or isolating switch. A mechanical switching device used for changing the connections in a circuit or for isolating a circuit or equipment from a source of power.

> *NOTE:* It is required to carry normal load current continuously as well as abnormal or short-circuit current for short intervals, as specified. It is also required to open or close circuits either when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the switch poles occurs. *Syn:* **disconnector, isolator.**

duct. A single enclosed raceway for conductors or cable.

effective ground/effectively grounded: Bonded to an effectively grounded neutral conductor or to a grounding system designed to minimize hazard to personnel and having resistances to ground low enough to permit prompt operation of circuit protective devices.

effectively grounded neutral conductor: A conductor that is intentionally connected to the source transformer neutral directly or through an impedance to limit phase-to-ground fault current and has not less than four grounds in each 1.6 km (1.0 mi) of line. The conductor shall be of sufficient size to carry the available fault current and permit prompt operation of circuit protective devices.

electric supply equipment. Equipment that produces, modifies, regulates, controls, or safeguards a supply of electric energy for the electric power supply grid that is (1) transferred to supply lines, or (2) used to provide power and/or control for other electric supply equipment, or (3) used to provide power to the devices of another utility. *Syn:* **supply equipment.**

> *NOTE*: *Electric supply equipment* does not include equipment whose purpose is to provide power to support locally mounted communication systems. For example, power supplies supporting CATV or communication amplifiers or repeaters are not considered to be supply equipment.

electric supply lines. *See:* **lines.**

electric supply station. Any building, room, or separate space within which electric supply equipment is located and the interior of which is accessible, as a rule, only to qualified persons. This includes generating stations and substations, including their associated generator, storage battery, transformer, and switchgear rooms or enclosures, but does not include facilities such as pad-mounted equipment and installations in manholes and vaults.

1. **generating station.** A plant wherein electric energy is produced by conversion from some other form of energy (e.g., fossil fuel, chemical, nuclear, solar, mechanical, wind, or hydraulic) by means of suitable apparatus. This includes all generating station auxiliaries and other associated equipment required for the operation of the plant. Not included are stations producing power exclusively for use with communications systems.
2. **substation.** An enclosed assemblage of equipment, e.g., switches, circuit breakers, buses, and transformers, under the control of qualified persons, through which electric energy is passed for the purpose of switching or modifying its characteristics to increase or decrease voltage or control frequency or other characteristics.
3. **switching station.** *See:* **substation.**

enclosed. Surrounded by case, cage, or fence designed to protect the contained equipment and limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects.

energized. Electrically connected to a source of potential difference, or electrically charged so as to have a potential significantly different from that of earth in the vicinity. *Syn:* **live.**

equipment. A general term including fittings, devices, appliances, fixtures, apparatus, and similar terms used as part of or in connection with an electric supply or communications system.

exclusive control. Generally covers installation, ownership, restricted access, operation, and maintenance by qualified and authorized persons.

exclusive control of utility. Where (a) energized facilities are separated from public access by a spatial or a physical barrier and accessible only to qualified personnel authorized by the serving utility, and (b) the utility is responsible for connection/disconnection of such facilities to/from energized sources of energy or signals.

exposed. Not isolated or guarded.

fall arrest system. The assemblage of equipment, such as a line-worker's body belt, aerial belt, or full body harness in conjunction with a connecting means, with or without an energy absorbing device, and an anchorage to limit the forces a worker can experience during a fall.

fall prevention system. A system, which may include a positioning device system, intended to prevent a worker from falling from an elevation.

fall protection program. A program intended to protect workers from injury due to falls from elevations.

fall protection system (hardware). Consists of either a fall prevention system or a fall arrest system.

fiber-optic cable—communication. A fiber-optic cable meeting the requirements for a communication line and located in the communication space of overhead or underground facilities.

fiber-optic cable—supply. A fiber-optic cable located in the supply space of overhead or underground facilities.

grounded. Connected to or in contact with earth or connected to some extended conductive body that serves instead of the earth.

grounded effectively. *See:* **effective ground/effectively grounded.**

grounded system. A system of conductors in which at least one conductor or point is intentionally grounded, either solidly or through a noninterrupting current-limiting device.

guarded. Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats or platforms, designed to limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects.

NOTE: Wires that are insulated but not otherwise protected are not normally considered to be guarded. See *EXCEPTIONS* under applicable rules.

handhole. An access opening, provided in equipment or in a below-the-surface enclosure in connection with underground lines, into which personnel reach but do not enter, for the purpose of installing, operating, or maintaining equipment or cable or both.

harness. A component with a design of straps that is fastened about the worker in a manner so as to contain the torso and distribute the fall arrest forces over at least the upper thighs, pelvis, chest, and shoulders with means for attaching it to other components and subsystems.

NOTE: Wherever the word *harness* is used in this Code, it refers to *full body harness*.

in service. Lines and equipment are considered in service when connected to the system and intended to be capable of delivering energy or communication signals, regardless of whether electric loads or signaling apparatus are presently being served from such facilities.

insulated. Separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current.

NOTE: When any object is said to be *insulated,* it is understood to be insulated for the conditions to which it is normally subjected. Otherwise, it is, within the purpose of these rules, uninsulated.

insulation (as applied to cable). That which is relied upon to insulate the conductor from other conductors or conducting parts or from ground.

insulation shielding. An envelope that encloses the insulation of a cable and provides an equipotential surface in contact with the cable insulation.

insulator. Non-conductive device designed to provide mechanical connection and electrical separation between objects.

NOTE: Examples include but are not limited to pin, post, or suspension insulators supporting conductors; electrical bus support insulators; and guy strain insulators.

isolated. Not readily accessible to persons unless special means for access are used.

isolated by elevation. Elevated sufficiently so that persons may safely walk underneath.

isolator. *See:* **disconnecting or isolating switch.**

jacket. A protective covering over the insulation, core, or sheath of a cable.

joint use. Simultaneous use by two or more utilities.

lanyard. A flexible line or webbing, rope, wire rope, or strap that generally has a connector at each end for connecting the line-worker's body belt, aerial belt, or full body harness to an energy absorbing device, lifeline, or anchorage.

lightning arrester. *See:* **surge arrester.**

limited access highways. As used herein, *limited access highways* are fully controlled highways where access is controlled by a governmental authority or a private toll road operator for purposes of improving traffic flow and safety. Fully controlled access highways have no grade crossings and have carefully designed access connections.

lines.

1. **communication lines.**
   a. **located in the communication space.** The conductors and their supporting or containing structures, equipment, and apparatus that are used for public or private signal or communications service, and which operate at potentials not exceeding 400 V to ground or 750 V between any two points of the circuit, and the transmitted power of which does not exceed 150 W. When operating at not more than 90 V ac or 150 V dc, no limit is placed on the transmitted power of the system. Under specified conditions, communication cables may include communication circuits exceeding the preceding limitation where such circuits are also used to supply power solely to communications equipment. Fiber-optic cables are considered as communication lines, regardless of whether they are installed in the communication space or supply space in accordance with applicable rules,

      NOTE: Public and private telephone, telegraph, railroad-signal, data, clock, fire, police-alarm, cable-television, and other systems conforming with the above are included. Lines used for signaling purposes, but not included under the above definition, are considered as supply lines of the same voltage and are to be so installed. Traffic signal light lines are considered as supply lines, not communication lines.

   b. **located in the supply space.** Communication lines located in the supply space and meeting Rule 224A may (a) operate at any voltage, (b) include supply circuits of any voltage, or (c) be included within a supply conductor or cable operating at any voltage.
2. **electric supply lines.** Those wires, conductors, and cables used to transmit electric or light energy and their necessary supporting or containing structures, equipment, and apparatus that are used to provide public or private electric supply or lighting service.

   Signal lines of more than 400 V and traffic signal lines of any voltage are always considered as supply lines within the meaning of the rules, and signal lines of less than 400 V may be considered as supply lines, if so run and operated throughout.

   Although fiber-optic lines are considered as communication lines, regardless of whether they are installed in the communication space or supply space in accordance with applicable rules, electric supply conductors to light amplifiers, etc., are considered as supply lines, unless contained within a communication cable in accordance with the definition of communication lines and applicable rules. *Syn:* **supply lines.**

3. **joint-use lines.** Overhead or underground lines containing or supporting facilities of two or more utilities. Lines containing or supporting facilities delivering two or more types of service by the same owner, such as electricity and lighting supply service or telephone and CATV communication service, are not considered as joint-use lines, unless also accompanied by one or more lines of another utility.

line-worker's body belt. A belt that consists of a belt strap and D-rings and which may include a cushion section or a tool saddle.

live. *See:* **energized.**

manhole. A subsurface enclosure that personnel may enter used for the purpose of installing, operating, and maintaining submersible equipment and cable.

manhole cover. A removable lid that closes the opening to a manhole or similar subsurface enclosure.

manhole grating. A grid that provides ventilation and a protective cover for a manhole opening.

manual. Capable of being operated by personal intervention.

minimum approach distance. The closest distance a qualified employee is permitted to approach either an energized or a grounded object, as applicable for the work method being used.

multigrounded/multiple grounded system. A system of conductors in which a neutral conductor is intentionally grounded solidly at specified intervals. A multigrounded or multiple grounded system may or may not be effectively grounded. *See:* **effective ground/effectively grounded.**

neutral conductor. A system conductor other than a phase conductor that provides a return path for current to the source. Not all systems have a neutral conductor. An example is an ungrounded delta system containing only three energized phase conductors.

out of service. Lines and equipment are considered out of service when disconnected from the system and when not intended to be capable of delivering energy or communications signals.

overhead ground wire. *See:* **shield wire.**

overvoltage. Voltage between two points of a system that is greater than the highest value appearing between the same two points under normal service conditions. Overvoltages include, but are not limited to, switching impulse (switching surge) overvoltages and temporary (transient) overvoltages.

pad-mounted equipment. A general term describing enclosed equipment, the exterior of which enclosure is at ground potential, positioned on a surface-mounted pad.

positioning device system. A system of equipment or hardware that, when used with its line-worker's body belt or full body harness, allows a worker to be supported on an elevated vertical surface, such as a pole or tower, and work with both hands free.

positioning strap. A strap with snap hook(s) to connect to the D-rings of a line-worker's body belt or full body harness.

premises. The land and buildings of a user located on the user side of the service point (sometimes called the *utility-user network point of demarcation* for communication wiring) to electric supply, communication, or signal premises wiring.

premises wiring (system). Interior and exterior wiring, including power, lighting, control, communication, and other signal circuit wiring together with all their associated hardware, fittings, and wiring devices, both permanently and temporarily installed either (a) from the service point or premises power source to the outlets, or (b) where there is no service point, from and including the non-utility power source to the outlets.

Such wiring does not include wiring internal to appliances, luminaires, motors, controllers, motor control centers, and similar equipment, nor does it include utility equipment and wiring on the utility side of the service point.

prestressed-concrete structures. Concrete structures that include metal tendons that are tensioned and anchored either before or after curing of the concrete.

pulling iron. An anchor secured in the wall, ceiling, or floor of a manhole or vault to attach rigging used to pull cable.

pulling tension. The longitudinal force exerted on a cable during installation.

qualified. Having been trained in and having demonstrated adequate knowledge of the installation, construction, or operation of lines and equipment and the hazards involved, including identification of and exposure to electric supply and communication lines and equipment in or near the workplace. An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training, and who is under the direct supervision of a qualified person, is considered to be a qualified person for the performance of those duties.

qualified climber. A worker who, by reason of training and experience, understands the methods and has routinely demonstrated proficiency in climbing techniques and familiarity with the hazards associated with climbing.

raceway. Any channel designed expressly and used solely for holding conductors.

random separation. Installed with less than 300 mm (12 in) separation and without deliberate separation.

remotely operable (as applied to equipment). Capable of being operated from a position external to the structure in which it is installed or from a protected position within the structure.

restricted access. Where exclusive control is maintained.

roadway. The portion of highway, including shoulders, for vehicular use. *See also:* **shoulder**; **traveled way.**

NOTE: A divided highway has two or more roadways.

sag.

1. The distance measured vertically from a conductor to the straight line joining its two points of support. Unless otherwise stated in the rule, the sag referred to is the sag at the midpoint of the span. See Figure D-2.
2. **initial sag.** The sag of a conductor prior to the application of any external load.
3. **final sag.** The sag of a conductor under specified conditions of loading and temperature applied, after it has been subjected for an appreciable period to the loading specified for the clearance zone in which it is situated or equivalent loading, and this loading is then removed. Final sag includes the effect of inelastic deformation.

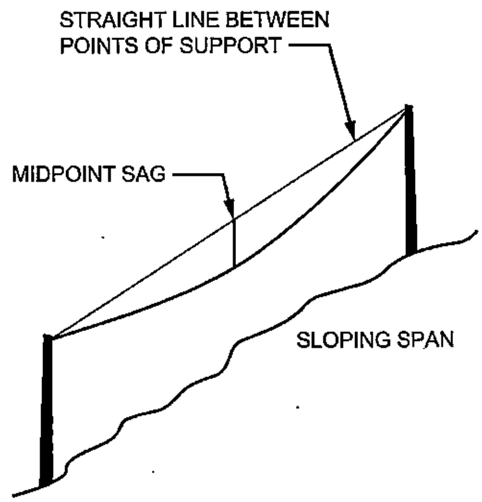


Figure D-2—Sag

separation. The distance between two objects, measured surface to surface, and usually filled with a solid or liquid material.

service drop. The overhead conductors between the electric supply or communication line and the building or structure being served.

service point. The point of connection between the facilities of the serving utility and the premises wiring.

> *NOTE:* The service point is the point of demarcation between the serving utility and the premises wiring. The service point is the point on the wiring system where the serving utility wiring ends and the premises wiring begins. The serving utility generally specifies the location of the service point based on the utility's condition of service.
>
> Because the location of the service point is generally determined by the utility, the service-drop conductors and the service-lateral conductors may or may not be part of the service covered by the NEC. For these types of conductors to be covered, they must be physically located on the premises wiring side of the service point. If the conductors are located on the utility side of the service point, they are not covered by the NEC definition of service conductors and are therefore not covered by the NEC.
>
> Based on the definitions of the terms *service point* and *service conductors,* any conductor on the serving utility side of the service point generally is not covered by the NEC. For example, a typical suburban residence has an overhead service drop from the utility pole to the house. If the utility specifies that the service point is at the point of attachment of the service drop to the house, the service-drop conductors are not considered service conductors because the service drop is not on the premises wiring side of the service point. Alternatively, if the utility specifies that the service point is "at the pole," and the service-drop conductors are not under utility control, the NEC would apply to the service drop.
>
> Exact locations for a service point may vary from utility to utility, as well as from occupancy to occupancy.

shield wire (also referred to as overhead ground wire, static wire, or surge-protection wire). A wire or wires, which may or may not be grounded, strung parallel to and above phase conductors to protect the power system from lightning strikes.

shoulder. The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles for emergency use and for lateral support of base and surface course.

side-wall pressure. The crushing force exerted on a cable during installation.

single-grounded system/unigrounded system. A system of conductors in which one conductor is intentionally grounded solidly at a specific location, typically at the source.

spacer cable. A type of electric supply-line construction consisting of an assembly of one or more covered conductors, separated from each other and supported from a messenger by insulating spacers.

spacing. The distance between two objects measured center to center.

span.

1. **span length.** The horizontal distance between two adjacent supporting points of a conductor.
2. **wind span.** The sum of half of the span lengths on either side of the supporting structures. See Figure D-3.

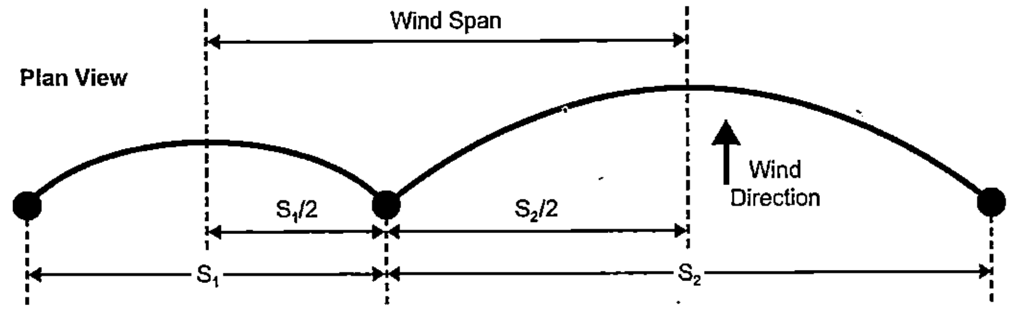
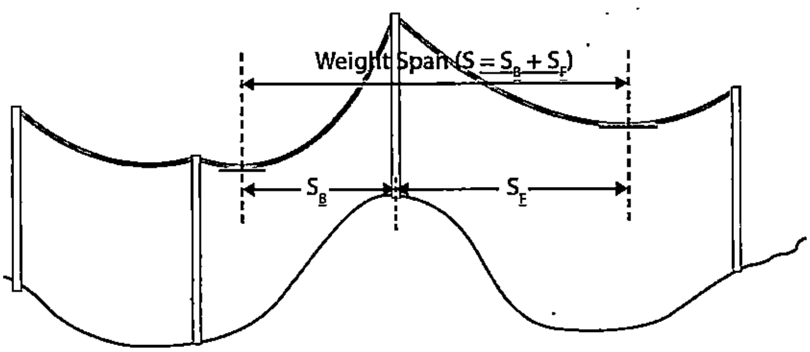


Figure D-3—Wind span

3. **weight span.** The sum of the horizontal distances from the supporting structure to the real or projected low point of conductor/cable sag in each supported span. See Figure D-4. *Syn:* **vertical span.**

   NOTE: Where the projected low point is beyond the adjacent structure, the weight span may exceed the actual span.



NOTE: Subscripts B and F stand for backspan and forespan, respectively.

Figure D-4—Weight span

span wire. An auxiliary suspension wire that serves to support one or more trolley contact conductors or a light fixture and the conductors that connect it to a supply system.

static wire. *See:* **shield wire.**

structure conflict. A line so situated with respect to a second line that the overturning of the first line will result in contact between its supporting structures or conductors and the conductors of the second line, assuming that no conductors are broken in either line.

substation. *See:* **electric supply station.**

supervised installation. Where conditions of maintenance and supervision ensure that only qualified persons monitor and service the system.

supply equipment. *See:* **electric supply equipment.**

supply space. The space on joint-use structures where supply facilities are separated from the communication space by the communication worker safety zone. See Figure D-5.

NOTE: Communication facilities may be located in the supply space (see Rule 224A).

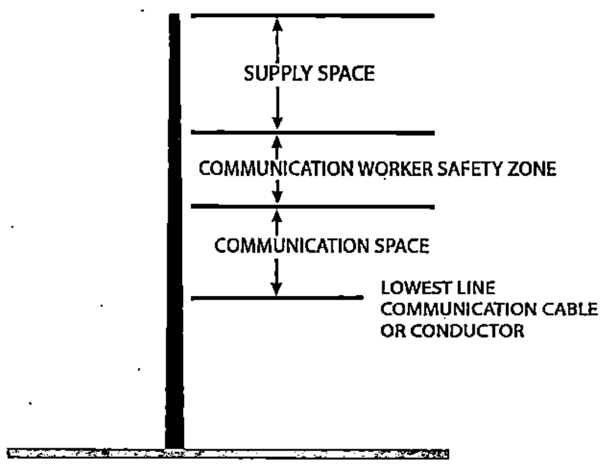


Figure D-5—Supply space

supply station. *See:* **electric supply station.**

supported facility. Any component of an overhead line system that is supported on, but is not intended to provide structural strength to, the supporting structure or mechanical support system.

NOTE: Examples of supported facilities include, but are not limited to, components such as messengers, conductors, line hardware, equipment hanger brackets, and switches.

supporting structure. The main supporting unit (usually a pole or tower) used to support supply and/or communication conductors, cables, and equipment.

NOTE: A supporting structure may consist of a single or multiple pole arrangement that supports supply and/or communication conductors, cables, and equipment at a line location.

1. **readily climbable.** A supporting structure having sufficient handholds or footholds so that the structure can be climbed easily by an average person without using a ladder, tools or devices, or extraordinary physical effort.

2. **not readily climbable.** A supporting structure not meeting the definition of a readily climbable structure, including but not limited to the following:

a. supporting structures, including poles and tower legs, with handholds or footholds arranged so that there is not less than 2.45 m (8 ft) between either: (1) the lowest handhold or foothold and ground or other accessible surface, or (2) the two lowest handholds or footholds. Diagonal braces on towers are not considered to be handholds or footholds except at their points of attachment.

b. guy wires

surge arrester. A protective device for limiting surge voltages.

surge-protection wire. *See:* **shield wire.**

susceptiveness. The characteristics of a communication circuit, including its connected apparatus, that determine the extent to which it is adversely affected by inductive fields.

switch. A device for opening and closing or for changing the connection of a circuit. In these rules, a switch is understood to be manually operable, unless otherwise stated.

switchboard. A type of switchgear assembly that consists of one or more panels with electric devices mounted thereon, and associated framework.

tag. Accident prevention tag (DANGER, PEOPLE AT WORK, etc.) of a distinctive appearance used for the purpose of personnel protection to indicate that the operation of the device to which it is attached is restricted.

tension

1. **initial.** The tension in a conductor prior to the application of any external load.
2. **final.** The tension in a conductor under specified conditions of loading and temperature applied, after it has been subjected for an appreciable period to the loading specified for the loading district (zone) in which it is situated, or equivalent loading, and this loading removed. Final tension includes the effect of inelastic deformation (creep).

termination. *See:* **cable terminal.**

transferring (as applied to fall protection). The act of moving from one distinct object to another (e.g., between an aerial device and a structure).

transformer vault. An isolated enclosure either above or below ground with fire-resistant walls, ceiling, and floor, in which transformers and related equipment are installed, and which is not continuously attended during operation. *See also:* **vault.**

transitioning (as applied to fall protection). The act of moving from one location to another on equipment or a structure.

traveled way. The portion of the roadway for the movement of vehicles, exclusive of shoulders and full-time parking lanes.

ungrounded system. A system of conductors in which no conductor or point is intentionally grounded, either solidly or through a noninterrupting current-limiting device.

unigrounded system. *See:* **single-grounded system/unigrounded system.**

utility. An organization responsible for the engineering and supervision (design, construction, operation, and maintenance) of a public or private electric supply, communication, area lighting, street lighting, signal, or railroad utility system.

1. **public utility.** A public utility is an entity that performs or provides one or more utility services for the benefit of multiple customers (at retail, wholesale, or both), including utilities formed for a singular purpose (including but not limited to providing street and outdoor lighting, municipal traffic signal control, or distributed generation). Public utilities include investor-owned, municipality/government-owned, cooperative-owned utility, public utility districts, irrigation districts, lighting districts, traffic signal or other signal utilities, and similar utilities.
2. **private utility.** A private utility is an entity that (a) performs or provides one or more utility services to its own facilities, such as a large industrial complex, large campus, military complex, railroad system, trolley system, or extensive gas or oil field through its own electric supply, communication, street and area lighting, or signal system and/or (b) generates or transmits power that is delivered to another utility.

   NOTE: Although many private utilities only operate a distribution level system, others operate generation and transmission systems.

utility interactive system. An electric power production system that is operating in parallel with and capable of delivering energy to a utility electric supply system.

utilization equipment. An electrical installation that uses electric or light energy for electronic, electromechanical, chemical, heating, lighting, testing, communication, signaling, or similar purposes on the premises wiring side of the service point.

> *NOTE:* Utilization equipment and premises wiring on the load side of the service point is intended to be performed under the NEC, regardless of whether a utility has exclusive control.

vault. A structurally solid enclosure, including all sides, top, and bottom, that is (1) associated with an underground electric supply or communication system, (2) located either (a) above or below ground or (b) in a building, and (3) where entry is limited to personnel qualified to install, maintain, operate, or inspect the equipment or cable enclosed. The enclosure may have openings for ventilation, personnel access, cable entrance, and other openings required for operation of equipment in the vault.

voltage.

1. The effective (rms) potential difference between any two conductors or between a conductor and ground. Voltages are expressed in nominal values unless otherwise indicated. The nominal voltage of a system or circuit is the value assigned to a system or circuit of a given voltage class for the purpose of convenient designation. The operating voltage of the system may vary above or below this value.
2. **voltage of circuit not effectively grounded.** The highest nominal voltage available between any two conductors of the circuit.

   NOTE: If one circuit is directly connected to and supplied from another circuit of higher voltage (as in the case of an autotransformer), both are considered to be of the higher voltage, unless the circuit of the lower voltage is effectively grounded, in which case its voltage is not determined by the circuit of higher voltage. Direct connection implies electric connection as distinguished from connection merely through electromagnetic or electrostatic induction.
3. **voltage of a constant-current circuit.** The highest normal full-load voltage of the circuit.
4. **voltage of an effectively grounded circuit.** The highest nominal voltage available between any conductor of the circuit and ground unless otherwise indicated.
5. **voltage to ground of:**
   a. **a grounded circuit.** The highest nominal voltage available between any conductor of the circuit and that point or conductor of the circuit that is grounded.
   b. **an ungrounded circuit.** The highest nominal voltage available between any two conductors of the circuit concerned.

6. **voltage to ground of a conductor of:**
   a. **a grounded circuit.** The nominal voltage between such conductor and that point or conductor of the circuit that is grounded.
   b. **an ungrounded circuit.** The highest nominal voltage between such conductor and any other conductor of the circuit concerned.

wire gauges. Throughout these rules, the American Wire Gauge (AWG) is the standard gauge for copper, aluminum, and other conductors, excepting only steel conductors, for which the American Steel Wire Gauge (Stl WG) is used.

worksite (as applied to fall protection). The location on the structure or equipment where, after the worker has completed the climbing (horizontally and vertically), the worker is in position to perform the assigned work or task.

CH XX #4
Respondent's Cross
Exhibit 4 I/A

INTERPRETATION (14 October 1996)

1. The neutral conductor must meet Rule 230E1 (which you state it does in your request for interpretation). Otherwise, Rule 230E2 applies.
2. Bonding the Rule 230E1 neutral and the Rule 230C3 cable messenger at every transformer pole *does not meet* the Rule 235G1 requirement (see Rule 92C for messenger grounding and bonding requirements). Rule 235G1 is a voltage limitation, which is met in your application.
3. In your application, the neutral and cable messenger will be of different materials, presumably with different sag-tension characteristics. Rule 235G2 requires that the specified clearance be maintained under all service conditions.

Table 235-5

Clearances for communication conductors located in supply space

REQUEST (12 July 1997) IR 504

Table 235-5 appears to allow communication conductors and cables to be installed in close proximity to supply conductors and cables in Category 1b as compared with Category 1a. However, there does not appear to be any stipulation as to when, and under what condition, that is allowed. Rule 238 has the requirements for clearances between communication facilities and supply facilities and has greater clearance requirements than in Table 235-5, Category 1b. This seems to be ambiguous and incomplete, with a need for clarification. It appears that if we install communication cables in the supply space in accordance with Table 235-5, Category 1b, we will then be in violation of Rule 238.

We interpret the rules as one of the two, as follows:

1. Category 1b of Table 235-5 can only be used for communication cables installed in the supply space if

installed, operated, and maintained by qualified persons as required by Rule 224A1.

& Sections 42 & 44

The clearances in Rule 238 are for communication facilities installed in the communication space, with an appropriate safety zone between the communication space and the supply space. The dimension of the safety zone is determined by the requirements of Rules 235 and 238.

Facilities in the communication space are intended to be worked upon by persons other than those qualified to be in the supply space; thus, the clearances of Rule 238 correspond closely with those in Table 235-5, Category 1a only.

2. The clearance requirements in Rule 238 preclude the clearances in Table 235-5, Category 1b from being utilized, even if the cables are installed, operated, and maintained by persons qualified to be in the supply space.

We think our interpretation number 1 is the correct one. However, please note that our confusion is exacerbated by reading Rule 224A2a, since it refers the reader to Rules 235 and 238 for further information on communication circuits located in the supply space. It is not clear, but we think that reference is only to the required clearances of 230E1 neutrals, since the communication cables on conductors in Rule 224A2a are to be treated as neutrals for clearance purposes. This also needs clarification.

INTERPRETATION (26 November 1996)

There is no conflict between Table 235-5, Item 1b and Rule 238 clearance requirements for communication cables installed in the supply space. In response to your request for interpretation, the following areas are clarified:

First, communication circuits located in the supply space must meet all of the Rule 224A requirements. Such circuits must be installed and maintained by personnel authorized and qualified to work in the supply space, as stated in Rule 224A1. Rule 224A2 covers clearance requirements; Rule 224A3 covers location/protection requirements.

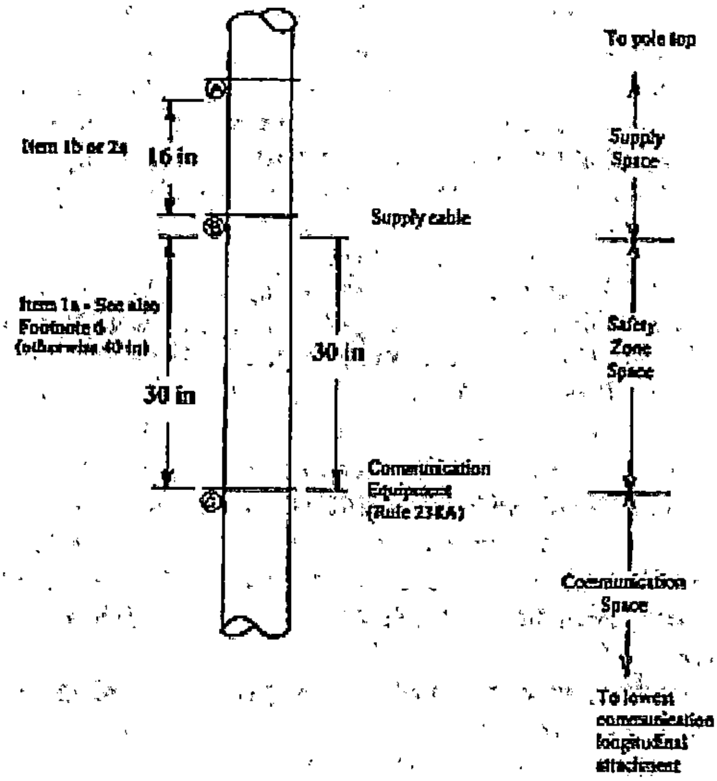
Second, clearance requirements *for insulated communication cables supported by an effectively grounded messenger* are stated in Rule 224A2a. This type of communication cable, when it is located in the supply space, may have the same clearances as neutrals meeting Rule 230E1 from other communication circuits located in the communication space and from supply conductors or cables located in the same supply space. Such cables are referred to as communication cables meeting Rule 224A2 and are treated as neutral conductors meeting Rule 230E1 for clearance purposes.

Pole clearances for a typical joint-use installation are shown in the enclosed figure IR 504-1. Note that the clearances specified for "B" in Table 235-5 are the same, whether "B" is a Rule 230E1 neutral or a Rule 224A2 communication cable (installed in the supply space). Also, note that Table 235-5 specifies clearances both to the supply cable above and to the communication cable below.

Third, Rule 238, including Table 238-1, does not specifically mention Rule 224A2 communication cables. However, such cables are treated as Rule 230E1 neutrals *for clearance purposes*. In the typical installation shown in Fig IR 504-1, the applicable clearance would be from the supply conductor (Rule 230E1 neutral or equivalent) to the communication through-bolt or bracket below (defined as equipment in Rule 238A for measuring clearance under this rule).

Finally, you commented that supply, communication and safety zone spaces are not defined in the code. This is correct. Both "communication lines" and "electric supply lines" are defined (see pages 7 and 8, 1993 Edition). These definitions include the associated conductors, cables and supporting or containing structures. While it should be intuitively obvious that communication lines are generally associated with communication space and supply lines with supply space, particularly with respect to longitudinal spans of conductors and cables, there are exceptions that preclude simple definitions. A generalized space allocation for the typical installation is also shown in Fig IR 504-1.

Table 235-5 Table 235-5



A. Supply—120/240V secondary cable (Rule 230C3)
B. Either Rule 230E1 neutral or communication cable in supply space (Rule 224A2a)
C. Communication cable in communication space

NOTE—Assumes B (either neutral or cable messenger) and C are bonded and grounded.

Figure IR 504-1

CH #5
Respondent's Cross
Exhibit 5 I/A

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Electrification Administration

BULLETIN 1726A-125

SUBJECT: **Joint Use Agreement With CATV Companies**

TO: REA Electric Borrowers and REA Electric Staff

EFFECTIVE DATE: Date of Approval

EXPIRATION DATE: Seven years from effective date

OFFICE OF PRIMARY INTEREST: Distribution Branch, Electric Staff Division

FILING INSTRUCTIONS: This is a new bulletin. File along with 7 CFR 1726 in the blue binders.

PURPOSE: The purpose of this bulletin is to (1) furnish REA borrowers with a sample joint use agreement with CATV companies, (2) provide borrowers with guidance in executing such an agreement, and (3) provide borrowers with guidelines regarding construction practices on joint use poles.

James B. Huff, Sr.	09/17/93
Administrator	Date

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2. Purpose
3. Application
4. Execution

APPENDIX: License Agreement

INDEX: Joint Use Agreement With CATV Companies

ABBREVIATIONS

CATV	Cable Television (Company)
NESC	National Electrical Safety Code (Accredited Standards Committee C2)

1. Introduction: A sample agreement for the joint use of poles, between REA borrowers and cable television companies, has been developed. A copy of this agreement, titled "License Agreement," is attached as an Appendix and a part of this bulletin.

2. Purpose: The purpose of this bulletin is to (1) furnish REA borrowers with a sample joint use agreement with CATV companies for the joint use of poles, (2) provide borrowers with guidance in executing such an agreement, and (3) provide borrowers with guidelines for construction and other related practices regarding joint use poles.

3. Application: The attached "License Agreement" is provided as a sample agreement which complies with all of the current, applicable REA requirements and recommendations.

3.1 The requirements for conformance to the NESC and other codes and regulations in Section 2, "Specifications," of the attached "License Agreement," are currently REA requirements and should remain essentially unchanged in the final executed agreement. The remaining provisions of the attached agreement clearly define and document good construction, maintenance, notification, and billing practices. Therefore, REA recommends, but does not require, that each one of these provisions be discussed and agreed upon by the parties, executed and enforced.

4. Execution: REA borrowers may execute the attached agreement without modifications, by filling in the appropriate information and securing the proper signatures. Alternately, the borrowers may modify the sample agreement as may be appropriate or required before signing. In either event, before executing the agreement, the borrower is advised to compare its provisions with the current requirements and guidelines of: (1) REA; (2) national, state, and local governing authorities having jurisdiction over contractual agreements and construction practices of the parties of the agreement; and (3) applicable national, state, and local safety and construction codes. The borrower is advised to have the agreement reviewed by a corporate attorney for form and content before execution.

LICENSE AGREEMENT
(SAMPLE FORMAT)

THIS AGREEMENT made and entered into the _______ day of ___________, 19___, by and between ______________________________ a(n) ____________ corporation, with its principal place of business in ______________________________ (hereinafter called "Licensor"), and ______________________________ a(n) ____________ corporation, with its principal place of business in ______________________________ (hereinafter called "Licensee").

WITNESSETH:

WHEREAS, Licensor owns, operates and maintains lines of poles extending in ______________________ County(s), ____________________; and

WHEREAS, Licensee desires to place certain lines, attachments and apparatus on certain poles of Licensor, for the limited purpose of the transmission of signals in compliance with any and all local, state or federal regulations; provided, that such transmission of signals does not interfere or compete with the corporate purposes of Licensor or interfere with the furnishing of electrical service to consumers of Licensor, and where in its judgement, safety will not be adversely affected.

WHEREAS, Licensor is willing to permit Licensee, to the extent it may lawfully do so, to place said lines, attachments, and apparatus on said poles in the area shown on Exhibit "A" set forth below:

NOW, THEREFORE, in consideration of the premises and the mutual covenants herein contained, the parties hereto, for themselves, their successors and assigns, do hereby covenant and agree as follows:

1. DEFINITIONS

(a) For the purpose of this agreement, the phrase "joint use pole" shall mean a pole conforming to the latest specifications of the American Standards Association.

(b) A "pole contact" is defined as any attachment by Licensee, to the poles of Licensor.

2. SPECIFICATIONS

(a) The joint use poles covered by this agreement shall be placed and maintained in accordance with the <u>most stringent</u> requirements, specifications, rules, and regulation of the latest edition of the National Electrical Safety Code (NESC), the Occupational Safety and Health Act (OSHA), the Rural Electrification Administration (REA), any governing authority having jurisdiction, and the rules and practices of Licensor as set forth in Exhibit"B".

(b) It is understood and agreed between the parties that the rules and practices set out in Exhibit "B" may be changed by Licensor, or new rules and practices may be adopted by Licensor, without resort to the provisions of Section 15, relating to supplementing or amending this agreement, and Licensee agrees to be bound by any such change or adoption.

(c) In the event that Licensor should change or adopt a rule or practice, or rules and practices, for the joint use of poles by Licensee, Licensor shall give Licensee written notice of such change or adoption in the manner contemplated by Section 18 and Licensee agrees to make such changes or alterations in its installations or maintenance of its facilities as may be required in order to fully comply with the provisions of such notice. In the absence of a contrary provision in said notice, Licensee agrees to make all required changes or alterations within thirty (30) days after receipt.

(d) No tag, brand, or other device showing Licensee's name or insignia shall be placed on, or attached to, any pole of Licensor, except such tag or insignia which shows Licensee to be the Licensee or lessee of such pole and not the owner thereof, and then only after obtaining the written consent of Licensor.

(e) The strength of poles covered by this Agreement shall be sufficient to withstand the transverse and vertical loads imposed upon them under the storm loadings of the National Electrical Safety Code assumed for the area in which they are located.

(f) Any unbalanced loading of Licensor's poles caused by the placement of Licensee's circuits shall be properly guyed and anchored by Licensee, at no expense to Licensor.

3. ESTABLISHING JOINT USE OF POLES

(a) Before the Licensee shall make use of any of the Licensor's poles under this Agreement, it shall request permission in writing on the application form attached and identified as Exhibit C, and shall comply with the procedures set forth in this section.

(b) If, in the judgement of the Licensor, joint use under the circumstances is undesirable, the Licensor shall have the right to reject the application. In any event, within thirty (30) days after the receipt of such application the Licensor shall notify the Licensee in writing whether the application is approved or rejected.

(c) After receipt of notice from the Licensor regarding the approved application, the Licensee shall furnish the Licensor detailed construction plans and drawings for each pole line, together with necessary maps, indicating specifically the poles of the Licensor to be used jointly, the number and character of the attachments to be placed on such poles, any rearrangement of the Licensor's fixtures and equipment necessary for joint use, any relocations or replacements of existing poles, and any additional poles which may be required. The Licensor shall, on the basis of such detailed construction plans and drawings, submit to the Licensee within thirty days a cost estimate (based on Licensor's method of computing costs) for all changes which may be required in each such pole line, including an estimated completion date for such changes. Upon written notice by the Licensee to the Licensor of the cost estimate being approved, the Licensor shall proceed with the necessary changes in the pole line covered by the referenced cost estimate. The Licensor shall make every effort to complete this work at a mutually agreed upon completion date. Nothing shall preclude the parties from making any mutually agreeable arrangement for contracting for or otherwise accomplishing the necessary changes. Upon completion of all changes, the Licensee shall have the right to use the poles jointly and to make attachments in accordance with the terms of the application and of this Agreement. The Licensee shall, at its own expense, make attachments in such manner as not to interfere with the service of the Licensor, and shall place guys and anchors to sustain any unbalanced loads caused by its attachments.

(d) Upon completion of all changes in each pole line to be used jointly, the Licensee shall pay to the Licensor the cost of making such changes. The obligations of the Licensee shall not be limited to amounts shown on estimates made by the Licensor. Costs include materials less salvage, labor, engineering, supervision, overheads, and tree trimming. (Engineering includes design, proper conductor spacing and bonding, and calculations to determine proper ground clearances and pole and downguy strength requirements for horizontal and transverse loading.) An itemized statement of the actual costs of all such changes shall be submitted by the Licensor to the Licensee, in a form mutually agreed upon.

(e) Any reclearing of existing right-of-way, and any tree trimming necessary for the establishment of joint use, shall be performed by the parties as may be mutually agreed. Each party shall bear 50% of the cost of any such right-of-way reclearing and trimming.

(f) All poles jointly used under this Agreement shall remain the property of the Licensor, and any payments made by the Licensee for changes in pole lines under this Agreement shall not entitle the Licensee to ownership of any of said poles.

(g) The Licensor reserves the right to exclude any of its facilities from joint use.

4. EASEMENTS AND RIGHT-OF-WAY FOR LICENSEE'S ATTACHMENTS

The Licensor does not warrant or assure to the Licensee any right-of-way privilege or easements; and if the Licensee shall at any time be prevented from placing or maintaining its attachments on the Licensor's poles, no liability shall attach to the Licensor. Each party shall be responsible for obtaining its own easements and right-of-way.

5. MAINTENANCE OF POLES, ATTACHMENTS AND RIGHT-OF-WAY

(a) The Licensor shall, at its own expense, inspect and maintain the poles in accordance with industry practices and the specifications mentioned in Section 2, and shall replace, reinforce or repair such poles as are determined to be defective.

(b) Whenever right-of-way considerations or public regulations make relocation of a pole necessary, such relocation shall be made by the Licensor at its own expense, except each party shall bear the cost of transferring its own attachments.

(c) Whenever it is necessary to replace or relocate a jointly used pole, the Licensor shall, before making such replacement or relocation, give twenty (20) days notice in writing (except in case of emergency, when verbal notice will be given and subsequently confirmed in writing) to the Licensee, specifying in such notice the time of such proposed replacement or relocation. Licensee shall, at the time so specified, transfer its attachments to the new or relocated joint pole. Should the Licensee fail to transfer its attachments to the new or relocated joint pole at the time specified for such transfer of attachments, the Licensor may elect to do such work, and the Licensee shall pay the Licensor the cost. In the event the Licensee fails to transfer its attachments and the Licensor does such work, the Licensor shall not be liable for any loss or damage to the Licensee's facilities which may result.

(d) Except as otherwise provided in (c) of this Section, each party shall at all times maintain all of its attachments in accordance with the specifications mentioned in Section 2 and shall keep them in thorough repair. All necessary right-of-way maintenance, including tree trimming or cutting, shall be performed by the parties as may be mutually agreed upon, and the cost shall be borne by the parties as provided in Section 3(e).

(e) Any existing joint use construction of the parties which does not conform to the specifications mentioned in Section 2 shall be brought into conformity as soon as practicable. When such existing construction shall have been brought into conformity with said specifications, it shall at all times thereafter be maintained as provided in (a) and (d) of this Section. Should the Licensee fail to comply, the Licensor may elect to do such work and the Licensee shall pay the Licensor the cost.

(f) Licensee expressly assumes responsibility for determining the condition of all poles to be climbed by its employees, contractors, or employees of contractors. Licensor disclaims any warranty or representation regarding the condition and safety of the poles of the Licensor. Licensor agrees that, upon written notification, it will replace any pole that has become unserviceable.

6. RECOVERY, REARRANGING OR RELOCATION OF FACILITIES

(a) In the event it is necessary for Licensor, or for another regulated utility with whom Licensor has an agreement for the joint use of wood poles, or for another Licensee with whom Licensor has a prior agreement for the joint use of wood poles, to use the space on poles occupied, or contracted for, by the Licensee, the Licensee shall, upon receipt of a thirty (30) day written notice, either vacate the space by the removal of its attachments or shall authorize Licensor to replace the poles at the expense of Licensee and Licensee shall pay for said replacements as provided for in 6(b), provided, however, that Licensee has not paid for the replacement of such poles.

(b) In any case where facilities of Licensor are required to be rearranged on the poles of the Licensor or of others to accommodate the attachments of Licensee, Licensee shall pay to Licensor the total costs incurred by Licensor in rearranging such facilities. The Licensee shall also reimburse other users of the poles of Licensor for their costs of rearrangement to provide space or clearance for the facilities of Licensee.

(c) Whenever it is necessary to replace or change the location of a joint use pole, for reasons other than those set out in 6(a) and (b), and over which Licensee has no control, Licensor shall, before making such change, give due notice to the Licensee, specifying in such notice the time of such proposed change, and the Licensee shall promptly begin to transfer or remove its attachments. In case of any such pole replacement or relocation where Licensor has transferred or removed its attachments and Licensee has not transferred or removed its attachments within sixty (60) days after receipt of such written notice, Licensee shall become liable for such old pole as provided in Section 8 (a).

(d) In the event of any changes contemplated under 6 (a), (b) or (c), Licensee shall pay the entire cost of any removal, transfer or installation of its own attachments.

7. INDEMNIFICATION

Licensee shall indemnify, protect, save harmless and insure Licensor from and against any and all claims and demands for damages to property, and for injury or death to persons, including payments made under any Workers' Compensation Law or under any plan for employees' disability and death benefits, and including all expenses incurred in defending against any such claims or demands, which may arise out of or be caused by the erection, maintenance, presence, use, rearrangement or removal of the attachments of Licensee's equipment to Licensor's poles or by the proximity of the Licensee's cables, wires, apparatus and appliances to those of Licensor or by any act of Licensee, its agents and employees on or in the vicinity of Licensor's poles. Licensee shall carry insurance in such form and in such companies as are satisfactory to Licensor to protect the parties from and against any and all claims, demands, actions, judgements, costs, expenses and liabilities of every name and nature which may arise or result directly or indirectly from or by reason of such loss, injury or damage.

The Licensee shall take out and maintain throughout the period during which this Agreement shall remain in effect insurance conforming with the REA requirements of CFR 1788. The Licensee shall furnish to the Licensor a certificate evidencing compliance with the above requirements. This certificate will list Licensor as additional insured and will note specific cancellation language, as follows: "In the event of cancellation of any of the said policies, the insuring company shall give the party to whom this certificate is issued fifteen (15) days' prior notice of such cancellation."

8. **ABANDONMENT OF JOINT USE POLES**

(a) If Licensor desires at any time to abandon any joint use pole, it shall give Licensee notice in writing to that effect at least sixty (60) days prior to the date on which it intends to abandon such pole. If, at the expiration of said period Licensor shall have no attachments on such pole but Licensee shall not have removed all of its attachments, such pole shall become the property of Licensee, and Licensee shall hold harmless the Licensor from every obligation, liability, or cost, and from all damages, expenses or charges incurred thereafter, arising out of, or because of, the presence of or the condition of such pole or any attachments; and shall pay to Licensor a sum equal to the present value in place of such abandoned pole or poles, or such other equitable sum as may then be agreed upon between the parties, and Licensor shall provide Licensee with a properly authorized bill of sale for such pole.

(b) Licensee may at any time abandon the use of a joint use pole by giving Licensor due notice in writing of such abandonment, as provided in Section 18, and removing from such pole all attachments that Licensee may have, and in case of such abandonment of the use of any such pole, Licensee shall pay to Licensor the full rental for the current year for the space on said pole set aside for the use of Licensee.

9. **RENTALS, CHARGES and RATES**

(a) On or about December 31 of each year, the parties, acting in cooperation, shall tabulate the total number of joint poles in use as of the preceding day. This tabulation shall indicate the number of poles on which rentals are to be paid. The rentals shall be computed on the basis of __________dollars per annum for each jointly used pole.

(b) The yearly rental period covered by this agreement shall be the twelve month period between January 1 and December 31. Rental payable for each such rental period during the continuance of this agreement shall be due and payable on February 1 following the end of the rental period. The annual rental per pole shall apply to any attachments made or removed during the year and rents shall not be prorated; <u>provided, however</u>, that if this agreement is executed between June 30 and December 31, Licensee shall pay to Licensor only one-half (1/2) of the annual rental due for attachments made during that period.

(c) In the event that Licensee requires a source of electrical energy for power supply to a cable system which constitutes a part of the licensed attachments and apparatus, such energy will be supplied by Licensor in accordance with the provisions of its standard service extension policies and approved rates and tariffs.

(d) All other amounts payable under this agreement, such as for erection, rearrangement, relocation or abandonment, shall be due and payable within thirty (30) days of billing by Licensor.

10. **DEFAULTS**

(a) If Licensee shall fail to comply with any of the provisions of this agreement or should default in any of its obligations under this agreement, and shall fail within thirty (30) days after written notice from Licensor to correct such noncompliance or default, Licensor may, at its option, and without further notice, declare this Agreement to be terminated in its entirety, or may terminate the permit covering the pole or poles in respect to which such default or noncompliance shall have occurred. In case of such termination, no refund of accrued rental shall be made.

(b) If Licensee shall make default in the performance of any work which it is obligated to do under this agreement, the Licensor may elect to do such work, and the Licensee shall reimburse the Licensor for the cost.

(c) If the Licensee shall make default in any of its obligations under this Agreement and it becomes necessary for the Licensor to obtain the services of an attorney, who is not a salaried employee of the Licensor, to enforce such obligations, the Licensee agrees to pay any and all attorney fees, court costs and other costs of litigation associated with the enforcement of such obligations.

11. UNAUTHORIZED ATTACHMENT

(a) If any of Licensee's facilities for which no license has been issued shall be found attached to Licensor's poles, Licensor may, without prejudice to its other rights or remedies under this Agreement, including termination, require Licensee to submit, within fifteen (15) days after the date of written or oral notification from Licensor of the unauthorized attachment, a pole attachment license application. If such application is not received by Licensor within the specified time period, Licensee shall immediately remove its unauthorized attachment, or Licensor may remove such Licensee facilities without liability, and the expense of such removal shall be borne by Licensee.

(b) No act or failure to act by Licensor with regard to said unauthorized attachment shall be deemed as a ratification or the licensing of the unauthorized attachment. If any license should be subsequently issued, said license shall not operate retroactively or constitute a waiver by Licensor of any of its rights or privileges under this Agreement; provided, however, that Licensee shall be subject to all liabilities, obligations and responsibilities of this Agreement from its inception in regard to said unauthorized attachment.

12. RIGHTS OF OTHER PARTIES

Nothing herein shall be construed to limit the right of Licensor, by contract or otherwise, to confer upon others, not parties to this agreement, rights or privileges to use the joint use poles covered by this agreement.

13. TERM OF AGREEMENT

This agreement shall continue in force and effect for a period of one (1) year from and after the date of this Agreement, and thereafter from year to year unless terminated by either party by giving written notice of its intention so to do not less than thirty (30) days prior to the end of any period, provided, however, if the Licensee shall fail to commence construction on the poles of Licensor within the period of one hundred eighty (180) days after the date of execution of this License Agreement, then this License Agreement shall be null and void, and of no further force and effect. Upon termination of this agreement, Licensee shall remove its attachments from the poles of Licensor within one hundred eighty (180) days after the effective date of such termination. Should the Licensee fail to comply, the Licensor may elect to do such work and the Licensee shall pay the Licensor the cost.

14. WAIVER OF TERMS OR CONDITIONS

The failure of either party to enforce or insist upon compliance with any of the terms or conditions of this agreement shall not constitute a general waiver or relinquishment of any such terms or conditions, but such conditions and terms shall be and remain at all times in full force and effect.

15. SUPPLEMENTAL AGREEMENTS

(a) This agreement may be amended or supplemented at any time upon written agreement by the parties hereto. Should either an amendment or supplement become necessary, the party desiring such amendment or supplement shall give thirty (30) days written notice to the other party setting out in detail the changes or additions desired.

(b) In the event that Licensee desires to add or reduce the number of pole contacts, Section 15 (a) shall not apply, but in each case a sketch, map, or other mutually acceptable notice shall be submitted to Licensor, setting out in detail the pole numbers and exact locations of the poles, and the quantity of poles involved in the addition or subtraction.

16. PAYMENT OF TAXES

Each party shall pay all taxes and assessments lawfully levied on its own property upon said jointly used poles, and the taxes and the assessments which are levied on said joint use poles shall be paid by the Licensor thereof, but any tax, fee or charge levied on Licensor's poles solely because of their use by the Licensee shall be paid by Licensee.

17. INTEREST AND PAYMENTS

All amounts to be paid by Licensee to Licensor under this Agreement shall be due and payable within thirty (30) days after an itemized statement is presented to the Licensee. Any payment not made within thirty (30) days from the due date shall bear interest at the rate of ______ Percent (____%) per annum until paid.

18. NOTICES

Any notice, request, consent, demand or statement which is contemplated to be made upon either party by the other party under any of the provisions of this agreement, shall be in writing and shall be treated as duly delivered when it is either (a) personally delivered to the office of Licensor in the case of a notice to be given to Licensor, or personally delivered to the office of Licensee in the case of a notice to be given to Licensee, or (b) deposited in the United States mail and properly addressed to the party to be served as follows:

(i) If notice is to Licensor,

(ii) If notice is to Licensee,

----

19. SUPPLYING INFORMATION

(a) It is understood and agreed to between the parties that Licensee shall furnish to Licensor within _________________ (   ) days after the execution of this agreement a detailed sketch or map upon which will be shown the precise locations by streets or roads of the joint use poles covered by this agreement, showing the facilities installed or to be installed upon the joint use poles and the pole numbers upon which these facilities are to be attached. Such sketch or map shall be reviewed by, and approved, commented upon, or rejected by the engineers of Licensor, and Licensee agrees to make any and all such changes in said sketch or map as are suggested by said engineers. Licensee shall not begin the installation of any facilities covered by this agreement until engineering approval by Licensor is granted.

(b) Within ________________ (   ) days after the completion of the initial installation of the facilities, as set forth on the above mentioned sketch or map, Licensee shall furnish to Licensor a revised copy of said sketch or map showing the precise location of each power supply, pole contact, and other attachment of Licensee which is actually installed on poles of the Licensor. Such revised sketch or map shall be verified by the Licensor and shall be the basis for determining the number of pole contacts made initially.

(c) Licensee shall promptly report to Licensor any changes made in the number of poles of the Licensor contacted by Licensee.

(d) Upon request of Licensor or Licensee, but not sooner than six (6) years after the execution of this agreement, and every six (6) years thereafter, or as may be mutually agreed upon, the parties shall make a joint field check to verify the accuracy of contact records. If, as a result of any such joint field check, it is found that the Licensee is occupying any poles of the Licensor without having advised the Licensor as provided in Section 16, the Licensee shall pay to the Licensor the rental for such poles from the date that Licensee's attachments were installed on such poles, or if dates of installation cannot be determined to the satisfaction of both parties, the installations shall be presumed to have occurred at the same rate as those reported throughout the entire period since the last field check was made.

20. CONSTRUCTION OF AGREEMENT

This agreement is deemed executed in the state of ________________ and shall be construed under the laws of the State of ________________.

21. PRIOR AGREEMENTS SUPERSEDED

This agreement supersedes and replaces any and all previous agreements entered into by and between Licensor and Licensee with respect to the subject matter of this agreement.

22. ASSIGNMENT OF AGREEMENT

Neither party shall assign or otherwise transfer this Agreement or any of its rights and interests to any firm, corporation or individual, without the prior written consent of the other party.

In witness whereof, the parties have caused this Agreement to be duly executed.

ATTEST:

____

____
Secretary

By: ________________________

Title: ________________________

ATTEST:

____

____
Secretary

By: ________________________

Title: ________________________

Attach here as Exhibit "A" a map or sketch entitled "Location of the Licensee Distribution System Service Area", stating the corporate name of Licensee, and showing, outlined in red, the service area of the Licensee as required on page 1 of this agreement. This map shall be marked Exhibit "A", should be no larger than 30" x 30", shall be properly folded to the size of 8 1/2" x 11" for inclusion in this Agreement and stapled to the Agreement in the upper left corner. This Exhibit need not show location of Licensor's poles and lines, (see Section 19, supply information); but should illustrate the area in which contacts are planned.

EXHIBIT "B"

RULES AND PRACTICES FOR TELEVISION ATTACHMENTS

1. All television facilities attached to Licensor's poles shall be installed in a manner to ensure compliance with the requirements of the "National Electrical Safety Code" in effect at the time of installation.

2. The location of all cables or power supplies on Licensor's poles shall be approved in writing by the Licensor. No attachments shall be made without prior approval of Licensor.

3. All television cables and power supplies shall be located on the same side of each pole as any existing telephone cable, or as designated by the Licensor.

4. On jointly used poles where Licensor has secondary conductors, all cables and power supplies shall be located on the side of the pole opposite the secondary conductors, or as designated by the Licensor.

5. Licensee's service connections or drops to its customers shall be installed and maintained so as to provide at least a forty (40) inch square climbing space directly over and corresponding to the climbing space provided for and through any telephone service connections or drops.

6. Licensee shall cause all cabinets and enclosures to be grounded by bonding to the existing pole ground with #6 solid, bare, soft drawn copper wire.

7. No power supply shall be installed on any of Licensor's poles on which are already installed transformers, underground electric services, capacitor banks, or sectionalizing equipment.

8. No bolt used by Licensee to attach its facilities shall extend or project more than one (1) inch beyond its nut.

9. All attachments or facilities of Licensee shall have at least two (2) inches clearance from unbonded hardware.

10. All television cables shall have at least forty (40) inches clearance under the effectively grounded parts of transformers, transformer platforms, capacitor banks and sectionalizing equipment and at least forty (40) inches clearance under the current carrying parts of such equipment (energized at 8700 volts or less). Clearances not specified in this rule shall be determined by reference to the "National Electrical Safety Code".

11. No service connection shall be made or installed by Licensor until after Licensee shall have completed installation of an approved fused service disconnect switch or circuit breaker.

12. The Licensee may, with the prior written approval of the Licensor, install crossarms, alley arms, or cable extension arms for the support of any of its facilities. However, Licensee shall not use any crossarm or alley arm brace above the arm which it supports.

13. Licensee shall install and maintain any and all of its facilities in a neat and workmanlike manner consistent with the maintenance of the overall appearance of the jointly used pole, and all subject to the approval of Licensor, provided that Licensee shall be solely responsible for compliance with the specifications referred to in Section 5 of this License Agreement.

14. All down guys, head guys or messenger dead ends installed by Licensee shall be attached to jointly used poles by the use of "thru" bolts. Such bolts placed in a "bucking" position shall have at least three inches vertical clearance. Under no circumstances shall Licensee install down guys, head guys or messenger dead ends by means of encircling jointly used poles with such attachments. All guys and anchors shall be installed prior to installation of any messenger wire or cables.

15. In the event that any of Licensee's proposed facilities are to be installed upon poles already jointly used by Licensor and other parties, without in any way modifying the clearance requirements set forth in these Rules and Practices, Licensee shall negotiate with such other parties, as to clearances between its facilities and the spans of Licensee and such other parties.

16. In the event Licensee desires to request a change in the number of pole contacts, it shall do so by submitting to Licensor the standard form suitable for that purpose.

17. The Licensee shall provide a written statement, signed by a Professional Engineer representing the Licensee, that its facilities, including protection devices, as installed are fully in compliance with the applicable rules of the NESC, other codes and requirements, and good engineering design. This inspection shall be made within thirty (30) days after installation has been completed. Failure to comply will result in termination of this agreement as outlined in Section 10, a, b, & c.

EXHIBIT "C"

Application and Permit for Use of Poles

Application No.______________

Date ________________ 19____,

In accordance with the terms of agreement dated ______________ 19____, application is hereby made for licensee to make attachments to ______ poles located in or near ______________________________ in the County of ____________________ and the State of ______________.

The poles, including proposed construction by (Cooperative) if necessary for which permission is requested are listed by pole number on the attached Exhibit "CI" and further identified on the attached map. Detailed construction plans and location drawings, will be furnished.

____
Licensee

By: ____________________________

Title: ____________________________

Certification to be completed

I hereby certify that upon final inspection (which will be made within 30 days after construction is complete) the attachments fully comply with the National Electrical Safety Code (NESC), latest edition, and no poles or facilities of ____ will be in violation of NESC as the result of said attachments.

____________________________ ____________________________
Registration Number (State) Engineer's Signature

Permission for construction granted ______________, 19____, subject to (1) your approval of the following changes and rearrangements at an estimated cost to you of $______________, (2) the necessary third-party rearrangements are done satisfactorily, and (3) that licensee construct according to standards.

By: ____________________________

Title: ____________________________
Licensor

The above estimates for make-ready changes and rearrangements approved ______________, 19____. Licensee intends to construct plant within 120 days after make-ready work is complete.

By: ____________________________

Title: ____________________________
Licensee

EXHIBIT "C1"

ATTACHMENTS TO BE INSTALLED

* LICENSEE: * LICENSOR:

COOPERATIVE POLE NUMBER	COMMENTS - MAKE-READY	PERMISSION GRANTED	ESTIMATED COST OF MAKE-READY

EXHIBIT "D"

NOTIFICATION OF REMOVAL

In accordance with the terms of Agreement dated ________________ 19____, notice is given to Licensor of the removal of attachments from ________________ poles located in or near ______________________________ in the County of ________________ and the State of ________________.

The poles from which attachments have been removed are listed below:

Exhibit D1 and further identified on the attached map.

COOPERATIVE POLE NUMBER	LICENSOR USE	COOPERATIVE POLE NUMBER	LICENSOR USE

____
Licensee

By: ________________________

Title: ______________________

Notice Acknowledged

______________________ 19____

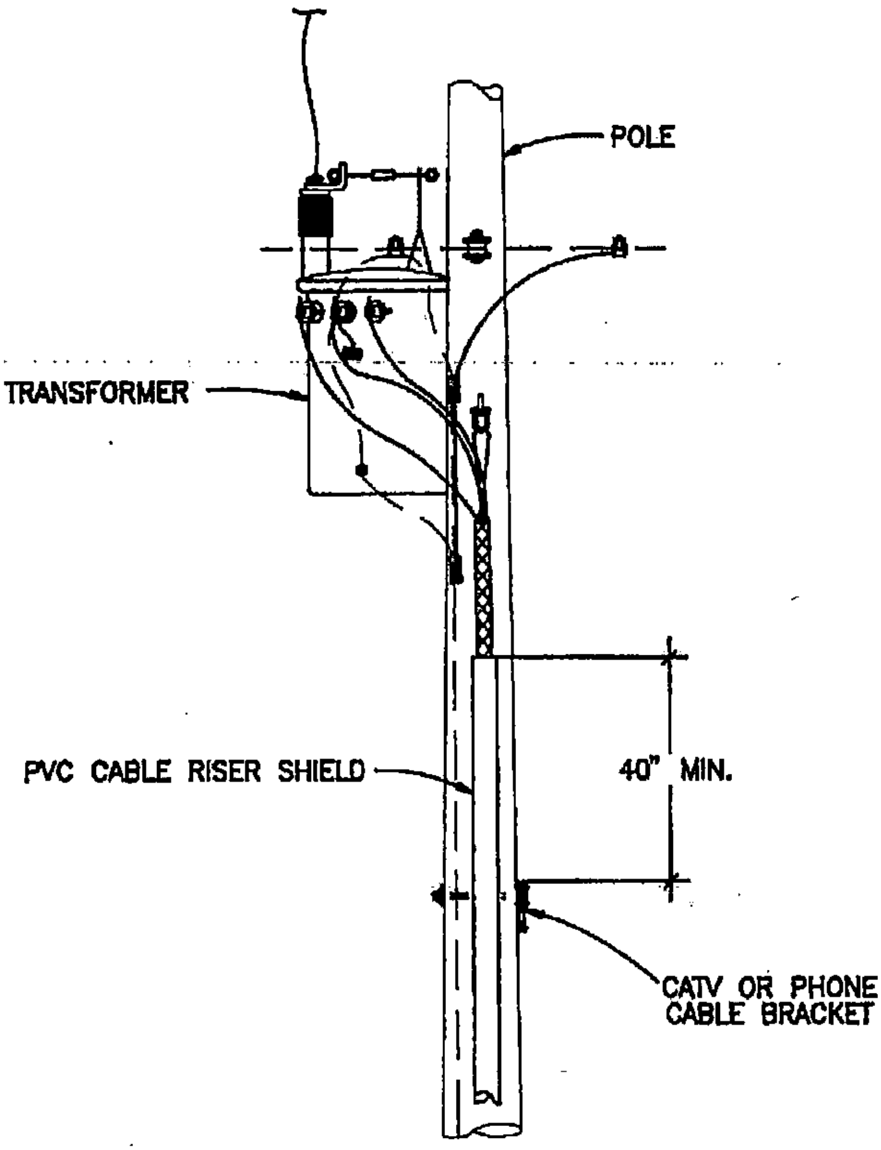
____
Licensor

By: ________________________

Title: ______________________

The drawings on pages 20-26 of this bulletin are not available as they no longer comply with the current National Electrical Safety Code (NESC).

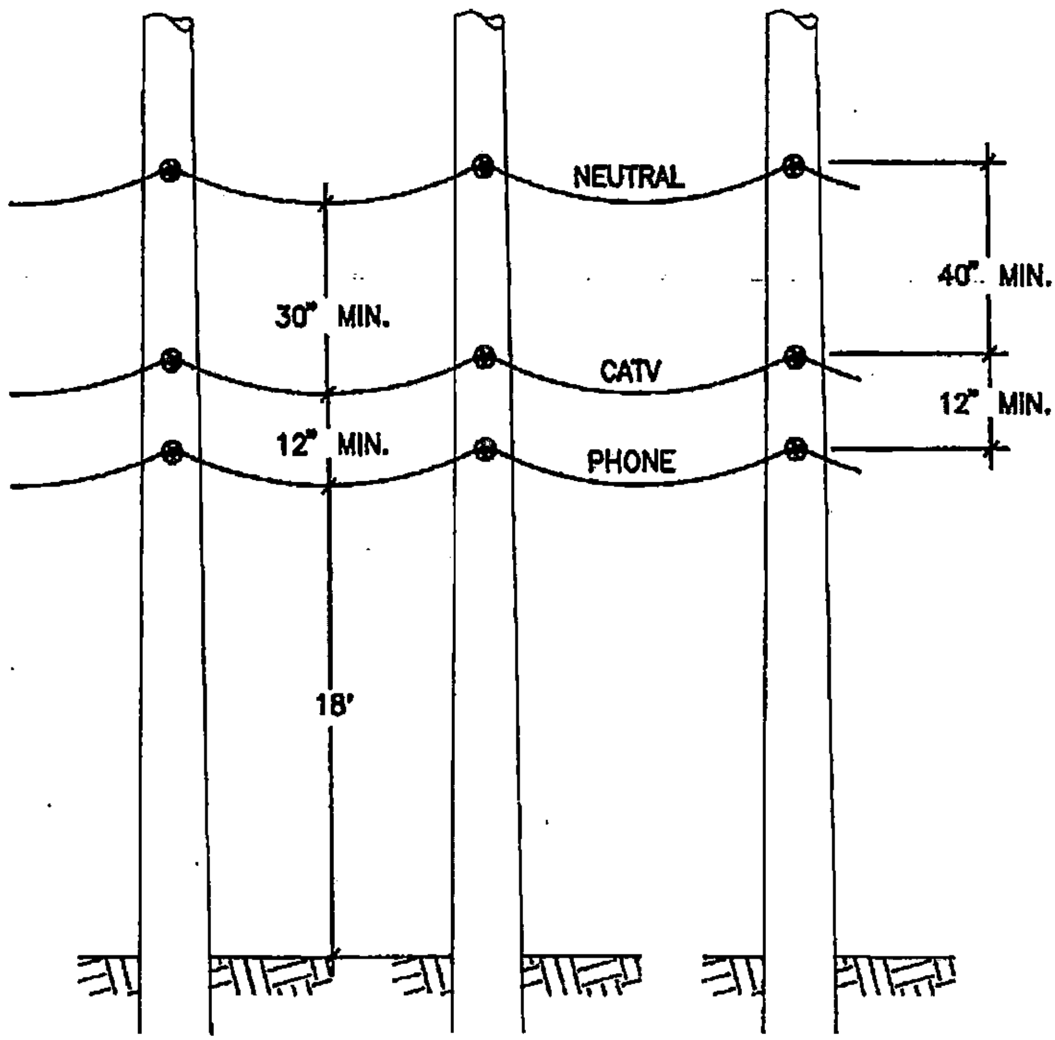
CLEARANCE FROM UNDERGROUND SERVICE RISER TO CATV OR PHONE ATTACHMENT



STANDARD CLEARANCES FOR CATV OR TELEPHONE ATTACHMENT

DRWN:	DATE:	REVS'D:

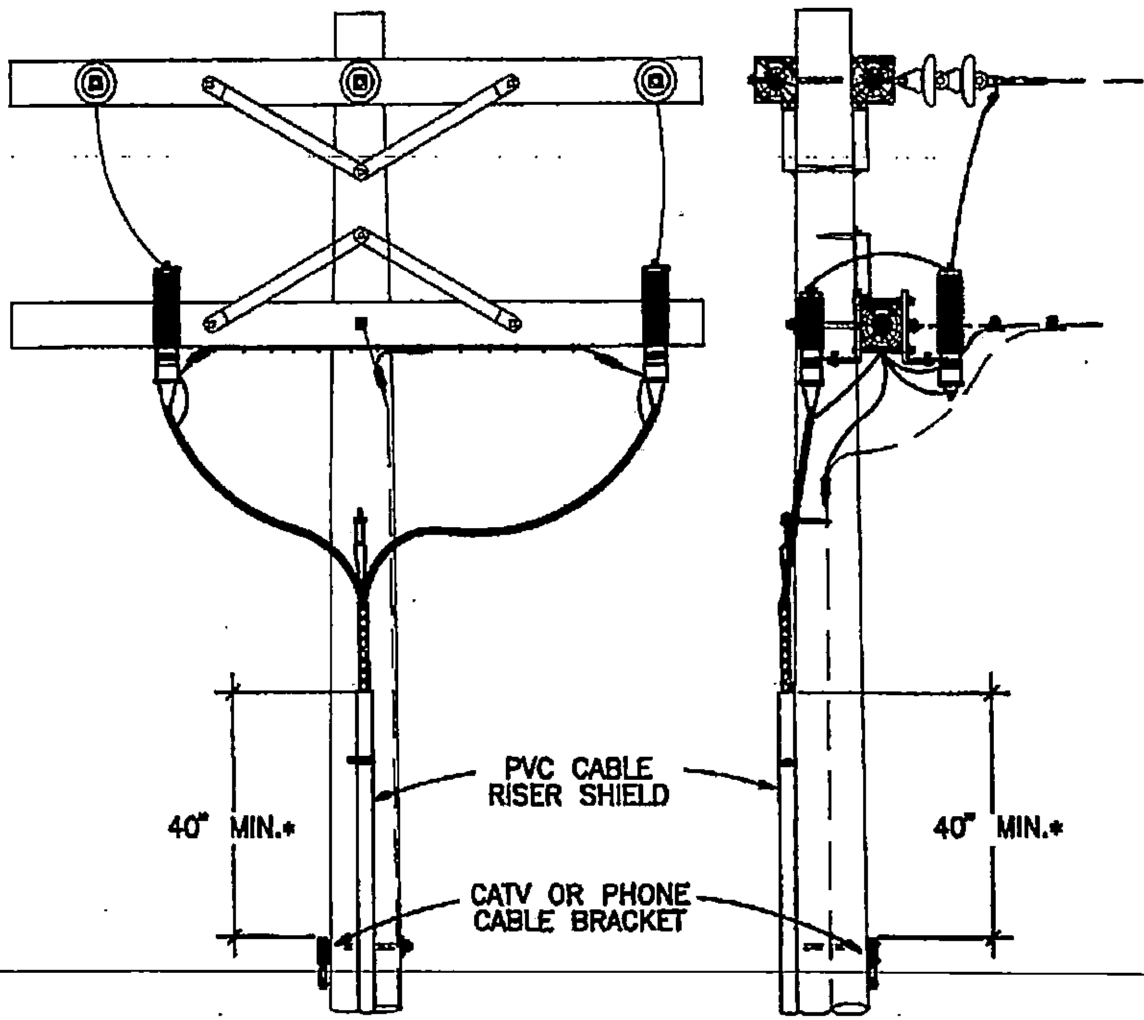
CLEARANCE BETWEEN POWER NEUTRAL AND CATV OR PHONE ATTACHMENTS



18' CLEARANCE, SHOWN ABOVE, DESIGNATES CLEARANCE ABOVE ROADS. PHONE AND CATV COMPANIES MUST ENSURE THAT 18' IS ADEQUTTE CLEARANCE TO MEET THE NESC REQUIREMENT OF 15.5 FEET AT MAXIMUM SAG CONDITIONS.

STANDARD CLEARANCES FOR CATV OR TELEPHONE ATTACHMENT		
DRWN:	DATE:	REVS'D:

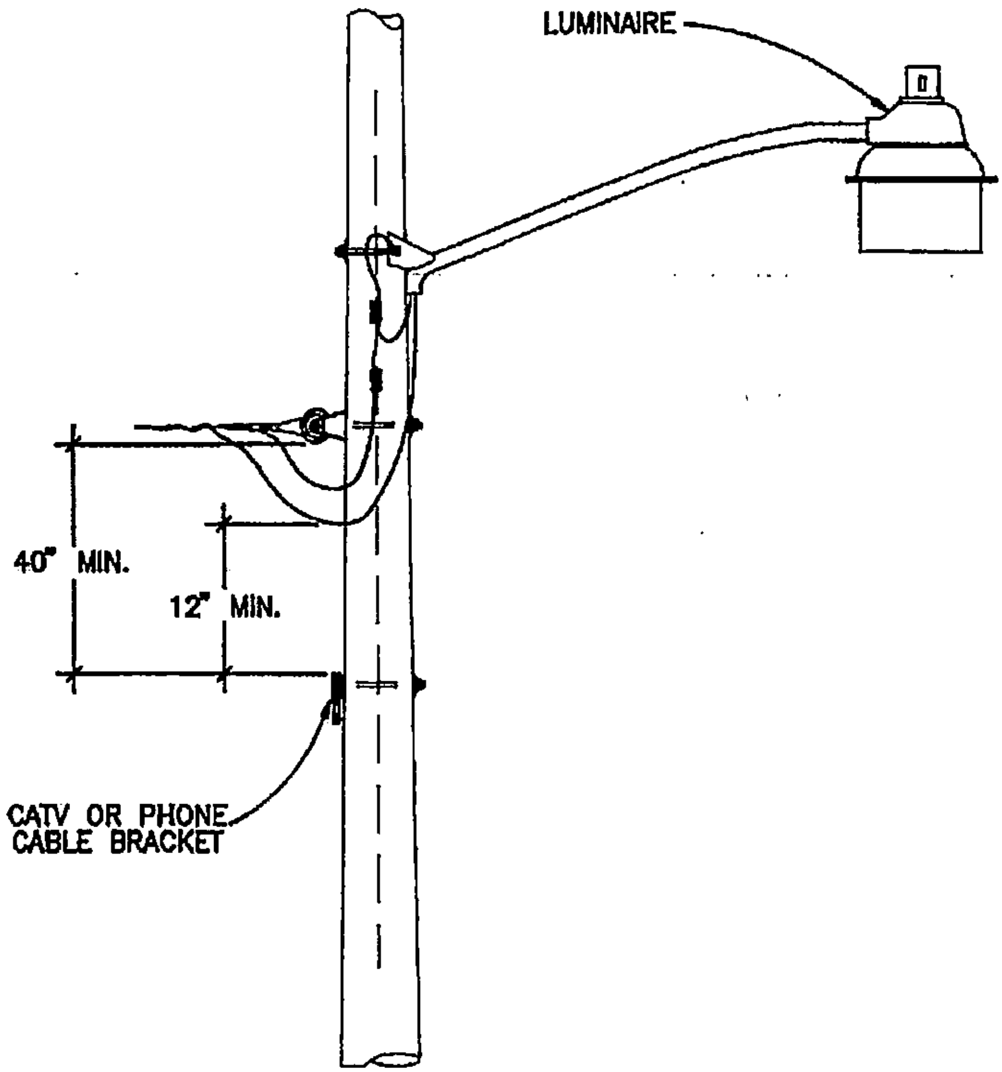
CLEARANCE FROM 7.2/12.5kV RISER TO CATV OR PHONE ATTACHMENT



* THIS CLEARANCE INCREASES TO 43" ON 14.4/24.9kV

STANDARD CLEARANCES FOR CATV OR TELEPHONE ATTACHMENT

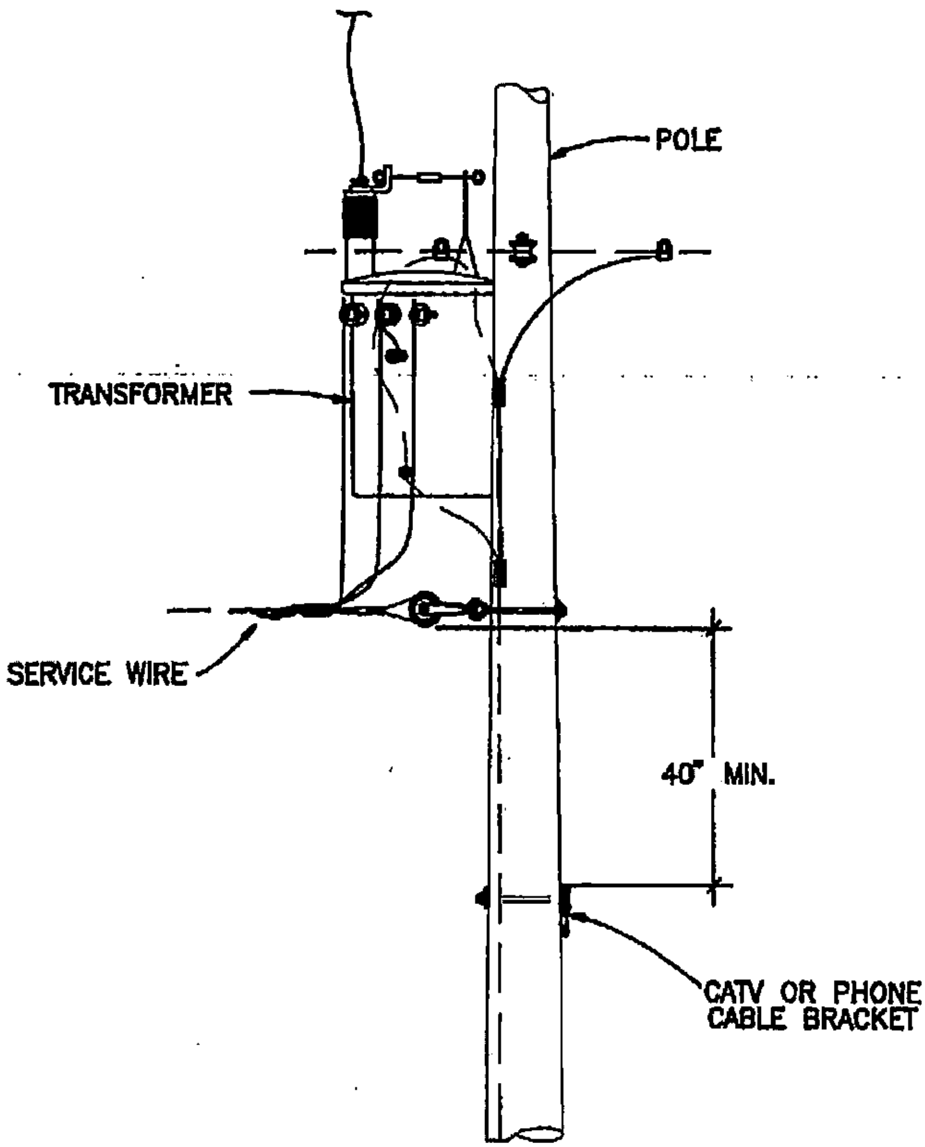
CLEARANCE FROM LIGHTS TO CATV OR PHONE ATTACHMENT



NOTE: BOTH THE 40" & 12" CLEARANCES MUST BE MAINTAINED.

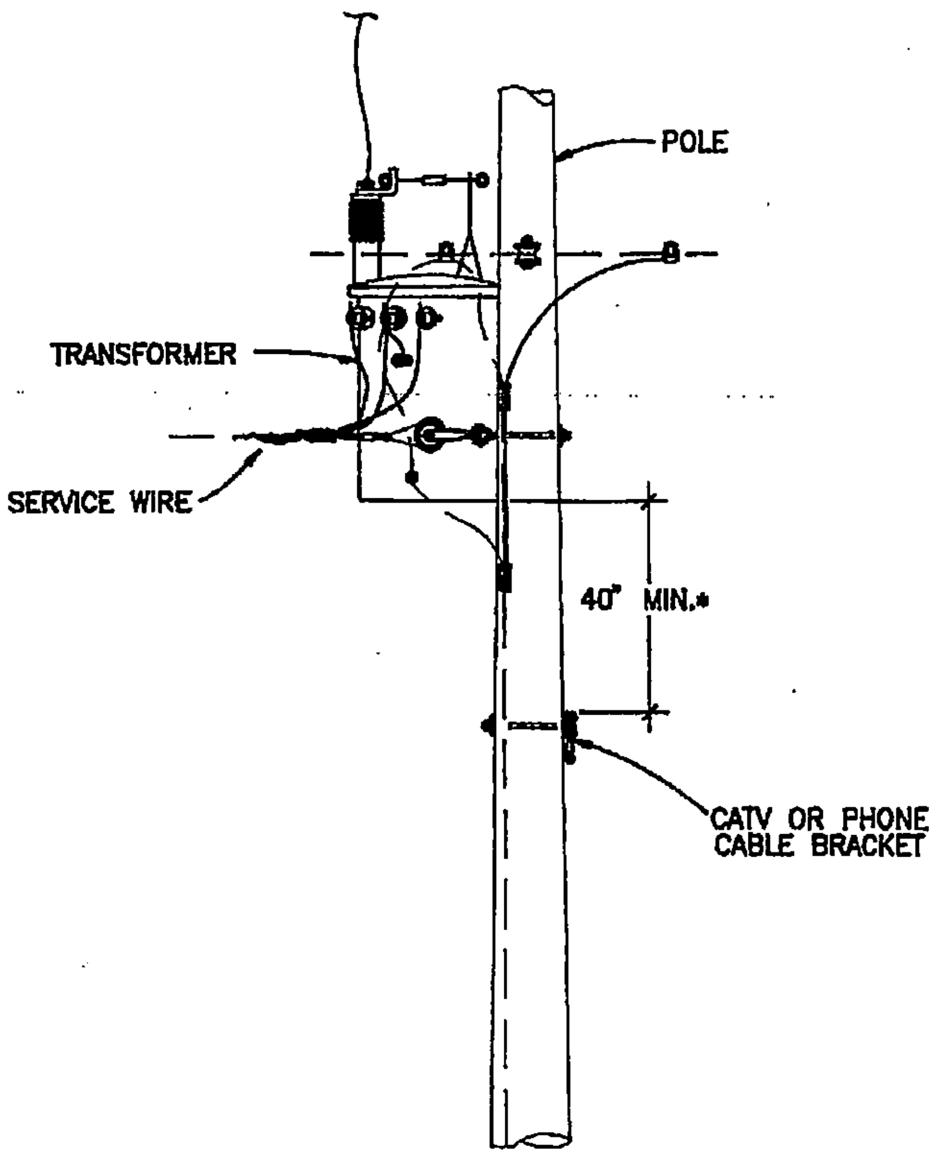
STANDARD CLEARANCES FOR CATV OR TELEPHONE ATTACHMENT

CLEARANCE FROM SERVICE WIRE TO CATV AND PHONE CABLE



STANDARD CLEARANCES FOR CATV OR TELEPHONE ATTACHMENT		
DRWN:	DATE:	REVS'D:

CLEARANCE FROM TRANSFORMERS AND SERVICE WIRE TO CATV AND PHONE CABLE



* MINIMUM CLEARANCE MAY BE REDUCED IF PERMITTED BY REQUIREMENTS OF THE MOST RECENT NESC.

STANDARD CLEARANCES FOR CATV OR TELEPHONE ATTACHMENT		
DRWN:	DATE:	REVS'D:

Ch. XX #6

Power Services

Engineering & Management Services

1616 E. Millbrook Road, Suite 210
Raleigh, NC 27609
Toll-Free: 1-866-231-6610
Tel: 919-256-5900
Fax: 919-256-5939
www.powerservices.com

Respondent's Cross Exhibit 6
I/A

October 31, 2017

Mr. David S. Tuttle
Board Counsel
NC Board of Examiners for Engineers and Surveyors
4601 Six Forks Road, Suite 310
Raleigh, NC 27609

Subject: Request for Guidance, "Practice of Engineering"
N.C. Gen. Stat. § 89C-3(6)

Dear Mr. Tuttle:

I have been asked to render an opinion as to whether the certain activities involving the design and attachment of communications facilities to electric utility poles in compliance with the requirements of the National Electrical Safety Code ("NESC") constitute the "practice of engineering" for the purposes of Section 89C-3(6) of the North Carolina General Statutes. As authorized by Section 62-350 of the North Carolina General Statutes and pursuant to contract, Charter Communications Properties LLC ("Charter") is permitted to attach cables, wires and associated facilities and equipment for the purpose of providing lawful communications signals to the poles owned by Blue Ridge Electric Membership Corporation ("Blue Ridge"). Section 62-350 specifically requires the communications providers such as Charter to comply with the requirements of the NESC. Additionally, Charter routinely "overlashes" to its existing facilities on Blue Ridge's poles. Overlashing is a practice that involves tying communications wires to existing strands that are already attached to poles, which effectively allows Charter to replace old or non-functioning cables or to expand the capacity of existing cables. Overlashing also increases the weight and surface area of the attachment, impacting the ice and wind loading calculations required by the NESC.

In developing my opinion, I seek guidance from the Board of Examiners for Engineers and Surveyors ("Board") as to whether Charter's activities constitute the "practice of engineering" for the purposes of Section 89C-3(6) of the North Carolina General Statutes. Specifically, based on previous opinions given by the Board in factually similar situations and a poll of those members of the Engineering Committee of the Board who are professional engineers, I seek the Board's guidance as to: i) whether actions relating to the attachment of cables, wires and associated facilities and equipment by Charter to poles owned by Blue Ridge may constitute the "practice of engineering" for purposes of the statute; and ii) whether actions relating to overlashing constitute the "practice of engineering" for purposes of the statute. In addition, if any of these activities does constitute the "practice of engineering," I seek the Board's guidance as to Charter's obligations in order to be in compliance with Chapter 89C of the North Carolina General Statutes.

I look forward to receiving your guidance. Thank you for your time and consideration.

Sincerely,

Gregory L. Booth, PE
President
Phone: 919-441-6440

glb/sk

--/A

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH

DOCKET NO. EC-23, SUB 50

BLUE RIDGE ELECTRIC MEMBERSHIP CORPORATION Petitioner, v. CHARTER COMMUNICATIONS PROPERTIES LLC, Respondent.	)	**CHARTER COMMUNICATIONS PROPERTIES LLC'S RESPONSES TO BLUE RIDGE ELECTRIC MEMBERSHIP CORPORATION'S FIRST SET OF DATA REQUESTS**

Pursuant to the Commission's June 7, 2017 Order Establishing Procedural Schedule and the parties' agreement to extend the time for meet and confer, objections, and responses, Charter Communications Properties LLC ("Charter"), by and through its undersigned counsel, responds to Blue Ridge Electric Membership Corporation's ("BREMC's") first set of data requests ("Requests") served on July 6, 2017, as follows:

PRELIMINARY STATEMENT

Charter incorporates herein by reference, and responds to the Requests ("Responses") to the extent consistent with, the limitations agreed upon in the parties' conferences on July 13, 18, and 19, 2017, as confirmed by email on August 2, 2017. By agreeing to search for and produce certain documents and information, Charter is not admitting that such documents in fact exist or that such information is within its present knowledge. Charter reserves the right to use documents discovered after the date of its Responses, which are now known but whose relevance, significance, or applicability has not yet been ascertained.

Furthermore, Charter's Responses are made without in any way intending to waive or waiving, but, on the contrary, intending to preserve and preserving:

1. The right to assert the attorney-client privilege, the common interest privilege, the work-product doctrine, and/or any other privilege or protective doctrine. Any inadvertent production of privileged or protected documents shall not constitute a waiver, in whole or in part, of any such privilege. Any document subject to a privilege or protection, if inadvertently produced, shall be returned by BREMC immediately. BREMC shall not use in any manner whatsoever any information derived solely from any inadvertently produced privileged or protected documents.

2. The right to designate documents containing information regarding trade secrets, confidential and/or proprietary business information, and/or information subject to confidentiality agreements with non-parties as confidential or highly confidential, and to produce such documents subject to the parties' Non-Disclosure Agreement and any protective order entered in this matter.

3. The right to question or object to the authenticity, foundation, relevancy, materiality, privilege, and admissibility of the documents produced in response to the Requests in any subsequent proceeding in, or the trial of, this or any other action.

4. The right to object to the use of the documents produced in response to the Requests in any subsequent proceeding in, or the trial of, this or any other action on any grounds.

5. The right to object to the introduction of the Responses into evidence.

6. The right to object on any ground at any time to other discovery involving the subject matter of these Requests or the Responses to these Requests.

7. The right to produce documents on a rolling basis given the breadth of the Requests, and to supplement its Responses and to produce additional documents, consistent with the Commission's rules and the Scheduling Order entered in this matter, should it discover further responsive documents after the date of its Response to BREMC's Requests.

RESPONSES TO REQUESTS

Incorporating the foregoing Preliminary Statement and Objections into each of the following responses, Charter responds to BREMC's requests as follows:

Request No. 1:

Identify and produce an organization chart depicting the corporate structure of Charter, its parents, subsidiaries and affiliates, both prior to and subsequent to the merger with Time Warner Cable.

RESPONSE:

Both pre- and post-merger, Charter Communications Properties LLC and its affiliates have served municipalities and counties in BREMC's service area. Prior to a post-merger internal reorganization in September 2016, Charter Communications Properties LLC and its affiliates operated in areas that include BREMC's service area as part of Charter's South Region. As of September 2016, Charter Communications Properties LLC and its affiliates operate in areas that include BREMC's service area as part of Charter's Carolina Region, specifically the Western North Carolina Market Area. Charter Communications Properties LLC has authority to execute a pole attachment agreement with BREMC that would apply to all of Charter's attachments to BREMC poles.

Request No. 2:

For each year from 2008 to present, identify the department or division within Charter, its parent, subsidiaries or affiliates, as well as the individual, that have been responsible since 2008 and will be responsible going forward for the design, construction, inspection and maintenance of attachments to BREMC's poles.

RESPONSE:

Personnel in Charter's Carolina Region and, specifically, its Western North Carolina Market Area, have responsibility for attachments to BREMC's poles. Before September 2016, Ronnie McWhorter served as Construction Manager for the areas that include BREMC's service area. As of September 2016, Nestor Martin, Senior Director of Construction, now serves in the role of overseeing construction operations in the area that includes BREMC's service area. Micheal Mullins is a Construction Supervisor for Charter in the areas that include BREMC's service area, and has been responsible for design and construction of attachments to BREMC's mainline poles since at least November 2011 to the present. Jeff Hutchinson is the Maintenance Manager for areas that include Charter's attachments to BREMC's poles, and has served in this role since at least November 2011.

Request No. 3:

Identify and produce copies of all currently-effective pole attachment agreements to which Charter has entered into since 2008, including any amendments thereto, with respect to its service footprint in North Carolina, South Carolina, Georgia, Alabama, Tennessee, and Virginia.

RESPONSE:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 4:

Identify all judicial or regulatory proceedings in North Carolina, South Carolina, Georgia, Alabama, Tennessee, and Virginia involving Charter's aerial facilities and/or pole attachment rates, terms and conditions from 2008 to the present—at a minimum, identify the jurisdiction, case name, case number, and all parties involved—and produce all copies of all pleadings and testimony filed by or against Charter in such proceedings.

RESPONSE:

After a diligent search, Charter has not identified any judicial or regulatory proceedings involving Charter's pole attachment rates, terms and conditions from November 2011 to the present in North Carolina, South Carolina, Tennessee, and Virginia.

Request No 5:

Identify the annual pole attachment rental rate that Charter or its parent, subsidiaries or affiliated entities has paid and currently pays to attach to the poles of every pole owner with which Charter has a pole attachment agreement with respect to its service footprint in North Carolina, South Carolina, Georgia, Alabama, Tennessee, and Virginia and the formula used to calculate the annual rental rate, for each year since 2008.

RESPONSE:

Charter will produce information responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 6:

Identify and produce copies of any economic or other analysis undertaken by Charter or its parent, subsidiaries or affiliated entities for planned and/or installed new facilities which compares the economics of aerial versus buried (a) initial costs and (b) total service life costs, for deployment of new facilities in North Carolina and nationwide, from 2008 to the present. If such information and documentation are not available for North Carolina as a whole, then provide it for every area in North Carolina for which it is available.

RESPONSE:

In the areas that include BREMC's service area, Charter's budgeted average cost per mile for aerial construction of new facilities, including labor and materials, is $26,432.37. Where Charter must build underground, its average cost per mile is substantially higher, budgeted at approximately $45,109.40, including materials and labor, but this does not include the costs of wreck outs or the expense of obtaining the necessary regulatory approvals, permits, and easements associated with such work. Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 7:

Identify the number and location of poles used for the distribution of communications services that are owned by Charter in North Carolina and nationwide. If such information and documentation are not available for North Carolina as a whole, then provide it for every area in North Carolina for which it is available.

RESPONSE:

Owing to economic, environmental, aesthetic, local zoning and rights-of-way restrictions, Charter cannot practicably build its own aerial network or system of poles. Charter thus does not install its own poles, except in unique and idiosyncratic circumstances and as determined by local construction personnel. Charter is not currently aware of any poles it has installed or owns that are used by other service providers in the Western North Carolina market area, but Charter is continuing to search its records and will supplement this response as appropriate.

Request No. 8:

Produce all documents showing Charter's or its parent's, subsidiaries' or affiliated entities' engineering and construction practices for aerial plant construction (both cable and wire) that are applicable in North Carolina.

RESPONSE:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 9:

Produce a copy of all of Charter's or its parent's, subsidiaries' or affiliated entities' engineering design standards, including sag tables and wind loading and ice loading analysis, for aerial cable construction that are applicable in North Carolina.

RESPONSE:

Charter directs BREMC to the design specifications identified in its pole attachment agreements produced in response to Request No. 3. Charter is continuing to search its records and will supplement this response as appropriate.

Request No. 10:

Produce a copy of Charter's or its parent's, subsidiaries' or affiliated entities' outside plant engineering planning guidelines that are applicable in North Carolina.

RESPONSE:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 11:

Produce all safety standards, plans, procedures, and agreements followed or used by Charter or any parent, subsidiary or affiliate of Charter in the completion of any safety inspection of Charter's facilities and attachments that are applicable in North Carolina.

RESPONSE:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 12:

Identify each attachment audit or inventory of poles with Charter's or its parent's, subsidiaries' or affiliated entities' attachments in North Carolina that was conducted or is currently being conducted by any pole owner or another person acting on that pole owner's behalf, from 2008 to the present, and produce all documents related to each such audit or inventory, including communications, documents reflecting the methodology used for each audit or inventory, records created during the course of each audit or inventory, and documents reflecting the results of each audit or inventory.

RESPONSE

AT&T/BellSouth, BREMC, Broad River Electric, Duke Energy, Duke Energy Progress, Energy United Electric Membership Corporation, and Rutherford Electric Membership have conducted attachment audits or inventories of their poles with TWC attachments since November 2011. Surry-Yadkin Electric Membership Corporation is currently conducting an inventory. Charter continues to search for responsive information and documents and will supplement this response, as necessary, at an appropriate time in the future. Answering further, documents related to BREMC's audits are already in the possession of the Cooperative.

<u>Request No. 13</u>:

Identify each pole attachment safety inspection of poles with Charter's or its parent's, subsidiaries' or affiliated entities' attachments in North Carolina that was conducted or is currently being conducted by any pole owner or another person acting on that pole owner's behalf, from 2008 to the present, to ensure compliance with the NESC or other safety standards, and produce all documents related to each such safety inspection, including communications, documents reflecting the methodology used for each inspection, records created during the course of each inspection, and documents reflecting the results of each inspection.

<u>RESPONSE</u>:

Surry-Yadkin Electric Membership Corporation is currently conducting an attachment audit that includes a safety inspection. Charter continues to search for responsive information and documents and will supplement this response, as necessary, at an appropriate time in the future.

<u>Request No. 14</u>:

Identify Charter's attachments to the Cooperative's poles made from 2008 to the present, which were attached after Charter or someone acting at Charter's direction performed engineering to ensure compliance with the NESC, including NESC wind and ice loading standards.

RESPONSE:

After a diligent search, Charter has been unable to locate any documentation or other means of identifying its attachments which were attached to the Cooperative's poles after Charter, or someone at its direction, performed "engineering." Charter submits permit applications to the Cooperative prior to making attachments to its poles, consistent with the parties' pole attachment agreement. Charter follows the engineering recommendations made by the Cooperative as part of the permit process, if any, and makes it attachments according to the permit issued by the Cooperative. Charter also makes it attachments pursuant to the NESC and Charter's safety standards and procedures.

Request No. 15:

Produce all documents which reflect the Charter inspection program for its attachments to BREMC poles, including the method of initial inspection and time of each initial inspection, how often it inspects its lines and facilities after installation, the items inspected, and the standards to which the inspections are performed and how Charter inspects construction once completed to ensure compliance with the NESC.

RESPONSE:

Charter continuously monitors the condition of its plant and conducts regular line inspections on a day-to-day basis as its employees, and contractors perform work in the field. Charter's contractors are responsible for making and maintaining attachments to BREMC poles. Charter's construction coordinators will meet with the contractors to complete a detailed review of the work done. Construction coordinators will also inspect a portion of the field work shortly after completion. During the course of construction, a contractor may occasionally find the work cannot be completed as planned due to safety or clearance issues, and a new plan of action is developed. Any deviations in the work from the plan are reviewed and corrected as they arise. Charter will produce documents, if any, responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 16:

Produce all documents evidencing pole attachment construction standards or design specifications which:

a. have been developed by or on behalf of Charter or any parent, subsidiary or affiliate of Charter; and

b. are currently required of Charter or any parent, subsidiary or affiliate of Charter by any pole owner in North Carolina.

RESPONSE:

Charter directs BREMC to the standards provided in Charter's pole attachment agreements with pole owners across North Carolina, produced in response to Request No. 3.

Request No. 17:

Identify every licensed professional engineer employed by or who works on behalf of Charter, or any parent, subsidiary or affiliate of Charter, with respect to North Carolina, along with a detailed description of his/her responsibilities. Additionally, identify by name and title each professional engineer who designs the Charter new construction, including overlashing, and who is responsible for the inspection of all completed construction and overlashing.

RESPONSE:

Charter does not employ any professional engineers who have responsibility for attachments in BREMC's service area. Charter contracts with or pays for the services of licensed professional engineers when necessary.

Request No. 18:

Identify the training, and provide related documentation, received by Charter employees and the employees of parent, subsidiary or affiliate of Charter, in the requirements and specifications of the NESC, the National Electrical Code, the North Carolina Department of Transportation, the Occupational Safety and Health Act, the Rural Utilities Service, the Society of Cable Television Engineer's Recommended Practices for Coaxial Cable Construction and Testing and for Optical Fiber Cable Construction, and the design and operational standards developed by the Cooperative.

RESPONSE:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 19:

Identify all vendors or contractors or subcontractors hired by Charter to install, maintain, inventory or service in any manner Charter's attachments to the Cooperative's poles from 2008 to the present and produce copies of all agreements or contracts between Charter and such vendors and contractors.

RESPONSE:

Charter uses Bigham Cable Construction to perform work on the Cooperatives poles. Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 20:

For the vendors and contractors or subcontractors hired by Charter to install, maintain, inventory or service in any manner Charter's attachments to the Cooperative's poles:

a. Identify the training such vendors and contractors receive in the requirements and specifications of the NESC, the National Electrical Code, the North Carolina Department of Transportation, the Occupational Safety and Health Act, the Rural Utilities Service, the Society of Cable Television Engineer's Recommended Practices for Coaxial Cable Construction and Testing and for Optical Fiber Cable Construction, and the design and operational standards developed by the Cooperative;

b. Provide documentation from each such training course; and

c. Provide verification that each such vendor or contractor has received such training.

RESPONSE:

Charter does not regularly conduct training for its vendors. Charter's vendors are contractually obligated to comply with all standards, rules, and laws required under the pole agreement, local, state, and federal laws and regulations. After a diligent search, Charter has been unable to locate any documents responsive to this request.

Request No. 21:

Identify and produce documents sufficient to show the linear feet of Charter facilities installed in the Cooperative's service area, in North Carolina and nationwide that have been overlashed. Identify the linear feet of Charter facilities that have one, two, three, four, five, and more cables overlashed in the same bundle. If such information and documentation is not available for North Carolina as a whole, then provide it for every area in North Carolina for which it is available.

RESPONSE:

After a diligent search, Charter has been unable to locate any documents responsive to this request. Charter is willing to make its system maps available for inspection by BREMC's counsel or authorized representatives at a mutually agreed upon time and place, to be coordinated with counsel for Charter.

Request No. 22:

Identify, and produce documents sufficient to demonstrate, each instance from 2008 to the present that Charter and/or another person acting on Charter's behalf has performed a loading analysis of BREMC's pole(s) on which Charter has installed attachments, including the pole(s) analyzed, the reason for the analysis (i.e. whether for overlashing or other attachments made by Charter or by another person), type of analysis performed and the program or software used to perform each analysis, the inputs used for each analysis, the equipment used for each analysis, the cost of performing each analysis, the results of each analysis, and communications related to the analysis.

RESPONSE:

Charter has not located any documents responsive to this request as of the date of these Responses. Charter will continue to search for non-privileged, non-attorney work product documents and will supplement this response as necessary.

Request No. 23:

Identify and produce every analysis performed by Charter, or any parent, subsidiary or affiliate of Charter, or on their behalf, analyzing the impact of overlashing on the wind and ice load of utility poles.

RESPONSE:

Charter has not located any documents responsive to this request as of the date of these Responses. Charter will continue to search for non-privileged, non-attorney work product documents and will supplement this response as necessary.

Request No. 24:

Identify every instance in which Charter has postponed overlashing, or decided not to overlash, existing Charter facilities on BREMC's poles because of preexisting NESC safety violations.

RESPONSE:

Charter does not maintain records tracking information responsive to this Request. Consistent with its standard construction process, Charter pre-inspects all poles and spans involved in its aerial plant construction, submits applications to BREMC for review, and may opt for underground construction if preexisting conditions on the pole make it unsafe or unsuitable for Charter's planned construction. Charter will continue to search for additional information responsive to this Request and will supplement this response as necessary.

Request No. 25:

Identify each instance since 2008 that Charter obtained a statement or opinion from a professional engineer regarding Charter's attachments to BREMC's poles, and produce such statement or opinion.

RESPONSE:

Charter has not identified any instances where it has obtained a statement or opinion from a professional engineer regarding Charter's attachments to BREMC's poles, except in those instances where BREMC may have provided statements or opinions upon review of Charter's attachment application. Charter will continue to search for additional information responsive to this Request and will supplement this response as necessary.

Request No. 26:

Identify Charter's procedures for handling "downed-line" calls and specify how such procedures differ from routine customer service calls. Include all procedural documentation and special "downed line" call training materials.

RESPONSE:

"Downed-line" calls are directed to Charter's Regional Operations Center, a 24/7 operations center, that will immediately dispatch the system technician on call for the area to the problem spot. The system technician will work to get the downed line "temped" or safely out of the way and get any service outage running within 90 minutes. If multiple lines are down in a small area at once due to a storm or some other similar event, it may take longer to respond to each and every problem spot. A contractor will also be called immediately to fix the line permanently—unless a new pole needs to be placed, in which case the permanent fix must wait for the utility to place the pole. A routine customer service call is not directed to the Regional Operations Center and will not trigger the 24/7 response. Routine service calls are directed to fulfillment technicians who help customers connect to Charter services.

Request No. 27:

Provide the specific location and number of personnel on call 24/7 in the BREMC service territory and the specific protocols and training documentation demonstrating how

Charter dispatches staff to respond to an emergency call, including a "downed-line" call.

RESPONSE:

Charter will produce information responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 28:

Identify each occurrence in which Charter's or its parent's, subsidiaries' or affiliated entities' aerial facilities in North Carolina have come into contact with vehicular traffic, bicycles or pedestrians from 2008 to the present, and for each such occurrence, please provide the following:

a. The date of each occurrence;
b. The location of the occurrence;
c. Any damage to Charter's facilities as a result of the contact;
d. Any remedial work performed by Charter after the occurrence;
e. Any damage to the vehicles or injuries to the vehicle's driver and passengers, bicyclists or pedestrians as a result of the contact; and
f. Any other damage or injuries as a result of the contact.

RESPONSE:

Charter is in the process of identifying and occurrences that rise to the level of "claims" or "causes of action" in North Carolina, subject to the parties' agreed-upon limitations, and will supplement this response at an appropriate time.

[Requests 29-35 withdrawn]

Request No. 36:

Specify the housing density threshold below which Charter does not or will not provide service in BREMC service area, in North Carolina and nationwide along with documentation sufficient to show Charter's policy regarding its service density.

RESPONSE:

Charter does not have a specific housing density threshold below which it will not provide service in the areas that include BREMC's service area.

Request No. 37:

Identify, and produce documents sufficient to show, the average number of homes passed per mile by Charter's video, voice, Internet, broadband, or other communications service in North Carolina and nationwide for each year since 2008. If such information and documentation is not available for North Carolina as a whole, then provide for every area in North Carolina for which it is available.

RESPONSE:

Charter has no knowledge at present regarding the average number of homes passed per mile by Charter's communications services in BREMC's service area. In 2016, Charter passed an average of approximately 53 homes per mile with its distribution plant in areas that include BREMC's service area. Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 38:

Provide customer counts within the zip codes served by Charter in BREMC's service territory and elsewhere in North Carolina.

RESPONSE:

Charter will provide customer counts within BREMC's service territory upon receipt of the zip codes BREMC serves.

Request No. 39:

Provide Form 10K and all other financial reports and filings publicly filed with the U.S. Securities and Exchange Commission.

RESPONSE:

Charter's Form 10-K and other financial reports and filings made to the SEC can be found at: http://ir.charter.com/phoenix.zhtml?c=112298&p=irol-sec.

Request No. 40:

Provide annual shareholder reports from 2008 forward.

RESPONSE:

Charter's annual reports to shareholders can be found at: http://ir.charter.com/phoenix.zhtml?c=112298&p=irol-reportsannual.

Request No. 41:

For each Charter franchise area that includes some portion of the service territory of the Cooperative, produce documents sufficient to explain to which portions of such franchise Charter offers video, voice, Internet, broadband, or other communications service, and to which portions Charter does not.

RESPONSE:

Charter's system maps contain information from which BREMC will be able to derive details regarding the information sought. Charter is willing to make those maps available for inspection by BREMC's counsel and/or authorized representatives at a mutually agreed-upon time and place, to be coordinated with counsel for Charter, subject to the Protective Order to be entered in this matter.

Request No. 42:

Produce all documents that identify any consideration, analysis, plans, and/or decision by Charter to extend the reach of its video, voice, Internet, broadband, or other communications service to areas unserved by Charter, including all communications and any documents prepared on behalf of or submitted to Charter by another person.

RESPONSE:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

Request No. 43:

Identify every BREMC pole to which Charter has received a permit or other authorization from BREMC to attach and produce a copy of all such permits or other authorizations received from BREMC.

RESPONSE:

Charter will make its permits and other records received from BREMC available for inspection by BREMC's counsel or authorized representatives at a mutually agreed-upon time and place, to be coordinated with counsel for Charter.

Request No. 44:

Identify the number of BREMC Secondary Poles to which Charter has installed new attachments since 2008.

RESPONSE:

Charter will make its records available for inspection by BREMC's counsel or authorized representative at a mutually agreed-upon time and place, to be coordinated with counsel for Charter.

Request No. 45:

Identify every BREMC pole besides Secondary Poles to which Charter has installed new attachments since 2008.

RESPONSE:

Charter will make its records available for inspection by BREMC's counsel or authorized representative at a mutually agreed-upon time and place, to be coordinated with counsel for Charter.

Request No. 46:

Identify what Charter understands to be the "electrical supply space" on BREMC's poles.

RESPONSE:

Charter does not use the phrase "electrical supply space," but understands it to refer to the top-most part of the pole used by BREMC for its electrical facilities.

Request No. 47:

Provide a copy of any and all specifications provided to construction personnel and contractors and inspectors, including the specific clearance Charter requires between the BREMC "supply space" and Charter's "communications space" with specifics on what Charter assumes is the BREMC "supply space."

RESPONSE:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations. Charter personnel comply with the minimum clearance requirements specified by the NESC. Charter attaches its facilities 72" below neutral on BREMC's poles.

Request No. 48:

Identify what Charter believes is the length of the uppermost portion of the pole allocated to BREMC in feet and inches.

RESPONSE:

Charter directs BREMC to the parties Pole Attachment License Agreement, which does not specifically allocate space to BREMC in feet and inches. Charter believes the space allocated to BREMC is the space actually used by the Cooperative's facilities attached to each pole, consistent with the specifications of the NESC.

Request No. 49:

Identify what Charter believes is the minimum "communication worker safety zone space" in inches from each voltage line on the BREMC system upon which Charter attaches its facilities.

RESPONSE:

The NESC identifies the minimum "communication worker safety zone space" from each voltage line and other facilities installed on poles.

<u>Request No. 50</u>:

Provide all documentation which Charter provides to its construction employees and construction contractors which specifies the location in which the Charter facilities must be installed on a BREMC pole.

<u>RESPONSE</u>:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations.

<u>Request No. 51</u>:

Identify every BREMC pole besides Secondary Poles for which Charter has requested a permit or other authorization from BREMC to attach since 2008, and produce a copy of such requests.

<u>RESPONSE</u>:

Charter will make its permits and other records from BREMC available for inspection by BREMC's counsel or authorized representatives at a mutually agreed-upon time and place, to be coordinated with counsel for Charter.

<u>Request No. 52</u>:

Identify each expert witness Charter intends to use in this case and his/her claimed subject matter expertise, and for each of the experts identified, specify the nature of the testimony the expert will be providing, and produce all documents related to the expert's testimony in this proceeding, including the expert's resume or curriculum vitae (listing, among other information, all prior testimony provided by the expert), contracts between the expert and Charter, documents provided to the expert by Charter or another person acting on its behalf, and documents on which the expert intends to rely upon, and/or actually relies upon, in developing the expert's testimony.

RESPONSE:

At this time, Charter may call Patricia Kravtin, of Patricia D. Kravtin Economic Consulting, 57 Phillips Avenue, Swampscott, Massachusetts, as an expert regarding rate calculations, methodologies, and related issues. Charter will supplement this Response, as necessary, at an appropriate time.

Request No. 53:

Identify all persons providing information contained in the answers to each of these data requests.

RESPONSE:

The following persons, excluding counsel for Charter, were involved in responding to these Requests:

Nestor Martin
Sr. Director of Construction, Carolina Region
Charter Communications
7910 Crescent Executive Drive, 5th Floor
Charlotte, NC 28217

Ronnie McWhorter
Director of Field Engineering
Charter Communications
1511 S. Batesville Road
Greer, SC 29650

Micheal Mullins
Construction Supervisor,
Charter Communications
220 McLean Drive
Lenoir, NC 28645

Request No. 54:

Identify the name, title and contact information for all former and current Charter personnel who are responsible for pole attachments, calculating pole attachment rates and/or the administration of pole attachment agreements in North Carolina.

RESPONSE:

Prior to September 2016, Ronnie McWhorter was responsible for pole attachments, and administration of pole attachment agreements in areas that include BREMC's service area. As of September 2016, Nestor Martin has taken over that responsibility.

Request No. 55:

Identify the name, title and contact information for all former and current Charter personnel who are responsible for the design, construction installation and maintenance of any attachment by Charter to BREMC poles.

RESPONSE:

Charter directs BREMC to its response to Request Nos. 2 & 53.

Request No. 56:

Identify the name, title and contact information for all former and current Charter personnel involved in any negotiations related to a pole attachment license agreement between Charter and BREMC, on behalf of Charter, from 2011 and forward.

RESPONSE:

The following persons, excluding counsel for Charter, were involved in negotiations between Charter and BREMC:

Ronnie McWhorter
Director of Field Engineering
Charter Communications
1511 S. Batesville Road

Greer, SC 29650

Micheal Mullins
Construction Supervisor,
Charter Communications
220 McLean Drive
Lenoir, NC 28645

Request No. 57:

Describe all communications and produce all documents from 2011 and forward, including but not limited to drafts, related to the negotiation of a pole attachment licensee agreement between Charter and BREMC.

RESPONSE:

Charter will produce documents responsive to this request.

Request No. 58:

Produce all unredacted deposition transcripts and pre-filed testimony of Time Warner Cable deponents/witnesses from the proceedings on-going in NCUC Docket Nos. EC-43, Sub 88; EC-49, Sub 55; EC-55, Sub 70 and EC-39, Sub 44.

RESPONSE:

Charter will produce documents responsive to this request, consistent with the parties' agreed-upon limitations and the subject to the parties' Non-Disclosure Agreement and any protective order entered in this matter.

Request No. 59:

Produce all documents you intend to present at any trial or evidentiary hearing in this proceeding.

RESPONSE:

Charter has not yet determined which documents it will introduce or present at any trial or evidentiary hearing in this proceeding. Charter will supplement its response to this request at an appropriate time.

This the 10th day of August, 2017.

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Attorneys for Charter Communications Properties, LLC

CERTIFICATE OF SERVICE

This is to certify that the undersigned has this date served the foregoing via electronic mail addressed to counsel of record in this proceeding.

This the 10th day of August, 2017.

Carrie A Ross

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