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March 7, 2018

VIA ELECTRONIC FILING AND HAND DELIVERY

Ms. M. Lynn Jarvis, Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, North Carolina 27699-4300

Re: Duke Energy Carolinas, LLC's REPS Cost Recovery Rider and 2017 Compliance Report
Docket No. E-7, Sub 1162

Dear Ms. Jarvis:

Enclosed for filing with the North Carolina Utilities Commission ("Commission") please find the Application of Duke Energy Carolinas, LLC ("DEC" or the "Company") pursuant to N.C. Gen. Stat. §62-133.8 and Commission Rule R8-67 relating to incremental costs for compliance with the renewable energy and energy efficiency portfolio standard ("REPS") for electric utilities, together with the testimony and exhibits of Megan W. Jennings and Veronica I. Williams containing the information required by Commission Rule R8-67. DEC's 2017 REPS Compliance Report, filed pursuant to N.C. Gen. Stat. §62-133.8 and Commission Rule R8-67(c), is attached as Exhibit No. 1 to Ms. Jennings' testimony in support of the Application. I will deliver fifteen (15) paper copies of the filing to the Clerk's Office by close of business on March 8, 2018.

Certain information contained in the exhibits of Ms. Williams and Ms. Jennings is a trade secret, and confidential, proprietary, and commercially sensitive information. For that reason, it is being filed under seal pursuant to N.C. Gen. Stat. §132-1.2. Parties to the docket may contact the Company regarding obtaining copies pursuant to an appropriate confidentiality agreement.

Please do not hesitate to contact me if you have any questions.

Sincerely,

Kendrick C. Fentress

Kendrick C. Fentress

Enclosure

cc: David Drooz (w/ attachments)

CERTIFICATE OF SERVICE

I certify that a copy of Duke Energy Carolinas, LLC's REPS Cost Recovery Rider and 2017 Compliance Report in Docket No. E-7, Sub 1162, has been served by electronic mail, hand delivery, or by depositing a copy in the United States Mail, 1st Class Postage Prepaid, properly addressed to parties of record.

This the 7th day of March, 2018.

Kendrick C. Fentress
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BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1162

In the Matter of: Application of Duke Energy Carolinas, LLC for Approval of Renewable Energy and Energy Efficiency Portfolio Standard (REPS) Compliance Report and Cost Recovery Rider Pursuant to N.C. Gen. Stat. § 62-133.8 and Commission Rule R8-67	))))))))	**APPLICATION FOR APPROVAL OF REPS COST RECOVERY RIDER AND 2017 REPS COMPLIANCE REPORT**

Duke Energy Carolinas, LLC ("DEC" or "Company"), pursuant to N.C. Gen. Stat. § 62-133.8 and Rule R8-67 of the Rules and Regulations of the North Carolina Utilities Commission ("Commission"), hereby makes this Application (1) for approval of its 2017 Renewable Energy Portfolio Standard ("REPS") Compliance Report, and (2) to implement a monthly charge to recover the incremental costs associated with compliance with the REPS. In support of this Application, the Company respectfully shows the following:

1. The Company is a public utility operating in the states of North Carolina and South Carolina where it is engaged in the generation, transmission, distribution, and sale of electricity for compensation. Its general offices are located at 550 South Tryon Street, Charlotte, North Carolina, and its mailing address is DEC 45A, 550 South Tryon Street, Charlotte, North Carolina 28202.

2. The attorneys for the Company, to whom all communications and pleadings should be addressed, are:

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3. N.C. Gen. Stat. § 62-133.8 requires North Carolina's electric power suppliers to supply six (6) percent of their North Carolina retail kilowatt hours ("kWh") sales from "renewable energy resources," as that term is defined by N.C. Gen. Stat. § 62-133.8(a)(8), for calendar year 2017. In addition, N.C. Gen. Stat. § 62-133.8(d) requires that the electric power suppliers supply 0.14 percent of their North Carolina retail kWh sales from solar photovoltaic or thermal solar resources in 2017. Further, N.C. Gen. Stat. § 62-133.8(e) and (f) require that the electric power suppliers also obtain their allocated share of the state-wide requirement of 0.14 percent of the total North Carolina retail kWh sold from swine waste resources and 900,000 megawatt hours ("MWh") of the total electric power sold to North Carolina retail customers from poultry waste resources, respectively, in 2017.[1]

4. N.C. Gen. Stat. § 62-133.8(h) provides that the electric public utilities shall be allowed to recover the incremental costs[2] associated with complying with N.C.

[1] Both the Poultry Waste and Swine Waste Set-Aside Requirements established by N.C. Gen. Stat. § 62-133.8 have been modified by Commission order pursuant to N.C. Gen. Stat. § 62-133.8(i)(2), as discussed herein.

[2] "Incremental costs" are defined as (1) all reasonable and prudent costs incurred by an electric utility to meet the solar and renewable generation requirements of the statute that are in excess of the utility's avoided costs, and (2) costs associated with research that encourages the development of renewable energy, energy efficiency, or improved air quality provided those research costs do not exceed one million dollars ($1,000,000) per year.

Gen. Stat. § 62-133.8 through an annual rider not to exceed the following per-account charges:

Customer Class	2008-2011	2012-2014	2015 and thereafter
Residential per account	$ 10.00	$ 12.00	$ 27.00
Commercial per account	$ 50.00	$ 150.00	$ 150.00
Industrial per account	$ 500.00	$ 1,000.00	$1,000.00

The statute provides that the Commission shall ensure that the incremental costs to be recovered from individual customers on a per-account basis are in the same proportion as the per-account annual charges for each customer class set out in the chart above.

5. Rule R8-67(c) requires the Commission to conduct an annual proceeding for each electric public utility to review the utility's costs to comply with N.C. Gen. Stat. § 62-133.8 and establish the electric public utility's annual rider to recover such costs in a timely manner. The Commission shall also establish an experience modification factor ("EMF") to collect the difference between the electric public utility's actual reasonable and prudent REPS costs incurred during the test period and the actual revenues realized during the test period. Rule R8-67(c) further provides that the Commission shall consider each electric public utility's REPS compliance report at the hearing provided for in Rule R8-67(e) and shall determine whether the electric public utility has complied with N.C. Gen. Stat. § 62-133.8(b), (d), (e) and (f).

6. According to Rules R8-67(c) and (e), the electric public utility is to file its application for recovery of its REPS costs, as well as its REPS compliance report, at the same time it files the information required by Rule R8-55, and the Commission is to conduct an annual rider hearing as soon as practicable after the hearing required by Rule R8-55.

7. Pursuant to the provisions of N.C. Gen. Stat. § 62-133.8 and Commission Rule R8-67(e), DEC requests the Commission to establish a rider to recover its reasonable and prudent forecasted REPS compliance costs to be incurred during the rate period. As provided in Rule R8-67(e), the Company requests to return to DEC's retail customers, through the EMF, $18,449,332 of REPS costs incurred and other credits for the period beginning January 1, 2017 through December 31, 2017 ("EMF Period") and collect from DEC's retail customers $27,196,722 for REPS costs to be incurred during the rate period from September 1, 2018 through August 31, 2019 ("Billing Period"). The REPS rider and EMF will be in effect for the twelve-month period September 1, 2018 through August 31, 2019.

8. Pursuant to the provisions of N.C. Gen. Stat. § 62-133.8 and Rule R8-67, DEC requests Commission approval of the annual billing statements, including both the REPS monthly charge and the EMF monthly charge, for each customer class as follows:

Customer Class	**REPS Monthly Charge** (excl. regulatory fee)	**Monthly EMF** (excl. regulatory fee)	**Total REPS Monthly Charge** (excl. regulatory fee)	**Total REPS Monthly Charge** (incl. regulatory fee)
Residential	$ 0.74	$ (0.53)	$ 0.21	$ 0.21
General[3]	$ 3.82	$ (2.25)	$ 1.57	$ 1.57
Industrial	$12.61	$ (15.84)	$(3.23)	$(3.23)

The calculation of these rates is set forth in Exhibit No. 4 of the direct testimony of Veronica I. Williams filed with this Application.

[3] Duke Energy Carolinas' General Service rate schedule generally covers the class of customers intended to be captured by the "Commercial" class included within N.C. Gen. Stat. § 62-133.8. The Company does not have a rate schedule for "Commercial" customers.

9. Further, pursuant to the provisions of N.C. Gen. Stat. § 62-133.8 and Commission Rule R8-67(c), the Company requests Commission approval of its 2017 REPS Compliance Report, attached as an exhibit to the direct testimony of Megan Jennings filed in support of this Application. As described by Ms. Jennings' testimony, and illustrated in DEC's 2017 REPS Compliance Report, the Company has complied with the requirements of N.C. Gen. Stat. § 62-133.8(b) and (d) for 2017. In its October 16, 2017 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief,* in Docket No. E-100, Sub 113, the Commission directed that the 2017 Poultry Waste Set-Aside Requirement (N.C. Gen. Stat. § 62-133.8(f)) remain at the same level as the 2016 requirement, which the Commission had previously approved at 170,000 MWh, and delayed by one year the scheduled increases in that requirement. The Commission also further delayed for one year the Swine Waste Set-Aside Requirement; accordingly, those requirements will now commence in compliance year 2018.[4] The Company has complied with this modified Poultry Waste Set-Aside Requirement.

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[4] In its *Order Modifying the Poultry and Swine Waste Set-Aside and Granting Other Relief* also issued in Docket No. E-100, Sub 113 (November 29, 2012), the Commission eliminated the Swine Waste Set-Aside Requirement for 2012 and delayed for one year the Poultry Waste Set-Aside Requirement (from 2012 to 2013). In its March 26, 2014, *Final Order Modifying the Poultry and Swine Waste Set-Aside Requirements and Providing Other Relief,* the Commission delayed the Swine and Poultry Waste Set-Aside Requirements for an additional year, so that the Swine Waste Set-Aside Requirement for 2014-2015 was 0.07 percent and the Poultry Waste Set-Aside Requirement for 2014 was 170,000 MWh. In its November 13, 2014 *Order Modifying the Swine Waste Set-Aside Requirement and Providing Other Relief,* the Commission directed that Swine Waste Set-Aside Requirement remain at 0.07 percent for the years 2015-2016. Subsequently, in its December 1, 2015 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief,* the Commission directed that the Swine Waste Set-Aside Requirement for 2015 be delayed an additional year and that the Poultry Waste Set-Aside Requirement for 2015 would be the same as the 2014 level. In its October 17, 2016 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief,* the Commission directed that the 2016 Poultry Waste Set-Aside Requirement remain at the same level as the 2015 requirement and delayed by one year the scheduled increases in that requirement. The Commission also further delayed commencement of the Swine Waste Set-Aside Requirements until 2017.

10. The information and data required to be filed under Commission Rule R8-67 is contained in the direct testimony and exhibits of Witnesses Jennings and Williams, which are being filed simultaneously with this Application and incorporated herein by reference.

WHEREFORE, the Company respectfully prays:

That consistent with this Application, the Commission approves the Company's 2017 REPS Compliance Report and allows the Company to implement the rate riders as set forth above.

Respectfully submitted, this the 7th day of March, 2018.

Kendrick C. Fentress

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ATTORNEYS FOR DUKE ENERGY CAROLINAS, LLC

VERIFICATION

STATE OF NORTH CAROLINA	)	
	)	DOCKET NO. E-7, SUB 1162
COUNTY OF MECKLENBURG	)	

Veronica I. Williams, being first duly sworn, deposes and says:

That she is Rates and Regulatory Strategy Manager for Duke Energy Carolinas, LLC; that she has read the foregoing Application and knows the contents thereof; that the same is true except as to those matters stated on information and belief; and as to those matters, she believes them to be true.

Veronica I. Williams

Veronica I. Williams

Sworn to and subscribed before me
this the 6 day of March, 2018.

Patricia C. Ross

Notary Public

My Commission Expires: 10-17-2019

PATRICIA C. ROSS
NOTARY PUBLIC
Mecklenburg County
North Carolina

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1162

In the Matter of Application of Duke Energy Carolinas, LLC for Approval of Renewable Energy and Energy Efficiency Portfolio Standard (REPS) Compliance Report and Cost Recovery Rider Pursuant to N.C. Gen. Stat. 62-133.8 and Commission Rule R8-67	))))))))	**DIRECT TESTIMONY OF MEGAN W. JENNINGS**

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Megan W. Jennings, and my business address is 400 South Tryon Street, Charlotte, North Carolina.

Q. PLEASE STATE YOUR POSITION WITH DUKE ENERGY AND DESCRIBE YOUR CURRENT RESPONSIBILITIES.

A. In my capacity as Renewable Compliance Manager, I am responsible for the development and implementation of renewable energy compliance strategies for Duke Energy Carolinas, LLC ("Duke Energy Carolinas," "DEC" or "the Company"), Duke Energy Progress, LLC ("Duke Energy Progress") and Duke Energy Ohio, LLC. My responsibilities include compliance with North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard ("REPS"), compliance with Ohio's Alternative Energy Portfolio Standard and evaluation of renewable generation initiatives and customer programs that relate to renewable compliance.

Q. PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND.

A. I received a Bachelor of Science in Mathematical Sciences from Clemson University and a Masters of Financial Mathematics from North Carolina State University.

Q. PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A. I joined Progress Energy, Inc. in 2008, where I held positions in Investor Relations and Regulatory Planning. Following the merger of Progress Energy, Inc. with Duke Energy Corporation, I worked in the Rates and Regulatory Strategy Department until June of 2015, when I moved to my current position as Renewable Compliance Manager in the Distributed Energy Technology Department.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE NORTH CAROLINA UTILITIES COMMISSION?

A. Yes, I most recently provided testimony in Docket No. E-2, Sub 1144 on Duke Energy Progress's 2016 REPS compliance report and application for approval of its REPS cost recovery rider.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to describe Duke Energy Carolinas' activities and the costs it has incurred, or projects it will incur, in support of compliance with North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard under N.C. Gen. Stat. ("G.S.") § 62-133.8 during the twelve months beginning on January 1, 2017 and ending on December 31, 2017 ("Test Period"), as well as during the twelve months beginning on September 1, 2018 and ending on August 31, 2019 ("Billing Period").

Q. PLEASE DESCRIBE THE EXHIBITS TO YOUR TESTIMONY.

A. My testimony includes fourteen exhibits: Jennings Confidential Exhibit No. 1 is the Company's 2017 REPS Compliance Report, and Jennings

Confidential Exhibit No. 2 provides actual and forecasted REPS compliance costs, by resource, that the Company has incurred during the Test Period and projects to incur during the Billing Period in support of compliance with REPS. Jennings Confidential Exhibit No. 3 is a worksheet detailing the other incremental costs included in the DEC REPS filing, listing the labor costs by activity, as directed by the North Carolina Utilities Commission ("Commission") in its August 25, 2017 Order in Docket No. E-7, Sub 1131. Jennings Confidential Exhibit No. 4 provides information on DEC's Renewable Energy Certificate ("REC") sales, as required to comply with the Commission's May 13, 2014 *Order Regarding Accounting Treatment for REC Sales* in Docket No. E-100, Sub 113. Jennings Exhibit Nos. 5-14 are the results of studies the costs of which the Company is recovering via the REPS Rider.

Q. WERE THESE EXHIBITS PREPARED BY YOU OR AT YOUR DIRECTION AND UNDER YOUR SUPERVISION?

A. Jennings Confidential Exhibit Nos. 1-4 were prepared by me or under my supervision. Jennings Exhibit Nos. 5-14 include the results of studies not prepared under my supervision. In my role at Duke Energy, however, I am familiar with the studies.

<u>Compliance with REPS Requirements</u>

Q. WHAT ARE DUKE ENERGY CAROLINAS' REPS REQUIREMENTS UNDER G.S. § 62-133.8?

A. Pursuant to G.S. § 62-133.8,[1] as an electric power supplier, Duke Energy Carolinas is required to comply with the overall REPS requirement ("Total Requirement") by submitting for retirement a total volume of RECs equivalent to the following percentages of its North Carolina retail sales in the prior year:

- Beginning in 2012, three percent (3%);
- In 2015, six percent (6%);
- In 2018, ten percent (10%); and
- In 2021 and thereafter, twelve point five percent (12.5%).

Furthermore, each electric power supplier must comply with the requirements of G.S. § 62-133.8 (d), (e), and (f) (individually referred to as the "Solar Set-Aside," "Swine Waste Set-Aside," and "Poultry Waste Set-Aside," respectively). That is, within the Total Requirement described above, each electric power supplier is to ensure that specific quantities of qualifying solar RECs, swine waste RECs, and poultry waste RECs are also submitted for retirement. The Company generally refers to its Total Requirement net of the three set-asides as its "General Requirement."

Specifically, each electric power supplier is to comply with the Solar Set-Aside by submitting for retirement a volume of qualifying solar RECs equivalent to the following percentages of its North Carolina retail sales in the prior year:

[1] In its *Order Clarifying Electric Power Suppliers' Annual REPS Requirements*, Docket No. E-100, Sub 113 (November 26, 2008), the Commission clarified that the calculation of these requirements for each year shall be based upon the electric utility's North Carolina retail sales for the prior year.

- Beginning in 2010, two-hundredths of one percent (0.02%);
- In 2012, seven-hundredths of one percent (0.07%);
- In 2015, fourteen-hundredths of one percent (0.14%); and
- In 2018 and thereafter, two-tenths of one percent (0.2%).

Each electric power supplier is also to comply with the Swine Waste Set-Aside by submitting for retirement a volume of qualifying swine waste RECs equivalent to its pro-rata share of total retail electric power sold in North Carolina multiplied by the statewide, aggregate Swine Waste Set-Aside Requirement.[2] Duke Energy Carolinas' Swine Waste Set-Aside Requirements, as modified by the Commission[3], are as follows:

- In 2018, its pro-rata share of seven-hundredths of one percent (0.07%) of the total retail electric power sold in North Carolina in the year prior;
- In 2020, its pro-rata share of fourteen-hundredths of one percent (0.14%) of total retail electric power sold in North Carolina in the year prior; and

[2] In its *Order on Pro Rata Allocation of Aggregate Swine and Poultry Waste Set-Aside Requirements and Motion for Clarification* in Docket No. E-100, Sub 113 (March 31, 2010), the Commission approved the electric power suppliers' proposed pro-rata allocation of the statewide aggregate swine and poultry waste set-aside requirements, such that the aggregate requirements will be allocated among the electric power suppliers based on the ratio of each electric power supplier's prior year retail sales to the total statewide retail sales.

[3] In its *Order Modifying the Swine and Poultry Waste Set-Aside Requirements And Providing Other Relief* (October 16, 2017) and its *Errata Order* (December 15, 2017), Docket No. E-100, Sub 113, the Commission further delayed for one year the Swine Waste Set-Aside Requirement; accordingly, the Swine Waste Set-Aside Requirements will now commence in compliance year 2018. The Commission also modified the 2017 Poultry Waste Set-Aside Requirement to remain at the same level as the 2016 requirement, and delayed by one year the scheduled increases in the requirement.

- In 2023 and thereafter, its pro-rata share of two-tenths of one percent (0.2%) of total retail electric power sold in North Carolina in the year prior.

Finally, each electric power supplier is also to submit for retirement a volume of qualifying poultry waste RECs equivalent to its pro-rata share of the aggregate state-wide Poultry Waste Set-Aside requirement. Duke Energy Carolinas' Poultry Waste Set-Aside Requirements, as modified by the Commission, are as follows:

- Beginning in 2014, its pro-rata share of 170,000 megawatt-hours ("MWh");
- In 2018, its pro-rata share of 700,000 MWh; and
- In 2019 and thereafter, its pro-rata share of 900,000 MWh.

The requirements that are described in this testimony and accompanying exhibits reflect the aggregation of the REPS requirements of Duke Energy Carolinas' retail customers as well as those wholesale customers, specifically Blue Ridge Electric Membership Corporation, Rutherford Electric Membership Corporation, Town of Dallas, Town of Forest City, City of Concord, Town of Highlands, and City of Kings Mountain (collectively "Wholesale"), for which the Company has been contracted to provide REPS compliance services. DEC's contracts to provide REPS compliance services for the City of Concord and the City of Kings Mountain end in December 2018, and thus the compliance requirements have been adjusted accordingly.

Q. PLEASE DISCUSS DUKE ENERGY CAROLINAS' REPS REQUIREMENTS FOR THE TEST AND BILLING PERIODS.

A. For the Test Period, the Company has submitted for retirement 3,627,191 RECs, which includes 20,076 Senate Bill 886 ("SB 886") RECs, each of which counts for two poultry waste and one general REC, to meet its Total Requirement of 3,667,343 RECs. Within this total, the Company has submitted for retirement 85,576 RECs to meet the Solar Set-Aside Requirement and 37,291 RECs, along with 20,076 SB 886 RECs (which count as 40,152 Poultry Waste Set-Aside RECs), to meet the Poultry Waste Set-Aside Requirement. During the prospective Billing Period, which spans two calendar years, with different requirements in each year, the Company's estimated requirements are as follows[4]:

In 2018, the Company estimates that it will be required to submit for retirement 5,951,836 RECs to meet its Total Requirement. Within this total, the Company is also required to retire the following: 119,038 solar RECs, 41,664 swine RECs and 318,866 poultry RECs.

In 2019, the Company estimates that it will be required to submit for retirement 6,102,936 RECs to meet its Total Requirement. Within this total, the Company estimates that it will be required to retire approximately 122,062 solar RECs, 42,725 swine waste RECs and 403,218 poultry waste RECs.

[4] The Company's projected requirements are based upon retail sales estimates and will be subject to change based upon actual prior-year North Carolina retail sales data.

Q. HAS THE COMPANY COMPLIED WITH ITS GENERAL REQUIREMENT FOR 2017?

A. Yes. The Company has met its 2017 General Requirement of 3,504,324 RECs. Specifically, the RECs to be used for 2017 compliance have been transferred from the North Carolina Renewable Energy Tracking System ("NC-RETS") Duke Energy Electric Power Supplier account to the Duke Energy Compliance Sub-Account and the Sub-Accounts of its Wholesale customers. Upon completion of this regulatory proceeding, the Commission will finalize retirement of the RECs.

Q. WILL DUKE ENERGY CAROLINAS COMPLY WITH ITS GENERAL REQUIREMENT IN 2018?

A. Yes, the Company is well-positioned to comply with its General Requirement in 2018.

Q. WHAT ACTIONS HAS DUKE ENERGY CAROLINAS TAKEN DURING THE TEST PERIOD TO SATISFY ITS CURRENT AND FUTURE REPS REQUIREMENTS?

A. During the Test Period, Duke Energy Carolinas has continued to produce and procure RECs to satisfy its REPS requirements. Specifically, the Company has taken the following actions: (1) executed and continued negotiations for additional REC purchase agreements with renewable facilities; (2) completed construction and operated two utility-scale solar projects totaling 75 megawatts ("MW"), generating RECs for compliance purposes - the Mocksville Solar Facility, placed in service in December

2016 and the Monroe Solar Facility, placed in service in April 2017; (3) continued operations of its solar and hydroelectric facilities; (4) enhanced and expanded energy efficiency programs that will generate savings that can be counted towards the Company's REPS requirement; and (5) performed research studies, both directly and through strategic partnerships, to enhance the Company's ability to comply with its future REPS requirements.

Q. HOW WILL THE COMPETITIVE PROCUREMENT OF RENEWABLE ENERGY ("CPRE") PROGRAM OF NORTH CAROLINA HOUSE BILL 589 ("NC HB 589") IMPACT DEC'S COMPLIANCE WITH ITS GENERAL REQUIREMENT?

A. Under G.S. § 62-110.8(a), DEC and DEP are responsible for procuring renewable energy and capacity through a competitive procurement program with the purpose of adding renewable energy to the state's generation portfolio in a manner that allows DEC and DEP to continue to reliably and cost-effectively serve their customers' future energy needs. To meet the CPRE Program requirements, the Companies must issue requests for proposals to procure energy and capacity from renewable energy facilities in the aggregate amount of 2,660 MW (subject to adjustment in certain circumstances) reasonably allocated over a term of 45 months beginning on February 21, 2018, when the Commission approved the CPRE Program.

Renewable energy facilities eligible to participate in the CPRE solicitation(s) include those facilities that use renewable energy resources identified in G. S. § 62-133.8(a)(8), the REPS statute. The renewable energy facilities to be developed or acquired by the Companies or procured from a third party through a power purchase agreement under the CPRE Program, must also deliver to the Companies the environmental and renewable attributes, or RECs, associated with the power. The Company's CPRE Program Guidelines, filed in Docket No. E-7, Sub 1156 on November 27, 2017, include a planned allocation of the 2,660 MW between the DEC and DEP service territories and a proposed timeline for each solicitation. DEC plans to use the RECs acquired through the CPRE RFP solicitations for its future REPS compliance requirements and has therefore included the planned MW allocation and timeline in its REPS compliance planning process. Since the Company will use the RECs acquired through CPRE for REPS compliance, CPRE program implementation costs could be recovered through the REPS Rider. However, the Company has elected to recover the reasonable and prudent costs incurred to implement the CPRE Program through the CPRE Rider as contemplated under Commission Rule R8-71(j).

Q. HAS THE COMPANY COMPLIED WITH ITS SOLAR SET-ASIDE REQUIREMENT FOR 2017?

A. Yes. The Company has met the 2017 Solar Set-Aside Requirement of 85,576 solar RECs. Pursuant to the NC-RETS Operating Procedures, the

Company has submitted for retirement 85,576 solar RECs. Specifically, the RECs to be used for 2017 compliance have been transferred from the NC-RETS Duke Energy Electric Power Supplier account to the Duke Energy Compliance Sub-Account and the Sub-Accounts of its Wholesale customers. Upon completion of this regulatory proceeding, the Commission will finalize retirement of the RECs.

Q. WILL DUKE ENERGY CAROLINAS COMPLY WITH ITS SOLAR SET-ASIDE REQUIREMENT IN 2018?

A. Yes, the Company is well-positioned to comply with its Solar Set-Aside Requirement in 2018.

Q. PLEASE PROVIDE AN UPDATE ON THE COMPANY'S EFFORTS TO COMPLY WITH ITS SOLAR SET-ASIDE REQUIREMENT.

A. The Company is well-positioned to comply with its Solar Set-Aside Requirement in 2018 through a diverse and balanced portfolio of solar resources. The Company's efforts to comply with the Solar Set-Aside Requirement include REC generation and procurement from solar renewable energy facilities.

As previously noted, the Company constructed two DEC-owned solar photovoltaic ("PV") facilities, which will generate an estimated 140,000 RECs per year over the life of the projects. These facilities include the Monroe Solar Facility, 60 MW located in Union County, and the Mocksville Solar Facility, 15 MW located in Davie County. In addition, the Company plans to begin construction on the Woodleaf Solar Facility, 6 MW located in Rowan County, in the second quarter of 2018 and have the project operational by the end of 2018. This project is estimated to generate approximately 14,500 RECs per year over the life of the project.

Q. PLEASE DESCRIBE THE OPERATIONAL STATUS OF THE COMPANY'S PV DISTRIBUTED GENERATION ASSETS.

A. The Company's approximately 10 MW-DC of solar PV generation facilities were operational and generating power for the benefit of its customers during the test period. In 2018, the Company plans to update monitoring equipment at its 18 nonresidential sites.

Q. HAS THE COMPANY COMPLIED WITH ITS POULTRY WASTE SET-ASIDE REQUIREMENT FOR 2017?

A. Yes. The Company has met the 2017 Poultry Waste Set-Aside Requirement of 77,443 RECs. Pursuant to NC-RETS Operating Procedures, the Company has submitted for retirement 37,291 poultry RECs and 20,076 SB 886 RECs (which count as 40,152 Poultry Waste Set-Aside RECs). Accordingly, the Company has submitted the equivalent of 77,443 poultry RECs for compliance. Specifically, the RECs to be used for 2017 compliance have been transferred from the NC-RETS Duke Energy Electric Power Supplier account to the Duke Energy Compliance Sub-Account and the Sub-Accounts of its Wholesale customers. Upon completion of this regulatory proceeding, the Commission will finalize retirement of the RECs.

Q. WILL DUKE ENERGY CAROLINAS COMPLY WITH ITS POULTRY WASTE SET-ASIDE REQUIREMENT IN 2018?

A. The Company's ability to comply with its Poultry Waste Set-Aside Requirement in 2018 is dependent on the performance of poultry waste-to-energy developers on current contracts and one new poultry waste-to-energy project that is scheduled to come online during 2018. Two poultry waste-to-energy facilities that were operational in 2017 encountered operational issues and had to shut down to perform plant modifications. Both facilities are expected back online in late 2018, but 2018 production will be lower than originally expected.

Q. WHAT ACTIONS HAS DUKE ENERGY CAROLINAS TAKEN DURING THE TEST PERIOD TO PROCURE OR DEVELOP POULTRY WASTE-TO-ENERGY RESOURCES TO SATISFY ITS POULTRY WASTE SET-ASIDE REQUIREMENTS?

A. In the Test Period, the Company (1) continued direct negotiations for additional supplies of both in-state and out-of-state resources with multiple counterparties; (2) secured contracts for additional poultry waste-to-energy resources; (3) worked diligently to understand the technological, permitting, and operational risks associated with various methods of producing qualifying poultry RECs to aid developers in overcoming those risks; when those risks could not be overcome, the Company worked with developers via contract amendments to adjust for more realistic outcomes; (4) explored leveraging current biomass contracts by working with developers to add poultry waste to their fuel mix; (5) explored adding thermal capabilities to current poultry sites to bolster REC production; and (6) utilized the Company's REC trader to search the broker market for out-of-state poultry RECs available in the market.

The Company remains committed to satisfying its statutory requirements for the Poultry Waste Set-Aside and will continue to reasonably and prudently pursue procurement of these resources.

Q. WILL DUKE ENERGY CAROLINAS COMPLY WITH ITS SWINE WASTE SET-ASIDE REQUIREMENT IN 2018?

A. The Company's ability to comply with its Swine Waste Set-Aside Requirement in 2018 is dependent on the performance of swine waste-to-energy developers on current contracts and two new swine waste-to-energy projects that came online in 2017 and are projected to ramp up production during 2018.

As part of its efforts to achieve compliance with the Swine Waste Set-Aside Requirement, the Company entered into contracts to purchase directed biogas derived from swine waste in the Midwest for generating electric power at the Company's North Carolina Dan River combined cycle facility. The Company filed to register this facility as a New Renewable Energy Facility under G.S. § 62-133.8(a) and Commission Rule R8-66 in June 2015 and received approval from the Commission in

March 2016. DEC started receiving biogas from one of the Midwest projects beginning in the summer of 2017. The other Midwest project encountered extreme weather events in the summer of 2017 that caused significant damage, leading the project to declare force majeure and terminate its contract with DEC.

The Company understands that current swine waste-to-energy projects have encountered difficulties in achieving the full REC output of their contracts due to issues including local opposition to siting of the facilities, the inability to secure firm and reliable sources of swine waste feedstock from waste producers in North Carolina, and technological challenges encountered when ramping up production.

Q. WHAT ACTIONS HAS DUKE ENERGY CAROLINAS TAKEN DURING THE TEST PERIOD TO PROCURE OR DEVELOP SWINE WASTE-TO-ENERGY RESOURCES TO MEET ITS SWINE WASTE SET-ASIDE REQUIREMENTS?

A. In the Test Period, the Company (1) issued a Request for Proposals for swine waste fueled proposals, soliciting up to 750,000 MMBtu of swine waste fueled biogas, or the equivalent in MWh, which is approximately 110,000 MWh, of electric power fueled by swine waste; (2) continued direct negotiations for additional supplies of both in-state and out-of-state resources; (3) continued support of the Loyd Ray Farms research and development project; (4) worked diligently to understand the technological, permitting, and operational risks associated with various methods of producing qualifying swine RECs to aid developers in overcoming those risks; when those risks could not be overcome, the Company worked with developers via contract amendments to adjust for outcomes that the developers believe are achievable based on new experience; (5) explored and is engaging in modification of current biomass and set-asides contracts by working with developers to add swine waste to their fuel mix; (6) utilized the Company's REC trader to search the broker market for out-of-state swine RECs available in the market; and (7) engaged the North Carolina Pork Council ("NCPC") in a project evaluation collaboration effort that will allow the Company and the NCPC to discuss project viability, as appropriate, with respect to the Company's obligations to keep certain sensitive commercial information confidential.

The Company remains committed to satisfying its statutory requirements for the Swine Waste Set-Aside and will continue to reasonably and prudently pursue procurement of these resources.

Q. IS DUKE ENERGY CAROLINAS CONTINUING TO EXECUTE ADDITIONAL REC PURCHASE AGREEMENTS?

A. Yes. The Company continues to execute additional REC purchase agreements and maintains an open solicitation for proposals from developers of renewable energy resources.

Q. DID THE COMPANY SELL ANY RECS DURING THE TEST PERIOD?

A. Yes, the Company sold poultry RECs during the test period to other electric suppliers in North Carolina to enable the state's electric power suppliers to comply with the aggregate Poultry Waste Set-Aside Requirement. These sales did not negatively impact compliance, and the proceeds were credited back to the Company's retail and Wholesale REPS customers.

Q. HAS THE COMPANY COMPLIED WITH THE COMMISSION'S MAY 2014 ORDER IN DOCKET NO. E-100, SUB 113, PERTAINING TO ACCOUNTING FOR REC SALES?

A. Yes. Please see Jennings Confidential Exhibit No. 4 for information on the Company's REC sales, as required by this Order.

Q. DOES THE COMPANY HAVE IN ITS INVENTORY ANY RECS THAT IT CANNOT USE FOR ITS OWN REPS COMPLIANCE REQUIREMENTS?

A. Yes. DEC has RECs in its inventory that it cannot use for its own REPS compliance requirements. The RECs were generated by specific hydroelectric generating facilities owned by the Company, each of which has a generation capacity of 10 MW or less and was placed into service prior to January 1, 2007.

Q. PLEASE EXPLAIN WHY THE COMPANY CANNOT USE THESE RECS TO MEET ITS OWN COMPLIANCE REQUIREMENTS.

A. Under G.S. § 62-133.8(b)(2), an electric public utility, such as DEC, may meet its REPS compliance requirement through several methods, including by "generat[ing] electric power at a new renewable energy facility." The Commission accepted the registration of these DEC-owned hydroelectric facilities as renewable energy facilities, but not as *new* renewable energy facilities, in its July 31, 2009 *Order Accepting Registration of Renewable Energy Facilities* in Docket Nos. E-7, Subs 886, 887, 888, 900, 903 and 904 ("*June 31, 2009 Registration Order*") and its December 9, 2010 *Order Accepting Registration of Renewable Energy Facilities* in Docket Nos. E-7, Subs 942, 943, 945 and 946 (collectively, "*Registration Orders*"). In the *Registration Orders*, the Commission specifically cited its June 17, 2009 *Order on Public Staff's Motion for Clarification* in Docket No. E-100, Sub 113, where it concluded that these utility-owned hydroelectric facilities do not meet the delivery requirement of G.S. § 62-133.8(a)(5)(c), which requires the delivery of electric power to an electric power supplier, such as DEC, by an entity other than the electric power supplier to qualify as a *new* renewable energy facility.

Q. HAS THE COMPANY EVALUATED THE SALE OR EXCHANGE OF THESE RECS FROM RENEWABLE ENERGY FACILITIES TO ANY OTHER NORTH CAROLINA ELECTRIC POWER SUPPLIERS?

A. Yes. The Company has discussed with the North Carolina Electric Membership Corporation ("NCEMC") potentially exchanging a portion of these RECs for an equal number of General Requirement RECs in NCEMC's inventory that DEC could use for REPS compliance. Unlike

DEC, NCEMC can use these RECs to comply with its REPS requirements because G.S. § 62-133.8(c)(2)(d) allows an electric membership corporation ("EMC") to meet its REPS requirements through the purchase of RECs derived from renewable, as opposed to new renewable, energy facilities.

Q. HOW DOES THIS PROPOSED REC EXCHANGE BENEFIT DEC'S CUSTOMERS?

A. DEC's customers would benefit from this proposed REC exchange because it would allow DEC to meet part of its General Requirement through the RECs exchanged with NCEMC, at no cost to DEC customers, rather than through the purchase of additional RECs from new renewable energy facilities. NCEMC's customers would be held harmless in the transaction as this exchange would simply replace RECs in NCEMC's inventory with different RECs that NCEMC would use to meet its General Requirement.

Q. DOES THE COMPANY BELIEVE THAT G.S. § 62-133.8(C)(2)(C) LIMITS NCEMC'S ABILITY TO USE THESE RECS TO COMPLY WITH THEIR REPS REQUIREMENTS?

A. No, the Company believes that G.S. § 62-133.8(c)(2)(c) does not limit NCEMC's use of these RECs generated by renewable energy facilities for REPS compliance purposes. I am not an attorney, and the Company is neither offering advice on, nor taking responsibility for, NCEMC's REPS compliance efforts; however, I am aware that G.S. § 62-133.8(c)(2) lists several methods by which an EMC may meet its REPS requirements. It may, for example, generate electric power at a new renewable energy facility. In addition, I am aware that, on page 3 of the Commission's *June 31, 2009 Registration Order*, the Commission expressly referenced two other distinct ways that EMCs may meet their REPS compliance requirements: through the purchase of electric power from a renewable energy facility or hydroelectric power facility or through the purchase of RECs from in-state or out-of-state renewable energy facilities. With respect to the purchase of electric power from a renewable energy facility or a hydroelectric facility, G.S. § 62-133.8(c)(2)(c) provides that no more than thirty percent (30%) of an EMC's annual compliance requirement may be met with hydroelectric power, including allocations by the Southeastern Power Administration. This 30% cap expressly applies to meeting REPS requirements through the use of or purchase of electric *power;* however, it does not limit NCEMC's purchase of unbundled in-state RECs to comply with its REPS requirements. In this proposed exchange of DEC's RECs from renewable energy facilities for NCEMC's general RECs, NCEMC acquires the unbundled RECs only and does not purchase the underlying power. Accordingly, the 30% limitation does not apply.

Cost of REPS Compliance

Q. WHAT ARE THE COMPANY'S COSTS ASSOCIATED WITH REPS COMPLIANCE DURING THIS TEST PERIOD AND THE UPCOMING BILLING PERIOD?

A. Duke Energy Carolinas' costs associated with REPS compliance are reflected in Jennings Confidential Exhibit No. 2 and are categorized by actual costs incurred during the Test Period and projected costs for the Billing Period.

Q. IN ADDITION TO RENEWABLE ENERGY AND REC COSTS, WHAT OTHER COSTS OF REPS COMPLIANCE DOES THE COMPANY SEEK TO RECOVER IN THIS PROCEEDING?

A. Jennings Confidential Exhibit Nos. 2 and 3 identify "Other Incremental Cost", "Solar Rebate Program Cost" and "Research Cost" that the Company has incurred, and estimates it will incur, in association with REPS compliance.

Other Incremental Costs and Solar Rebate Program Costs

Q. PLEASE EXPLAIN THE OTHER INCREMENTAL COSTS INCLUDED FOR RECOVERY.

A. Other Incremental Costs include labor costs associated with REPS compliance activities and non-labor costs associated with administration of REPS compliance. Among the non-labor costs associated with REPS compliance are the Company's subscription to NC-RETS, and accounting, tracking, and forecasting tools related to RECs, reduced by proceeds from

REC sales and agreed-upon liquidated damages paid by sellers for failure to meet contractual milestones, and amounts paid for administrative contractual amendments requested by sellers.

Q. PLEASE PROVIDE INFORMATION ON THE NC HB 589 SOLAR REBATE PROGRAM.

A. As required by G.S. § 62-155(f), DEC filed an application with the NCUC, in Docket Nos. E-7, Sub 1166 and E-2 Sub 1167, requesting approval of a Solar Rebate Program offering reasonable incentives to residential and nonresidential customers for the installation of small customer owned or leased solar energy facilities participating in the Company's net metering tariff. The incentive is limited to 10 kilowatts alternating current ("kW AC") for residential solar installations and 100 kW AC for nonresidential solar installations. The program incentive shall be limited to 10,000 kW of installed capacity annually starting January 1, 2018 and continuing until December 31, 2022. Under NC HB 589, DEC shall be authorized to recover all reasonable and prudent costs of incentives provided to customers and program administrative costs through the REPS Rider.

Q. ARE COSTS RELATED TO THE NC HB 589 SOLAR REBATE PROGRAM INCLUDED FOR RECOVERY IN THIS FILING?

A. Yes. Pursuant to G.S. § 62-155(f), each public utility required to offer a solar rebate program, "shall be authorized to recover all reasonable and prudent costs of incentives provided to customers and program administrative costs by amortizing the total program incentives distributed during a calendar year and administrative costs over a 20-year period, including a return component adjusted for income taxes at the utility's overall weighted average cost of capital established in its most recent general rate case, which shall be included in the costs recoverable by the public utility pursuant to G.S. 62-133.8(h)." G.S. § 62-133.8(h) provides for an electric power supplier's cost recovery and customer charges under the REPS statute; NC HB 589 amended it by adding a provision to allow for the recovery of incremental costs incurred to "provide incentives to customers, including program costs, incurred pursuant to G.S. § 62-155(f)." Therefore, DEC has included for recovery in this filing costs projected to be incurred in the Billing Period related to the implementation of the NC HB 589 Solar Rebate Program. As detailed on Jennings Confidential Exhibit No. 3, these costs include the annual amortization of incentives paid to customers and program administration costs, including labor, information technology and marketing costs.

Q. PLEASE PROVIDE DETAIL ON THE NON-LABOR COSTS ASSOCIATED WITH THE NC HB 589 SOLAR REBATE PROGRAM.

A. The NC HB 589 Solar Rebate Program is anticipated to launch in June 2018 with the first rebate payments occurring in July 2018. Even though the rebate payments are not projected to start until July 2018, DEC anticipates the program to be fully subscribed in 2018 with payments for the full annual limit of 10,000 kW. In 2019, the rebate payments are projected to be made ratably throughout the year. Also included in non-labor costs are program marketing costs and information technology costs for the automation of program administrative tasks.

Q. PLEASE PROVIDE DETAIL ON THE INTERNAL LABOR COSTS ASSOCIATED WITH THE NC HB 589 SOLAR REBATE PROGRAM.

A. The labor dollars related to the NC HB 589 Solar Rebate Program included for recovery in this filing include projected costs for one Program Manager, two Program Specialists and two complex billing staff. The Program Manager will be responsible for marketing, installer communications, reporting and overseeing the Program Specialists, who will be responsible for processing applications, initiating incentive payments and handling customer inquiries. In addition, incremental employees are needed in complex billing as the number of net metering accounts is expected to increase as a result of the NC HB 589 Solar Rebate Program.

Q. PLEASE PROVIDE DETAIL ON THE INTERNAL LABOR COSTS THAT ARE ASSOCIATED WITH REPS COMPLIANCE AND NC HB 589 SOLAR REBATE PROGRAM ACTIVITIES THAT ARE INCLUDED IN DEC'S CURRENT APPLICATION FOR REPS COST RECOVERY.

A. DEC charges only the incremental cost of REPS compliance and the NC HB 589 Solar Rebate Program to the REPS cost recovery rider. Consistent with that policy and DEC's practices in previous applications for cost recovery for REPS compliance, internal employees that work to comply with G.S. § 62-133.8 and G.S. § 62-155(f) charge only that portion of their labor to REPS. The departments/functions that charged labor to REPS during the Test Period are detailed in Jennings Confidential Exhibit No. 3.

Q. HOW DO EMPLOYEES CHARGE THEIR REPS-RELATED AND NC HB 589 SOLAR REBATE PROGRAM-RELATED LABOR COSTS TO REPS?

A. Employees positively report their time, which means that each employee is required to submit a timesheet every two weeks in DEC's time reporting system. The hours reported for the period are split according to the accounting entered in the time reporting system for that specific employee. The division of hours is updated for the reporting period as necessary, as the nature of the employee's work changes.

To educate employees to account for their time properly, DEC annually provides instructions for charging time to REPS to affected employees and the management of the employee groups performing REPS work. Additionally, every year prior to filing for approval of the DEC REPS Compliance Report and Cost-Recovery Rider, the labor hours charged are carefully reviewed and confirmed.

Q. ARE THERE ANY LABOR AND NON-LABOR INTERCONNECTION-RELATED COSTS INCLUDED FOR RECOVERY IN THIS FILING?

A. No. As directed by the NCUC in Docket No. E-2, Sub 1109, all internal interconnection-related labor costs, such as those related to employees in the Distributed Energy Resources Standard PPAs and Interconnection Team and the Renewables Service Center, contract labor costs, such as those for temporary employees working on interconnection information technology projects and non-labor costs, such as PowerClerk platform costs, have not been included for recovery in this filing.

Research Costs

With respect to Research and Development ("R&D") activities during the Test Period and projected for the Billing Period, the Company has incurred or projects to incur costs associated with the support of various pilot projects and studies related to distributed energy technology and the Company's REPS compliance.

Q. THE COMMISSION'S *ORDER APPROVING REPS AND REPS EMF RIDERS AND 2012 REPS COMPLIANCE* REQUIRES DUKE ENERGY CAROLINAS TO FILE WITH ITS 2017 REPS RIDER APPLICATION STUDY RESULTS FOR ANY STUDIES THE COSTS OF WHICH IT HAS RECOVERED VIA THE REPS RIDER. IS THE COMPANY SUPPLYING SUCH STUDIES IN THIS FILING?

A. Yes. The Company's R&D efforts are an integral part of its REPS Compliance efforts. The following summary outlines efforts undertaken by the Company in the test period and specifies the availability of applicable study results.

- CAPER, PV Synchronous Generator ("PVSG") – In 2017, the Company worked with North Carolina State University ("NC State") and Clemson University, through the Center for Advanced Power Engineering Research ("CAPER"), on a project to develop and demonstrate a 40 kW PVSG system. The results of this project can be found in Jennings Exhibit No. 5. This project will continue in 2018.
- CAPER, Distributed Generation Valuation – In 2017, the Company worked with NC State and the University of North Carolina at Charlotte ("UNCC"), through CAPER, on a project to properly value the distributed generation in relation to its impacts on the grid, and to determine best practices for the southeast region. The first phase of the project aims to review recently conducted studies on the value of distributed generation. The phase one results can be found in Jennings Exhibit No. 6. This project will continue in 2018.
- Closed Loop Biomass – The Company continues to support a closed-loop biomass research project to better understand yield potential for various woody crops, including Loblolly Pine, Hybrid

Poplar, Hybrid Aspen, Sweetgum, Willow and Cottonwood trees. Crop production levels may take several years to reach full maturity. American Forest Management ("AFM") provides project management support and periodic updates to the Company, as seen in Jennings Exhibit No. 7. In addition to their regular crop assessments, in 2017 AFM started collecting woody biomass samples from various plots. These were then provided to Mineral Labs so that the lab could perform Ultimate Analysis on each woody biomass sample. Jennings Exhibit No. 8 provides the results from the analyses as well as a sample report from Mineral Labs.

- Coalition for Renewable Natural Gas – the Company joined the Coalition for Renewable Natural Gas in 2017 to add a valuable resource of knowledge and public policy advocation in this growing sector of potential animal waste supply. The Coalition for Renewable Natural Gas provides its members with exclusive whitepapers, support on model pipeline gas specifications and access to other members for discussions on current and future projects.
- Electric Power Research Institute ("EPRI") – In 2017, the Company subscribed to the following EPRI programs, the costs of which were recovered via the REPS rider: Program 193 – Renewable Generation, which includes Program PS193C – Solar.

EPRI designates such study results as proprietary or as trade secrets and licenses such results to EPRI members, including Duke Energy Carolinas. As such, the Company may not disclose the information publicly. Non-members may access these studies for a fee. Information regarding access to this information can be found at http://www.epri.com/Pages/Default.aspx.

- NC State University's Future Renewable Electric Energy Delivery and Management ("FREEDM") Systems Center – Duke Energy supports NC State's FREEDM Center through annual membership dues. The FREEDM partnership provides Duke Energy with the ability to influence and focus research on materials, technology, and products that will enable the utility industry to transform the electric grid into a 2-way power flow system supporting distributed generation.
- Institute for Electrical and Electronics Engineers ("IEEE") 1547 Conformity Assessment – The IEEE 1547 Conformity Assessment Steering Committee has been working to develop industry standard tools and methodologies to assure consistent and comprehensive compliance prior to utility grid interconnection sign off. IEEE and the Company share a common goal to accelerate and broaden industry adoption through the development and publication of well-designed and managed conformity assessment and certification programs. This project was about establishment and

execution of an IEEE 1547 Commissioning Test demonstration for solar installations within the eGRID laboratory located at Clemson University. The project formally commissioned the operation of a 50kW inverter, established an operational test bed for more advanced interconnection evaluation. The results of this project can be found in Jennings Confidential Exhibit No. 9.

- Distributed Energy Resource – Islanding Detection and Control ("DER-IDC") – There is growing consensus in the industry that as DER grows in its penetration levels, the effectiveness of anti-islanding schemes currently in use in inverters and protective relaying schemes will degrade, and that future schemes will likely need to involve some sort of communications. This sentiment has been discussed multiple times at recent IEEE working group meetings, at which the Company is an active participant. To that end, DEC engaged in an initial study to look at wide-scale communications methods that could be used to solve this growing concern. DEC contracted with Northern Plains Power Technologies ("NPPT"), an engineering consulting firm, to study data collected from Duke Energy facilities and research potential algorithms and communications methods that would be effective for communications-based IDC methods. In 2017, NPPT evaluated the technical challenges of the identified islanding detection method, and presented the feasible alternatives. The results of the study can be found in Jennings Confidential Exhibit No. 10. In addition, DEC contracted with Green Energy Corp who developed the data translator for local access and filtering of streaming PMU data at distribution measurement equipment back to a phaser data concentrator in the back-office. A status report for this project can be found in Jennings Exhibit No. 11.

- Loyd Ray Farms – The Company partnered with Duke University to develop a pilot-scale, sixty-five kW swine waste-to-energy facility, which initiated operation and began producing renewable energy in 2011. Jennings Exhibit No. 12 summarizes the project's progress through December 31, 2017.
- Marshall Solar Site Algorithm – In 2017, the Company continued to work with UNCC on a project to utilize the operational data to design and implement an autonomous active and reactive power dispatch algorithm with PV farms and/or Battery Energy Storage system on any feeder considering DMS coordination. The results of this project can be found in Jennings Confidential Exhibit No. 13.
- Mini-DVAR Project – In 2016, the Company started a project to investigate a new technology manufactured by American Superconductor Corporation which makes a device called Mini-DVAR. This device can potentially be used for voltage stability/VAR support for renewable energy applications such as

voltage compliance, grid reliability, efficiency, energy savings and grid integration of distributed PV. The project also included engineering design of a protection scheme with Schweitzer Engineering Laboratories, and the procurement of switch gear from ABB. In 2017, the Company completed the following tasks of the project: (1) power quality meter installation for base line data collection; (2) design and implementation of the direct transfer trip for the mini-DVAR device; (3) mini-DVAR device field installation and commissioning; and (4) test run of the mini-DVAR to verify it's fully functional. This project will continue in 2018.

- Rocky Mountain Institute ("RMI") – The Company participates in eLab, a forum sponsored by RMI, composed of a number of North Carolina and nationally based entities, and organized to overcome barriers to economic deployment of distributed energy resources in the U.S. electric sector. Specifically, the Company seeks to gauge customer desires related to distributed resources and provide ideas of potential long-term solutions for distributed energy resources and microgrids. Please visit RMI's website at http://www.rmi.org/elab for more information on eLab.
- Swine Extrusion/Poultry Mortality – The Animal and Poultry Waste Management Center ("APWMC") at NC State University – In 2017, the Company began support of the various projects being

undertaken by the APWMC. The initial work is centered around drying swine lagoon solids and poultry mortalities at a farm-based level to create a higher MMBtu fuel that can be safely and easily transported to a central plant for combustion. A detailed description of the project along with future testing plans can be found in Jennings Confidential Exhibit No. 14.

Q. ARE YOU SATISFIED THAT THE ACTUAL COSTS INCURRED IN THE TEST PERIOD HAVE BEEN, AND THAT THE PROJECTED COSTS OF THE BILLING PERIOD WILL BE, PRUDENTLY INCURRED?

A. Yes. Duke Energy Carolinas believes it has incurred and projects to incur all of these costs associated with REPS compliance in a prudent manner. The Company continues to exercise thorough and rigorous technical and economic analysis to evaluate all options for compliance with its REPS requirements. Duke Energy Carolinas has developed strong foundational market knowledge related to renewable resources. The Company continues to enhance and develop expertise in this field through the Company's various solicitations for renewable energy and the operation of its unsolicited bid process, its implementation of the Duke Energy North Carolina Solar PV Distributed Generation Program, its construction of DEC-owned utility-scale solar facilities, its participation in industry research, and daily interaction with developers of renewable energy facilities. As a result of these efforts, the Company has been able to identify, procure, and develop a diverse portfolio of renewable resources to meet its REPS requirements in a prudent, reasonable and cost-effective manner.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

JENNINGS EXHIBIT NO. 1
*****REDACTED VERSION*****

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1162

In the Matter of Application of Duke Energy Carolinas, LLC for Approval of Renewable Energy and Energy Efficiency Portfolio Standard (REPS) Compliance Report and Cost Recovery Rider Pursuant to N.C. Gen. Stat. 62-133.8 and Commission Rule R8-67	DUKE ENERGY CAROLINAS, LLC 2017 RENEWABLE ENERGY & ENERGY EFFICIENCY PORTFOLIO STANDARD COMPLIANCE REPORT

DUKE ENERGY CAROLINAS, LLC
RENEWABLE ENERGY AND ENERGY EFFICIENCY PORTFOLIO STANDARD ("REPS") COMPLIANCE REPORT

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(A) INTRODUCTION

Duke Energy Carolinas, LLC ("Duke Energy Carolinas" or the "Company") submits its Renewable Energy and Energy Efficiency Portfolio Standard ("REPS") Compliance Report ("Compliance Report") in accordance with N.C. Gen. Stat. § 62-133.8 and Commission Rule R8-67(c). This Compliance Report provides the required information for the calendar year 2017.[1] As part of its REPS Compliance Plan, filed in Docket No. E-100, Sub 147, Duke Energy Carolinas plans to provide services to native load priority wholesale customers that contract with the Company for services to meet the REPS requirements, including delivery of renewable energy resources and compliance planning and reporting. These native load priority wholesale customers – including distribution cooperatives and municipalities – may rely on Duke Energy Carolinas to provide this renewable energy delivery service in accordance with N.C. Gen. Stat. § 62-133.8(c)(2)e.

This Compliance Report provides the required information in aggregate for the Company and the following wholesale customers for whom the Company provided renewable energy resources and compliance reporting services: Blue Ridge Electric Membership Corporation, Rutherford Electric Membership Corporation, Town of Dallas, Town of Forest City, City of Concord, Town of Highlands, and City of Kings Mountain ("Wholesale").

(B) REPS COMPLIANCE REPORT

I. RENEWABLE ENERGY CERTIFICATES

The table below reflects the renewable energy certificates ("RECs") used to comply with N.C. Gen. Stat. § 62-133.8(d) for the year 2017.

[BEGIN CONFIDENTIAL]

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[1] Pursuant to NCUC Rule R8-67(c)(1), this Compliance Report reflects Duke Energy Carolinas' efforts to meet the REPS requirements for the previous calendar year.

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[END CONFIDENTIAL]

II. ACTUAL 2017 TOTAL NORTH CAROLINA RETAIL SALES AND YEAR-END NUMBER OF ACCOUNTS, BY CUSTOMER CLASS

North Carolina Retail Sales (MWh)	2017
Duke Energy Carolinas	56,012,299
Wholesale	3,506,052
Total MWh Sales	59,518,351

2017 Year-end Number of REPS Accounts			
Account Type	Duke Energy Carolinas	Wholesale	Total
Residential	1,704,089	163,138	1,867,227
General	243,614	19,504	263,118
Industrial	4,820	273	5,093

III. AVOIDED COST RATES

The avoided cost rates below, applicable to energy received pursuant to power purchase agreements, represent the annualized avoided cost rates in Schedule PP or PP-N (NC), Distribution Interconnection, approved in the following avoided cost proceedings:

ANNUALIZED TOTAL CAPACITY AND ENERGY RATES						
(CENTS PER KWH)						
Docket No.:	**E-100 Sub 148 (Current)**	**E-100, Sub 140**	**E-100, Sub 136**	**E-100, Sub 127**	**E-100, Sub 117**	**E-100, Sub 106**
Year filed:	2016	2014	2012	2010	2008	2006
Variable Rate	3.26	4.32	4.98	5.48	6.4	5.4
5 Year	N/A	4.52	5.19	5.63	6.39	5.46
10 Year	3.86	5.15	5.52	6.28	6.42	5.51
15 Year	N/A	5.62	5.84	6.63	6.56	5.64

IV. ACTUAL TOTAL AND INCREMENTAL COSTS INCURRED IN 2017

Actual costs incurred in 2017 for REPS compliance were comprised of the following cost of energy purchases and the purchase of various types of RECs, solar distributed generation at Duke Energy Carolinas-owned facilities, and other reasonable and prudent costs incurred to meet the requirements of the statute.

Actual Costs Incurred	Energy and REC Costs	Other	Total Costs
Total costs incurred	$82,394,781	$1,363,452	$83,758,233
Avoided costs	$64,556,582	$0	$64,556,582
Incremental costs	$17,838,199	$1,363,452	$19,201,651

V. ACTUAL INCREMENTAL COSTS COMPARISON TO THE ANNUAL COST CAP AS OF THE PREVIOUS CALENDAR YEAR

Account Type	Total 2016 Year-end number of Retail Accounts[(1)]	Annual Per-Account Cost Cap	Total Annual Cost Cap
Residential	1,843,033	$27	$49,761,891
General	258,596	$150	$38,789,400

(1) Includes number of retail accounts for Duke Energy Carolinas and its Wholesale REPS customers

Account Type	Total 2016 Year-end number of Retail Accounts(1)	Annual Per-Account Cost Cap	Total Annual Cost Cap
Industrial	5,130	$1,000	$5,130,000
	Total Annual Cost Cap		**$ 93,681,291**
	Actual Incremental Costs		**$ 19,201,651**

VI. STATUS OF COMPLIANCE WITH REPS REQUIREMENTS

Pursuant to N.C. Gen. Stat. § 62-133.8(b) for Duke Energy Carolinas Retail and N.C. Gen. Stat. § 62-133.8(c) for the Company's Wholesale REPS customers, the REPS requirement for calendar year 2017 is set at 6% of 2016 North Carolina retail sales. In order to comply with the combined REPS obligation for Duke Energy Carolinas Retail and its Wholesale REPS customers, the Company submitted 3,627,191 RECs, including 20,076 Senate Bill 886 ("SB886") RECs each of which counts for two poultry waste and one general REC. Accordingly, the Company submitted the equivalent of 3,667,343 RECs for compliance, representing 6% of combined 2016 retail megawatt-hour sales of 61,122,331. Details of the composition of RECs retired to meet the total REPS compliance requirement are contained in Section I. of this report.

Pursuant to N.C. Gen. Stat. § 62-133.8(d), the REPS requirement for calendar year 2017 is at least 0.14% of the total electric power in kilowatt hours sold to retail electric customers in the prior calendar year in the State, or an equivalent amount of energy, shall be supplied by a combination of new solar electric facilities and new metered solar thermal energy facilities. As a result, 85,576 solar RECs were used to meet the Solar Set-Aside Requirement. 467,674 additional solar RECs were retired toward compliance with the General REPS Requirement (the total REPS requirement net of the solar, poultry, and swine set-aside obligations).

In its October 16, 2017 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief* ("2017 Delay Order") in Docket No. E-100, Sub 113, the Commission further delayed for one year the Swine Waste Set-Aside Requirement, which will now commence in compliance year 2018. In addition, the 2017 Delay Order lowered the 2017 Poultry Waste Set-Aside Requirement to 170,000 MWh state-wide, maintaining the same level as the 2016 requirement, and delayed the subsequent increases by one year.

In its August 5, 2016 *Order Establishing 2016, 2017, and 2018 Poultry Waste Set-Aside Requirement Allocation* in Docket No. E-100, Sub 113, the Commission directed the annual aggregate Poultry Waste Set-Aside Requirement to be allocated among electric power suppliers and utility compliance aggregators based on the load ratio share calculations shown on the spreadsheet filed by the NC-RETS Administrator in the same docket on July 11, 2016.

In order to comply with the combined Poultry Waste Set-Aside Requirement allocated to Duke Energy Carolinas Retail and its Wholesale REPS customers, the Company submitted 37,291 poultry waste RECs along with 20,076 SB886 RECs, which count as 40,152 Poultry Waste Set-Aside RECs. Accordingly, the Company submitted the equivalent of 77,443 poultry RECs for compliance, and met its Poultry Waste Set-Aside Requirement.

VII. IDENTIFICATION OF RECs CARRIED FORWARD

The table below reflects the RECs at year-end 2017 that the Company has banked for use in compliance in future years.

[BEGIN CONFIDENTIAL]

	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	
	[redacted]	[redacted]	

[redacted]

[END CONFIDENTIAL]

VIII. DATES AND AMOUNTS OF ALL PAYMENTS MADE FOR RENEWABLE ENERGY CERTIFICATES

Confidential Appendix 1 provides the dates and amounts of payments made for RECs for calendar year 2017.

(C) METHODOLOGY FOR DETERMINING NUMBER OF CUSTOMERS AND CUSTOMER CAP

In its *Order Approving REPS Riders*, issued in Docket No. E-7, Sub 872 (December 15, 2009), the Commission approved the following method of determining number of customer accounts as proposed by Duke Energy Carolinas. For purposes of defining which accounts will be assessed a REPS charge, and determining account totals by class that will be included in calculating its annual cap on costs incurred to comply with REPS requirements, the Company implemented the method described below. The Company defines "account" as an "agreement," or "tariff rate," between Duke Energy Carolinas and a customer in order to determine the monthly REPS charge for each account, and to compare the charges per account for a twelve-month period to the applicable annual per-account cost cap established in N.C. Gen. Stat. § 62-133.8(h)(4). The same definition applies when compiling account totals by class, to which the annual per-account caps are applied to determine the overall cap for total annual compliance costs incurred established in N.C. Gen. Stat. § 62-133.8(h)(3). There is a limited number of exceptions to this definition of account. The following service schedules should not be considered accounts for purposes of the per-account charge because of the near certainty that customers served under these schedules already will pay a per-account charge under another residential, general service or industrial service agreement and because they represent small auxiliary service loads. The following agreements fall within this exception[2]:

- Outdoor Lighting Service (Schedule OL)
- Floodlighting Service (Schedule FL and FL-N)
- Street and Public Lighting Service (Schedule PL)
- Yard Lighting (Schedule YL)
- Governmental Lighting (Schedule GL)
- Nonstandard Lighting (Schedule NL)
- Off-Peak Water Heating (Schedule WC is a sub-metered service)
- Non-demand metered, nonresidential service, provided on Schedule SGS, at the same premises, with the same service address, and with the same account name as an agreement for which a monthly REPS charge has been applied.

Within the Wholesale customer group, Blue Ridge Electric Membership Corporation, Rutherford Electric Membership Corporation, Town of Forest City and the City of Concord have proposed a methodology for determining Wholesale year-end number of accounts that is generally consistent with that proposed by Duke Energy Carolinas. The Town of Highlands, Town of Dallas, and City of

[2] Lighting service schedules have been updated to reflect the addition of new schedules Governmental Lighting service (Schedule GL) and Nonstandard Lighting service (Schedule NL) and the cancellation of Street Lighting service (Schedule SL) as approved by the Commission on December 7, 2009 in Docket No. E-7, Sub 909, *Order Granting General Rate Increase and Approving Amended Stipulation.*

Kings Mountain propose to define an account in the manner the information is reported to the Energy Information Administration for annual electric sales and revenue reporting.

Respectfully submitted this 7th day of March, 2018.

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Dates and Amounts of payments for RECs - Calendar Year 2017

Redacted Version

Counterparty and Payment Dates		REC Cost
[redacted]		
Dec-2017	$	1,036
Nov-2017	$	3,248
[redacted]		
Feb-2017	$	172
[redacted]		
Apr-2017	$	2,248
Aug-2017	$	2,480
Dec-2017	$	1,628
Feb-2017	$	1,204
Jan-2017	$	1,124
Jul-2017	$	2,428
Jun-2017	$	2,324
Mar-2017	$	1,828
May-2017	$	2,112
Nov-2017	$	1,640
Oct-2017	$	2,248
Sep-2017	$	2,208
[redacted]		
Apr-2017	$	4,645
Aug-2017	$	4,520
Dec-2017	$	3,055
Feb-2017	$	2,130
Jan-2017	$	2,360
Jul-2017	$	4,615
Jun-2017	$	4,755
Mar-2017	$	3,730
May-2017	$	4,340
Nov-2017	$	4,060
Oct-2017	$	4,240
Sep-2017	$	4,320
[redacted]		
Apr-2017	$	4,695
Aug-2017	$	5,320
Dec-2017	$	3,355
Feb-2017	$	2,180
Jan-2017	$	2,675
Jul-2017	$	4,760
Jun-2017	$	4,895
Mar-2017	$	3,925
May-2017	$	4,420
Nov-2017	$	4,265
Oct-2017	$	4,475
Sep-2017	$	4,440
[redacted]		
Apr-2017	$	633
Aug-2017	$	930
Dec-2017	$	895
Jan-2017	$	638
Jul-2017	$	983
Jun-2017	$	1,528
Mar-2017	$	730
May-2017	$	1,535
Nov-2017	$	838
Oct-2017	$	710
Sep-2017	$	823
[redacted]		
Apr-2017	$	60
Aug-2017	$	965
Dec-2017	$	1,720
Feb-2017	$	543
Jan-2017	$	418
Jul-2017	$	2,228
Jun-2017	$	1,890

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Counterparty and Payment Dates		REC Cost
Mar-2017	$	818
May-2017	$	1,233
Nov-2017	$	205
Oct-2017	$	280
Sep-2017	$	248
[redacted]		
Apr-2017	$	2,230
Aug-2017	$	2,308
Dec-2017	$	1,570
Feb-2017	$	1,065
Jan-2017	$	1,243
Jul-2017	$	2,195
Jun-2017	$	2,180
Mar-2017	$	1,768
May-2017	$	1,993
Nov-2017	$	1,915
Oct-2017	$	2,040
Sep-2017	$	2,040
[redacted]		
Apr-2017	$	1,988
Aug-2017	$	2,236
Dec-2017	$	1,296
Feb-2017	$	952
Jan-2017	$	964
Jul-2017	$	2,032
Jun-2017	$	2,028
Mar-2017	$	1,644
May-2017	$	1,908
Nov-2017	$	1,736
Oct-2017	$	1,860
Sep-2017	$	1,780
[redacted]		
Apr-2017	$	1,096
Aug-2017	$	1,216
Dec-2017	$	644
Feb-2017	$	1,528
Jan-2017	$	996
Jul-2017	$	1,664
Jun-2017	$	2,312
Mar-2017	$	1,052
May-2017	$	1,740
Nov-2017	$	748
Oct-2017	$	844
Sep-2017	$	852
[redacted]		
Apr-2017	$	13
Dec-2017	$	55
Feb-2017	$	75
Jan-2017	$	13
Jul-2017	$	63
Jun-2017	$	168
Mar-2017	$	90
May-2017	$	153
Nov-2017	$	75
Oct-2017	$	55
Sep-2017	$	30
[redacted]		
Apr-2017	$	5,884
Aug-2017	$	2,860
Dec-2017	$	1,712
Jul-2017	$	2,612
Jun-2017	$	2,568
May-2017	$	2,568
Nov-2017	$	1,796

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Counterparty and Payment Dates		REC Cost
Oct-2017	$	2,604
Sep-2017	$	2,280
[redacted]		
Apr-2017	$	1,770
Aug-2017	$	1,933
Dec-2017	$	1,253
Feb-2017	$	955
Jan-2017	$	1,003
Jul-2017	$	1,773
Jun-2017	$	1,793
Mar-2017	$	1,463
May-2017	$	1,623
Nov-2017	$	1,610
Oct-2017	$	1,703
Sep-2017	$	1,645
[redacted]		
Apr-2017	$	4,580
Aug-2017	$	4,715
Dec-2017	$	2,960
Feb-2017	$	2,240
Jan-2017	$	2,105
Jul-2017	$	3,830
Jun-2017	$	4,545
Mar-2017	$	3,695
May-2017	$	3,320
Nov-2017	$	3,565
Oct-2017	$	3,880
Sep-2017	$	4,045
[redacted]		
Apr-2017	$	2,545
Aug-2017	$	2,840
Dec-2017	$	1,700
Feb-2017	$	1,150
Jan-2017	$	1,370
Jul-2017	$	2,675
Jun-2017	$	2,325
Mar-2017	$	2,025
May-2017	$	2,395
Nov-2017	$	2,085
Oct-2017	$	2,300
Sep-2017	$	2,420
[redacted]		
Apr-2017	$	6,584
Aug-2017	$	7,018
Jan-2017	$	2,041
Jul-2017	$	14,471
Jun-2017	$	15,457
Mar-2017	$	154
May-2017	$	8,381
Nov-2017	$	23,432
Oct-2017	$	22,243
Sep-2017	$	16,385
[redacted]		
Apr-2017	$	2,636
Aug-2017	$	2,876
Dec-2017	$	1,760
Feb-2017	$	1,204
Jan-2017	$	1,396
Jul-2017	$	2,692
Jun-2017	$	2,708
Mar-2017	$	2,248
May-2017	$	2,492
Nov-2017	$	2,200
Oct-2017	$	2,460

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Counterparty and Payment Dates		**REC Cost**
Sep-2017	$	2,228
[redacted]		
Apr-2017	$	77,104
Aug-2017	$	70,608
Feb-2017	$	79,620
Jan-2017	$	96,212
Jul-2017	$	67,692
Jun-2017	$	86,348
Mar-2017	$	151,200
May-2017	$	88,268
Nov-2017	$	72,580
Oct-2017	$	71,856
Sep-2017	$	69,964
[redacted]		
Apr-2017	$	2,664
Aug-2017	$	3,008
Dec-2017	$	1,924
Jul-2017	$	2,904
Jun-2017	$	2,744
Mar-2017	$	3,016
May-2017	$	1,960
Nov-2017	$	2,472
Oct-2017	$	2,544
Sep-2017	$	2,752
[redacted]		
Apr-2017	$	1,210
Aug-2017	$	16,380
Dec-2017	$	1,480
Feb-2017	$	1,094
Jan-2017	$	1,404
Jul-2017	$	18,646
Jun-2017	$	850
Mar-2017	$	1,325
May-2017	$	280
Nov-2017	$	1,042
Oct-2017	$	11,957
Sep-2017	$	8,351
[redacted]		
Apr-2017	$	3,332
Aug-2017	$	4,108
Dec-2017	$	2,448
Feb-2017	$	1,820
Jan-2017	$	1,960
Jul-2017	$	3,684
Jun-2017	$	3,676
Mar-2017	$	2,928
May-2017	$	3,380
Nov-2017	$	3,260
Oct-2017	$	3,536
Sep-2017	$	3,420
[redacted]		
Apr-2017	$	1,438
Aug-2017	$	1,273
Dec-2017	$	1,880
Feb-2017	$	2,603
Jan-2017	$	1,815
Jul-2017	$	1,538
Jun-2017	$	3,878
Mar-2017	$	1,400
May-2017	$	3,018
Nov-2017	$	1,088
Sep-2017	$	148
[redacted]		
Apr-2017	$	283

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Counterparty and Payment Dates		REC Cost
Aug-2017	$	208
Dec-2017	$	325
Feb-2017	$	393
Jan-2017	$	245
Jul-2017	$	213
Jun-2017	$	148
Mar-2017	$	255
May-2017	$	340
Nov-2017	$	298
Oct-2017	$	250
Sep-2017	$	208
[redacted]		
Dec-2017	$	1,872
Nov-2017	$	2,504
Oct-2017	$	3,112
Sep-2017	$	5,420
[redacted]		
Apr-2017	$	7,012
Aug-2017	$	7,525
Dec-2017	$	7,268
Feb-2017	$	7,255
Jan-2017	$	7,237
Jul-2017	$	7,147
Jun-2017	$	7,282
Mar-2017	$	6,093
May-2017	$	7,012
Nov-2017	$	7,485
Oct-2017	$	7,228
Sep-2017	$	7,593
[redacted]		
Apr-2017	$	57,674
Aug-2017	$	56,296
Dec-2017	$	52,411
Feb-2017	$	62,264
Jan-2017	$	52,010
Jul-2017	$	56,379
Jun-2017	$	60,533
Mar-2017	$	50,474
May-2017	$	59,767
Nov-2017	$	56,058
Oct-2017	$	52,442
Sep-2017	$	56,524
[redacted]		
Apr-2017	$	1,440
Aug-2017	$	1,624
Dec-2017	$	988
Feb-2017	$	772
Jan-2017	$	940
Jul-2017	$	1,452
Jun-2017	$	1,476
Mar-2017	$	1,148
May-2017	$	1,352
Nov-2017	$	1,312
Oct-2017	$	1,452
Sep-2017	$	1,392
[redacted]		
Feb-2017	$	87,500
[redacted]		
Apr-2017	$	4,435
Aug-2017	$	4,950
Dec-2017	$	3,120
Feb-2017	$	2,050
Jan-2017	$	2,465
Jul-2017	$	4,430

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Counterparty and Payment Dates		REC Cost
Jun-2017	$	4,520
Mar-2017	$	3,710
May-2017	$	4,145
Nov-2017	$	3,935
Oct-2017	$	4,185
Sep-2017	$	4,185
[redacted]		
Apr-2017	$	16,926
Aug-2017	$	16,153
Dec-2017	$	16,822
Feb-2017	$	17,446
Jan-2017	$	17,461
Jul-2017	$	15,499
Jun-2017	$	15,975
Mar-2017	$	15,395
May-2017	$	15,484
Nov-2017	$	16,257
Oct-2017	$	16,391
Sep-2017	$	16,420
[redacted]		
Apr-2017	$	2,250
Aug-2017	$	2,548
Dec-2017	$	1,580
Feb-2017	$	975
Jan-2017	$	1,303
Jul-2017	$	2,408
Jun-2017	$	2,215
Mar-2017	$	1,708
May-2017	$	2,103
Nov-2017	$	1,985
Oct-2017	$	2,073
Sep-2017	$	2,198
[redacted]		
Apr-2017	$	11,007
Aug-2017	$	11,022
Dec-2017	$	7,296
Feb-2017	$	5,550
Jan-2017	$	5,207
Jul-2017	$	10,352
Jun-2017	$	10,757
Mar-2017	$	7,764
May-2017	$	9,229
Nov-2017	$	9,931
Oct-2017	$	10,726
Sep-2017	$	9,962
[redacted]		
Apr-2017	$	4,430
Aug-2017	$	4,970
Dec-2017	$	2,955
Feb-2017	$	2,105
Jan-2017	$	2,380
Jul-2017	$	4,655
Jun-2017	$	4,570
Mar-2017	$	3,450
May-2017	$	3,995
Nov-2017	$	2,980
Oct-2017	$	4,305
Sep-2017	$	4,340
[redacted]		
Apr-2017	$	3,415
Aug-2017	$	1,890
Dec-2017	$	1,365
Feb-2017	$	940
Jan-2017	$	1,160

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Counterparty and Payment Dates		REC Cost
Jul-2017	$	3,235
Oct-2017	$	1,750
Sep-2017	$	3,275
[redacted]		
Apr-2017	$	27,510
Aug-2017	$	25,701
Dec-2017	$	24,373
Feb-2017	$	28,677
Jan-2017	$	25,492
Jul-2017	$	25,580
Jun-2017	$	27,229
Mar-2017	$	23,167
May-2017	$	22,885
Nov-2017	$	26,445
Oct-2017	$	24,393
Sep-2017	$	26,344
[redacted]		
Apr-2017	$	2,488
Aug-2017	$	2,696
Dec-2017	$	1,516
Feb-2017	$	1,044
Jan-2017	$	1,060
Jul-2017	$	2,660
Jun-2017	$	2,568
Mar-2017	$	1,956
May-2017	$	2,452
Nov-2017	$	2,012
Oct-2017	$	2,240
Sep-2017	$	2,360
[redacted]		
Mar-2017	$	100,000
[redacted]		
Apr-2017	$	1,188
Aug-2017	$	1,448
Dec-2017	$	1,016
Feb-2017	$	580
Jan-2017	$	756
Jul-2017	$	1,464
Jun-2017	$	1,400
Mar-2017	$	1,092
May-2017	$	1,504
Nov-2017	$	1,260
Oct-2017	$	1,324
Sep-2017	$	1,488
[redacted]		
Apr-2017	$	4,550
Aug-2017	$	4,970
Dec-2017	$	3,270
Feb-2017	$	2,650
Jan-2017	$	2,570
Jul-2017	$	4,725
Jun-2017	$	4,760
Mar-2017	$	3,995
May-2017	$	4,280
Nov-2017	$	3,955
Oct-2017	$	4,440
Sep-2017	$	4,345
[redacted]		
Apr-2017	$	3,444
Aug-2017	$	3,684
Dec-2017	$	2,284
Feb-2017	$	1,440
Jan-2017	$	1,780
Jul-2017	$	3,056

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Counterparty and Payment Dates		REC Cost
Jun-2017	$	3,468
Mar-2017	$	2,540
May-2017	$	3,204
Nov-2017	$	3,028
Oct-2017	$	3,172
Sep-2017	$	3,152
[redacted]		
Apr-2017	$	16,237
Jan-2017	$	43,764
Jul-2017	$	26,293
Nov-2017	$	35,764
[redacted]		
Apr-2017	$	3,628
Aug-2017	$	4,016
Dec-2017	$	2,588
Jul-2017	$	3,796
Jun-2017	$	3,660
Mar-2017	$	4,332
May-2017	$	3,500
Nov-2017	$	3,328
Oct-2017	$	3,636
Sep-2017	$	3,432
[redacted]		
Apr-2017	$	2,484
Aug-2017	$	2,612
Dec-2017	$	1,284
Feb-2017	$	1,048
Jan-2017	$	1,064
Jul-2017	$	2,508
Jun-2017	$	2,524
Mar-2017	$	1,888
May-2017	$	2,272
Nov-2017	$	2,056
Oct-2017	$	2,160
Sep-2017	$	2,216
[redacted]		
Apr-2017	$	2,160
Aug-2017	$	2,420
Dec-2017	$	1,376
Feb-2017	$	936
Jan-2017	$	1,040
Jul-2017	$	2,360
Jun-2017	$	2,232
Mar-2017	$	1,692
May-2017	$	2,096
Nov-2017	$	1,824
Oct-2017	$	1,996
Sep-2017	$	2,084
[redacted]		
Apr-2017	$	25,536
Aug-2017	$	13,777
Dec-2017	$	23,380
Feb-2017	$	16,679
Jan-2017	$	19,668
Jul-2017	$	20,462
Jun-2017	$	23,831
Mar-2017	$	20,764
May-2017	$	23,614
Nov-2017	$	21,980
Oct-2017	$	21,636
Sep-2017	$	18,412
[redacted]		
Apr-2017	$	55,976
Aug-2017	$	60,258

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Counterparty and Payment Dates		REC Cost
Dec-2017	$	59,007
Feb-2017	$	58,633
Jan-2017	$	51,542
Jul-2017	$	58,194
Jun-2017	$	61,378
Mar-2017	$	37,771
May-2017	$	55,888
Nov-2017	$	60,280
Oct-2017	$	52,243
Sep-2017	$	38,650
[redacted]		
Apr-2017	$	14,694
Aug-2017	$	15,030
Dec-2017	$	13,003
Feb-2017	$	13,440
Jan-2017	$	13,925
Jul-2017	$	13,742
Jun-2017	$	15,154
Mar-2017	$	13,619
May-2017	$	14,683
Nov-2017	$	13,238
Oct-2017	$	11,738
Sep-2017	$	15,322
[redacted]		
Apr-2017	$	903
Aug-2017	$	428
Dec-2017	$	223
Feb-2017	$	1,953
Jan-2017	$	540
Jul-2017	$	1,503
Jun-2017	$	1,785
Mar-2017	$	765
May-2017	$	1,473
Nov-2017	$	213
Oct-2017	$	403
Sep-2017	$	315
[redacted]		
Apr-2017	$	1,856
Aug-2017	$	2,014
Dec-2017	$	1,217
Feb-2017	$	878
Jan-2017	$	963
Jul-2017	$	1,888
Jun-2017	$	1,888
Mar-2017	$	1,494
May-2017	$	1,726
Nov-2017	$	1,631
Oct-2017	$	1,708
Sep-2017	$	1,665
[redacted]		
Aug-2017	$	70
Jan-2017	$	20
[redacted]		
Apr-2017	$	3,588
Aug-2017	$	4,012
Dec-2017	$	2,544
Feb-2017	$	2,088
Jan-2017	$	1,956
Jul-2017	$	3,704
Jun-2017	$	3,776
Mar-2017	$	2,484
May-2017	$	3,444
Nov-2017	$	3,104
Oct-2017	$	3,504

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Counterparty and Payment Dates		REC Cost
Sep-2017	$	3,440
[redacted]		
Apr-2017	$	3,452
Aug-2017	$	3,620
Dec-2017	$	2,236
Jul-2017	$	3,632
Jun-2017	$	3,436
Mar-2017	$	5,240
May-2017	$	3,280
Nov-2017	$	2,800
Oct-2017	$	3,120
Sep-2017	$	3,352
[redacted]		
Apr-2017	$	4,690
Aug-2017	$	5,715
Dec-2017	$	3,140
Feb-2017	$	2,370
Jan-2017	$	2,465
Jul-2017	$	5,075
Jun-2017	$	5,055
Mar-2017	$	3,870
May-2017	$	4,555
Nov-2017	$	4,225
Oct-2017	$	4,825
Sep-2017	$	4,805
[redacted]		
Jun-2017	$	2,749
[redacted]		
Apr-2017	$	1,715
Aug-2017	$	1,895
Dec-2017	$	1,145
Feb-2017	$	870
Jan-2017	$	1,015
Jul-2017	$	1,745
Jun-2017	$	1,750
Mar-2017	$	1,405
May-2017	$	1,595
Nov-2017	$	1,580
Oct-2017	$	1,640
Sep-2017	$	1,625
[redacted]		
Apr-2017	$	1,690
Aug-2017	$	1,570
Dec-2017	$	1,115
Feb-2017	$	845
Jan-2017	$	905
Jul-2017	$	1,730
Jun-2017	$	1,725
Mar-2017	$	1,370
May-2017	$	1,615
Nov-2017	$	1,215
Oct-2017	$	1,510
Sep-2017	$	1,465
[redacted]		
Apr-2017	$	1,008
Aug-2017	$	1,444
Dec-2017	$	824
Feb-2017	$	636
Jan-2017	$	720
Jul-2017	$	1,360
Jun-2017	$	1,148
Mar-2017	$	1,080
May-2017	$	960
Nov-2017	$	1,000

Counterparty and Payment Dates		REC Cost
Oct-2017	$	1,032
Sep-2017	$	1,212
[redacted]		
Apr-2017	$	1,160
Aug-2017	$	1,576
Dec-2017	$	1,016
Feb-2017	$	704
Jan-2017	$	756
Jul-2017	$	1,472
Jun-2017	$	1,408
Mar-2017	$	1,124
May-2017	$	1,308
Nov-2017	$	1,352
Oct-2017	$	1,416
Sep-2017	$	1,364
[redacted]		
Apr-2017	$	1,480
Aug-2017	$	1,756
Dec-2017	$	940
Feb-2017	$	724
Jan-2017	$	644
Jul-2017	$	1,584
Jun-2017	$	1,572
Mar-2017	$	1,196
May-2017	$	1,416
Nov-2017	$	1,296
Oct-2017	$	1,468
Sep-2017	$	1,460
[redacted]		
Apr-2017	$	1,428
Aug-2017	$	1,596
Dec-2017	$	980
Feb-2017	$	636
Jan-2017	$	780
Jul-2017	$	1,476
Jun-2017	$	1,472
Mar-2017	$	1,152
May-2017	$	1,292
Nov-2017	$	1,132
Oct-2017	$	1,336
Sep-2017	$	1,344
[redacted]		
Dec-2017	$	17,000
[redacted]		
Apr-2017	$	875
Aug-2017	$	415
Dec-2017	$	713
Feb-2017	$	798
Jan-2017	$	840
Jul-2017	$	823
Jun-2017	$	758
Mar-2017	$	815
May-2017	$	760
Nov-2017	$	690
Oct-2017	$	738
Sep-2017	$	348
[redacted]		
Apr-2017	$	1,360
Aug-2017	$	1,632
Dec-2017	$	760
Feb-2017	$	568
Jan-2017	$	544
Jul-2017	$	1,488
Jun-2017	$	1,472

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Mar-2017	$	1,056
May-2017	$	1,336
Nov-2017	$	1,132
Oct-2017	$	1,352
Sep-2017	$	1,356
[redacted]		
Apr-2017	$	3,636
Aug-2017	$	4,136
Dec-2017	$	2,592
Feb-2017	$	2,676
Jul-2017	$	3,780
Jun-2017	$	3,748
Mar-2017	$	2,756
May-2017	$	3,388
Nov-2017	$	3,388
Oct-2017	$	3,588
Sep-2017	$	3,460
[redacted]		
Apr-2017	$	6,104
Aug-2017	$	7,176
Dec-2017	$	5,093
Feb-2017	$	7,238
Jan-2017	$	4,363
Jul-2017	$	6,145
Jun-2017	$	7,939
Mar-2017	$	5,093
May-2017	$	8,578
Nov-2017	$	5,526
Oct-2017	$	4,392
Sep-2017	$	4,701
[redacted]		
Apr-2017	$	11,753
Aug-2017	$	6,866
Dec-2017	$	7,196
Feb-2017	$	7,196
Jan-2017	$	6,038
Jul-2017	$	8,681
Jun-2017	$	9,444
Mar-2017	$	10,475
May-2017	$	11,114
Nov-2017	$	3,402
Oct-2017	$	6,722
Sep-2017	$	6,949
[redacted]		
Apr-2017	$	7,547
Aug-2017	$	8,928
Dec-2017	$	5,959
Feb-2017	$	8,702
Jan-2017	$	4,234
Jul-2017	$	7,299
Jun-2017	$	9,630
Mar-2017	$	6,207
May-2017	$	10,269
Nov-2017	$	6,310
Oct-2017	$	5,011
Sep-2017	$	4,701
[redacted]		
Apr-2017	$	13,716
Aug-2017	$	19,188
Dec-2017	$	17,076
Feb-2017	$	22,872
Jan-2017	$	20,760
Jul-2017	$	19,992
Jun-2017	$	20,856

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Mar-2017	$	19,428
May-2017	$	15,084
Nov-2017	$	18,420
Oct-2017	$	18,996
Sep-2017	$	18,492
[redacted]		
Apr-2017	$	23,450
Aug-2017	$	24,646
Dec-2017	$	20,900
Feb-2017	$	21,712
Jan-2017	$	20,910
Jul-2017	$	23,541
Jun-2017	$	23,992
Mar-2017	$	21,622
May-2017	$	22,931
Nov-2017	$	13,407
Oct-2017	$	15,415
Sep-2017	$	24,782
[redacted]		
Apr-2017	$	3,640
Aug-2017	$	4,345
Dec-2017	$	2,655
Feb-2017	$	1,755
Jan-2017	$	2,110
Jul-2017	$	3,475
Jun-2017	$	2,905
Mar-2017	$	3,070
May-2017	$	3,235
Nov-2017	$	3,250
Oct-2017	$	3,490
Sep-2017	$	3,755
[redacted]		
Apr-2017	$	-
Aug-2017	$	-
Dec-2017	$	-
Feb-2017	$	-
Jan-2017	$	-
Jul-2017	$	-
Jun-2017	$	-
Mar-2017	$	-
Nov-2017	$	-
Oct-2017	$	-
Sep-2017	$	-
[redacted]		
Apr-2017	$	1,420
Aug-2017	$	1,804
Dec-2017	$	1,016
Feb-2017	$	1,848
Jul-2017	$	1,588
Jun-2017	$	1,612
Mar-2017	$	1,296
May-2017	$	1,288
Nov-2017	$	1,380
Oct-2017	$	1,536
Sep-2017	$	1,516
[redacted]		
Apr-2017	$	360
Aug-2017	$	440
Dec-2017	$	220
Feb-2017	$	160
Jan-2017	$	160
Jul-2017	$	400
Jun-2017	$	400
Mar-2017	$	280

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Counterparty and Payment Dates		REC Cost
May-2017	$	360
Nov-2017	$	280
Oct-2017	$	360
Sep-2017	$	380
[redacted]		
Apr-2017	$	3,680
Aug-2017	$	3,968
Dec-2017	$	2,556
Feb-2017	$	2,020
Jan-2017	$	1,808
Jul-2017	$	3,692
Jun-2017	$	3,812
Mar-2017	$	3,220
May-2017	$	3,568
Nov-2017	$	3,280
Oct-2017	$	3,564
Sep-2017	$	3,388
[redacted]		
Apr-2017	$	4,355
Aug-2017	$	4,745
Dec-2017	$	2,915
Feb-2017	$	1,895
Jan-2017	$	2,475
Jul-2017	$	4,640
Jun-2017	$	4,340
Mar-2017	$	3,360
May-2017	$	4,115
Nov-2017	$	3,690
Oct-2017	$	3,890
Sep-2017	$	4,190
[redacted]		
Apr-2017	$	1,818
Aug-2017	$	1,933
Dec-2017	$	1,310
Feb-2017	$	1,179
Jan-2017	$	1,026
Jul-2017	$	1,730
Jun-2017	$	1,807
Mar-2017	$	1,591
May-2017	$	1,708
Nov-2017	$	1,528
Oct-2017	$	1,746
Sep-2017	$	1,620
[redacted]		
Apr-2017	$	916
Aug-2017	$	972
Dec-2017	$	688
Feb-2017	$	1,228
Jan-2017	$	872
Jul-2017	$	1,248
Jun-2017	$	1,896
Mar-2017	$	756
May-2017	$	1,352
Nov-2017	$	704
Oct-2017	$	752
Sep-2017	$	736
[redacted]		
Dec-2017	$	34,000
[redacted]		
Apr-2017	$	10,464
Aug-2017	$	4,320
Dec-2017	$	2,572
Jul-2017	$	3,996
Jun-2017	$	3,924

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May-2017	$	3,576
Nov-2017	$	3,344
Oct-2017	$	3,676
Sep-2017	$	3,688
[redacted]		
Apr-2017	$	523
Aug-2017	$	373
Dec-2017	$	388
Feb-2017	$	840
Jan-2017	$	178
Jul-2017	$	778
Jun-2017	$	1,473
Mar-2017	$	523
May-2017	$	1,158
Nov-2017	$	440
Oct-2017	$	243
Sep-2017	$	118
[redacted]		
Apr-2017	$	4,770
Aug-2017	$	5,470
Dec-2017	$	3,335
Feb-2017	$	2,335
Jan-2017	$	2,625
Jul-2017	$	5,090
Jun-2017	$	4,940
Mar-2017	$	3,930
May-2017	$	4,595
Nov-2017	$	4,065
Oct-2017	$	4,505
Sep-2017	$	4,505
[redacted]		
Apr-2017	$	2,304
Aug-2017	$	2,560
Dec-2017	$	1,636
Feb-2017	$	1,072
Jan-2017	$	1,352
Jul-2017	$	2,428
Jun-2017	$	2,304
Mar-2017	$	1,728
May-2017	$	2,180
Nov-2017	$	1,988
Oct-2017	$	2,116
Sep-2017	$	2,188
[redacted]		
Apr-2017	$	2,172
Aug-2017	$	2,500
Dec-2017	$	1,428
Feb-2017	$	1,040
Jan-2017	$	1,264
Jul-2017	$	2,396
Jun-2017	$	2,344
Mar-2017	$	1,856
May-2017	$	2,188
Nov-2017	$	1,904
Oct-2017	$	2,056
Sep-2017	$	2,112
[redacted]		
Apr-2017	$	3,640
Aug-2017	$	3,916
Dec-2017	$	2,488
Feb-2017	$	1,936
Jan-2017	$	1,988
Jul-2017	$	3,672
Jun-2017	$	3,700

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Counterparty and Payment Dates		REC Cost
Mar-2017	$	3,120
May-2017	$	3,416
Nov-2017	$	3,144
Oct-2017	$	3,392
Sep-2017	$	3,388
[redacted]		
Apr-2017	$	2,090
Aug-2017	$	2,388
Dec-2017	$	1,585
Feb-2017	$	1,068
Jan-2017	$	1,235
Jul-2017	$	2,248
Jun-2017	$	2,213
Mar-2017	$	1,825
May-2017	$	2,008
Nov-2017	$	1,988
Oct-2017	$	2,080
Sep-2017	$	2,035
[redacted]		
Apr-2017	$	3,564
Aug-2017	$	4,036
Dec-2017	$	2,712
Jul-2017	$	3,856
Jun-2017	$	3,972
Mar-2017	$	6,172
May-2017	$	3,300
Nov-2017	$	3,264
Oct-2017	$	3,724
Sep-2017	$	3,560
[redacted]		
Apr-2017	$	1,931
Aug-2017	$	2,124
Dec-2017	$	1,307
Feb-2017	$	875
Jan-2017	$	1,094
Jul-2017	$	1,996
Jun-2017	$	1,881
Mar-2017	$	1,537
May-2017	$	1,805
Nov-2017	$	1,625
Oct-2017	$	1,715
Sep-2017	$	1,845
[redacted]		
Apr-2017	$	1,324
Aug-2017	$	1,120
Dec-2017	$	800
Feb-2017	$	636
Jan-2017	$	752
Jul-2017	$	1,516
Jun-2017	$	660
Mar-2017	$	1,240
May-2017	$	1,212
Nov-2017	$	732
Oct-2017	$	1,408
Sep-2017	$	1,332
[redacted]		
Apr-2017	$	4,475
Aug-2017	$	4,895
Dec-2017	$	2,990
Jan-2017	$	4,630
Jul-2017	$	4,600
Jun-2017	$	4,470
Mar-2017	$	3,660
May-2017	$	4,220

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Counterparty and Payment Dates		REC Cost
Nov-2017	$	3,585
Oct-2017	$	3,980
Sep-2017	$	4,100
[redacted]		
Apr-2017	$	484
Aug-2017	$	1,092
Dec-2017	$	912
Feb-2017	$	840
Jan-2017	$	492
Jul-2017	$	1,588
Jun-2017	$	1,404
Mar-2017	$	916
May-2017	$	1,332
Nov-2017	$	248
Oct-2017	$	764
Sep-2017	$	696
[redacted]		
Apr-2017	$	1,892
Aug-2017	$	3,336
Dec-2017	$	3,816
Feb-2017	$	2,420
Jan-2017	$	1,768
Jul-2017	$	4,144
Jun-2017	$	3,868
Mar-2017	$	2,392
May-2017	$	3,824
Nov-2017	$	1,884
Oct-2017	$	2,484
Sep-2017	$	2,280
[redacted]		
Apr-2017	$	632
Aug-2017	$	1,756
Dec-2017	$	2,808
Feb-2017	$	452
Jan-2017	$	448
Jul-2017	$	2,472
Jun-2017	$	3,084
Mar-2017	$	1,076
May-2017	$	2,260
Nov-2017	$	848
Oct-2017	$	1,028
Sep-2017	$	1,252
[redacted]		
Apr-2017	$	1,272
Aug-2017	$	4,648
Dec-2017	$	5,620
Feb-2017	$	2,328
Jan-2017	$	1,140
Jul-2017	$	5,976
Jun-2017	$	6,292
Mar-2017	$	2,896
May-2017	$	4,968
Nov-2017	$	3,308
Oct-2017	$	4,024
Sep-2017	$	2,972
[redacted]		
Jan-2017	$	441
[redacted]		
Apr-2017	$	99,504
Jan-2017	$	83,440
Jul-2017	$	53,492
Oct-2017	$	83,276
[redacted]		
Apr-2017	$	3,640

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Aug-2017	$	4,268
Dec-2017	$	2,320
Feb-2017	$	1,868
Jan-2017	$	2,088
Jul-2017	$	3,780
Jun-2017	$	3,740
Mar-2017	$	3,008
May-2017	$	3,508
Nov-2017	$	3,372
Oct-2017	$	3,620
Sep-2017	$	3,552
[redacted]		
Feb-2017	$	4,141
[redacted]		
Apr-2017	$	1,033
Aug-2017	$	1,175
Dec-2017	$	1,270
Feb-2017	$	1,203
Jan-2017	$	455
Jul-2017	$	1,360
Jun-2017	$	2,438
Mar-2017	$	578
May-2017	$	2,623
Nov-2017	$	1,038
Oct-2017	$	818
Sep-2017	$	943
[redacted]		
Apr-2017	$	728
Aug-2017	$	795
Dec-2017	$	870
Feb-2017	$	915
Jan-2017	$	480
Jul-2017	$	983
Jun-2017	$	1,923
Mar-2017	$	445
May-2017	$	1,893
Nov-2017	$	1,118
Oct-2017	$	740
Sep-2017	$	825
[redacted]		
Apr-2017	$	230
Aug-2017	$	103
Dec-2017	$	188
Feb-2017	$	290
Jan-2017	$	173
Jul-2017	$	240
Jun-2017	$	310
Mar-2017	$	220
May-2017	$	285
Nov-2017	$	145
Oct-2017	$	98
Sep-2017	$	80
[redacted]		
Aug-2017	$	309,515
Dec-2017	$	49,465
Oct-2017	$	170,507
Sep-2017	$	236,479
[redacted]		
Aug-2017	$	3,812
Dec-2017	$	4,526
Jul-2017	$	3,236
Jun-2017	$	5,567
Nov-2017	$	4,850
Oct-2017	$	3,088

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Sep-2017	$	3,063
[redacted]		
Apr-2017	$	2,888
Aug-2017	$	3,004
Dec-2017	$	1,636
Feb-2017	$	5,600
Jul-2017	$	2,788
Jun-2017	$	2,876
Mar-2017	$	2,248
May-2017	$	2,620
Nov-2017	$	2,312
Oct-2017	$	2,488
Sep-2017	$	2,504
[redacted]		
Apr-2017	$	1,950
Aug-2017	$	2,215
Dec-2017	$	1,380
Feb-2017	$	940
Jan-2017	$	1,105
Jul-2017	$	2,070
Jun-2017	$	2,010
Mar-2017	$	1,655
May-2017	$	1,845
Nov-2017	$	1,750
Oct-2017	$	1,865
Sep-2017	$	1,305
[redacted]		
Apr-2017	$	10,659
Aug-2017	$	70,737
Dec-2017	$	115,083
Feb-2017	$	51,927
Jan-2017	$	174,690
Jul-2017	$	102,372
Jun-2017	$	52,155
Mar-2017	$	24,795
May-2017	$	48,279
Nov-2017	$	79,059
Oct-2017	$	94,905
Sep-2017	$	99,009
[redacted]		
Apr-2017	$	10,100
Jan-2017	$	11,276
Jul-2017	$	11,031
Oct-2017	$	11,895
[redacted]		
Apr-2017	$	24,121
Jan-2017	$	22,809
Jul-2017	$	23,656
Oct-2017	$	21,596
[redacted]		
Apr-2017	$	3,010
Aug-2017	$	3,175
Dec-2017	$	2,025
Jan-2017	$	3,145
Jul-2017	$	2,935
Jun-2017	$	3,005
Mar-2017	$	2,580
May-2017	$	2,855
Nov-2017	$	2,475
Oct-2017	$	2,665
Sep-2017	$	2,630
[redacted]		
Apr-2017	$	115
Aug-2017	$	45

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Counterparty and Payment Dates		REC Cost
Dec-2017	$	85
Feb-2017	$	110
Jan-2017	$	15
Jul-2017	$	175
Jun-2017	$	285
Mar-2017	$	80
May-2017	$	205
Nov-2017	$	45
Oct-2017	$	13
Sep-2017	$	30
[redacted]		
Apr-2017	$	4,665
Aug-2017	$	5,340
Dec-2017	$	3,260
Feb-2017	$	2,625
Jan-2017	$	2,495
Jul-2017	$	4,915
Jun-2017	$	4,885
Mar-2017	$	3,935
May-2017	$	4,445
Nov-2017	$	4,180
Oct-2017	$	4,700
Sep-2017	$	4,515
[redacted]		
Apr-2017	$	2,895
Aug-2017	$	1,725
Dec-2017	$	1,570
Jan-2017	$	1,000
Jul-2017	$	1,655
Jun-2017	$	3,440
Oct-2017	$	1,490
Sep-2017	$	1,560
[redacted]		
Aug-2017	$	720
Dec-2017	$	592
Jan-2017	$	743
Jul-2017	$	740
Jun-2017	$	862
May-2017	$	3,755
Oct-2017	$	594
Sep-2017	$	770
[redacted]		
Apr-2017	$	1,444
Aug-2017	$	1,748
Dec-2017	$	680
Feb-2017	$	520
Jan-2017	$	408
Jul-2017	$	1,572
Jun-2017	$	1,560
Mar-2017	$	1,116
May-2017	$	1,408
Nov-2017	$	1,248
Oct-2017	$	1,468
Sep-2017	$	1,460
[redacted]		
Apr-2017	$	3,420
Aug-2017	$	4,152
Dec-2017	$	1,900
Feb-2017	$	1,408
Jan-2017	$	1,336
Jul-2017	$	3,728
Jun-2017	$	3,716
Mar-2017	$	2,656
May-2017	$	3,344

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Counterparty and Payment Dates		REC Cost
Nov-2017	$	2,904
Oct-2017	$	3,432
Sep-2017	$	3,448
[redacted]		
Apr-2017	$	4,470
Aug-2017	$	4,970
Dec-2017	$	3,025
Feb-2017	$	2,100
Jan-2017	$	2,390
Jul-2017	$	4,530
Jun-2017	$	4,490
Mar-2017	$	3,620
May-2017	$	4,115
Nov-2017	$	3,935
Oct-2017	$	4,120
Sep-2017	$	4,045
[redacted]		
Apr-2017	$	3,152
Aug-2017	$	3,664
Dec-2017	$	2,164
Feb-2017	$	1,640
Jan-2017	$	1,704
Jul-2017	$	3,220
Jun-2017	$	3,284
Mar-2017	$	2,660
May-2017	$	2,908
Nov-2017	$	2,524
Oct-2017	$	2,712
Sep-2017	$	3,080
[redacted]		
Apr-2017	$	270
Aug-2017	$	238
Dec-2017	$	230
Jan-2017	$	273
Jul-2017	$	178
Jun-2017	$	390
Mar-2017	$	190
May-2017	$	635
Nov-2017	$	208
Oct-2017	$	158
Sep-2017	$	195
[redacted]		
Aug-2017	$	3,980
Dec-2017	$	2,296
Jul-2017	$	3,884
Jun-2017	$	11,548
Nov-2017	$	3,028
Oct-2017	$	3,232
Sep-2017	$	3,200
[redacted]		
Apr-2017	$	188
Aug-2017	$	512
Dec-2017	$	472
Jul-2017	$	504
Jun-2017	$	472
Mar-2017	$	12
May-2017	$	452
Nov-2017	$	268
Oct-2017	$	460
Sep-2017	$	472
[redacted]		
Apr-2017	$	3,764
Aug-2017	$	4,308
Dec-2017	$	2,712

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Counterparty and Payment Dates		REC Cost
Feb-2017	$	1,680
Jan-2017	$	2,072
Jul-2017	$	4,132
Jun-2017	$	3,904
Mar-2017	$	3,004
May-2017	$	3,192
Nov-2017	$	2,744
Oct-2017	$	3,456
Sep-2017	$	3,760
[redacted]		
Dec-2017	$	45,555
Mar-2017	$	67,575
May-2017	$	42,060
Oct-2017	$	20,355
Sep-2017	$	111,570
[redacted]		
Apr-2017	$	4,495
Aug-2017	$	3,735
Dec-2017	$	3,055
Feb-2017	$	2,160
Jan-2017	$	2,715
Jul-2017	$	4,880
Jun-2017	$	4,675
Mar-2017	$	3,745
May-2017	$	4,000
Nov-2017	$	3,365
Oct-2017	$	4,195
Sep-2017	$	4,175
[redacted]		
Apr-2017	$	28,390
Aug-2017	$	30,411
Dec-2017	$	21,002
Feb-2017	$	20,109
Jan-2017	$	19,770
Jul-2017	$	29,065
Jun-2017	$	30,061
Mar-2017	$	24,423
May-2017	$	28,144
Nov-2017	$	24,374
Oct-2017	$	25,740
Sep-2017	$	27,072
[redacted]		
Apr-2017	$	487
Aug-2017	$	661
Dec-2017	$	522
Feb-2017	$	244
Jan-2017	$	407
Jul-2017	$	905
Jun-2017	$	870
Mar-2017	$	348
May-2017	$	522
Nov-2017	$	452
Oct-2017	$	452
Sep-2017	$	487
[redacted]		
Apr-2017	$	37,550
Aug-2017	$	41,626
Dec-2017	$	30,426
Feb-2017	$	27,647
Jan-2017	$	27,673
Jul-2017	$	41,123
Jun-2017	$	40,285
Mar-2017	$	33,343
May-2017	$	37,555

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Counterparty and Payment Dates		REC Cost
Nov-2017	$	35,067
Oct-2017	$	36,044
Sep-2017	$	36,296
[redacted]		
Apr-2017	$	4,396
Aug-2017	$	5,039
Dec-2017	$	2,788
Feb-2017	$	2,359
Jan-2017	$	2,145
Jul-2017	$	3,431
Jun-2017	$	4,610
Mar-2017	$	3,539
May-2017	$	4,289
Nov-2017	$	3,645
Oct-2017	$	4,182
Sep-2017	$	2,467
[redacted]		
Apr-2017	$	2,380
Aug-2017	$	4,172
Dec-2017	$	2,632
Feb-2017	$	1,896
Jul-2017	$	3,856
Jun-2017	$	5,216
Mar-2017	$	2,368
May-2017	$	3,456
Nov-2017	$	3,248
Oct-2017	$	3,456
Sep-2017	$	3,532
[redacted]		
Aug-2017	$	1,243
Dec-2017	$	2,900
Jan-2017	$	1,130
Jul-2017	$	1,518
Jun-2017	$	1,943
Nov-2017	$	1,640
Oct-2017	$	1,705
Sep-2017	$	980
[redacted]		
Aug-2017	$	4,460
Dec-2017	$	2,648
Jul-2017	$	11,876
Nov-2017	$	3,324
Oct-2017	$	3,672
Sep-2017	$	3,728
[redacted]		
Apr-2017	$	2,150
Aug-2017	$	2,360
Dec-2017	$	1,460
Feb-2017	$	988
Jan-2017	$	1,165
Jul-2017	$	2,200
Jun-2017	$	2,145
Mar-2017	$	1,715
May-2017	$	1,948
Nov-2017	$	1,880
Oct-2017	$	1,993
Sep-2017	$	2,023
[redacted]		
Apr-2017	$	548
Aug-2017	$	612
Dec-2017	$	296
Feb-2017	$	224
Jan-2017	$	284
Jul-2017	$	620

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Counterparty and Payment Dates		REC Cost
Jun-2017	$	584
Mar-2017	$	412
May-2017	$	540
Nov-2017	$	388
Oct-2017	$	460
Sep-2017	$	548
[redacted]		
Apr-2017	$	1,953
Aug-2017	$	2,174
Dec-2017	$	1,364
Feb-2017	$	1,033
Jan-2017	$	1,076
Jul-2017	$	2,023
Jun-2017	$	2,016
Mar-2017	$	1,670
May-2017	$	1,841
Nov-2017	$	1,742
Oct-2017	$	1,834
Sep-2017	$	1,874
[redacted]		
Apr-2017	$	115,520
Aug-2017	$	188,390
Dec-2017	$	209,368
Feb-2017	$	106,450
Jan-2017	$	126,317
Jul-2017	$	169,161
Jun-2017	$	136,364
Mar-2017	$	83,065
May-2017	$	117,314
Nov-2017	$	214,522
Oct-2017	$	194,828
Sep-2017	$	110,806
[redacted]		
Apr-2017	$	217,053
Aug-2017	$	206,287
Dec-2017	$	233,218
Feb-2017	$	207,542
Jan-2017	$	249,436
Jul-2017	$	231,799
Jun-2017	$	192,946
Mar-2017	$	188,539
May-2017	$	162,755
Nov-2017	$	210,528
Oct-2017	$	216,593
Sep-2017	$	234,140
[redacted]		
Apr-2017	$	34,137
Aug-2017	$	31,945
Dec-2017	$	23,081
Feb-2017	$	28,319
Jan-2017	$	28,224
Jul-2017	$	31,691
Jun-2017	$	23,181
Mar-2017	$	32,432
May-2017	$	22,213
Nov-2017	$	35,235
Oct-2017	$	30,833
Sep-2017	$	36,727
[redacted]		
Apr-2017	$	79,209
Feb-2017	$	94,774
Jan-2017	$	85,318
Jul-2017	$	23,081
Jun-2017	$	34,447

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Counterparty and Payment Dates		REC Cost
Mar-2017	$	95,458
May-2017	$	42,760
[redacted]		
Apr-2017	$	4,270
Aug-2017	$	5,000
Dec-2017	$	2,690
Feb-2017	$	1,875
Jan-2017	$	2,165
Jul-2017	$	4,710
Jun-2017	$	4,560
Mar-2017	$	3,360
May-2017	$	4,155
Nov-2017	$	3,590
Oct-2017	$	4,020
Sep-2017	$	4,165
[redacted]		
Apr-2017	$	1,922
Aug-2017	$	1,953
Dec-2017	$	1,375
Feb-2017	$	970
Jan-2017	$	1,078
Jul-2017	$	1,910
Jun-2017	$	1,913
Mar-2017	$	1,600
May-2017	$	1,816
Nov-2017	$	1,638
Oct-2017	$	1,748
Sep-2017	$	1,778
[redacted]		
Apr-2017	$	1,520
Aug-2017	$	1,668
Dec-2017	$	964
Feb-2017	$	3,324
Jul-2017	$	1,632
Jun-2017	$	1,612
Mar-2017	$	1,184
May-2017	$	1,492
Nov-2017	$	1,280
Oct-2017	$	1,416
Sep-2017	$	1,480
[redacted]		
Apr-2017	$	12,722
Aug-2017	$	12,609
Dec-2017	$	11,925
Jan-2017	$	22,908
Jul-2017	$	11,884
Jun-2017	$	12,977
Mar-2017	$	11,129
May-2017	$	13,140
Nov-2017	$	13,089
Oct-2017	$	12,140
Sep-2017	$	13,038
[redacted]		
Apr-2017	$	2,592
Aug-2017	$	2,812
Dec-2017	$	1,820
Feb-2017	$	1,200
Jan-2017	$	1,484
Jul-2017	$	2,600
Jun-2017	$	2,604
Mar-2017	$	2,040
May-2017	$	2,376
Nov-2017	$	2,240
Oct-2017	$	2,352

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Counterparty and Payment Dates		REC Cost
Sep-2017	$	2,448
[redacted]		
Apr-2017	$	1,424
Aug-2017	$	1,644
Dec-2017	$	940
Feb-2017	$	776
Jan-2017	$	696
Jul-2017	$	1,488
Jun-2017	$	1,484
Mar-2017	$	1,180
May-2017	$	1,364
Nov-2017	$	1,216
Oct-2017	$	1,412
Sep-2017	$	1,320

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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period January 1, 2017 - December 31, 2017				Billing Period September 1, 2018 - August 31, 2019			
			Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs	Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs
[redacted]										

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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period January 1, 2017 - December 31, 2017 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs	Billing Period September 1, 2018 - August 31, 2019 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs
[redacted]										

REDACTED VERSION

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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period January 1, 2017 - December 31, 2017 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs	Billing Period September 1, 2018 - August 31, 2019 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs
[redacted]										

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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period January 1, 2017 - December 31, 2017 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs	Billing Period September 1, 2018 - August 31, 2019 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs
[redacted]										

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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period January 1, 2017 - December 31, 2017 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs	Billing Period September 1, 2018 - August 31, 2019 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs
[redacted]										

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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period January 1, 2017 - December 31, 2017				Billing Period September 1, 2018 - August 31, 2019			
			Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs	Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs
[redacted]										

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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period January 1, 2017 - December 31, 2017 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs	Billing Period September 1, 2018 - August 31, 2019 Total Units (A) (B)	Total Cost per Unit	Total Cost	RECs
[redacted]										
172	Other Incremental (see Jennings Exhibit No. 3 for Incremental Cost worksheet}				$ 797,661				$ 1,155,500	
173	Billing Period estimated receipts related to contract performance				$ -	Note 1			$ (1,000,000)	Note 1
174	Solar Rebate Program (see Jennings Exhibit No. 3 for cost detail)				$ -				$ 844,000	
175	Research (see Jennings Exhibit No. 3 for Research cost detail)				$ 565,791				$ 755,000	
176	**Total Other Incremental and Research Cost**				**$ 1,363,452**				**$ 1,754,500**	
177	[redacted]				[redacted]				[redacted]	
178	EMF Period actual credits for receipts related to contracts - to Williams Exhibit No.4 - footnote (3)				$ 1,090,096	Note 1				

Note 1: EMF Period contract receipts are not included in the under/overcollection calculation on Williams Exhibit No. 2, instead they are credited directly to customer class on Williams Exhibit No. 4. Estimated contract receipts are included in Billing Period total other incremental cost as a reduction in REPS charges proposed for the Billing Period.

Footnotes: [redacted]

DUKE ENERGY CAROLINAS, LLC
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REDACTED VERSION*

Line No.	Incremental Cost Worksheet:	EMF Period Jan 2017 - Dec 2017	Projected Billing Period Sep 2018 - Aug 2019
	Labor by activity:		
1–19	[redacted]		
20	**Total Other Incremental Cost**	$ 797,661	$ 1,155,500
	Solar Rebate Program Cost Detail (recovery in REPS pursuant to G.S. 62-155(f)): (1)		
21	Annual Amortization of Incentives Provided to Customers	-	$ 805,000
22	Annual Amortization of Program Administrative Labor Costs		[redacted]
23	Annual Amortization of Program Administrative Non-Labor Costs		
24	**Total Solar Rebate Program Cost**	$ -	

(1) All annual Solar Rebate Program costs reflect amortization of incurred costs over 20 years, including a return on the unamortized balance.

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Line No.	Incremental Cost Worksheet:	EMF Period Jan 2017 - Dec 2017	Projected Billing Period Sep 2018 - Aug 2019
	Research Cost Detail:		
25	CAPER – PV Synchronous Generator	[redacted]	
26	CAPER –Distributed Generation Valuation		
27	Closed Loop Biomass - American Forest Management		
28	Closed Loop Biomass - Mineral Labs Inc		
29	Coalition for Renewable Natural Gas membership		
30	eLab - Rocky Mountain Institute		
31	Electric Power Research Institute - EPRI		
32	FREEDM Center - NC State		
33	IEEE 1547 Conformity Assessment - IEEE Standards Association		
34	Islanding Detection & Control - Green Energy Corp		
35	Islanding Detection & Control - Northern Plains Power Technologies		
36	Loyd Ray Farms - Duke University		
37	Marshall Solar Site Algorithm - UNCC		
38	Mini-DVAR Project - American SuperConductor		
39	Mini-DVAR Project - IJUS		
40	Mini-DVAR Project - MasTec		
41	Mini-DVAR Project - Schweitzer Engineering Laboratories		
42	Mini-DVAR Project - Various		
43	Swine Extrusion/Poultry Mortality - NC State Natural Resources Foundation		
44	**Total Research Cost**	**$ 565,791**	[redacted]
45	**Total Other Incremental Cost**	$ 797,661	$ 1,155,500
46	Projected credits for receipts related to contract amendments/liquidated damages, etc		$ (1,000,000)
47	**Total Other Incremental Cost, Jennings Exhibit No. 2**	$ 797,661	$ 155,500
48	**Total Solar Rebate Program Cost, Jennings Exhibit No. 2**	-	$ 844,000
49	**Total Research Cost, Jennings Exhibit No. 2**	565,791	$ 755,000
50	**Total Other Incremental, Solar Rebate Program, and Research Cost**	**$ 1,363,452**	**$ 1,754,500**

** Information in italics is confidential*

REDACTED VERSION

DUKE ENERGY CAROLINAS, LLC
Docket No. E-7, Sub 1162
REC sales for EMF Period January 1, 2017 - December 31, 2017

Jennings Exhibit No. 4

March 7, 2017

Note:

Pursuant to the Commission's May 13, 2014 *Order Regarding Accounting Treatment For REC Sales* issued in Docket No. E-100, Sub 113, the Company provides the following transaction details for all RECs sold by the Company during the calendar year 2017 REPS rider true-up (EMF) period. All REC sales transactions for the test period involved selling RECs to other electric power suppliers in the State for the purpose of meeting the aggregate poultry compliance requirement for the 2016 compliance year.

Line No.	Month RECs sold	Fuel Type (NC-RETS)	REC Vintage	Quantity	Original purchase price / REC	Sales price / REC	Sales proceeds (a)	Incremental transaction costs [1] (b)	Net proceeds from REC sales (a) - (b)	Cost of replacement RECs [2]
[redacted]										
									(3)	

Footnotes:

(1) No incremental administrative costs, brokerage fees, or other transaction costs were identified with respect to these REC sales.

(2) All REC sales transactions were made in support of the meeting the 2016 statewide aggregate poultry compliance requirement, and no poultry REC purchases by the Company were specifically obtained or identified as replacements for the RECs sold.

(3) Net REC sales proceeds are included as a credit in Other Incremental Cost for the EMF period as detailed in the worksheet reflected on Jennings Exhibit No. 3.

Jennings Exhibit No. 5
Docket No. E-7, Sub 1162

CAPER PVSG Project Progress Report

PI: Alex Huang

Dec 13, 2017

Dr. Huang's team has previously developed a single phase PVSG, this work has been accomplished and one paper was published. See paper in "Integration of DC Microgrids as Virtual Synchronous Machines Into the AC Grid," in *IEEE Transactions on Industrial Electronics*, vol. 64, no. 9, pp. 7455-7466, Sept. 2017. The CAPER project focus is on development and demonstration of a 40 KW three PVSG system. In particularly, the architecture is changed so that the concept can work with existing PV installations. So far, the following major accomplishments have been made:

1. Hardware architecture defined and major components/subsystem in place
2. New control architecture proposed and simulated. A typical simulation result is shown in Figure 1.
3. PVSG controller hardware design finished and manufacturing is underway
4. System rack in place and ready for hardware integration

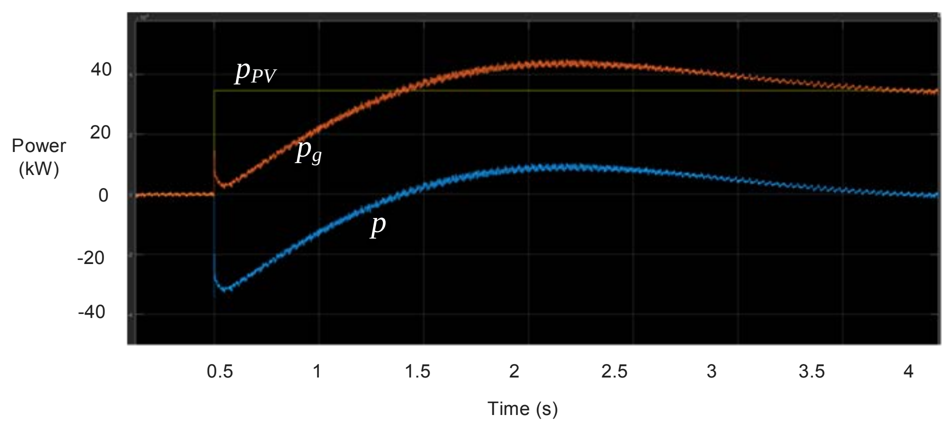


Figure 1 Virtual inertia simulation when there is a sudden increase in irradiation level

Table below shows a summary of remaining work. The remaining work are

1) Manufacturing and testing of a new digital controller needed for the PVSG
2) Software coding of the control system
3) Hardware integration and testing
4) Summary, report and publication.

Tasks / Gantt bar / Month	1st 2017 6	2nd 2017 7	3rd 2017 8	4th 2017 9	5th 2017 10	6th 2017 11	7th 2017 12	8th 2018 1	9th 2018 2	10th 2018 3	11th 2018 4	12th 2018 5
Analysis of the function for PVSG												
Literature review & Modeling & Control design & Simulation												
Hardware design & PCB												
Platform built & coding												
Experiment and improvement												
Writing of papers												

Current date

CAPER

Center for Advanced Power Engineering Research

How State Regulators are Attributing Costs and Benefits to Distributed Generation

Phase I: A Review of Distributed Generation Valuation Studies and Methodologies

Mesut Baran, Autumn Proudlove, Badrul Chowdhury,
Keith Dsouza, Sumedh Halbe, Micah Thomas

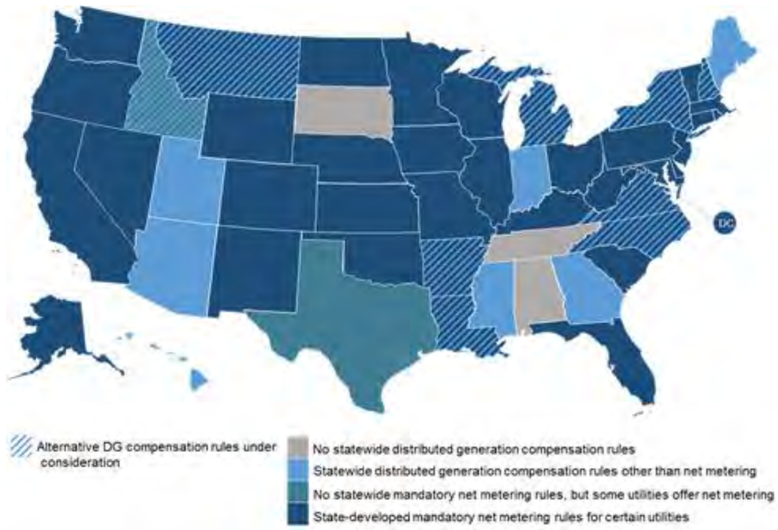
Abstract

The first phase of the project aims to review recently conducted studies on the value of distributed generation. This report provides the findings of this phase of the project. A number of widely available reports on distributed generation valuation are reviewed to determine the methods used to quantify the cost/benefit components across eleven components. Core categories included in almost every study were avoided energy, avoided generation capacity, avoided transmission and distribution capacity, and system/line losses. Most studies also included solar integration costs and at least some environmental benefits. However, it is noted that each study utilizes different assumptions and methods in calculating these components. A summary of the methodologies adopted in these studies for each component is provided.

Introduction

As more distributed solar is being added to the electric grid, states and utilities are reevaluating the way in which customer-generators are compensated. In the vast majority of U.S. states (as Figure 1 shows) these customers have been compensated through a mechanism called net metering. Under net metering, a customer's total kilowatt-hour (kWh) energy production and consumption over the billing period are netted. States differ in their policies for compensating monthly net excess generation; some states allow these credits to roll over month-to-month at the full retail rate, while others may credit this net excess at the avoided cost rate or reduce the credit after a certain period of time.

Figure 1: Net Metering and DG Compensation Policies (Oct. 2017)

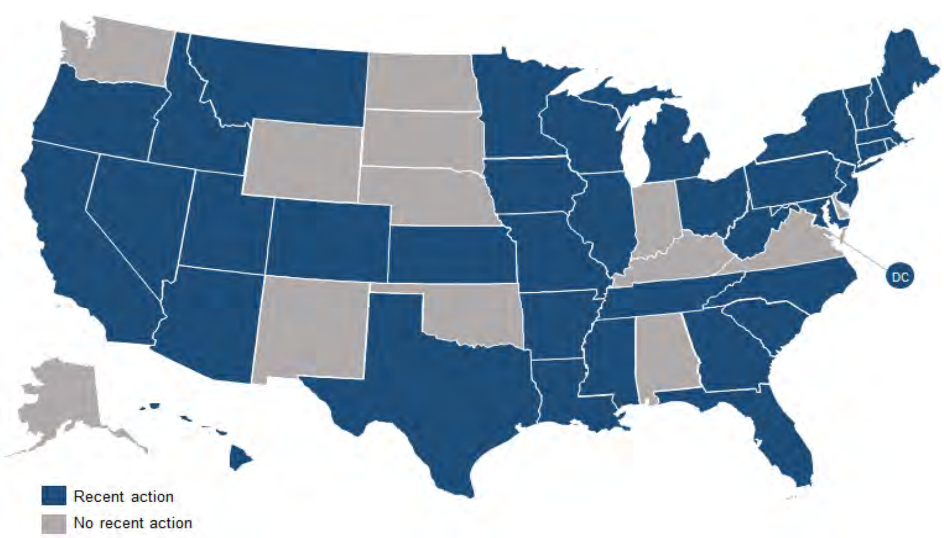


Source: NC Clean Energy Technology Center, 50 States of Solar Q3 2017, October 2017

While net metering has been the dominant compensation structure for distributed solar for many years, a growing number of states are examining alternatives to net metering, including net billing and buy-all, sell-all structures. At the heart of these net metering successor discussions is how the credit rate for excess generation should be calculated. One method, which many different stakeholders have expressed a desire for, is a value-based credit. This interest in value-based compensation has led many states, utilities, and other stakeholders to conduct studies examining the value of solar or distributed generation in efforts to inform net metering successor discussions (see Figure 2). However, these studies utilize many different methodologies and result in a wide range of ultimate values.

The first phase of this project aims to review recently conducted studies on value of distributed generation. The results of this review have been outlined below.

Figure 2: State-Led DG Valuation Action (2015 – 2017)



Source: NC Clean Energy Technology Center, 50 States of Solar Q1 2015 - Q3 2017

Existing Studies

One of the project partners, the NC Clean Energy Technology Center (NCCETC), has been compiling studies commissioned by either state regulatory bodies or utilities on value of distributed generation as part of its *50 States of Solar* quarterly report series. This database was first scanned to identify a short list of studies to be further reviewed for this project. Table 1 shows the full list of studies considered, as well as the cost/benefit components considered within each study. A list of studies is also provided in Appendix I.

Many states, utilities, advocacy organizations, and others have conducted these studies in order to examine the value of distributed generation, or solar specifically. The results of these studies vary dramatically, as Figure 3 shows.

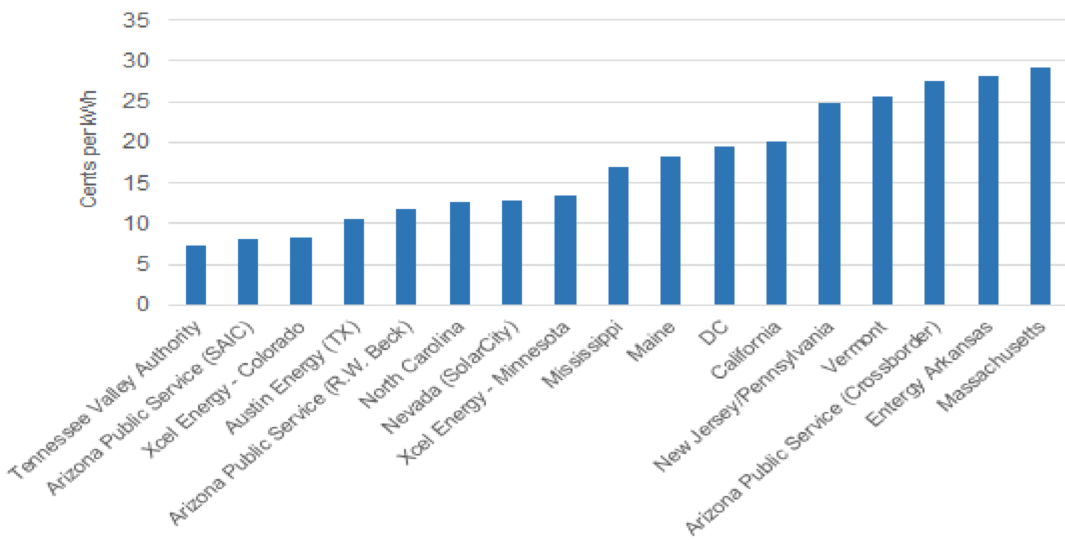
There are multiple reasons for this variation. The first is due to the utility's generation mix and infrastructure. As avoided energy and capacity costs are typically tied to the marginal generation unit, the particular unit that is on the margin will greatly impact the ultimate value. Furthermore, the utility's existing transmission and distribution network will affect the value of transmission and distribution expenditures avoided by distributed solar.

Table 1: Cost and Benefit Components Included in Recent Studies

Year	Study	Costs		Benefits									
		Integration Cost	Admin. Cost	Avoided Energy	Avoided Gen. Capacity	Avoided Transmission	Avoided Distribution	System/Line Losses	Ancillary Services	Risk/Price Hedging	Market Price Suppression	Env. Benefits	Other
2006	Austin Energy (CPR)												
2009	Arizona Public Service (R.W. Beck)												
2012	Michigan (NREL)												
2012	New Jersey/Pennsylvania (CPR)												
2013	CPS Energy												
2013	Arizona Public Service (SAIC)												
2013	Xcel Energy – CO (CPR)												
2013	Arizona Public Service (Crossborder)												
2013	North Carolina (Crossborder)												
2013	Austin Energy (CPR)												
2014	Utah (CPR)												
2014	Xcel Energy – MN (CPR)												
2014	Nevada (E3)												
2014	Mississippi (Synapse)												
2014	Vermont (Public Service Dept.)												
2015	Maine (CPR)												
2015	Massachusetts (Acadia Center)												
2015	Louisiana (Acadian Consulting)												
2015	Tennessee Valley Authority (EPRI)												
2015	South Carolina (E3)												
2016	Arizona Public Service (Crossborder)												
2016	Nevada (SolarCity)												
2016	Nevada (E3)												
2017	Georgia Power (Georgia Power)												
2017	District of Columbia (Synapse)												
2017	Oregon (PUC)												
2017	Entergy Arkansas (Crossborder)												

Variation across studies also results from the difference in solar penetration from location to location. Jurisdictions with high levels of distributed solar on the system may see diminished benefits from additional solar capacity, while jurisdictions with very little distributed solar are more likely to realize larger benefits, at least initially.

Figure 3: Value of DG Study Results



Finally, a significant reason for variation across studies is due to the different set of cost and benefit components included within each study. While some studies are narrower in focus, only including avoided energy and generation capacity for example, others are more expansive, including ancillary services and environmental benefits. Furthermore, for each cost or benefit component, there exists a variety of methodologies to calculate its quantitative value.

Cost-Benefit Methodologies

The first study reviewed was a meta-study conducted by the Rocky Mountain Institute (RMI) in 2013 [1]. This study provides a broad summary of the 16 benefit/cost studies for Distributed PV (DPV) systems conducted by utilities, national laboratories, and other organizations between 2005 and 2013. The study lists the following cost/benefit categories/components:

- Category 1: Energy: This includes avoided energy and avoided system losses.
- Category 2: Capacity: This includes avoided generation capacity, T&D Capacity, and DPV installed capacity.
- Category 3: Grid support services: also known as ancillary services and includes operating reserves, voltage control, and frequency regulation.
- Category 4: Financial Risk: Estimates the potential for DPV to provide a “hedge” against price volatility, and thus reducing risk exposure to utilities and customers.
- Category 5: Security Risk: Potential of DPV to reduce outages and also potential for customers to have back-up power capability.
- Category 6: Environmental: Potential to reducing carbon emissions.

- Category 7: Social: Social value of DPV based on its contribution to economic growth.

The report indicates that there is significant deviation about how these components are quantified. A more detailed summary of this report is provided in Appendix II.

The project team then selected five more recent DG valuation studies for a more in-depth review. These studies were selected to represent examples of studies conducted in other southeastern states, studies with varying cost and benefit components included, and studies conducted by different authors (frequently, outside consultants will be hired to conduct the study analysis, and many existing studies utilize the same consultancies). The studies reviewed are shown below.

Study	Description
Georgia Power [2] (2016, authored by utility)	This study was conducted as part of the utility's integrated resource planning process. The study considers technology and supporting infrastructure as they exist presently. The purpose of the report is to define an impact related to distributed energy resources as a cost and/or benefit and to quantify the same.
Minnesota [3] (2014, authored by consultant on behalf of state govt.)	This study was conducted by Clean Power Research on behalf of the Minnesota Department of Commerce. The state developed a methodology to calculate the value solar with an eventual aim to replace the existing net metering policy with a value of solar rate structure. If known and measurable evidence of other costs and/or benefits existed, then it was decided to incorporate them into the methodology.
Mississippi [4] (2014, authored by consultant on behalf of state govt.)	This study was conducted by Synapse Energy Economics on behalf of the Mississippi Public Service Commission as part of an investigation into the creation of net metering rules for the state.
Tennessee Valley Authority [5] (2015, authored by EPRI/stakeholder group)	This study was led by the EPRI, with a stakeholder group developing the cost-benefit categories. The purpose of the study was to select cost/benefit categories and develop a firm analytical basis for calculating each of these categories. The study was limited to rooftop solar and aimed to create a transparent, fair, adaptable, and versatile methodology. The final calculation did not include societal values that were identified and set aside for potential future inclusion.
Vermont [6] (2014, authored by state govt.)	This study was conducted by the Vermont Public Service Department. Act 99, enacted in 2014, direct the Department to conduct an evaluation of net metering in the state.

Each of these studies has been reviewed in detail to determine the methods used to quantify the cost/benefit components the study considered. Table I shows the main components considered in these studies. Below is a summary of the methodologies adopted in these studies for each component. A more detailed summary for each study reviewed is provided in Appendix III.

Cost 1: Solar Integration Costs

The majority of studies include the costs associated with integrating distributed solar in their cost-benefit calculations. The table below summarizes the methods used by the five studies examined.

Study	Methodology
Georgia Power	Distribution operating costs is given a placeholder value, as the utility has not developed a methodology to calculate the expected costs associated with significant penetration of renewable resources. A point was made that interconnection costs are directly assignable to the generator at the time of implementation, and should therefore not be included in the methodology.
Minnesota	Included in the cost-benefit stack, but a methodology has not yet been developed.
Mississippi	Solar integration costs were ignored. Synapse concluded that grid integration costs increase as penetration level increases. They found very little evidence that significant costs are incurred by grid operators or distribution companies since penetration levels are low in Mississippi.
Tennessee Valley Authority	Not included in study, although the authors noted that the transmission capacity value may be revised to include integration costs.
Vermont	Notably, as the location out of the five examined with the most net-metered capacity, this component is not included in the study.

Cost 2: Administrative Costs

A smaller number of studies include administrative costs associated with distributed solar (such as administering a net metering program) in their calculations. The table below summarizes the methods used by the three studies addressing administrative costs.

Study	Methodology
Georgia Power	A placeholder value is provided in the report, but a methodology has not been determined.
Mississippi	The authors collected cost data for energy efficiency programs from many states. The authors estimated that an average utility spends between 6-9% of energy efficiency program expenses on administrative costs (average is 7.5%). Energy efficiency programs in Mississippi cost approximately $12 million, and 7.5% of $12 million is $0.9 million.
Vermont	Administrative costs are assumed to be the same values as reported in “Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012,” which include two types of costs: procedural and billing.

Benefit 1: Avoided Energy

Solar PV generation avoids the need for a certain amount of energy from the marginal generators (typically natural gas). Avoided energy values often factor in fuel price forecasts, power plant efficiencies, and variable operating and maintenance (O&M) costs. The table below summarizes the methods used by the five studies examined.

Study	**Methodology**
Georgia Power	Calculated as the weighted average of the energy produced by solar PV per hour and the system avoided cost of energy for that period. This value depends on the resource displaced, its incremental heat rate, variable O&M, fuel handling costs, and losses.
Minnesota	A virtual solar heat rate is computed based on the heat rate vs energy production of each generator. This weighted heat rate is then multiplied by the burnertip fuel unit price to give the value of avoided fuel costs.
Mississippi	Avoided energy costs are estimated by multiplying the variable operating and fuel costs of the marginal resource by the projected MWh of solar generation modeled in each year.
Tennessee Valley Authority	The Resource Planning Process is run with and without PV using an hourly time-step. The value depends upon the avoided resource and the fuel price.
Vermont	Avoided energy was calculated on an hourly basis by multiplying the production of real Vermont generators by the hourly price set in the ISO-NE market. These calculations indicated that fixed solar PV had a weighted average avoided energy price 9% lower than the annual ISO-NE average spot market price.

Benefit 2: Avoided Generation Capacity

Distributed generation may defer or obviate the need for new investments in generation capacity. In most locations, natural gas combustion turbines are the marginal units, and avoided generation capacity value is based on the cost of these units. The table below summarizes the methods used by the five studies examined.

Study	**Methodology**
Georgia Power	Calculated as the product of capacity value and capacity equivalence. Capacity equivalence is similar to Effective Load Carrying Capacity (ELCC), wherein only some fraction of the installed solar PV is considered to reduce capacity needs from the grid. Also includes Generation Remix Costs (GRC), which are identified as being either a cost or a benefit. GRC includes two components, (1) the capital cost and (2) the production cost. The GRC formula can be found in Appendix III.

	Support capacity costs are calculated as the difference between the capital (or production) cost in the base case and the capital (or production) cost with PV in the system (generation remix case).
Minnesota	The solar-weighted capacity cost is based on the installed capital cost of a peaking combustion turbine and the installed capital cost of a combined cycle gas turbine, interpolated based on heat rate.
Mississippi	The authors calculated the amount of installed solar capacity every year (assumed 88 MW for analysis) and calculated the number of MW that contribute to reduction in peak load by using an Effective Load Carrying Capability (ELCC) of 58%. Thus, capacity contribution will be 58% of 88MW, which is 51 MW. The authors multiplied this capacity contribution by the capacity value in each year and divided this by total solar generation in that year to yield a $/MWh value.
Tennessee Valley Authority	The Resource Planning Process is run with and without PV for a period of 20 years. A multiplier - Net Dependable Capacity (NDC) - is used for capacity-related benefits and reflects the proportion of PV capacity that offsets conventional generation capacity. The system peak and the related solar output at that time are compared to calculate NDC. A 50% NDC is used to calculate avoided generation capacity.
Vermont	The study examined the timing of relevant peaks: ISO-NE's peak for capacity costs, Vermont summer peaks for in-state transmission costs, monthly Vermont peaks for Regional Network Service (RNS) costs and utility specific peak hours for distribution costs. The ability of variable generators to help avoid ISO-NE capacity costs depends on the level of generation during summer hours when ISO-NE's system demand peaks.

Benefit 3: Avoided Transmission and Distribution Capacity

Distributed generation may relieve congestion on the transmission and distribution (T&D) system, deferring or obviating the need for new investments. More granular analyses may develop locational values for avoided T&D. The table below summarizes the methods used by the five studies examined.

Study	**Methodology**
Georgia Power	A single transmission line outage contingency analysis is performed. The analysis is performed with and without PV to study the impact (and cost or benefit) of PV on the grid. Georgia Power only includes avoided transmission, and does not include avoided distribution investment in its analysis.
Minnesota	Calculated in a similar way as avoided generation capacity. No degradation in capacity is considered. It is based on the utility's 5-year average MISO OATT Schedule 9 charge in start year U.S. dollars.
Mississippi	Authors used their in-house database to calculate avoided T&D costs calculated for DG and energy efficiency programs to provide a rough estimate.
Tennessee Valley	The costs and benefits are evaluated by considering the system peak, NDC, PV profile, and avoided costs; a simplified calculation with the point to point service rate and monthly peak factors was

Authority	ultimately used.
Vermont	Avoided Regional Transmission Costs: The values quantified for these costs are based on the ISO-NE forecast for the next three years' worth of Regional Network Service charges and escalated based on historical increases in the handy-Whitman Index of public utility construction costs. Avoided In-State Transmission and Distribution Costs: Burlington Electric Department forecasts show that there are no load growth related infrastructure investments planned for next 20 years, hence these costs have been excluded. In-state transmission and distribution upgrades deferred due to load reduction are calculated considering the critical value of how much generation the grid can rely on during peak times. Reliability peak coincidence values were calculated separately from economic peak coincidence values.

Benefit 4: Avoided System and Line Losses

As distributed generation is located nearer to end-use consumers, it may reduce system and line losses associated with transmitting power from centralized generators long distances to reach end users. System losses are sometimes included within avoided energy and avoided T&D capacity. The table below summarizes the methods used by the five studies examined.

Study	Methodology
Georgia Power	As the load is reduced or displaced in the model by DG, the impact of the load reduction and related transmission system losses is inherently included in the analysis of any change in timing of transmission investment. The demand component is recognized as a benefit that is already included in the avoided transmission capacity value. The reduced distribution energy loss is calculated by applying an 8760-hour distribution loss profile to the system avoided energy costs. The benefit of the reduced distribution energy losses is incorporated into the avoided energy cost calculation.
Minnesota	Calculated on a marginal basis as the difference in losses between the cases with and without marginal PV resource. A loss saving factor is calculated, based on the avoided energy with and without losses.
Mississippi	Synapse estimates avoided system losses using a weighted average line loss during each daylight hour. Calculated by weighing daylight line losses of each T&D system in proportion to the load each system serves. Avoided system losses were calculated as the product of weighted average system losses and projected generation from solar in each year times the avoided energy cost in the same year.
Tennessee Valley Authority	All components except environmental market value are multiplied by an average loss savings value. A 1 MW AC solar PV case was used to model average marginal loss savings.
Vermont	Included as part of the methodologies for avoided energy and avoided generation capacity.

Benefit 5: Ancillary Services

Solar PV can sometimes reduce the need for certain ancillary services, including operating reserves, reactive supply, voltage control, frequency regulation, energy imbalance, and scheduling. Some studies may quantify the value of multiple ancillary services or only one. The table below summarizes the methods used by the three studies addressing ancillary services.

Study	Methodology
Georgia Power	Includes ancillary services (reactive supply, voltage control, and regulation) as a *cost*, rather than a benefit. The regulating reserve requirement is calculated and consists of two components: (1) regulating reserve reliability impact and (2) forecast error reliability impact.
Minnesota	Avoided voltage control cost is included in the cost-benefit stack, but a methodology has not yet been determined.
Tennessee Valley Authority	Ancillary services value was acknowledged, but not included in calculation. Authors determined that further study and data is needed.

Benefit 6: Price Hedging and Risk Reduction

Solar PV offers price certainty, while the cost of energy from fossil fuel fired generators depends upon variable fuel prices. Price hedging value is typically based on the price of natural gas futures and estimates of future natural gas costs. The table below summarizes the methods used by the three studies addressing price hedging.

Study	Methodology
Georgia Power	Georgia Power addressed fuel hedging in its study, but recommended not including this in the cost-benefit framework, stating that it does not believe renewable resources provide this benefit.
Minnesota	The avoided fuel cost value includes the avoided cost of price volatility risk.
Mississippi	The risk reduction benefit estimation was calculated by applying an adder (adjustment factor) to the avoided costs rather than attempting a technical analysis. Current optimal practice supports a 10% adder to avoided costs of renewables like solar.

Benefit 7: Market Price Suppression

Solar PV can suppress wholesale market prices by reducing customer demand for energy or by being directly bid into wholesale markets (either larger PV facilities or smaller aggregated facilities). This can cause the marginal generator to be a lower-cost unit, reducing electricity costs for all customers. The table below summarizes the methods used by the two studies addressing market price suppression.

Study	Methodology
Minnesota	Market price reduction is addressed in the study, but was not included in the final value of solar methodology.
Vermont	Approximated this using the analysis based on the 2013 Avoided Energy supply cost study calculations of the demand reduction induced price effect for Vermont.

Benefit 8: Environmental Compliance and Benefits

Many DG valuation studies include a value for environmental benefits or reduced environmental compliance costs. These values include reduced carbon emissions, criteria air pollutants, water use, land use, as well as avoided or costs of complying with renewable portfolio standard policies and other clean energy or environmental regulations.[1] Table below summarizes the methods used.

Study	Methodology
Georgia Power	Avoided cost of complying with existing environmental regulations is included as part of avoided energy costs. Other environmental benefits and compliance with potential future regulations are not included.
Minnesota	Environmental costs are based on existing Minnesota and EPA externality costs. CO_2 and non-CO_2 natural gas emissions factors (lb per MM BTU of natural gas) are taken from the EPA. The costs are adjusted for inflation (converted to current dollars), converted to dollars per short ton, and then converted to cost per unit fuel consumption using the assumed values. The externality costs are taken as the midpoint of the low and high values for the urban scenario, adjusted to current dollars, and converted to a fuel-based value.
Mississippi	The analysis uses the mid case of the authors' avoided environmental compliance estimation. It is forecasted that a carbon price begins in 2020 at $15 per ton and increases to $60 per ton in 2040.
Tennessee Valley Authority	Compliance Value: Environmental compliance value is based on the carbon intensity of the generation assets deferred. A CO_2 compliance cost curve beginning in 2022 is assumed. Market Value: This is the value of a renewable energy credit (REC). A $1/MWh value (based on national voluntary REC market prices) is applied with a 1.9% escalation rate, consistent with TVA's integrated resource planning process. A placeholder for other environmental benefits is also included.
Vermont	Renewable Energy Credit Value: A fixed value of $30/MWh is assumed for potential future regulatory value of REC retirement. (At the time of this study, Vermont did not have a mandatory renewable portfolio standard (RPS). In 2015, the Vermont legislature adopted a binding RPS of 75% by 2032.) Environmental Compliance Value: Analysis was done for non-participating ratepayers both with

[1] Rocky Mountain Institute, A Review of Solar PV Benefit and Cost Studies, September 2013.

	and without an externalized cost of greenhouse gas emissions. The authors assumed a value of $100/metric ton of CO_2.

Benefit 9: Other Benefits

A handful of studies included other societal benefits, such as local economic development (3 studies examined) and enhanced security (2 studies examined). Several studies acknowledged these additional benefits, but did not attempt to quantify them.

Sensitivity Analysis

Many DG valuation studies include various sensitivity analyses in order to display the range of values produced by adjusting assumptions and methods. For example, several studies calculate one value based on the "direct" benefits of solar, and a separate value including societal benefits. Other studies vary the time horizon over which the analysis is conducted, assumptions about future fuel prices, or the amount of installed solar capacity.

Study	Sensitivity Analyses
Georgia Power	No sensitivity analyses were conducted.
Minnesota	No sensitivity analyses were conducted, likely because a state methodology had been adopted.
Mississippi	Sensitivity analyses are conducted for low, mid and high fuel price scenarios and capacity value scenarios. Synapse utilized the 25^{th} and 75^{th} percentiles of its T&D cost database to produce T&D cost sensitivities. Low, mid, and high cases were also examined for CO_2 prices. Two combined sensitivities were also modeled, which included the assumptions that would produce the lowest and highest benefits for solar.
Tennessee Valley Authority	Illustrative values are provided for several of the placeholder categories that are not included in the DG-IV methodology, although no formal sensitivity analysis was conducted.
Vermont	The costs and benefits for six different types of solar and wind systems are calculated, although no sensitivity analyses for these systems are conducted.

Of the five studies examined, the Mississippi study is the only study including formal sensitivity analyses. Low, mid, and high cases are modeled for fuel prices, capacity value, T&D costs, and CO_2 price, as well as two combined sensitivities that reflect the assumptions yielding the lowest and highest benefits to solar.

Conclusion

Existing studies examining the value of DER display great variation in cost-benefit categories and methodologies, producing a large spread in results. Core categories included in nearly every study the team examined were avoided energy, avoided generation capacity, avoided transmission and distribution capacity, and system/line losses. Most studies also included solar integration costs and at least some environmental benefits. Despite these commonalities, each study utilizes different assumptions and methods in calculating these components.

Several studies utilized a stakeholder or state-led process to develop the categories to be included in the study, as this can greatly influence the final results. Some states, such as Oregon and Rhode Island, have developed official cost-benefit frameworks through stakeholder processes before attaching any quantitative values to categories. Studies conducted by singular, non-government parties (solar advocacy organizations, utilities, etc.) are not to be discredited, but should be read with funder and author in mind.

Many studies include various sensitivity analyses to display multiple possibilities, varying both technical assumptions as well as which cost-benefit components are included (several studies produce results with and without a broader set of societal benefits). This approach makes available a large amount of data, helping to answer the question of whether DG provides each benefit, while leaving the question of whether DG should be compensated for each benefit to policymakers, utilities, and advocates.

Phase II of this project will evaluate the various methodologies utilized in existing DG valuation studies to develop a methodology for use in a North Carolina case study.

References

[1] *A Review of Solar PV Benefit & Cost Studies*, Rocky Mountain Institute, 2013. https://rmi.org/wp-content/uploads/2017/05/RMI_Document_Repository_Public-Reprts_eLab-DER-Benefit-Cost-Deck_2nd_Edition131015.pdf

[2] *A Framework for Determining the Costs and Benefits of Renewable Resources in Georgia*, Georgia Power, 2017. http://www.psc.state.ga.us/factsv2/Document.aspx?documentNumber=167588

[3] *Minnesota Value of Solar: Methodology*, Clean Power Research. 2014. https://www.cleanpower.com/wp-content/uploads/MN-VOS-Methodology-2014-01-30-FINAL.pdf

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http://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/Net_Metering/Act%2099%20NM%20Study%20Revised%20v1.pdf

Appendix I: Existing Value of Solar and Net Metering Cost-Benefit Studies

Date	Jurisdiction	Initiator	Author
Jan. 2009	Arizona Public Service	Arizona Public Service	R.W. Beck
Jan. 2012	Michigan	Public Service Commission	National Renewable Energy Laboratory
Nov. 2012	New Jersey, Pennsylvania	MDV SEIA, PA SEIA	Clean Power Research
Mar. 2013	CPS Energy (Texas)	Solar San Antonio	Clean Power Research, Solar San Antonio
May 2013	Arizona Public Service	Arizona Public Service	SAIC
May 2013	Xcel Energy (Colorado)	Xcel Energy	Xcel Energy
May 2013	Arizona Public Service	The Alliance for Solar Choice	Crossborder Energy
Oct. 2013	North Carolina*	NC Sustainable Energy Assn.	Crossborder Energy
Dec. 2013	Austin Energy (Texas)	Austin Energy	Clean Power Research
Jan. 2014	Rocky Mountain Power (Utah)	Utah Clean Energy	Clean Power Research
Apr. 2014	Xcel Energy (Minnesota)	Xcel Energy	Clean Power Research, Xcel Energy
Jul. 2014	Nevada*	Public Utilities Commission	E3
Sep. 2014	Mississippi	Public Service Commission	Synapse Energy Economics
Nov. 2014	Vermont*	Department of Public Service	Department of Public Service
Mar. 2015	Maine	Public Utilities Commission	Clean Power Research
Apr. 2015	Massachusetts	Acadia Center	Acadia Center
Sep. 2015	Louisiana*	Public Service Commission	Acadian Consulting
Oct. 2015	Tennessee Valley Authority	Tennessee Valley Authority	EPRI, stakeholder group
Dec. 2015	South Carolina*	Office of Regulatory Staff	E3
Feb. 2016	Arizona Public Service	The Alliance for Solar Choice	Crossborder Energy
May 2016	Nevada*	SolarCity, NRDC	SolarCity, NRDC
Aug. 2016	Nevada*	Legislative Committee on Energy	E3
Mar. 2017	Georgia Power	Georgia Power	Georgia Power
May 2017	District of Columbia	Office of the People's Counsel	Synapse Energy Economics
July 2017	Rhode Island	Public Utilities Commission	Public Utilities Commission, stakeholders
Sep. 2017	Oregon	Public Utilities Commission	Public Utilities Commission, stakeholders
Sep. 2017	Entergy Arkansas*	Sierra Club	Crossborder Energy

* Net metering cost-benefit study

Appendix II: Summary of Rocky Mountain Institute Report: *A Review of Solar PV Benefit and Cost Studies (2013)*

The aim of this report was to compare various methodologies for evaluating different value streams of distributed solar photovoltaics (DPV). The report is based on a review of 16 DPV benefit-cost studies completed by utilities, national laboratories, and other organizations between 2005 and 2013.

The report points out the framework developed in the California Standard Practice Manual, which establishes the general standard for evaluating the costs and benefits of energy efficiency among stakeholders was adopted. This framework describes the followings costs:

1. **Participant Cost:** Cost that is incurred by the participants in order to generate energy through DERs. (Equipment and installation costs, etc.)
2. **Rate Impact:** The change in rates for non-participating customers due to cost shifting/cross subsidization that occurs as a result of DERs on the grid.
3. **Utility Cost:** The cost that the utility incurs to support the smooth function of DERs on the grid, while maintaining reliability and quality of service.
4. **Total Resource Cost:** The total cost of operating and supporting DERs on the grid. This includes the costs borne by participants, other customers, and the utility.
5. **Societal and Environmental Cost:** The cost avoided in the form of environmental compliance, regulation etc., as well as, the additional revenue generated from economic activities related to DER.

As illustrated in Figure A1, the report identifies the following benefit & cost categories:

1. **Energy** value is created when DPV generates energy (kWh) that displaces the need to produce energy from another resource. There are two components of energy value: the amount of energy that would have been generated equal to the DPV generation, and the additional energy that would have been generated, but is lost in delivery due to inherent inefficiencies in the transmission and distribution system. The second component is system losses.
    - This value will depend on the resource on the margin at each time interval
    - Depends on the market structure, fuel price, plant efficiency, and Variable O&M costs

2. **Capacity**

    2.1: Generation Capacity value is the amount of central generation capacity that can be deferred or avoided due to the installation of DPV. Key drivers of this value include: (1) DPV's effective capacity and (2) system capacity needs. Deferred value depends on the effective load carrying capacity (ELCC), which depends on the system peak and the capacity of DPV during the same period.

    2.2 Transmission and Distribution (T&D) Capacity value is a measure of the net change in T&D infrastructure as a result of the addition of DPV. Benefits occur when DPV is able to meet rising demand locally, relieving capacity constraints upstream and deferring or avoiding T&D upgrades. Costs are incurred when additional T&D investments are necessary to support the addition of DPV, which could occur when the amount of solar energy exceeds the demand in the local area and increases needed line capacity. This value depends on ELCC/peak load reduction.

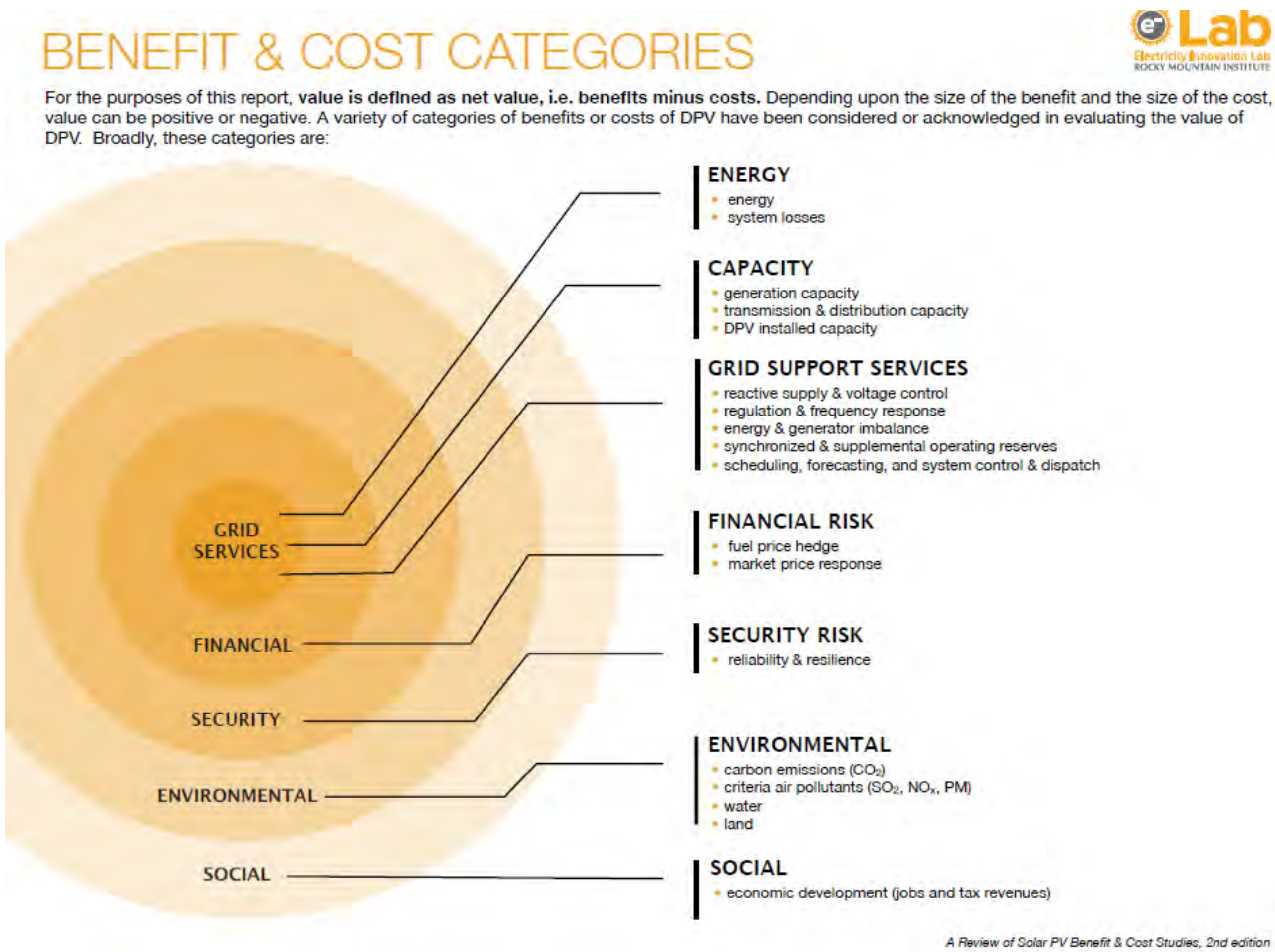


Figure A1: RMI Benefit and Cost Categories

3. **Grid Support Services**, also commonly referred to as ancillary services in wholesale energy markets, are required to enable the reliable operation of interconnected electric grid systems. These services include operating reserves; reactive supply and voltage control; frequency regulation; energy imbalance; and scheduling. The value DPV could provide comes by reducing load and required reserves or the ancillary services that DPV could provide when coupled with other technologies. This value depends on market structure and the type of services that DPV can provide.

4. **Financial Risk:** DPV produces roughly constant-cost power compared to fossil fuel generation, which is tied to potentially volatile fuel prices. DPV can provide a “hedge” against price volatility, reducing risk exposure to utilities and customers. The addition of DPV, especially at higher penetrations, can affect the market price of electricity in a particular market or service territory. These market price effects span energy and capacity values in the short term and long term, all of which are interrelated. This value depends on resource being displaced.

5. **Security Risk**: The grid security value that DPV could provide is attributable to three primary factors, the last of which would require coupling DPV with other technologies to achieve the benefit:
   - The potential to reduce outages by reducing congestion along the T&D network. Power outages and rolling blackouts are more likely when demand is high, and the T&D system is stressed.
   - The ability to reduce large-scale outages by increasing the diversity of the electricity system's generation portfolio with smaller generators that are geographically dispersed.
   - The benefit to customers to provide back-up power sources available during outages through the combination of PV, control technologies, inverters and storage.

6. **Environmental**: The benefits of reducing carbon emissions and other pollutants include (1) reducing future compliance costs, carbon taxes, or other fees and (2) mitigating the heath and ecosystem damages potentially caused by these pollutants, as well as climate change. The cost related to a reduction in the use of land, water, and other such resources can also be considered.

7. **Social:** The assumed social value from DPV is based on any job and economic growth benefits that DPV brings to the economy, including jobs and increased tax revenue. The value of economic development depends on the number of jobs created or displaced, as measured by a job multiplier, as well as the value of each job, as measured by average salary and/or tax revenue.

One of the main conclusions of the report is that there is a significant range of estimated values across studies. Figure A2 illustrates these variations. The authors point out that these variations are driven primarily by differences in local context, input assumptions, and methodological approaches:

- Local context: Electricity system characteristics—generation mix, demand projections, investment plans, market structures vary across utilities, states, and regions.
- Input assumptions: Input assumptions—natural gas price forecasts, solar power production, power plant heat rates can vary widely.
- Methodologies: Methodological differences that most significantly affect results include (1) resolution of analysis and granularity of data, (2) assumed cost and benefit categories and stakeholder perspectives considered, and (3) approaches to calculating individual values.

Another issue highlighted by this report is the cross subsidization that can occur between DER and non-DER customers, especially through net metering. DER customers are charged only for their net usage, which may not their fixed costs for use of the grid. In the short term, utility costs are fixed, and as a result, the reduced revenue collected from DER customers must be recovered from non-DER customers.

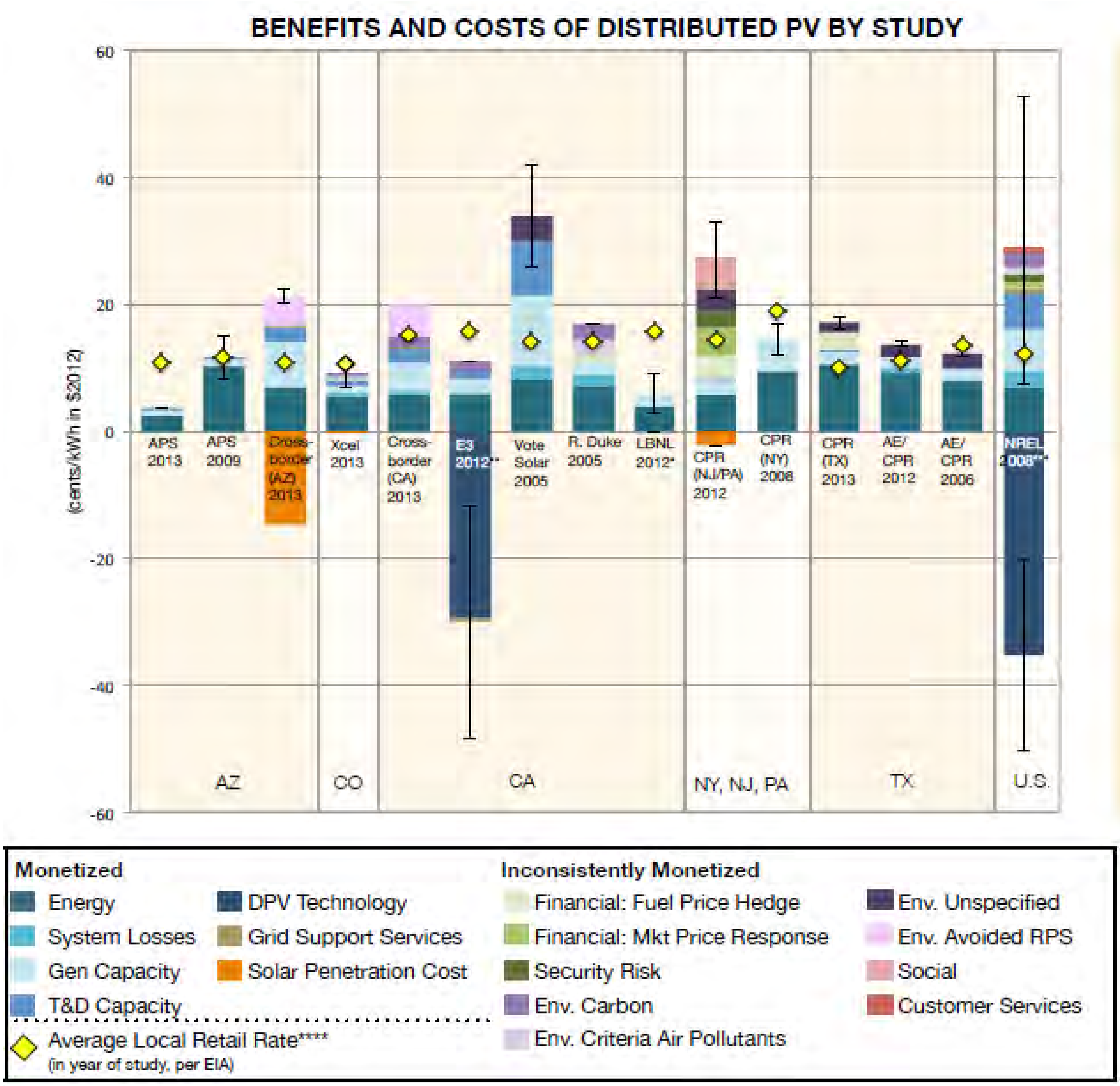


Figure A2: Variation of DPV Values in Studies Reviewed By RMI

Appendix III.A: Summary of Study: *A Framework for Determining the Costs and Benefits of Renewable Resources in Georgia (Georgia Power, 2017)*

As part of Georgia Power's 2016 Integrated Resource Planning proceeding, the utility developed a framework for determining the costs and benefits of renewable resources. The study considers technology and supporting infrastructure as they exist presently and examines both utility-scale and distributed generation. The purpose of the report is to define each impact related to renewables as a cost and/or benefit and to quantify each. The quantitative values ultimately arrived at are redacted.

The value streams identified in the report are as follows:

1. Avoided Fuel and Power cost
2. Avoided Generation VO&M Cost
3. Avoided Environmental Compliance Cost
4. Deferred Generation Capacity Cost
5. Deferred Generation FO&M Cost
6. Reduced Transmission Energy Losses
7. Reduced Transmission Capacity Losses
8. Deferred Transmission Investment
9. Reduced Distribution Energy Losses
10. Distribution Operations Cost
11. Generation Remix Cost

The report further expounded on the following items:

1. **Avoided Energy Costs:** Calculated as the weighted average of the energy produced by solar PV per hour and the system avoided cost of energy for that period. This value depends on the resource displaced, its incremental heat rate, variable O&M, fuel handling costs, and losses.

2. **Deferred Capacity Costs:** Calculated as the product of capacity value and capacity equivalence. Capacity equivalence is similar to Effective load carrying capacity (ELCC), wherein only some fraction of the installed solar PV is considered to reduce capacity needs from the grid.

3. **Deferred Transmission Investment Costs:** Calculated in a similar manner as avoided generation capacity; the planning horizon considered is 20 years. A single transmission line outage contingency analysis is performed using MUST (Managing and Utilizing System Transmission) power flow analysis tool. The analysis is performed with and without PV to study the impact (and cost or benefit) of PV on the grid. Georgia Power only includes avoided transmission, and does not include avoided distribution investment in its analysis.

4. **Reduced Transmission Losses:** The demand component of transmission losses represents the reduction in demand (MW) on the transmission system, resulting from a reduction in transmission system losses due to the renewable generation. As the load is reduced or displaced in the model by DG, the impact of the load reduction and related transmission system losses is inherently included in the analysis of any change in timing of transmission investment. The demand component is recognized as a benefit that is already included in the avoided transmission capacity value.

5. **Reduced Distribution Energy Losses:** The reduced distribution energy loss due to the addition of DG is calculated by applying an 8760-hour (8784 for leap year) distribution loss profile to the system avoided energy costs. Alternatively, the DG profile can be grossed up by the amount of distribution losses. In this case, the benefit of the reduced distribution energy losses is incorporated into the avoided energy cost calculation.

6. **Generation Remix Costs:** This has two components: capital cost and production cost.
   a. The capital component is calculated as follows:

$$GRC = (SMC_{remix} - SMC_{base}) - DGCC$$

   GRC = Generation Remix Capital Cost, SMC_{base} = Capital cost of the future build-out of the System Mix base case, SMC_{remix} = Capital cost of the future build-out of the System Mix case with the renewable resource, *DGCC* = Deferred Generation Capacity Costs associated with the renewable resource.

   b. The production cost/energy component is calculated as follows:

$$GRP = (SPC_{remix} - SPC_{base}) - AEC.$$

   GRP = Generation Remix Production Cost, SPC_{base} = System production cost of the base case, SPC_{remix} = System production cost of the case with the renewable resource and modified expansion plan, and *AEC* = Avoided Energy Cost associated with the renewable resource

7. **Support Capacity Costs:** It is calculated in the same way as generation remix costs, it also has two components related to capital and production. It is calculated as difference between the capital (or production) cost in the base case and the capital (or production) cost with PV in the system (generation remix case).

8. **Regulating Reserve Requirement:** Consists of the regulating reserves required when solar PV is installed on the grid. It has two components: (1) the regulating reserve reliability impact, which depends on the expected reserve requirement as a percent of nominal DER capacity (as it is scaled by the capacity worth factor) and (2) the forecast error reliability impact, which depends on the expected DER forecast error as a percent of nominal DER capacity.

The report also highlights the need to study peak shifting and ramping issues as solar PV production increases. Other costs, such as Bottom Out Costs, Starts-Based Maintenance Costs, Planning Reserve Margin Costs, Distribution Operating Costs, and Program and Administrative Costs were given placeholder values, as Georgia Power has not developed a methodology to calculate the expected costs associated with significant penetrations of renewable resources.

Appendix III.B: Summary of Study: ***Minnesota Value of Solar: Methodology (Clean Power Research, 2014)***

Clean Power Research, on behalf of the Minnesota Department of Commerce, developed a methodology to determine the value of solar (VOS) in Minnesota. The aim was to replace the existing net metering program with a VOS rate structure. While the state developed an official methodology, no utility has yet adopted a VOS compensation structure for distributed solar customers. The categories identified and evaluated were as follows:

1. Avoided Fuel Cost
2. Avoided Plant Operation and Maintenance – Fixed
3. Avoided Plant Operation and Maintenance – Variable
4. Avoided Generation Capacity Cost
5. Avoided Reserve Capacity Cost
6. Avoided Transmission Capacity Cost
7. Avoided Distribution Capacity Cost
8. Avoided Environmental Cost
9. Placeholder for Avoided Voltage Control Costs and Solar Integration Costs

The PV output was estimated either through direct metering or simulation models with actual/expected parameters. The PV was treated as a marginal resource. If known and measurable evidence of other costs and/or benefits existed, then it was decided to incorporate them into the methodology. The end result would be a $/kWh rate. The main components are estimated as follows:

1. **Avoided Energy** is the sum of the total fleet production on a yearly basis.

2. **Avoided Losses** are calculated on marginal bases as the difference in losses between the case with and without marginal PV resource. T&D losses are considered separately, while No Load losses are not included. A loss saving factor is calculated, based on the avoided energy with and without losses. The same is used later to derive other quantities.

3. **Avoided Fuel Costs**: The fuel that would have been required to produce the energy that has been subsequently displaced by PV. It is based on the NYMEX Futures Market. A virtual solar heat rate is computed based on the Heat rate vs energy production of each generator. This weighted heat rate is then multiplied by the burnertip fuel unit price which give the value of avoided fuel costs.

4. **Avoided O&M (Fixed and Variable):** Avoided O&M is the O&M cost (total) multiplied by the ratio of PV capacity to utility capacity. They are avoided only when the resource requiring fixed O&M is avoided. Per-unit PV production is considered with annual degradation taken into account.

5. **Avoided Generation Capacity**: The solar-weighted capacity cost is based on the installed capital cost of a peaking combustion turbine and the installed capital cost of a combined cycle gas turbine, interpolated based on heat rate.

   The following formula quantifies it:

$$Cost = Cost_{CCGT} + (HeatRate_{PV} - HeatRate_{CCGT}) \times \frac{Cost_{CT} - Cost_{CCGT}}{HeatRate_{CT} - HeatRate_{CCGT}}$$

   The avoided reserve margin is calculated similarly, multiplying utility costs by the reserve margin.

6. **Avoided Reserve Capacity Costs:** This is identical to the generation capacity cost calculation, except utility costs are multiplied by the reserve capacity margin.

7. **Avoided Transmission Capacity**: It is calculated on a similar way to avoided generation costs. No degradation is capacity is considered. It is based on the utility's 5-year average MISO OATT Schedule 9 charge in Start Year USD

8. **Avoided Distribution Capacity Costs**:
   a. **System-Wide Avoided Costs**: These are calculated using utility-wide costs and lead to a VOS rate that is "averaged" and applicable to all solar customers. The costs and growth rate are determined using actual data from each of the last 10 years. They must be taken over the same time period because the historical investments must be tied to the growth that led to the investments.

   The amount of new distribution capacity is calculated based on the growth rate, and this is multiplied by the cost per kW to get the cost for the year. The total discounted cost is calculated and amortized over the 25 years. PV is assumed to be installed in sufficient capacity to allow this investment stream to be deferred for one year. Utility costs are calculated using the difference between the amortized costs of the conventional plan and the amortized cost of the deferred plan.

   b. **Location-Specific Avoided Costs**: These are calculated using location-specific costs, growth rates, etc., and lead to location-specific VOS rates.

9. **Avoided Environmental Costs**: Environmental costs are included as a required component and are based on existing Minnesota and EPA externality costs. CO2 and non-CO2 natural gas emissions factors (lb per MM BTU of natural gas) are taken from the EPA. The costs are adjusted for inflation (converted to current dollars), converted to dollars per short ton, and then converted to cost per unit fuel consumption using the assumed values. The externality costs are taken as the midpoint of the low and high values for the urban scenario, adjusted to current dollars, and converted to a fuel-based value

Proposed Formula

To calculate a utility's Value of Solar rate, a set of avoided cost components are each multiplied by a load match factor (if one is appropriate) and a loss savings factor. Adding the results of these separate component calculations produces the utility's total Value of Solar rate.

$$\sum Avoided\ Cost_{component} \times Load\ Match\ Factor_{component} \times (1 + Loss\ Savings\ Factor_{component}) = Value\ of\ Solar$$

The load match factor is 1 for energy related quantities, and it is the ELCC/PLR for demand/capacity related quantities. Figure A3 shows the value of each component calculated with this methodology. The final value of solar rate was $0.135 per kWh.

25 Year Levelized Value	Gross Starting Value ($/kWh)	×	Load Match Factor (%)	× (1 +	Loss Savings Factor (%)	) =	Distributed PV Value ($/kWh)
Avoided Fuel Cost	$0.061				8%		$0.066
Avoided Plant O&M - Fixed	$0.003		40%		9%		$0.001
Avoided Plant O&M - Variable	$0.001				8%		$0.001
Avoided Gen Capacity Cost	$0.048		40%		9%		$0.021
Avoided Reserve Capacity Cost	$0.007		40%		9%		$0.003
Avoided Trans. Capacity Cost	$0.018		40%		9%		$0.008
Avoided Dist. Capacity Cost	$0.008		30%		5%		$0.003
Avoided Environmental Cost	$0.029				8%		$0.031
Avoided Voltage Control Cost							
Solar Integration Cost							
							$0.135

Figure A3: Minnesota Value of Solar Calculation by Component

Appendix III.C: Summary of Study: ***Net Metering in Mississippi: Costs, Benefits, and Policy Considerations (Synapse Energy Economics, 2014)***

As part of a docket investigating the establishment of net metering and interconnection rules, the Mississippi Public Service Commission hired Synapse Energy Economics to conduct a study of the potential costs and benefits of net metering in the state. The following cost/benefit components were addressed in the study:

1. **Solar Integration Costs**

   Synapse concluded that grid integration costs increase as solar penetration level increases. As penetration levels are low in Mississippi, the authors found a very little evidence that significant costs are incurred by grid operators or distribution companies. Synapse referred to Xcel Energy's Colorado report, which concludes DG would add $2 per MWh in costs at a penetration level of 2%, which is four times that of Mississippi.

2. **Administrative Costs**

   Since data on net metering costs from all states is not available or easily separable from the program costs, the authors collected cost data for energy efficiency programs from many states, which is widely available. The authors estimated that an average utility spends between 6% and 9% of energy efficiency program expenses on administrative costs (average is 7.5%). The authors compared the dataset for net metering programs in California and Vermont to their respective energy efficiency programs. Administration costs for net metering were less than energy efficiency programs, so this provides a high-end estimate. Energy efficiency programs in Mississippi cost approximately $12 million, and 7.5% of $12 million is $0.9 million.

3. **Avoided Energy**

   Avoided energy costs are estimated by multiplying the per-MWh variable operating and fuel costs of the marginal resource by the projected MWh of solar generation modeled in each year. The authors used data from the U.S. Energy Information Administration's 2014 Annual Energy Outlook (AEO) to calculate O&M costs. For fuel costs, they used AEO 2014 data to project costs on a MMBtu basis and unit heat rates to convert fuel costs to dollars per MWh.

4. Avoided Generation Capacity

Avoided generation capacity value is calculated as the contribution of solar net metering projects to increasing capacity availability within the state. The authors calculated the amount of installed capacity every year (assumed 88 MW for analysis) and calculated the number of MW that contribute to reduction in peak load by using an Effective Load Carrying Capability (ELCC) of 58%. Thus, capacity contribution will be 58% of 88MW, which is 51 MW. The authors multiplied this capacity contribution by the capacity value in each year and divided this by total solar generation in that year to yield a dollars per MWh value.

5. Avoided Transmission and Distribution Capacity

The authors used an in-house database to calculate avoided T&D costs calculated for DG and energy efficiency programs to provide a rough estimate. Average avoided transmission costs from the database were set as $33 per kW per year. Average avoided distribution costs were $55 per kW per Year. The database includes studies of avoided T&D costs from over 20 utilities and distribution companies. The authors developed a low, mid, and high estimate for these costs by taking the 75th percentile for the high value, the 25th percentile for low value, and the average of these two for the mid value.

6. Avoided Risks/Price Hedging

The report notes that a number of risks are reduced as a result of renewable generation. The risk reduction benefit estimation was done by applying an adder (adjustment factor) to the avoided costs rather than attempting a technical analysis. Current optimal practice supports a 10% adder to avoided costs of renewables like solar.

7. Avoided System/Line losses

Synapse's analysis estimates avoided system losses using a weighted average line loss during each daylight hour. This is calculated by weighing daylight line losses of each T&D system in proportion to the load each system serves. Avoided system losses were calculated as product of weighted average system losses and projected generation from solar panels in each year (in kWh) times the avoided energy cost (in dollars per kWh) in the same year.

8. Environmental Compliance/Benefits

Environmental benefits calculated are primarily associated with avoided CO_2 emissions. The authors' analysis uses the mid case of their avoided environmental compliance estimation. It is forecasted that a carbon price begins in 2020 at $15 per ton and increases to $60 per ton in 2040. Entergy has developed a system-wide integrated resource plan, which modeled a CO_2 price in its reference case. Other greenhouse gases, such as SO_x and NO_x, are not mentioned.

9. Market Price Suppression

Market price suppression effects are acknowledged in the report, but are not monetized.

10. Local Economic Benefits

Local economic benefits are not included. Although it is mentioned that PV provides the most job-years per average megawatt, this benefit is not monetized.

11. Ancillary Services

Grid support services/ancillary services are addressed in the report, but are not monetized.

Appendix III.D: Summary of Study: ***Distributed Generation – Integrated Value (DG-IV): A Methodology to Value DG on the GRID (Electric Power Research Institute and DG-IV Stakeholders, 2015)***

The purpose of the report was to select cost/benefit categories for inclusion in a framework and develop a firm analytical basis for calculating each of these categories. The stakeholders examined value of solar studies from other jurisdictions to identify categories to include. The study was limited to rooftop solar. A transparent, fair, adaptable, versatile methodology was to be created.

The stakeholders, after due deliberation, arrived at the following DG-IV components:

Categories	Description
Avoided Energy	Fuel, variable operations and maintenance, and start-up value
Generation Capacity Deferral	Capital and fixed operations and maintenance
Transmission System Impact	Net change (transmission required, deferred, or eliminated)
Distribution System Impact	Net change (distribution required, deferred, or eliminated)
T&D Losses	Net change in T&D system losses
Environmental Impact	Compliance (e.g., CO_2, coal ash, cooling water) and market (renewable energy credits) value
Local Power Company (LPC) Costs & Benefits	Cost of implementing renewable energy programs (administrative, operational, engineering) and LPC-specific distribution system benefits
Economic Development	Regional job and economic growth
Customer Satisfaction	Value associated with preference, optionality, and flexibility
Local Differentiation	Site-specific benefits

System Integration/Ancillary Services	Symbiotic value of smart grid and high levels of DG, as well as integration costs
Additional Environmental Considerations	Environmental benefits not part of the compliance and market values included above
Security Enhancement	Increased resiliency
Disaster Recovery	System restoration assistance after natural disasters
Technology Innovation	Impact value of technology-driven investment

= Included in DG-IV Methodology
= Program Design Considerations
= Placeholder Topics

For the purpose of the report, a multiplier – Net Dependable Capacity (NDC) is used for capacity-related benefits. This multiplier is similar to the ELCC term discussed in other reports. The NDC reflects the proportion of PV capacity that offsets conventional generation capacity. The system peak and solar output at that time are compared to calculate NDC.

Evaluation of these quantities was carried out using TVA's Resource Planning Process - [RPP] (Figure A4). The process computes two quantities (capital costs in $/kW, and production costs $/kWh). The net result is the Total Plan Cost. The methods used to compute the main components are as follows:

1. **Avoided Energy:** The Resource Planning Process is run with and without PV using an hourly time-step. The cost of PV is not considered. The value depends upon the avoided resource and the fuel price.

2. **Generation Deferral:** The Resource Planning Process is run with and without PV for a period of 20 years, using a 50% NDC.

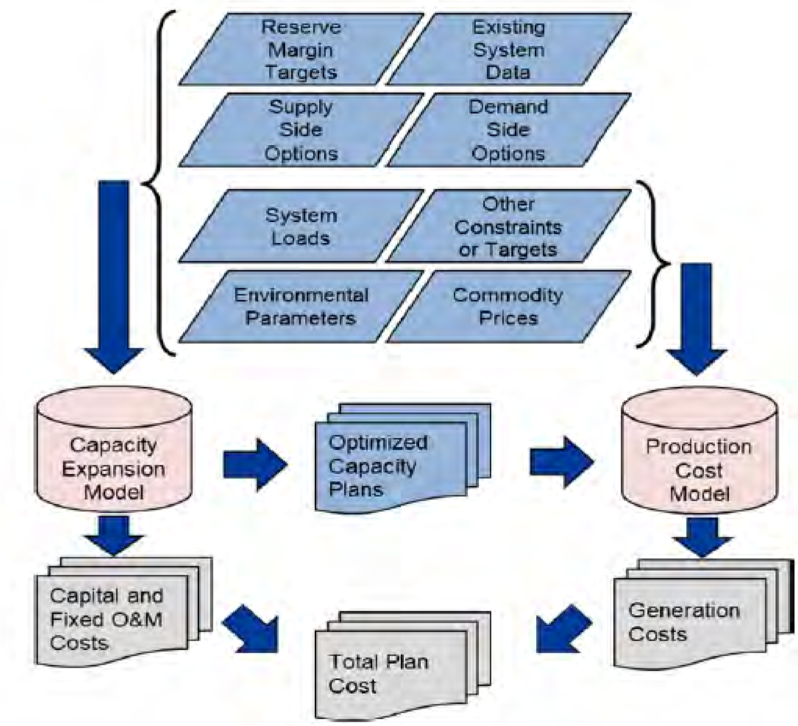


Figure A4: Resource Planning Model Process

3. **Environmental:** This includes two components: (1) Environmental Compliance and (2) Market Value. Environmental compliance value is calculated based on the carbon intensity of the generation assets deferred, and a CO_2 compliance cost curve is assumed beginning in 2022. The market value is based on renewable energy credit (REC) value. A $1/MWh value is assumed, based on national voluntary REC market prices. A 1.9% escalation rate is applied to this, based on TVA's integrated resource planning. Other environmental benefits are considered in the report, but set aside as placeholder categories.

4. **Transmission Impacts and Losses:** The costs and benefits are evaluated by considering the system peak, NDC, PV profile, and avoided costs; a simplified calculation with the point to point service rate is used. Three scenarios are studied: Positive, Negative, and Neutral, and an assumption is made that PV is installed in a manner that will be beneficial to the grid. It was generally observed that losses decrease when PV is added to loaded regions; however, they increase when PV is added to lightly loaded regions due to reverse power flow.

5. **Distribution Impacts and Losses:** System impacts, and marginal losses were studied. EPRI's Integrated Grid Initiative tool was used which incorporated feeder hosting capacity. It was observed that PV will benefit the system up to the hosting capacity after which system performance will deteriorate and need mitigation. No negative impacts were considered in the report.

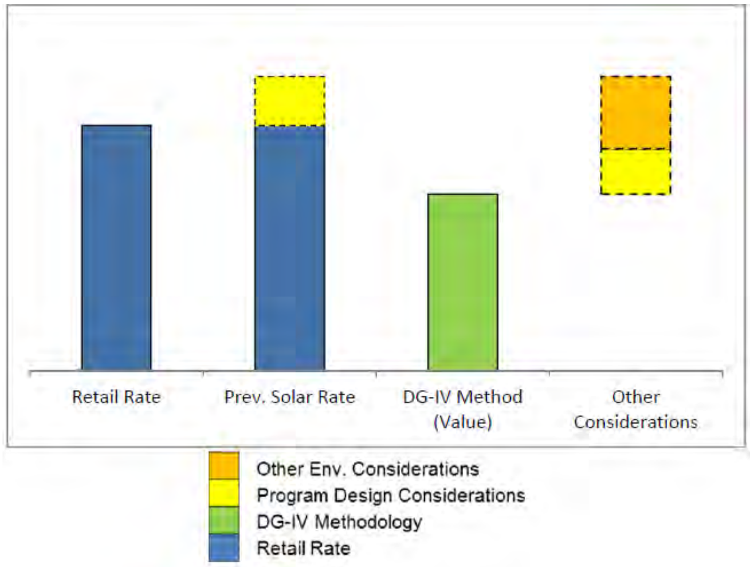


Figure A5: TVA DG-IV Calculation

Overall, it was found that the current compensation rate for PV is higher than that calculated by the DG-IV method (see Figure A5). However, this calculation does not include the other program design considerations and placeholder categories identified by the stakeholder group, and the report notes that this value is intended to be representative and not definitive.

Appendix III.E: Summary of Study: *Evaluation of Net Metering in Vermont Conducted Pursuant to Act 99 of 2014 (Vermont Public Service Department, 2014)*

This study was conducted by the Vermont Public Service Department with the broad purpose of evaluating net metering in the state of Vermont. The study examined six different types of net-metered systems: (1) a 4 kW fixed PV system, (2) a 4 kW 2-axis tracking PV system, (3) a 4 kW wind generator, (4) a

100 kW fixed group net metering PV system, (5) a 100 kW 2-axis tracking group net metering PV system, and (6) a 100 kW group net metering wind system.

Ultimately, the study concluded that the impact of net metering is positive, primarily for those who install distributed generation systems. The study pointed to grid stability and reliability, economic and environmental benefits (they did not attempt to quantify these due to the arbitrary nature of pricing), shared distribution between net-metering and non-net-metering customers, and the current tax credit system as primary net positives for net metering.

1. **Avoided Energy:** The authors assumed that the energy source displaced or avoided by the use of net metering is energy purchased on the ISO-NE real-time spot market. Avoided energy was calculated on an hourly basis by multiplying the production of real Vermont generators by the hourly price set in the ISO-NE market. These calculations indicated that fixed solar PV had a weighted average avoided energy price 9% lower than the annual ISO-NE average spot market price. The capacity factor for each solar technology is projected using the National Renewable Energy Laboratory's PV-Watts tool for a location in Montpelier using all default settings.

2. **Avoided Generation Capacity:** The Department examined the timing of the relevant peaks: ISO-NE's peak for capacity costs, Vermont summer peaks for in-state transmission costs, monthly Vermont peaks for Regional Network Service (RNS) costs and utility specific peak hours for distribution costs. The ability of variable generators to help avoid ISO-NE capacity costs depends on the level of generation during summer hours when ISO-NE's region wide grid demand peaks.

3. **Avoided Regional Transmission Costs:** Regional Network Service (RNS) charges are charged by ISO-NE to each of the region's utilities to pay for the cost of upgrades to the region's infrastructure. These costs are required to meet reliability standards and thus cannot be entirely avoided - only their allocation among New England ratepayers can be changed. Avoiding these costs through net metering shifts the costs to ratepayers from other states. RNS charges are allocated to each utility based on its share of the monthly peak load within Vermont. The values quantified for these costs are based on the ISO-NE forecast for the next three years' worth of RNS charges and escalated based on historical increases in the handy-Whitman Index of public utility construction costs.

4. **Avoided In-State Transmission and Distribution Costs:** These costs are incurred by the state's distribution utilities or VELCO and are not subject to regional cost allocation. Burlington Electric Department forecasts show that even without the effects of energy efficiency, there are no load growth related infrastructure investments planned for next 20 years, hence these costs have been excluded. In-state transmission and distribution upgrades deferred due to load reduction are calculated considering the critical value of how much generation the grid can rely on during peak times. Reliability peak coincidence values were calculated separately from economic peak coincidence values.

5. **Market Price Suppression:** The Department approximated this using an analysis based on the 2013 Avoided Energy supply cost study calculations of the demand reduction induced price effect for Vermont.

6. **Renewable Energy Credit Value:** A fixed value of $30/MWh is assumed. Potential future regulatory value in REC retirement to utilities. (At the time of this study, Vermont did not have a mandatory renewable portfolio standard (RPS). In 2015, the Vermont legislature adopted a binding RPS of 75% by 2032.)

7. **Environmental Compliance:** Analysis was done for the state's non-participating ratepayers both with and without an externalized cost of greenhouse gas emissions. The authors assumed a value of $100/metric ton of CO_2.

The Department also considered three costs as part of its cost-benefit analysis:

1. **Lost Utility Revenue (Due to Reduced Bills):** The Department considered the cost of lost utility revenue due to net metering customers paying lower bills.

2. **Administrative Costs:** Administrative costs are assumed to be the same values as reported in "Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012." Wherein, it was assumed that administrative costs are composed of two types of costs: procedural and billing. The authors calculated the combined annual value as $200,000. This corresponds to a set-up cost of approximately $20 per kW of net metering system capacity, ongoing costs of about $20 per kW per year for billing group net-metered systems, and no ongoing billing cost for individual net-metered systems.

3. **Vermont Solar Credit:** Credit for net excess generation is provided at the blended residential rate.

It is notable that solar integration costs are not included in the Department's analysis, particularly given that Vermont has one of the highest percentages of installed solar capacity in the country (the state's net metering aggregate capacity limit of 15% was surpassed by Green Mountain Power in 2016).

The Department carried out its analysis on various systems to determine if cross subsidization is occurring. The Department ultimately found that the aggregate net cost over 20 years to non-participating ratepayers due to net metering under the current policy framework is close to zero. Therefore, there does not need to be a direct link between the value provided by DG resources and the amount or form of compensation provided through net metering program. The Department stated that in order to achieve long-term goals for DG deployment, compensation may need to be greater than the value provided for particular technologies or time periods.

MANAGEMENT REPORT - 2017 Year End

December 12, 2017

Management Plans and Budgets

- Biomass Project. Status is as follows:
  - A. TSA 200-03, Bottomland Timber Sales. No activity.
  - B. TSA 200-04, Upland Pine Plantings. No activity.
  - C. TSA 200-05, Land Lease for NWSG. Terminated.
  - D. TSA 200-08, Grasses. Terminated.
  - E. TSA 200-09, Loblolly Nelder plot. Regular inspections indicate crop is growing well. No problems noted.
  - F. TSA 200-10, Hybrid Poplar spacing study. Regular inspections indicate crop is growing well. No problems noted.
  - G. TSA 200-12, Arborgen Hybrid Poplar/Aspen Taxon study. Regular inspections indicate crop is growing well. No problems noted.
  - H. TSA 200-14, Miscanthus. Eradication complete. No further activity needed.
  - I. TSA 200-16, Bottomland Hardwoods. Regular inspections indicate crop is growing well. No problems noted.
  - **J.** TSA 200-17, Measurements and Harvest. TSA Dropped.
  - K. TSA 200-18, Stand 4.03 Aerial Pine Release. No activity.
  - L. TSA 200-19. No activity. TSA succeeded by TSA 200-20.
  - M. TSA 200-20. Work plan approved. Samples obtained for testing and lab report received (moisture content, BTU; ash content, chemical composition, etc.). Summary results attached. Crop inspections performed periodically.
- An updated budget spreadsheet showing expenditures to date is attached.
- 2017-2018 work plan approved, plan and budgeting modified due to collapse of biomass/fuelwood markets and inability to locate suitable contractors for small harvest areas. 2018 activities as described in that plan (attached).

Timber Sales

- No activity.

Timber Sale Audit

- No activity.

Forest Management Contracts

- Management contracts executed and in force.

Tract Improvements

- Minor road improvements conducted.

Tract Problems

- None

Outsales / Acquisitions

- None

Leases

- No activity.

Miscellaneous Issues

- None

FTP Site

- No changes. Pictures can be found at ftp://216.54.213.21/a26

Fred Schatzki, R.F.
Forester

SC8 Biomass Project 2017-18 Work Plan and Budget

Site	TSA	Age	2017		Age	2018		
Upland Hardwood		(End Season)	Activity	Cost	(End Season)	Activity	Cost	Total
Hybrid Poplar Spacing Study	200-10	7	Qual Assess (1)	(575.00)	8	Inventory (3)	(1,560.00)	(2,135.00)
Hybrid Aspen/Hybrid Poplar Taxon Study	200-12	7	Qual Assess (1)	(575.00)	8	Inventory (3)	(1,560.00)	(2,135.00)
Greenwood Hybrid Poplar	200-15	7	Qual Assess (1)	(575.00)	8	Inventory (3)	(1,560.00)	(2,135.00)
Hybrid Poplar/Aspen	200-15	7	Measure (2)					
Upland Pine								
Loblolly Nelder Plot	200-09	7	Qual Assess (1)	(575.00)	8	Inventory (3)	(1,170.00)	(1,745.00)
Loblolly Biomass Plantings	200-04	7	Qual Assess (1)	(575.00)	8	Qual Assess (1)	(575.00)	(1,150.00)
	N/A	11	Qual Assess (1)	(575.00)	12	Measure (2)	(2,120.00)	(2,695.00)
Bottomland Hardwood								
Sweetgum/Willow	200-16	6	Qual Assess (1)	(575.00)	7	Inventory (3)	(3,685.00)	(4,260.00)
Poplar/Cottonwood	200-16	6	Measure (2)	(2,705.00)	7	Inventory (3)	(3,685.00)	(6,390.00)
Total				($6,730.00)			($15,915.00)	(22,645.00)

NOTES

(1): Three annual inspections. Estimated costs distributed evenly across all TSAs

(2): Cost includes collection, moisture testing, and lab delivery of samples

(3): Inventory design, data collection, reporting. Includes Qual Assess time

Timber Type Map

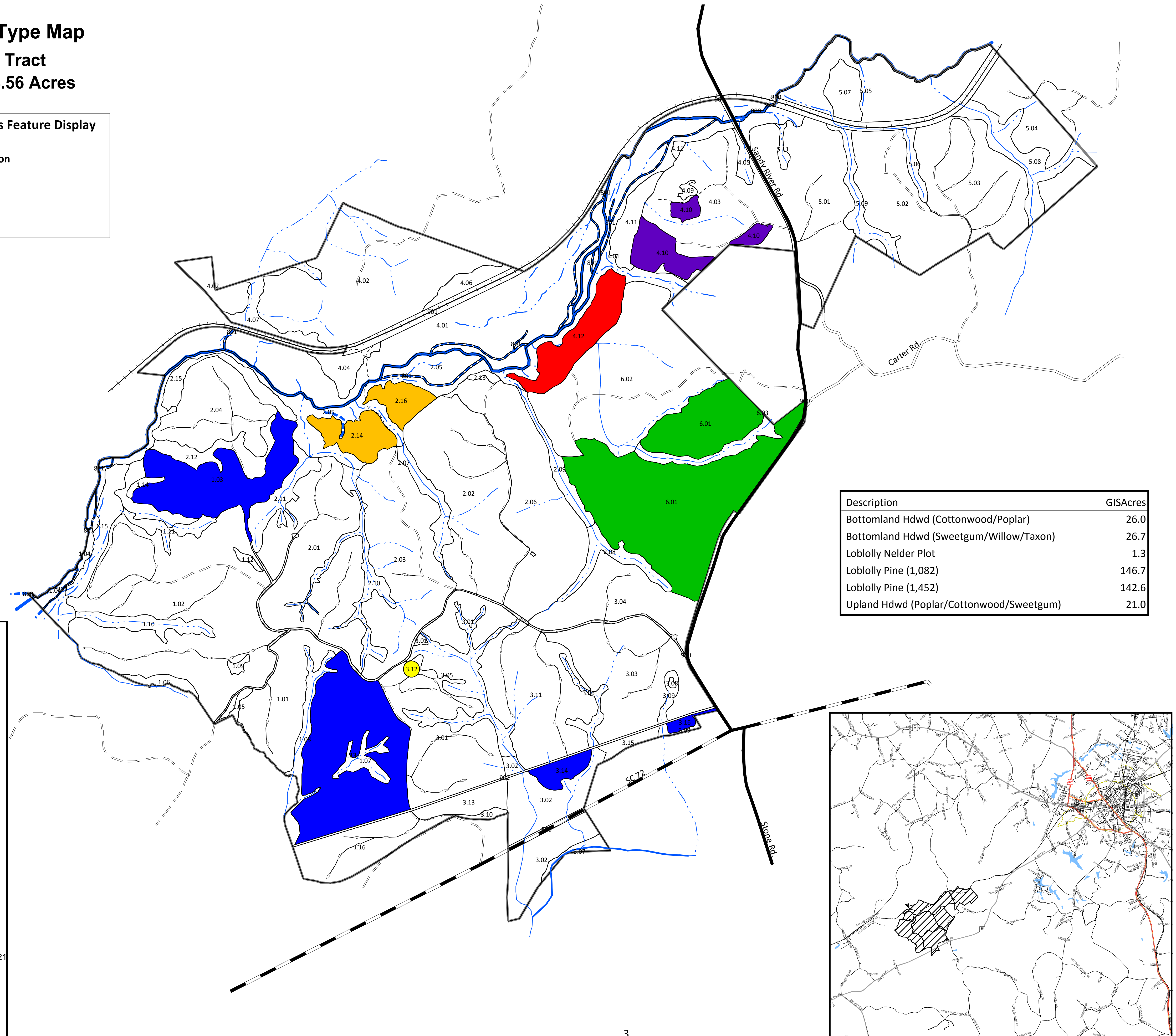
SC 8 Tract

+/- 2,444.56 Acres

N

StandsBiomass Feature Display

- BH-Ctn/Pop
- BH-SG/Wi/Taxon
- Nelder
- Lob1082
- Lob1452
- Upland Hdwd



Description	GISAcres
Bottomland Hdwd (Cottonwood/Poplar)	26.0
Bottomland Hdwd (Sweetgum/Willow/Taxon)	26.7
Loblolly Nelder Plot	1.3
Loblolly Pine (1,082)	146.7
Loblolly Pine (1,452)	142.6
Upland Hdwd (Poplar/Cottonwood/Sweetgum)	21.0

TIMBER TYPE LEGEND

StandID Description	Type	Yr_Est	GISAcres
1.01: Loblolly Pine (545)	P-LB-P-U	2011	39.0
1.02: Loblolly Pine (545)	P-LB-P-U	2011	167.5
1.03: Loblolly Pine (1,452)	P-LB-P-U	2011	48.6
1.04: Bottomland Hardwood	H-M-N-B	1984	13.7
1.05: Slope Hardwood	H-M-N-U	1950	1.7
1.06: Slope Hardwood	H-M-N-B	1950	4.0
1.07: Slope Hardwood	H-M-N-B	1950	6.6
1.08: Slope Pine-Hardwood	PH-M-N-U	1950	11.4
1.09: Non-Productive	P-M-N-Z	0	1.3
1.10: Loblolly Pine	P-LB-P-B	1977	10.5
1.11: Loblolly Pine	P-LB-P-B	1977	6.8
1.12: Loblolly Pine	P-LB-P-B	1977	1.2
1.13: Loblolly Pine (1,542)	P-LB-P-U	2011	84.3
1.14: Loblolly Pine	P-LB-P-B	1977	1.6
1.15: Cutover	CO-0-0-B	2010	13.8
1.16: Cutover	CO-0-0-U	2008	31.1
2.01: Loblolly Pine (545)	P-LB-P-U	2011	85.8
2.02: Loblolly Pine (545)	P-LB-P-U	2011	86.3
2.03: Loblolly Pine	P-LB-N-U	2006	79.3
2.04: Cutover	CO-0-0-U	2007	43.1
2.05: Bottomland Hardwood	H-M-N-B	1950	41.0
2.06: Loblolly Pine	P-LB-P-U	2001	81.3
2.07: Slope Hardwood	H-M-N-B	1950	9.6
2.08: Slope Hardwood	H-M-N-B	1994	10.5
2.09: Slope Hardwood	H-M-N-B	1950	8.6
2.10: Slope Hardwood	H-M-N-B	1950	16.6
2.11: Slope Hardwood	H-M-N-U/B	1950	13.0
2.12: Slope Hardwood	H-M-N-U	1950	13.5
2.13: Nonforested	NF-0-0-0	0	1.3
2.14: Bottomland Hardwood Rsrch	H-M-P-B	2012	15.7
2.15: Cutover	CO-0-0-B	2010	11.5
2.16: Bottomland Hardwood Rsrch	H-M-P-B	2012	11.0
3.01: Loblolly Pine (545)	P-LB-P-U	2011	79.0
3.02: Loblolly Pine	P-LB-P-U	1999	49.8
3.03: Loblolly Pine (545)	P-LB-P-U	2011	67.6
3.04: Loblolly Pine (545)	P-LB-P-U	2011	41.3
3.05: Slope Hardwood	H-M-N-U/B	1950	28.5
3.06: Slope Hardwood	H-M-N-B	1950	5.1
3.07: Slope Hardwood	H-M-N-B	1950	3.7
3.08: Pond	WZ-0-0-Z	0	0.3
3.09: Loblolly Pine	P-LB-P-U	1996	4.1
3.10: Slope Hardwood	H-M-N-U	1950	1.8
3.11: Loblolly Pine (545)	P-LB-P-U	2011	67.5
3.12: Loblolly Nelder Plot	P-LB-P-U	2011	1.3
3.13: Cutover	CO-0-0-U	2007	11.5
3.14: Loblolly Pine (1,452)	P-LB-P-U	2011	7.5
3.15: Loblolly Pine (545)	P-LB-P-U	2011	4.2
3.16: Loblolly Pine (1,452)	P-LB-P-U	2011	2.3
4.01: Bottomland Hardwood	H-M-N-B	1950	166.6
4.02: Loblolly Pine	P-LB-P-U	1999	116.9
4.03: Loblolly Pine (545)	P-LB-P-U	2011	65.1
4.04: Pine-Hardwood	PH-M-N-U	1950	9.0
4.05: Slope Hardwood	H-M-N-B	1950	3.2
4.06: Non-Productive	HP-M-N-Z	0	6.9
4.07: Bottomland Hardwood	H-M-N-B	1945	11.3
4.09: Loblolly Pine	P-LB-P-U	1994	1.3
4.10: Upland Hardwood Rsrch	H-M-P-U	2011	21.0
4.11: Cutover	CO-0-0-B	2010	12.2
4.12: Poplar/Cottonwood	H-M-P-B	2012	26.0
5.01: Loblolly Pine	P-LB-P-U	1999	71.4
5.02: Loblolly Pine	P-LB-P-U	2003	53.7
5.03: Cutover	CO-0-0-U	2008	61.1
5.04: Loblolly Pine	P-LB-P-U	2002	34.9
5.05: Bottomland Hardwood	H-M-N-B	1950	55.2
5.06: Slope Hardwood	H-M-N-B	1950	4.4
5.07: Pine-Hardwood	PH-M-N-U	1950	10.5
5.08: Slope Hardwood	H-M-N-B	1950	21.8
5.09: Slope Hardwood	H-M-N-B	1950	11.2
5.11: Slope Hardwood	H-M-N-B	1950	1.8
6.01: Loblolly Pine (1,082)	P-LB-P-U	2001	146.7
6.02: Loblolly Pine	P-LB-P-U	1999	106.7
6.03: Loblolly Pine	P-LB-P-B	1994	9.4
800.00: Sandy River	WZ-0-0-Z	0	14.1
801.00: Old River Channel	WZ-0-0-Z	0	7.4
900.00: Roads	RD-0-0-Z	0	19.3
901.00: Railroad	RR-0-0-Z	0	25.3
902.00: Gas ROW	EZ-0-0-Z	0	5.0

LEGEND

BOUNDARY
- Property
- Stand

HYDROLOGY
- Main Run Sandy River
- Old River Channel
- Floodplain Intermittent
- Perennial
- Upland Intermittent
- Upland Ephemeral

ROADS
- Primary
- Secondary
- County
- Woods
- ATV Trail
- Rail
- Skid Trail

Owner: TBP Properties, LLC
County: Chester
Date: June 7, 2013
Prepared By: Fred Schatzki, R.F. #1371
Parcel ID Nos. 042-00-00-001, 052-00-00-021
Deed Book 0958 Page 0129

1" = 1,650' (1:19,800) or 1" = 25 Chains

This map was produced from a combination of aerial photos, deed references, and plats and is not guaranteed to be exact.

Duke Energy SC8 Biomass Results

June 12, 2017

AFM Label	Tract	Species	Wood Chips	Lab No.	% Moisture	% Ash	% Ash (Dry)	B.T.U.	B.T.U. (Dry)	Moisture Ash Free M.A.F.B.T.U.	% Sulfur	% Sulfur (Dry)	SO2 (lbs/mmBtu)	Ash (lbs/mmBtu)	Carbon	Carbon (Dry)	Hydrogen	Hydrogen (Dry)	Nitrogen	Nitrogen (Dry)	Sulfur	Sulfur (Dry)	Ash	Ash (Dry)	Oxygen (diff.)	Oxygen (diff.) (Dry)
BL10-CW-WB	Bottomland	Cottonwood	Mixed	17015993	32.84	0.79	1.18	5733	8536	8638	0.05	0.07	0.16	1.38	28.99	43.16	4.67	6.96	0.19	0.29	0.05	0.07	0.79	1.18	32.47	48.34
BL11-CW-WO	Bottomland	Cottonwood	Wood Only	17015590	29.81	0.27	0.39	6515	9282	9318	0.06	0.09	0.19	0.42	32.22	45.9	4.79	6.83	0.18	0.25	0.06	0.09	0.27	0.39	32.67	46.54
BL12-CW-BO	Bottomland	Cottonwood	Bark Only	17015587	54.22	1.53	3.35	3880	8476	8770	0.01	0.02	0.05	3.95	19.48	42.56	3.11	6.8	0.15	0.33	0.01	0.02	1.53	3.35	21.49	46.94
BL13-HP-WB	Bottomland	Hybrid Poplar	Mixed	17015586	37.19	0.64	1.02	6362	10129	10233	0.03	0.04	0.08	1.01	28.67	45.65	4.37	6.96	0.22	0.35	0.03	0.04	0.64	1.02	28.88	45.98
BL14-HP-WO	Bottomland	Hybrid Poplar	Wood Only	17015585	37.02	0.2	0.31	6122	9721	9751	0.03	0.05	0.1	0.32	29.02	46.08	4.2	6.67	0.2	0.32	0.03	0.05	0.2	0.31	29.33	46.57
BL15-HP-BO	Bottomland	Hybrid Poplar	Bark Only	17015583	66.43	1.46	4.35	2954	8800	9200	0.01	0.04	0.09	4.94	14.47	43.09	2.23	6.65	0.21	0.63	0.01	0.04	1.46	4.35	15.19	45.24
BL16-SG-WB	Bottomland	Sweetgum	Mixed	17015581	31.48	0.2	0.29	5648	8243	8267	0.01	0.01	0.02	0.35	29.44	42.97	4.77	6.96	0.23	0.34	0.01	0.01	0.2	0.29	33.87	49.43
BL17-SG-WO	Bottomland	Sweetgum	Wood Only	17015580	36.73	0.13	0.2	5256	8307	8324	0.06	0.09	0.22	0.24	28.41	44.9	4.42	6.98	0.21	0.33	0.06	0.09	0.13	0.2	30.05	47.5
BL18-SG-BO	Bottomland	Sweetgum	Bark Only	17015578	60.72	1.81	4.62	3056	7780	8157	0.01	0.03	0.08	5.94	17.72	45.1	2.33	5.93	0.16	0.4	0.01	0.03	1.81	4.62	17.25	43.92
BL19-WI-WB	Bottomland	Willow	Mixed	17015576	33.53	0.81	1.22	5448	8196	8297	0.02	0.03	0.07	1.49	28.87	43.44	4.63	6.97	0.24	0.36	0.02	0.03	0.81	1.22	31.89	47.98
BL20-WI-WO	Bottomland	Willow	Wood Only	17015574	31.04	0.15	0.22	6560	9513	9534	0.17	0.25	0.53	0.23	31.38	45.51	4.58	6.64	0.17	0.25	0.17	0.25	0.15	0.22	32.5	47.13
BL21-WI-BO	Bottomland	Willow	Bark Only	17015573	53.1	2.27	4.84	4055	8645	9085	0.02	0.05	0.12	5.6	20.53	43.78	2.84	6.06	0.26	0.56	0.02	0.05	2.27	4.84	20.97	44.71
UP01-AS-WB	Upland	Aspen	Mixed	17015592	28.6	0.57	0.8	6700	9384	9460	0.04	0.06	0.13	0.85	33.86	47.42	4.71	6.59	0.16	0.23	0.04	0.06	0.57	0.8	32.06	44.9
UP02-AS-WO	Upland	Aspen	Wood Only	17015591	28.26	0.32	0.44	6514	9080	9120	0.06	0.08	0.18	0.48	33.87	47.21	4.8	6.69	0.15	0.21	0.06	0.08	0.32	0.44	32.55	45.37
UP03-AS-BO	Upland	Aspen	Bark Only	17015589	58.34	1.94	4.65	3356	8056	8449	0.02	0.05	0.12	5.77	19.06	45.74	2.65	6.37	0.21	0.51	0.02	0.05	1.94	4.65	17.78	42.68
UP04-HP-WB	Upland	Hybrid Poplar	Mixed	17015588	31.45	0.8	1.17	5768	8415	8515	0.01	0.01	0.02	1.39	29.17	42.56	4.74	6.92	0.23	0.33	0.01	0.01	0.8	1.17	33.6	49.01
UP05-HP-WO	Upland	Hybrid Poplar	Wood Only	17015584	31.75	0.38	0.56	6444	9442	9495	0.01	0.01	0.02	0.59	28.88	42.32	4.92	7.21	0.24	0.35	0.01	0.01	0.38	0.56	33.82	49.55
UP06-HP-BO	Upland	Hybrid Poplar	Bark Only	17015582	58.71	1.99	4.81	4200	10173	10687	0.01	0.02	0.04	4.73	17.7	42.86	2.84	6.89	0.22	0.53	0.01	0.02	1.99	4.81	18.54	44.89
UP07-CW-WB	Upland	Cottonwood	Mixed	17015579	33.02	0.67	1	6419	9584	9681	0.01	0.02	0.04	1.04	30.17	45.05	4.76	7.1	0.23	0.35	0.01	0.02	0.67	1	31.13	46.48
UP08-CW-WO	Upland	Cottonwood	Wood Only	17015577	37.88	0.31	0.5	5181	8341	8383	0.01	0.01	0.02	0.6	24.05	38.71	4.21	6.78	0.15	0.24	0.01	0.01	0.31	0.5	33.4	53.76
UP09-CW-BO	Upland	Cottonwood	Bark Only	17015575	56.13	2	4.57	4043	9216	9657	0.02	0.05	0.11	4.96	20.15	45.93	2.89	6.59	0.17	0.38	0.02	0.05	2	4.57	18.64	42.48

DEC's Observations from Results

By Wood Chip Type

Wood Chips	Average of % Ash (Dry)	Average of B.T.U. (Dry)	Average of Carbon (Dry)	Average of Hydrogen (Dry)	Average of Nitrogen (Dry)	Average of Sulfur (Dry)
Bark Only	4.455714286	8735.142857	44.15142857	6.47	0.477142857	0.037142857
Mixed	0.954285714	8926.714286	44.32142857	6.922857143	0.321428571	0.034285714
Wood Only	0.374285714	9098	44.37571429	6.828571429	0.278571429	0.082857143
Grand Total	**1.928095238**	**8919.952381**	**44.28285714**	**6.74047619**	**0.359047619**	**0.051428571**

Summary:
Bark definitely increases Ash production
B.T.U. measurements definitely fluctuated but the general trend is that Wood has a higher BTU content than Bark
Carbon and Hydrogen are consistent regardless of wood chip type
Nitrogen is higher in bark than wood only
Sulfur is generally higher in wood than bark

By Species:

Species	Average of % Ash (Dry)	Average of B.T.U. (Dry)	Average of Carbon (Dry)	Average of Hydrogen (Dry)	Average of Nitrogen (Dry)	Average of Sulfur (Dry)
Aspen	1.963333333	8840	46.79	6.55	0.316666667	0.063333333
Cottonwood	1.831666667	8905.833333	43.55166667	6.843333333	0.306666667	0.043333333
Hybrid Poplar	2.036666667	9446.666667	43.76	6.883333333	0.418333333	0.028333333
Sweetgum	1.703333333	8110	44.32333333	6.623333333	0.356666667	0.043333333
Willow	2.093333333	8784.666667	44.24333333	6.556666667	0.39	0.11
Grand Total	**1.928095238**	**8919.952381**	**44.28285714**	**6.74047619**	**0.359047619**	**0.051428571**

Summary:
Due to a wide range of B.T.U. results, more samples would be needed to accurately say which species has a higher B.T.U. content
There is not a significant % difference between species for Ash, Carbon, or Hydrogen.
Differences in Nitrogen are largely driven by the Bark only results. The Bark for Cottonwood and Sweetgum has less Nitrogen than other species. Aspen appears to have the least Nitrogen in Wood only though
The Sulfur results do not appear to be consistent enough to draw conclusions.

By Tract (Cottonwood and Hybrid Poplar Only):

Tract	Average of % Ash (Dry)	Average of B.T.U. (Dry)	Average of Carbon (Dry)	Average of Hydrogen (Dry)	Average of Nitrogen (Dry)	Average of Sulfur (Dry)
Bottomland	1.766666667	9157.333333	44.40666667	6.811666667	0.361666667	0.051666667
Upland	2.101666667	9195.166667	42.905	6.915	0.363333333	0.02
Grand Total	**1.934166667**	**9176.25**	**43.65583333**	**6.863333333**	**0.3625**	**0.035833333**

Summary:
Ash appears to be higher for Upland samples.
Sulfer appears to be consisently higher for Upland samples. Although it is hard to say if any samples had a significant amount of Sulfur.
Everything else is consistent between both tracts.

MINERAL LABS INC.
Box 549
Salyersville, Kentucky 41465
Phone (606) 349-6145

Certificate of Analysis

COMPANY REQUESTING ANALYSIS:		
Duke Energy SC8 Biomass 400 S. Tryon St. Charlotte, NC 28202	Date Analyzed:	6/12/2017
	Lab No.	17015591
	Sampled By/Type:	Customer

Sample ID: Mail In: Wood: Duke Energy SC8 Site: Chester, SC: 6-7-17: ID-UP2-AS-WO

PROXIMATE ANALYSIS	As Received	Dry Basis
% Moisture (D3302/D3173)	28.26	
% Ash (D3174)	0.32	0.44
% Volatile (D3175)	xxxxx	xxxxx
% Fixed Carbon (Calculated)	xxxxx	xxxxx
B.T.U (D5865/D5864)	6514	9080
M.A.F.B.T.U. (Calculated)	9120	
% Sulfur (D4239)	0.06	0.08
SO_2 lbs./mm Btu	0.18	
Ash lbs./mm Btu	0.48	

ULTIMATE ANALYSIS (ASTM D5373)	As Received	Dry Basis
Moisture	28.26	
Carbon	33.87	47.21
Hydrogen	4.80	6.69
Nitrogen	0.15	0.21
Sulfur	0.06	0.08
Ash	0.32	0.44
Oxygen (diff.)	32.55	45.37

SULFUR FORMS (ASTM D2492)	As Received	Dry Basis
% Pyritic Sulfur	xxxxx	xxxxx
% Sulfate Sulfur	xxxxx	xxxxx
% Organic Sulfur	xxxxx	xxxxx
% Total Sulfur	xxxxx	xxxxx

FUSION TEMPERATURE OF ASH (D1857)	Reducing (°F)	Oxidizing (°F)
Initial Temp.	xxxxx	xxxxx
Softening Temp. H=W	xxxxx	xxxxx
Hemispherical Temp. H=1/2 W	xxxxx	xxxxx
Fluid Temp	xxxxx	xxxxx

T-250 Temp. of Ash	xxxxx

MINERAL ANALYSIS (ASTM D4326)		% Wt. Ignited Basis
Silicon dioxide	SiO_2	xxxxx
Aluminum oxide	Al_2O_3	xxxxx
Titanium dioxide	TiO_2	xxxxx
Iron oxide	Fe_2O_3	xxxxx
Calcium oxide	CaO	xxxxx
Magnesium oxide	MgO	xxxxx
Potassium oxide	K_2O	xxxxx
Sodium oxide	Na_2O	xxxxx
Sulfur trioxide	SO_3	xxxxx
Phosphorus pentoxide	P_2O_5	xxxxx
Strontium oxide	SrO	xxxxx
Barium oxide	BaO	xxxxx
Manganese oxide	MnO	xxxxx
Undetermined		xxxxx

Base/Acid Ratio	xxxxx
Fouling Factor	xxxxx
Slagging Factor	xxxxx

WATER SOLUBLE ALKALIES (Reported in %)	
CaO	xxxxx
K_2O	xxxxx
Na_2O	xxxxx

Arsenic ppm (ASTM D6357)	xxxxx
Chlorine ppm (ASTM 6721)	xxxxx
Mercury ppm (ASTM D6722)	xxxxx
Oxidation (ASTM D5263)	xxxxx
Selenium ppm (ASTM D6357;MOD)	xxxxx
Free Swelling Index (D720)	xxxxx
Equilibrium Moisture (ASTM D1412)	xxxxx
Grindability Index (D409)	xxxxx

Submitted By: Sharlonda Matthews

JENNINGS CONFIDENTIAL EXHIBIT NO. 9

DOCKET NO. E-7, SUB 1162

CONFIDENTIAL – FILED UNDER SEAL

JENNINGS CONFIDENTIAL EXHIBIT NO. 10

DOCKET NO. E-7, SUB 1162

CONFIDENTIAL – FILED UNDER SEAL

Final Status Report - SOW 3: Rankin Development
Report: December 12, 2017
Project Completed July 2017
by : Green Energy Corp, John S. Camilleri

The activities of this SOW include the following:

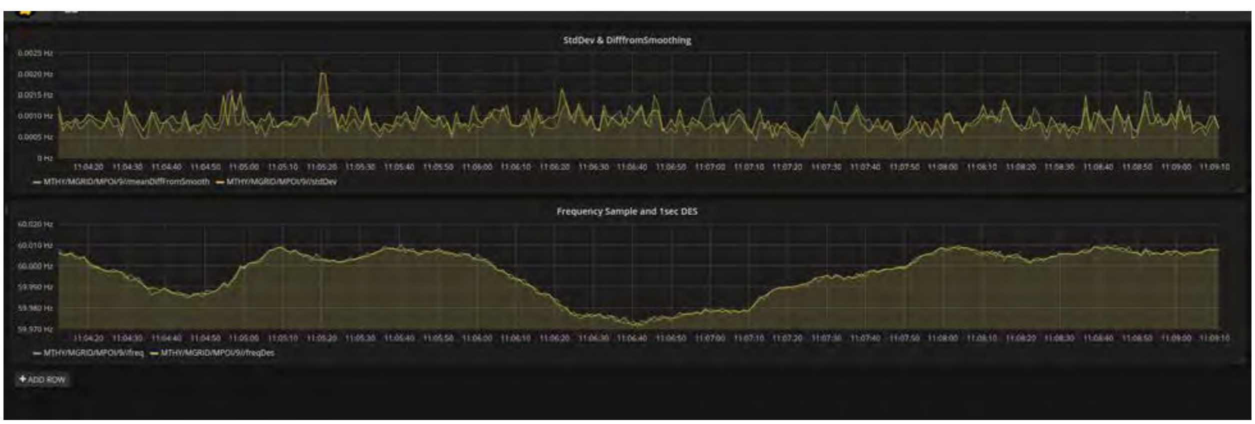
1. Detailed Requirement Documented
2. DDS Adapters to support field communications
3. C37.118 OpenFMB Adapter + Island Detection Application
4. Implement POI Service for multiple DER on Feeder. (Modified - See below)

Task 1 and 2 were completed in 2016.

Task 3 involved creating a PMU OpenFMB Driver. The specification was produced and reviewed in 2016. The adapter was created and tested on the Mount Holly Microgrid system. The project repo (PMU Adapter) was shared with Duke Energy.

The island detection application will use local time series values within the microgrid to attempt and detect an islanding event without proper Point of Common Coupling(PCC) operation. This will be a application running on an edge node. GEC will develop the algorithm approach and deploy in Mount Holly for testing. The application will also monitor other devices in the system including the PCC and Battery System.
The adapter was created and tested on the Mount Holly Microgrid system. The project repo (PMU Adapter) was shared with Duke Energy.

The charts below show the algorithm running in Mount Holly.



Task 4 will document the islanding application in Task 3 and the expected communication configuration and operation of the monitored devices. This documentation will also consider the application in a configuration with DER on a distribution circuit.

All tasks have been completed. Code and documentation were turned over to Duke Energy. The ETO Team at Mount Holly continue to pursuing further experimentation on their own.

Appendix A: Code Readme Documentation

Part of task #4.

Repo - PMU-Adapter

Projects:

- pmu-adapter-protocol: Library for connecting to C37 protocol connections. Implements Netty protocol handlers.
- pmu-adapter-publisher: GreenBus Edge endpoint publisher that reads PMU data and publishes aggregate statistics.
- pmu-adapter (assembly): Packages PMU adapter as runnable service.

Important classes:

- UnbufferedDes: Implements double-exponential smoothing on a time series.
- PmuTcpHandler: Netty handler that decodes PMU protocol frames and passes results to an observer.
- PmuEndpoint: Observes a PMU connection, keeping running statistics and publishing at an interval.

Appendix B: Application Documentation

Part of task #4

Problem Statement

Detecting variations in trending values can be useful for identifying anomalies in a system. In an electrical system where distributed generation is deployed certain conditions can arise that produce a safety issue. One of these conditions is called `unintended islanding`.

Typically this is where the main source of the feeder or microgrid has been interrupted and power is flowing backwards from the DER or Microgrid across the Point of Common Coupling (PCC). This is where the PCC did not operate or the DER did not shutdown appropriately to stop the backflow. This backflow could be feeding a low current fault, energizing a portion of the line that crews might be working on and/or damaging customer equipement due to poor power quality.

Being able to detect and then provide automatic control cost effectively is the ultimate goal.

Approach

The selected approach identifies and attempts to rectify the problem uses several technologies. The first technology was developed by Green Energy Corp and allows a distributed application to run in the field on a CPU Node in front of the PMU. The second technology was implemented by Netflix to support Operational Insight for millions of trending values. Netflix implemented an algorithm call Double Exponential Smoothing (DSM) to predict and support anomaly detection.

As specified in Task #3 above, GEC will implement and deploy the approach described.

Location of Deployment

Duke Energy has deployed a SEL 735 which provides C37.118. It is located between the PCC and POI at Mount Holly and will enable Duke Energy to monitor high resolution frequency and /or voltage phase angles at that location. It should be noted that this location is not part of the Microgrid so that when the Microgrid Islands the SEL 735 will still see the grid side measurements.

Breath of Solution

This approach has numerous applications for in-field analytics. Some of the potential areas include detecting voltage anomalies at distribution transformers to determine bad windings. Identification of excess current draws on motors indicating short circuits in the armatures.

This approach can enable a low cost power quality monitoring system that can also integrate with other in-field analytics and data to predict system level behaviour.

Basic Mathematical Approach

The Double Exponential Smoothing (DES) uses two equations[^1]

S_t = $\alpha*y_t$ + (1 + α)($S_(t-1)$ + $B_(t-1)$)

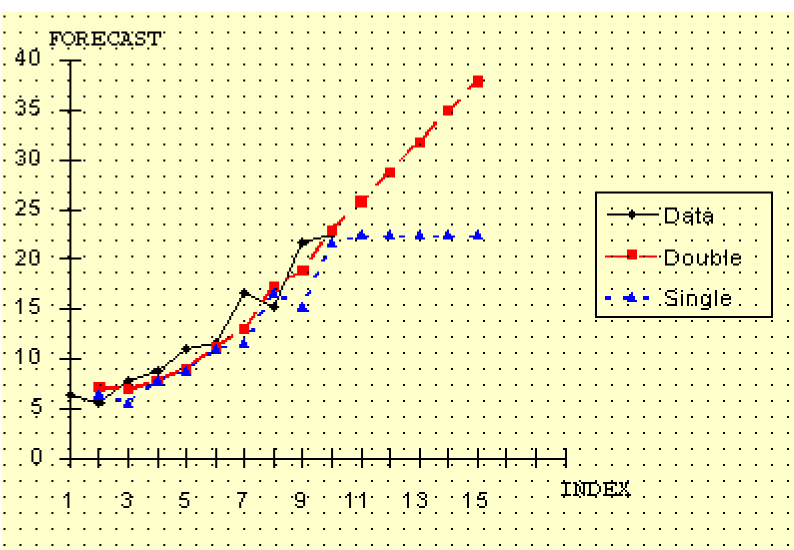
where $0 \le \alpha \le 1$

b_t = γ*($S_t - S_(t-1) +(1-\gamma)*b_(t-1)$

where $0 \le \gamma \le 1$

Both α and γ have to be tuned to for the specific trending variable.

The following graph from NIST shows the DSE and forecast based on DES and exponential smoothing with the actual data.



The based concept is to monitor the variation between the actual and DES forecasted to determine when the actual is *out of range* to trigger an anomaly event.

Coding Approach

Green Energy Corp will take the open source version of DES from Netflix[^2] as the base algorithm. A PMU adapter will be implemented on GreenBus Edge to support communication with the the SEL 735. This is based off of previous work[^3]. There are also other implementation of DES[^4] that are liberally licensed on `github` for further consideration.

Observations

The system will be able to be tuned and monitored for the Mount Holly Data Center. This will allow Duke and GEC to determine the best parameters and the limit settings for detecting anomalies of the trended values. The specific goal of this demonstration is to verify an approach to implement automatic control based on the analytics, therefore we will only implement events to be logged in the system for verification.

References

[^1]:NIST Definition of DES

[^2]:Netflix Project

[^3]: C37.118 - OpenFMB Adapter Design Document

[^4]:DES github reference

Loyd Ray Farms, Inc.
Innovative Animal Waste Management System
Permit No. AWI990031
Permit Compliance Semi-Annual Report

July 1, 2017 – December 31, 2017 Semi-Annual Reporting Period

Submitted January 20, 2018

Submitted on Behalf of:
Loyd Ray Farms, Inc.
2049 Center Rd.
Boonville, NC 27011

This Semi-Annual Compliance Report provides an overview of the manner in which the subject facility has maintained compliance with the conditions of the Innovative Animal Waste Management System permit for the reporting period from July 1, 2017 through December 31, 2017. During this reporting period, the system was operated in accordance with the Innovative Swine Waste Treatment System, and subject to the requirements thereof.

In addition to addressing compliance with the conditions of the permit, this report provides a brief overview of the system maintenance and repairs (page 5-7) and then lists all sampling and reporting requirements per the Innovative Animal Waste Management System Permit, No. AWI990031 (page 8-10). For each requirement, this report records monitoring that occurred and a brief explanation for each (page 10-15).

The report was completed on behalf of Loyd Ray Farms, Inc., by Cavanaugh & Associates, P.A., under the direction of the Duke Carbon Offsets Initiative (DCOI). Please contact Matt Arsenault at 919-613-7466 with any questions. A copy of this report will be provided to Loyd Ray Farms, Inc., and will be maintained on-site with the other permit compliance documentation.

Overview of System Maintenance and Repairs
For the time period from July 1, 2017 through December 31, 2017, which is the period covered by this report, all processes that comprise the innovative swine waste treatment system were operational, and electricity generation was capable for the majority of the reporting period. The following summarizes, in general, the operations of the system for the reporting period:

During the warmer, summer months, biogas production was substantial, and at times, the rate at which biogas was accumulated and stored beneath the HDPE cover exceeded the capacity of the microturbine, and the flare was used periodically to augment biogas use. During the reporting period, the electricity generation system had an up-time of approximately 55% (102 days of 185), although there were 29 days with SCADA system errors that could have erroneously reported uptime, so the actual uptime may have varied by as much as 15%. Down-time resulted from maintenance activities (described in more detail, below) and scheduled down-time due to reduced biogas production at the very end of the reporting period due to cooler temperatures affecting biogas generation. The following graph illustrates the operating times and amount of electricity generated by the system for the reporting period:

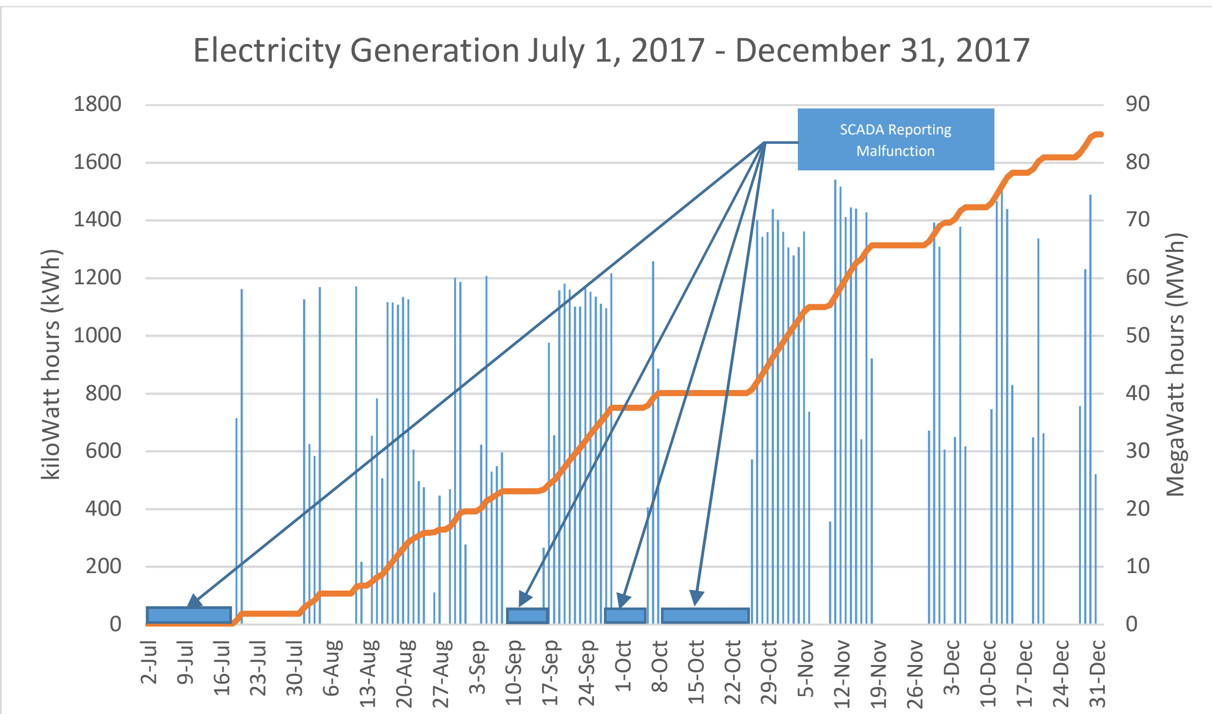


Figure 1. Generator Uptime

Although the generation reported from the SCADA system indicates approximately 85 MWh of electricity generation for the period, the reported values from the electricity meter used for measuring REC transfer to Duke Energy reports approximately 101 MWh of generation. The 16 MWh discrepancy can be attributed to the 29 days of SCADA reporting malfunction, as described above. As an additional depiction of the electrical generation efficiency of the system for the reporting period, the following graph illustrates the power generation rate, expressed in kilowatts (kW). As typical, the generation efficiency increases in the cooler months when the differential between the ambient temperature and the temperature of combustion is greater.

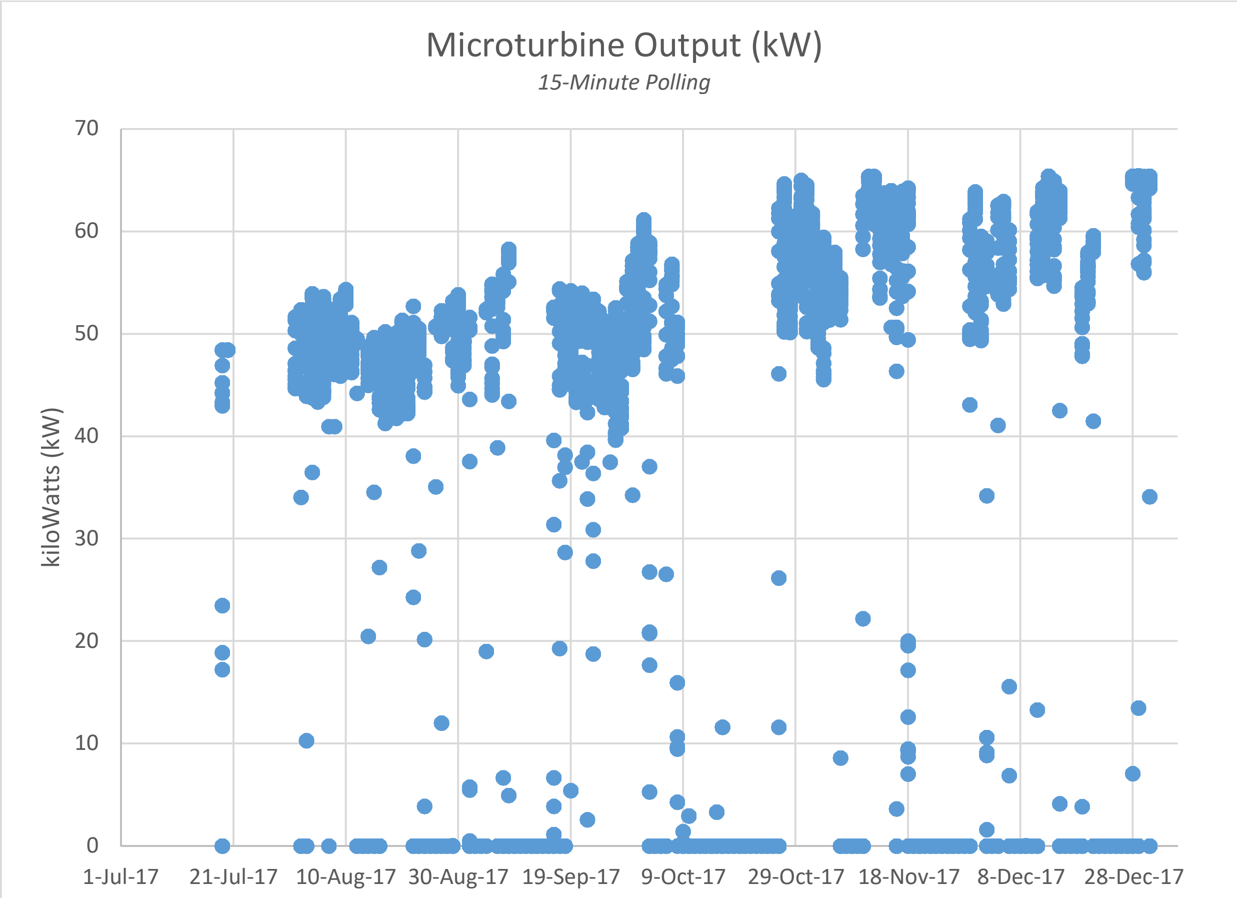


Figure 2. Microturbine Output

Biogas flow is also monitored and recorded for the system. The disposition of the biogas may only occur through use by the microturbine and flare, controlled release through venting, or through leaks from the system, which cannot be measured. The following graph illustrates the measured biogas usage for the system. Flare usage, as indicated by measured flow to the flare meter, for the reporting period may also be surmised from the graph. It should be noted that days that indicate zero flow may also indicate a disruption with the data acquisition system, which was observed to occur more significantly in the latter half of 2017, as described above.

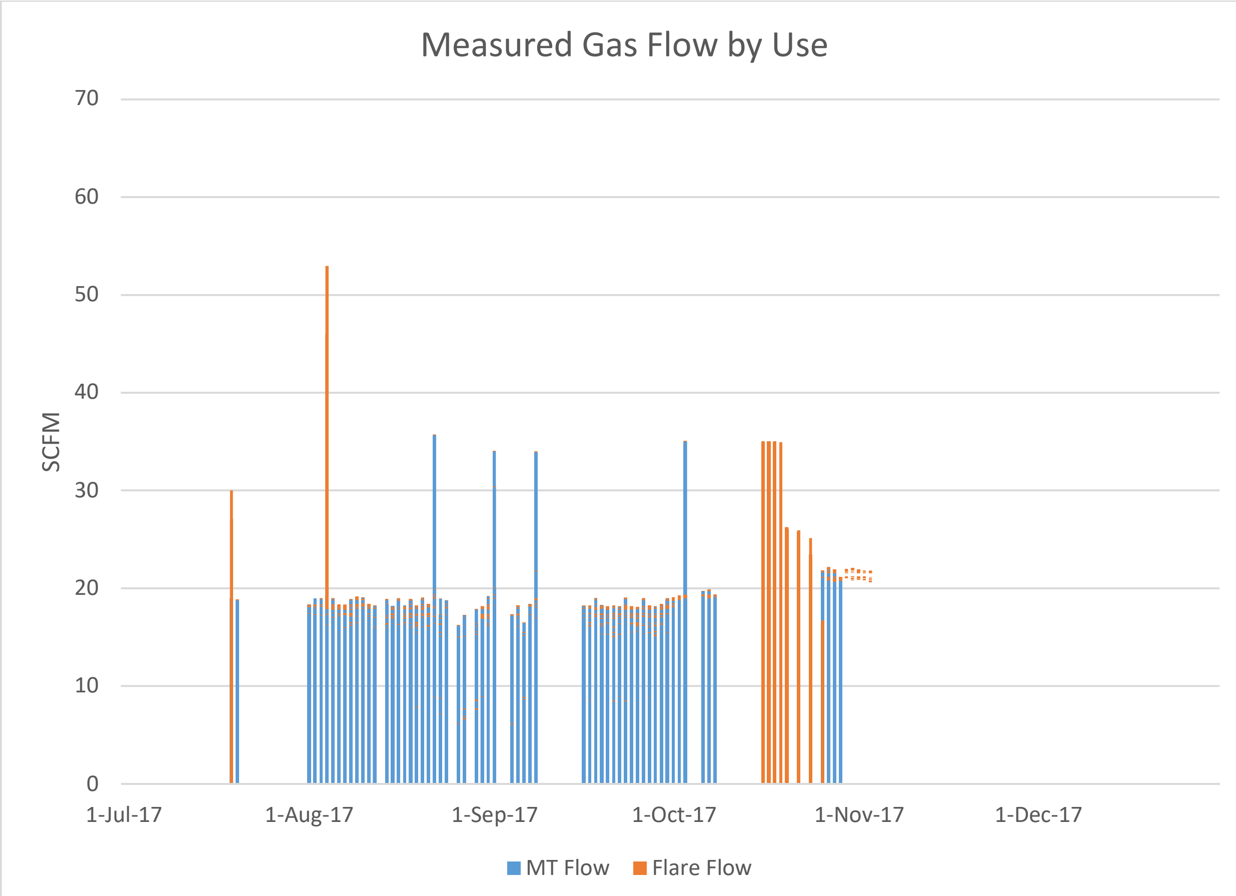


Figure 3. Biogas Flow and Use (Report from SCADA System)

The environmental treatment system was operational for the entirety of the reporting period; however, required maintenance activities and disrepair led to reduced duplicity of certain environmental treatment system components, such as the aeration system pumps. The anaerobic mixing system uptime was 75% for the reporting period, while the aeration system uptime was reported as 53%. However, SCADA reporting errors, as described above, most likely accounted for a lower reported uptime. Maintenance activities for the environmental treatment system included mixing, jet motive, and flush pump maintenance, and repairs to the cover (welding small cracks, holes, and tears resulting from normal wear).

The farm staff also experienced difficulty in maintaining a regular flushing schedule to remove waste from the animal barns, which resulted in increased maintenance activities to ensure environmental system operation. The following graph depicts operating times for the environmental treatment system. Additional observations of system performance are noted in the operator log included with this report.

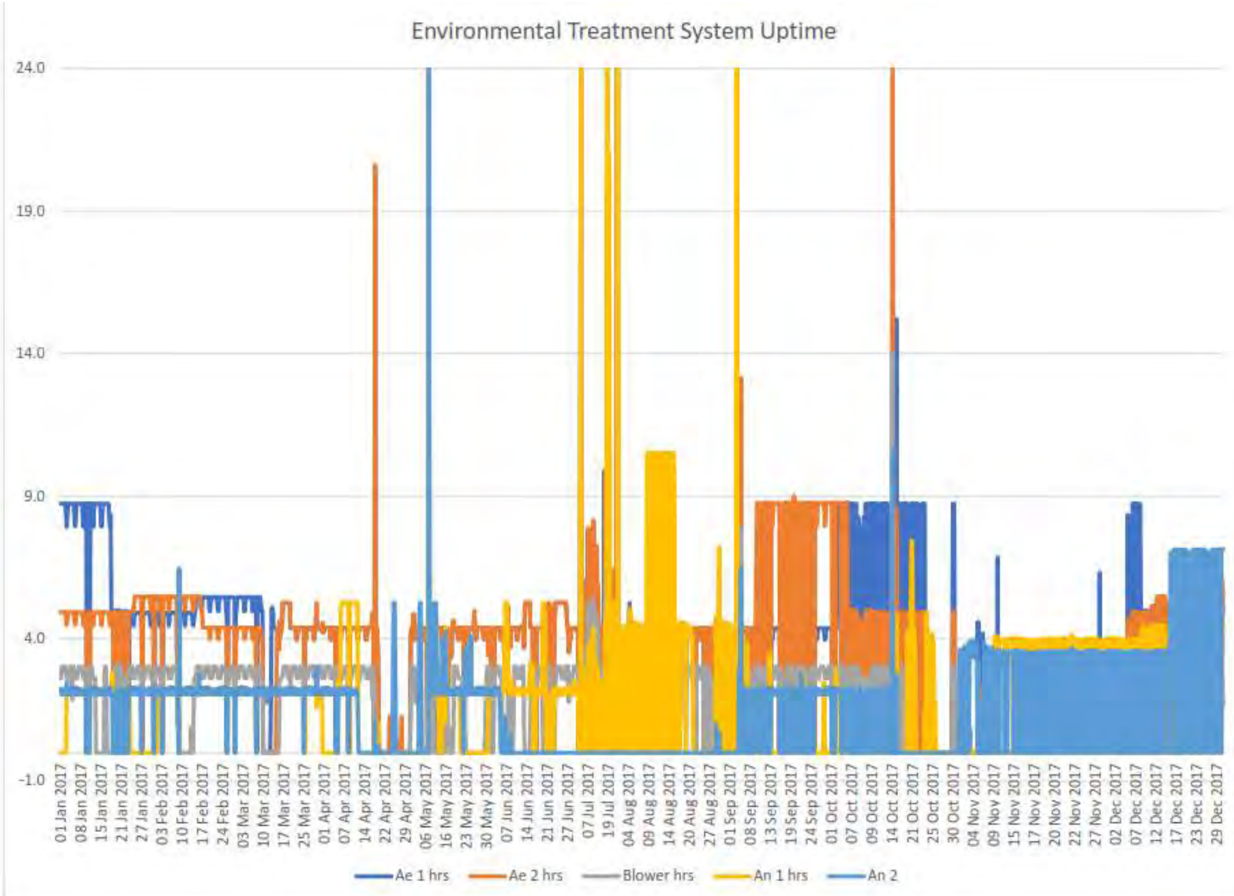


Figure 4. Environmental System Uptime Chart

Overall, the system performed very well during the reporting period - from power generation, greenhouse gas emission reduction, and environmental performance perspectives. While no major system disruptions or significant maintenance activities were required during the reporting period, the following describes the routine activities invested in the system operation (also noted in the operator log):

Date	Operations Log Synopsis
7/16/2017	Installed new computer. Updated scada with new version
7/19/2017	Found system was down got on site. Found MT breaker was tripped from storm. Once system was back up and running shut down after 15 mins, due to error on the gas skid. After a talked with Unison found broken wire connected to temp prop. Fixed wire and system started up. Ran flare for an hour.
7/21/2017	Digester pump guys here today to replace leaky pump and check on why motor was not running. Found out the motor on the pump is bad. Going to get us a quote on a new one with installation. Burn flare when I was on site.
8/1/2017	Cont. to work on new computer change out. Able to get things working again with the help of IT guy. Removed riser pipe in aeration basin since lagoon level is lowers.
8/4/2017	Site visit to monitor system and continue to work on new computer Film crew from Duke was on site to work on a film of our system

8/14/2017	Site visit to check on why MT might have shut down other than low gas. Pumped surface water and found the Gas MH half full of water and choking off gas flow. Pumped out MH and started MT
8/16/2017	Site visit to take water samples. Discounted solar panel for manhole pump and hooked up a battery charger to maintain battery life.
8/28/2017	Site visit to meet with Digester repair folks, they are replacing motor on pump 2 and I found that pump 2 was in fault they checked it and it is running a little high in Amps. I did a walk on the cover to check for leaks. Checked in with Kevin and checked out Basin pumps and cleaned up the office some. We had a very hard time with pumps and valves and we may have a clogged pipe We are running on one pump
8/29/2017	Site visit to continue work on the clogged digester pump. Stated MT and checking on some meter issues
9/5/2017	Site visit able to unclogged dig pumps by back flushing using the aeration pumps and fire hose. Hopping to get more gas from 2 pumps running now. System running good with gas we have.
9/6/2017	Site visit to check on computer issues, could not log on. Found plug breaker was tripped that ran computer and internet, must of happen during thunderstorm last night. All other systems cont. to run.
9/19/2017	Site visit to check. Found MT will not stay running. Contacted E-finity to log in and check system. All else looks good, Skid is running and we have gas.
10/2/2017	Retook fecal sample out of aeration basin. Digester mixing pump still tripping breaker. Gas is getting low, not sure how much longer we can run.
10/9/2017	The MT started stopping and starting again this morning. After talking with Efinity we found a bad cooling fan that caused the electrical components to overheat. They are going to try to overnight one and I can replace it in the tomorrow.
10/16/2017	MT has been down and we have a strong gas build up. I started Flare at 9:20 gas flow at 35 SCFM.Tech. worked on MT from 1-4:30 no avail we will continue to flare. Called Tech about one digester pump he will get back to schedule a repair visit. System: # 2 Digester pump down and # 1 Digester pump kicks the breaker now and then. Basin all systems are OK
10/19/2017	I had shut the flare down at 6:30 Wednesday morning. Site visit to start flare MT is down start at 35 SCFM-- 8588502.1 System: # 2 Digester pump down and # 1 Digester pump kicks the breaker now and then. Basin all systems are OK. Pumped surface water off NE corner of Digester. Used Vacuum to clean out Gas MH. Used mulch mower to mow center Aisle between Digester and Basin. I talked to Andrew on Monday about the need to mow rather than weed eat because of the debris going into Basin.
10/25/2017	Got several problems with mixing pumps. Digester -Pump 1 broke the collar that connects the motor to pump shaft -Pump 2 will run but trips the breaker some Preferred Sources will be on site Mon, depending on if the new motor, for Pumps 2 if needed, shows up this will Aeration-Pump 1 broken the belts (should be in next week)- Pump 2 will not pump Thinking the intake side of the aeration line is clogged tried to back flush with digester pump 2(when it is running) but not having any luck. Hopefully once we get both digester pump running we can have more pressure to blow anything out of the Aeration line. Also with the new belts for the aeration pump both of them running could be able to get pumping again.
10/26/2017	Efinity on site to repair MT, found bad liner and temp gauge in unit. Everything back up and running. Mixing Pumps are still down.
10/27/2017	Mike with Pro*Pump was on site today hooking part of the new monitoring system for flush pumps I worked with Andrew and Landon with their flushing clogged line and our pumps that are down Josh Amon is supposed to be here to work on Dieser pumps next week A-Basin Pump Belts should be here the first of next week

10/30/2017	Site visit to install new belts and get Basin Pumps running and back on line. Completed Primed the pumps and they are now running and set on auto. We hope to get digester pumps up and running Wednesday
10/31/2017	Site visit: I noticed the Basin Pumps had failed they were turning but not pumping. I shut them down and worked the remainder of the day trying to get them to pump. I had very little success. I will try again tomorrow. Josh Amon is scheduled to come to LRF to work on the Digester pumps on Wednesday
11/1/2017	Site visit: Josh Amon came today and worked on both Digester pumps he and his helper were from 10:15 until 6:00, he was able to get both pumps running but one has a leak in the priming cap and is so full of sludge ha we had to shut it down. Josh will order and install a new cap. I spent the whole day working on the Basin pumps. I finally had to open the right-hand pump and found that the check valve flapper had broken off and was in the pump. I still could not get them to prime and run. I contacted Mike Osborne and he is to send me some data. IU assisted Josh with his repair in between my attempts.
11/6/2017	Site visit: I worked on getting the Basin Pumps to working I pumped and ran the Blower for about 3.5 to 4 hrs. The digester {Only one was working) is clogged Kevin and I will work on it tomorrow. I found a small snag {may have come from Mower} in the cover at the ground /cover edge on the North side. I taped it and if we have time we might weld it tomorrow. I shut the MT down to save the gas for tomorrow.
11/7/2017	Site visit: Kevin and Marvin met with Jeff C. and the testing team from Duke. The Chiller failed, and we were unable to do gas test. Kevin called in for service on the chiller and conditioner and they are scheduled to come to LRF tomorrow. Kevin and I were able to flush out the crossover line Digester to Basin and flush out the Digester pump. The basin Pumps are still not working properly. We will try again tomorrow.
11/8/2017	Site visit: I met with service man to find out about the chiller and after checking everything and consulting with all the Tech discovered a bad heat exchanger and all the coolant had leaked out. They are ordering the needed parts and will return to complete the service call as soon as possible. The basin Pumps are still not working properly. I was able to remove the Vacuum gauge and will get parts to re-install. We will try again tomorrow to get them running.
11/10/2017	Site visit: I met with service Tech and installed heat exchanger and loaded Glycol. I worked on Basin Pumps and got them running for 6 hours with blower running 3 tried to restart them but failed time for the man MT is running and I reattached cable for Flush Pump the crossover pipe is flowing great. I am going home.
11/16/2017	Site visit: I worked with Basin pumps and worked with Andrew on flushing pumped surface water Worked with Dr. Marc Talked with Andrew we are still clogged
11/21/2017	Took water samples.
11/28/2017	Site visit to meet with Unison for skid service flushed barn 9 and ran water through 6-7-8 Got the Basin pumps running and the ran from11:00-4:00 with Blower of and on. Started the Auto surface pump
11/28/2017	Site visit to meet with Unison for skid service flushed barn 9 and ran water through 6-7-8 Surface water check and System check
12/5/2017	Site visit to meet with Mike Osborne for service of basin pumps and installing of back flow flappers washed my boat out and found the plug broken and will need replacing, Basin pumps are now back on automatic and Andrew is flushing

The following table lists the compliance requirements as per the permit for the subject system, and the performance / compliance relative to each requirement:

	Description of Monitoring Requirement	Status	Result
1	Maintenance of adequate records by Permittee to track the amount of sludge/separated solids disposed.	N/A	No solids or sludge disposal occurred during the reporting period; some sludge returned to the anaerobic digester for further breakdown in accordance with the Division approved Operations & Maintenance Plan.
2	Inspection of entire Innovative System waste collection, treatment, and storage structures and runoff control measures at a frequency to insure proper operation but at least monthly and after all storm events of greater than one (1) inch in 24 hours; Permittee maintenance of inspection log or summary including at least the date and time of inspection, observations made, and any maintenance, repairs, or corrective actions taken by Permittee.	☑	Inspections and observations conducted by representatives of Loyd Ray Farms, Inc., Cavanaugh & Associates, P.A., and DCOI. Observations recorded, and actions taken to adjust the operation of the System are recorded in log book kept onsite (copies of which attached to report; Appendix A).
3	Maintenance of a log of all operational changes made to the Innovative System including at least the process parameter that was changed, date and time of the change, reason for the change, and all observations made both at the time of the change and subsequently as a result of the change by Permittee/Permittee's designee.	☑	Log book entries, as described in item #2, above, maintained on site; copies attached to report (Appendix A).
4	Representative Standard Soil Fertility Analysis to be conducted annually on each application site receiving animal waste.	☒	The Standard Soil Fertility Analysis was required to be completed by LRF by EOY 2017. The analysis was not completed, and therefore not included in this Report.
	Wastewater Analysis		
5	Quarterly tests shall be conducted once w/in each of the following windows w/ at least sixty (60) days between any 2 sampling events. Water quality samples include analysis of copper, zinc, total suspended solids, pH, total nitrogen, TKN, $NO_2 + NO_3$, phosphorus, ammonia, and fecal coliform.		
	Quarter 3 (July 1 – September 30)	☑	Sample Collected: 8/16/2017 Sample Analyzed: 8/16-31/2017 Results Reported: 9/8/2017 ***Non-compliant Fecal Coliform*** Re-Sample Collected: 10/2/2017

			Sample Analyzed: 10/2/2017 Results Reported: 10/11/2017 Results included in the attached report from Research & Analytical Laboratories, Inc. (Appendix B)
	Quarter 4 (October 1 – December 31)	☑	Sample Collected: 11/21/2017 Sample Analyzed: 11/21-12/5/2017 Results Reported: 12/15/2017 ***Non-compliant Fecal Coliform*** Re-Sample Collected: 1/22/2018 Sample Analyzed: 1/22/2018 Results Reported: 1/29/2018 Results included in the attached report from Research & Analytical Laboratories, Inc. (Appendix B)
	Performed at a minimum of twice a year for the first two years to determine the calibration coefficient for the mass balance as described in the Monitoring Plan submitted March 17, 2010. Ambient air sampling shall be scheduled in summer and winter seasons.		
	Summer Season Ambient Air Sampling	☐	Summer season ambient air sampling was completed in June 2017. Additional summer season sampling will occur in the summer of 2018.
	Waste Treatment and Storage System	☐	
	Barns	☐	
	Sprayfields	☐	
	Winter Season Ambient Air Sampling	☑	Winter season ambient air sampling was conducted on November 16, 2017. Results included in the attached Explanation of Results and Sampling Methods.
	Waste Treatment System	☑	
	Barn Exhaust	☑	
	Sprayfields	☒	As per previous documentation and reports submitted to DWR, sampling of air emissions from the sprayfields was not performed.
	Odor Sampling		

6	Permittee shall monitor for odor compliance quarterly at both upwind and downwind locations on the property boundary. Permittee shall document monitoring locations on a site map, indicating prevailing wind direction, for each monitoring event.		
	Quarter 3 (July 1 – September 30)	☒	Odor sampling was not able to be provided by Duke University in Q3 due to staffing issues.
	Quarter 4 (October 1 – December 31)	☑	Odor sampled 11/16/2017. Results included in the attached Explanation of Results and Sampling Methods.
	Record Keeping		
7	All records, including operation, maintenance, and repair records, shall be maintained on site and in chronological and legible form for a minimum of five (5) years by the Permittee; records shall be maintained on forms provided by or approved by the Division and shall be readily available for inspection.	☑	A copy of the report and all monitoring records are maintained in a binder in the System Control Building; the electronic form combines inspection and operations records on a single form, entitled "Loyd Ray Farms Inspection, Operations & Maintenance Log Sheet" which are being collected electronically, and submitted to the Regional Office via email.

EXPLANATION OF RESULTS AND SAMPLING METHODS

1. Amount of Sludge or Separated Solids Disposed

N/A. No disposal of sludge or separated solids was required from the Innovative System during the 7/1/2017- 12/31/2017 reporting period. Some sludge was returned from the aeration basin to the anaerobic digester for further breakdown, as per usual and typical operations, in accordance with the design and Operation and Maintenance Manual.

2. Log of System Inspections

See Operator Log Book, Appendix A.

3. Log of Operational Changes to the Innovative System

See Operator Log Book, Appendix A.

4. Results of Standard Soil Fertility Analysis

The Soil Fertility Analysis was required by LRF by end of calendar year 2017. This Soils Analysis was not completed in accordance with the requirement.

5. Results of Water and Air Quality Sampling

Water Quality samples were taken in each quarter. Results from these samples are further detailed below. Air Quality samples were last taken in June 2017 representing warm season, or summer, conditions; additional warm season samples will be taken in the summer of 2018. Air quality samples representative of a cool season (winter) conditions were taken on November 16, 2017. Results from these sampling efforts are further detailed below.

a. Results of Waste Water Analysis

Water quality samples were taken in each quarter. Samples were analyzed by Research Analytical Laboratories, Inc. in Kernersville. The initial 3rd and 4th quarter samples resulted in higher fecal coliform counts than expected, and thus, and additional sample was taken. The re-sampling resulted in lower, compliant results. The following table compares the results of the water quality analysis of the final effluent from the Innovative System:

	Sample Date		
Parameter	8/8/2017	11/16/2016	12/13/2016
TOT N	1,040		2090
TKN	1,040		2050
NO2+NO3	0.143		38.3
TP	30.4		428
NH3-N	854		1480
COPPER	0.144		0.089
ZINC	0.704		0.283
TS	582		472
FECAL	110,000	5,350[1]	9,200
pH	8.23		8.33

[1] Re-sampling event.

b. Results from Ammonia Emissions Sampling and Analysis

Emissions from Animal Waste Treatment and Storage System

Ammonia nitrogen emissions from the aeration basin and lagoon were quantified to determine if significant volatilization of NH_3-N occurred from this part of the waste management system. Emissions from the water surfaces were determined using a buoyant convective flux chamber (BCFC) which method was described in details and illustrated with pictures in the February 15, 2012 report. Sampling took place on November 16, 2017 between 10 am and 12:30 pm. It was a nice and sunny day, relatively windy (2-5 m/s). Temperature was 65 F.

Results were as follows:

- Size of the chamber: 50.8 cm wide by 53.3 cm long and 2.5 cm in height.
- Air sampling flow rate: 0.40 L/min
- **Average ammonia concentrations** in sweep air from the aeration basin while aeration was off: **28 ppm** (4 samples) or on average in mass concentration 0.0159 g-N/m^3

- Ammonia concentrations in sweep air while aeration was on was not measured, earlier monitoring indicated that ammonia concentration in sweep air during aeration was slightly lower.

The total emission from the aeration basin can be calculated from the air sampling flow rate, the surface of the chamber and the surface area of the aeration basin. The latter surface is nominally 24,500 ft^2 (or 2277 m^2). Emission rate is calculated as follows:

NH_3 emission rate = NH_3 concentration × Sampling flow rate × Aeration basin area / Buoyant chamber area

After unit conversion, one obtains values of 3.2 g/h. This corresponds to a NH_3 emission rate of **0.538 kg NH_3-N/week.** This is a very low value compared to the **allowable emissions of 106 kg NH_3-N/week** from the swine waste treatment and storage structures as specified in Section I.6.a.i of the Swine Animal Waste Management Permit.

Surface emission rate of NH_3 from the **lagoon** was determined following the same method. Average concentration of ammonia in the sweep air (with the same chamber and at the same flowrate of 0.4 L/min) was 21.3 ppm. With the surface area of the lagoon (19,425 m^2), emission of NH_3 from the lagoon are estimated to be **3.50 kg NH_3-N/week**.

Results for the emissions from the aeration basin and the lagoon are summarized in the table below. Total ammonia (TAN) in the aeration basin and lagoon at the time of sampling is also reported for information and were relatively low. The low overall emissions reported this period are consistent with the lower than usual TAN concentrations. These numbers all show the system is performing well.

	Aeration basin	**Lagoon**
Surface area	2277 m^2	4.8 acres = 19,425 m^2
TAN	890 mg-N/L	420 mg-N/L
Emission rate	0.54 kg NH_3-N/week	3.50 kg NH_3-N/week
Total emission (lagoon + aeration basin)	**4.04 kg NH_3-N/week**	

Thus, together lagoon and aeration basin contribute to the emission of **4.04 kg NH_3-N/week**. This is well below the allowable 106 kg NH_3-N/week.

Emissions from the Barns

Ammonia emissions from the barns were also determined on June 6, 2017. It should be noted that accurate determination of emissions from animal houses is a difficult exercise. This is because of the variable nature of the emission, the difficulty in accurately measuring air flow from the fans on the animal houses, and the fact that fan operation is automated, i.e., they are turned on and off automatically triggered by a thermostat. Thus, uncertainties on the numbers reported below exist and can be important.

Ammonia in the exhaust air from the barns was determined using Draeger tubes. Details on the concentrations and number of fans on at the time of sampling are shown in the table below.

Barn	NH_3 Concentration (ppm)	Fans working
1	5.5	1 Large 1 Small
2	3.6	2 Large 1 Small
3	2	1 Large 1 Small
4	4	1 Small
5	Turned off	0
6	Turned off	0
7	7.5	2 Large
8	7.5	1 Large 1 Small
9	10	1 Large 1 Small

The total emission of ammonia can be estimated by multiplying the ammonia concentration in each of the barn's exhausts by the exhaust flowrate of that barn (33,000 cfm for large fans and 13,000 cfm for the small fans). At the time of sampling, total exhaust flow was 342,000 cfm and concentrations ranged from 2 to 10 ppm (see Table above). The calculated total weekly ammonia emissions from the barns was **320 kg NH_3-N/week.**

Adding the emission from the treatment system and the lagoon (**4.04 kg NH_3-N/week**) to the emissions from the barns (320 kg NH_3-N/week) amounts to a **total of 324 kg NH_3-N/week** from the swine farm**.** This is below the allowable value of 476 kg NH_3-N/week specified in Section I.6.a.iii of the Swine Animal Waste Management Permit.

Emissions from the Sprayfield

Emissions from the sprayfield were not assessed during this reporting period due to previously reported complications in performing the assessment and inability to detect emissions from the sprayfields from previous attempts by Duke University.

Summary Table

Emissions Source	Winter Season (December 9, 2015)
Treatment and Storage System	4 kg NH_3-N/week
Barns	320 kg NH_3-N/week
Sprayfields	*Not Detected*
Total Farm:	324 kg NH_3-N/week

Thus, the emissions of ammonia are calculated to be well below the allowable value of 476 kg NH_3-N/week specified in Section I.6.a.iii of the Swine Animal Waste Management Permit.

6. Odor Sampling

Results of odor sampling – 11/16/2016

Odor was monitored to comply with Section I.6.b.ii of the Swine Animal Waste Management Permit. One monitoring event was conducted on November 16, 2017.

Sampling took place at about 10 am. It was a nice and sunny day, unusually warm for the season (65 F) but relatively windy (2-5 m/s). Several measurements for wind speed and direction were taken to ensure that data were representative. The average wind speed was 3.1 m/s, however, the wind speed was very variable with strong gusts of variable direction up to 4.5 m/s. The wind direction and points for monitoring odor are shown in Figure 1, below.

Odor was monitored by Marc Deshusses. Odor panelist rules were listed in the previous report and are not repeated here. Odor was monitored using a Nasal Ranger (http://www.nasalranger.com/) field olfactometer, following the manufacturer recommended instructions.

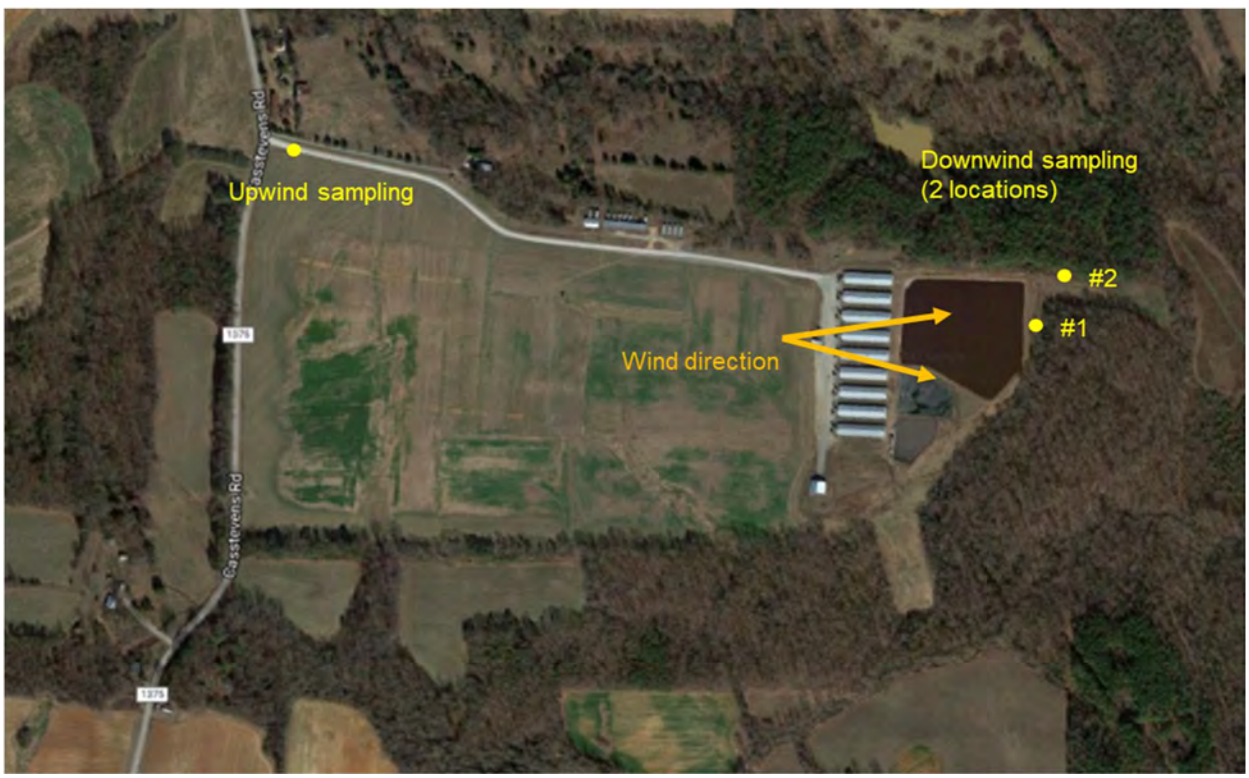


Figure 1. Aerial view of the facility and location of the monitoring points for odor for the June 6, 2017 sampling. The arrows indicate the prevailing wind direction the day of the sampling.

<u>Sampling upwind</u>

Odor could not be detected at the 2 D/T level. This indicates that the odor level was lower than 2 D/T. Then the Nasal Ranger was taken off the nose and ambient air was sniffed and compared to odorless air from the Nasal Ranger. This was to determine whether a difference could be detected between ambient air and odorless air from the Nasal Ranger. No significant difference could be detected.

<u>Sampling downwind</u>
Odor sampling at location #1 found odor at the 2 D/T level. The measurement was difficult to reproduce as odor (as recorded without the olfactometer) was typically coming in gusts with the wind. Note that Location #1 is not at the property line. Sampling was repeated a little further away at location #2. No odor could be detected at the 2 D/T level. This indicates that the odor level was lower than 2 D/T. Then the Nasal Ranger was taken off the nose and ambient air was sniffed and compared to odorless air from the Nasal Ranger. This was to determine whether a difference could be detected between ambient air and odorless air from the Nasal Ranger. No significant difference could be detected.

These results indicate that odor levels complied with Section I.6.b.ii of the Swine Animal Waste Management Permit

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This semi-annual Compliance Report compiled and respectfully submitted by:

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Appendix A.

Operations & Maintenance Log

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Kevin	Date7-6-2017	Visit Start Time 9:15 AM	Visit Stop Time: 2:30 PM
Condition: Temperature 78 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours:		Wind: (mph): N 4 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Installed new computer. Updated scada with new version

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	90	70		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	*Affiliation*	*Phone Number/Email*

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Kevin	**Date7-19-2017**	**Visit Start Time 9:15 AM**	**Visit Stop Time: 2:30 PM**
Condition: Temperature 92 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours:		**Wind: (mph): N 4 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Found system was down got on site. Found MT breaker was triped from storm. Once system was back up and running shut down after 15 mins, due to error on the gas skid. After a talked with Unison found broken wire connected to temp prop. Fixed wire and system started up. Ran flare for a hour.

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	90	70		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	*Affiliation*	*Phone Number/Email*

NOTES:

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Entry Made By: Kevin	**Date7-21-2017**	**Visit Start Time 9:15 AM**	**Visit Stop Time: 2:30 PM**
Condition: Temperature 92 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours:		**Wind: (mph): N 4 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Digester pump guys here today to replace leaky pump and check on why motor was not running. Found out the motor on the pump is bad. Going to get us a quote on a new one with installation. Burn flare when I was on site.

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	90	70		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	*Affiliation*	*Phone Number/Email*

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date7-22-26-2017**	**Visit Start Time 7:00**	**Visit Stop Time: 8:30 PM**
Condition: Temperature 92 F	☒ Clear	☐ Cloudy	☐ Balmy
Precip Past 24 hours:		**Wind: (mph): N 4 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Monitoring system remotely with Camera all during the daylight hours

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	**Operational Status**
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	**Set Point**	**Current**	**Modified Set Pt**	**Notes**
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**90**	**70**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	**Run Time**	**Set Speed**	**Notes**
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			
Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date7-27-2017**	**Visit Start Time 8:30**	**Visit Stop Time: 4:30 PM**
Condition: Temperature 88 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		**Wind: (mph): N 4 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Sight visit removing wasp nest and preparing for visitors see sign in log Tour conducted for Duke U

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	90	70		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

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Entry Made By: Kevin and Marvin	**Date: 8-1-2017**	**Visit Start Time 8:30**	**Visit Stop Time: 4:30 PM**
Condition: Temperature 88 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		**Wind: (mph): N 4 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Cont to work on new computer change out. Able to get things working again with the help of IT guy. Removed riser pipe in aeration basin since lagoon level is lowers.

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	**Operational Status**
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	**Set Point**	**Current**	**Modified Set Pt**	**Notes**
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**90**	**70**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	**Run Time**	**Set Speed**	**Notes**
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			
Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

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Entry Made By: Kevin and Marvin	**Date: 8-4-2017**	**Visit Start Time 2:30 PM**	**Visit Stop Time: 4:30 PM**
Condition: Temperature 88 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours:0		**Wind: (mph): N 4 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to monitor system and continue to work on new computer Film crew from Duke was on site to work on a film of our system

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	90	70		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Marvin	**Date: 8-7-2017**	**Visit Start Time 2:30 PM**	**Visit Stop Time: 4:30 PM**
Condition: Temperature 81 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: Trace		**Wind: (mph): N 4 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to monitor system and pump surface water from morning showers

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	90	70		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 8-08-2017**	**Visit Start Time 2:30 PM**	**Visit Stop Time: 5:00 PM**
Condition: Temperature 77 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0,75 inches		**Wind: (mph): N 4 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to monitor system and pump surface water from morning showers

ENVIRONMENTAL SYSTEM OBSERVATIONS: No Readings

Equipment Observed:	**Operational Status**
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☒ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☒ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	**Set Point**	**Current**	**Modified Set Pt**	**Notes**
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**90**	**70**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	**Run Time**	**Set Speed**	**Notes**
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			
Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	*Affiliation*	*Phone Number/Email*

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 8-14-17**	**Visit Start Time 6:30 AM**	**Visit Stop Time: 10:00 AM**
Condition: Temperature 40 F	☐ Clear	☒ Cloudy/rainy	☐ Balmy
Precip Past 24 hours: 1/2		**Wind: (mph): 2-4 mph gusty during showers**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to check on why MT might have shut down other than low gas. Pumped surface water and found the Gas MH half full of water and choking off gas flow. Pumped out MH and started MT

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	37		
Aerobic	190	0		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 8-15-17**	**Visit Start Time 11:00 AM**	**Visit Stop Time: 2:00 PM**
Condition: Temperature 40 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0.1		**Wind: (mph): 2-4 mph gusty during showers**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to pump surface water and travel to Elkin to get a Battery for gas MH Pump

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	62		
Aerobic	190	0		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

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Entry Made By: Kevin	**Date: 8-16-17**	**Visit Start Time 10:00 AM**	**Visit Stop Time: 12:00 PM**
Condition: Temperature 80 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0.1		**Wind: (mph): 2-4 mph gusty during showers**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to take water samples. Discounted solar panel for manhole pump and hooked up a battery charger to maintain battery life.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	62		
Aerobic	190	0		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

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Entry Made By: Marvin	Date: 8-28-2017	Visit Start Time 7:45 AM	Visit Stop Time: 4:00 PM
Condition: Temperature 80 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		Wind: (mph): 3-7 mph gusty during showers	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to meet with Digester repair folks, they are replacing motor on pump 2 and I found that pump 2 was in fault they checked it and it is running a little high in Amps. I did a walk on the cover to check for leaks. Checked in with Kevin and checked out Basin pumps and cleaned up the office some. We had a very hard time with pumps and valves and we may have a clogged pipe We are running on one pump

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Marvin	**Date: 8-29-2017**	**Visit Start Time 10:oo AM**	**Visit Stop Time: 4:30 PM**
Condition: Temperature 69 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: Trace		**Wind: (mph): 3-7 mph gusty during light showers**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to continue work on the clogged digester pump. Stated MT and checking on some meter issues

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Kevin	**Date: 9-5-2017**	**Visit Start Time 10:00AM**	**Visit Stop Time: 2:30 PM**
Condition: Temperature 85 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours:		**Wind: (mph): 3-7 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit able to unclogged dig pumps by back flushing using the aeration pumps and fire hose. Hopping to get more gas from 2 pumps running now. System running good with gas we have.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Kevin	Date: 9-6-2017	Visit Start Time 10:00AM	Visit Stop Time: 2:30 PM
Condition: Temperature 70 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: .03		Wind: (mph): 3-7 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to check on computer issues, could not log on. Found plug breaker was tripped that ran computer and internet, must of happen during thunderstorm last night. All other systems cont to run.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	Date: 9-13-2017	Visit Start Time 10:0AM	Visit Stop Time: 2:00 PM
Condition: Temperature 75 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 2.1 "		Wind: (mph): 3-7 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to check on water in MH issues, and I performed an site in section.

There is water on the cover but as we allow the gas to build up it will push the surface water to the auto pump. I talked with Andrew about the flush schedule. I found that we must have a bad bilge pump so I removed it to take home and test. My plans are to let the gas build in the coming warm days and then restart. We had a digester pump to trip the breaker might be storm related.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

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Entry Made By: Marvin	Date: 9-19-2017	Visit Start Time 12:00	Visit Stop Time: 2:00 PM
Condition: Temperature 85 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours:		Wind: (mph): 3-7 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to check. Found MT will not stay running. Contacted E-finity to log in and check system. All else looks good, Skid is running and we have gas.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

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Entry Made By: Kevin	Date: 10-2-2017	Visit Start Time 11:00	Visit Stop Time: 2:00 PM
Condition: Temperature 85 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours:		Wind: (mph): 3-7 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Retook fecal sample out of aeration basin. Digester mixing pump still tripping breaker. Gas is getting low, not sure how much longer we can run.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	Operational Status				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	Date: 10-16-2017	Visit Start Time 9:15	Visit Stop Time: 5:15PM
Condition: Temperature 57-68 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0.5 inches		Wind: (mph): 3-7 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

MT has been down and we have a strong gas build up. I started Flare at 9:20 gas flow at 35 SCFM. Tech. worked on MY from 1-4:30 o no avail we will continue to flare. Called Tech about one digester pump he will get back to schedule a repair visit.

System: # 2 Digester pump down and # 1 Digester pump kicks the breaker now and then. Basin all systems are OK

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 10-17-2017**	**Visit Start Time 6:45**	**Visit Stop Time: 8:00 AM**
Condition: Temperature 42-60 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		**Wind: (mph): 3-7 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to start flare MT is down start at 35 SCFM-- 8498202.1 System: # 2 Digester pump down and # 1 Digester pump kicks the breaker now and then. Basin all systems are OK

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 10-19-2017**	**Visit Start Time 1:15**	**Visit Stop Time: 4:30 PM**
Condition: Temperature 42-60 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		**Wind: (mph): 3-7 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

I had shut the flare down at 6:30 Wednesday morning. Site visit to start flare MT is down start at 35 SCFM-- 8588502.1 System: # 2 Digester pump down and # 1 Digester pump kicks the breaker now and then. Basin all systems are OK. Pumped surface water off NE corner of Digester. Used Vacuum to clean out Gas MH. Used mulch mower to mow center Aisle between Digester and Basin. I talked to Andrew on Monday about the need to mow rather than weed eat because of the debris going into Basin.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

NOTES:

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Entry Made By: Marvin	**Date: 10-20-2017**	**Visit Start Time 11:45 AM**	**Visit Stop Time: 3:00 PM**
Condition: Temperature 68-72 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		**Wind: (mph): 3-7 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to finish mowing the aisle between Digester and Basin, trimmed around flare, building, chiller and conditioner. Started conditioner and flare at 1:05 PM. Start 8620924.0 SCF at the flare. The gas balloon is up some I will flare for a bit and then monitor all weekend. I plan to work on Gas MH Bilge pump and hose reel, I reset timers for the digester pumps to 90 on 45 off.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	Operational Status				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	*Affiliation*	*Phone Number/Email*

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Kevin	Date: 10-25-2017	Visit Start Time 11:45 AM	Visit Stop Time: 3:00 PM
Condition: Temperature 68-72 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		Wind: (mph): 3-7 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Got several problems with mixing pumps. Digester -Pump 1 broke the collar that connects the motor to pump shaft -Pump 2 will run but trips the breaker some
Preferred Sources will be on site Mon, depending on if the new motor, for Pumps 2 if needed, shows up this will Aeration-Pump 1 broken the belts(should be in next week)-Pump 2 will not pump Thinking the intake side of the aeration line is clogged tried to back flush with digester pump 2(when it is running) but not having any luck. Hopefully once we get both digester pump running we can have more pressure to blow anything out of the Aeration line. Also with the new belts for the aeration pump both of them running could be able to get pumping again.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

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Entry Made By: Kevin	**Date: 10-26-2017**	**Visit Start Time 7:45 AM**	**Visit Stop Time: 3:00 PM**
Condition: Temperature 68-72 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		**Wind: (mph): 3-7 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Efinity on site to repair MT, found bad liner and temp gauge in unit. Everything back up and running.

Mixing Pumps are still down.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	**Operational Status**
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	**Set Point**	**Current**	**Modified Set Pt**	**Notes**
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**180**	**180**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	**Run Time**	**Set Speed**	**Notes**
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Marvin	**Date: 10-27-2017**	**Visit Start Time 8:30 AM**	**Visit Stop Time: 1:30 PM**
Condition: Temperature 36-69 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Mike with Pro*Pump was on site today hooking part of the new monitoring system for flush pumps

I worked with Andrew and Landon with their flushing clogged line and our pumps that are down Josh Amon is supposed to be here to work on Dieser pumps next week A-Basin Pump Belts should be here the first of next week

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	Date: 10-30-2017	Visit Start Time 2:30 PM	Visit Stop Time: 6:00 PM
Condition: Temperature 32-58 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0.1”		Wind: (mph): 4-8 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to install new belts and get Basin Pumps running and back on line. Completed Primed the pumps and they are now running and set on auto. We hope to get digester pumps up and running Wednesday.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 10-31-2017**	**Visit Start Time 11:00 AM**	**Visit Stop Time: 5:00 PM**
Condition: Temperature 38-62 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0.0"		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I noticed the Basin Pumps had failed they were turning but not pumping. I shut hem down and worked the remainder of the day trying to get them to pump. I had very little success.

I will try again tomorrow. Josh Amon is scheduled to come to LRF to work on the Digester pumps on Wednesday

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Kevin	**Date: 10-9-2017**	**Visit Start Time 11:00**	**Visit Stop Time: 2:00 PM**
Condition: Temperature 85 F	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours:		**Wind: (mph): 3-7 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

The MT started stopping and starting again this morning. After talking with Efinity we found a bad cooling fan that caused the electrical components to overheat. They are going to try to overnight one and i can replace it in the tomorrow.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			
Mixing Pump 4A		60 Hz	
Mixing Pump 4B		60 Hz	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	Operational Status				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	*Affiliation*	*Phone Number/Email*

NOTES:

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 11-01-2017**	**Visit Start Time 9:00 AM**	**Visit Stop Time: 6:10 PM**
Condition: Temperature 48-70 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0.0”		**Wind: (mph): 3-6 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: Josh Amon came today and worked on both Digester pumps he and his helper were from 10:15 until 6:00, he was able to get both pumps running but one has a leak in the priming cap and is so full of sludge ha we had to shut it down. Josh will order and install a new cap.. I spent the whole day working on the Basin pumps. I finally had to open the right-hand pump and found that the check valve flapper had broken off and was in the pump. I still could not get them to prime and run. I contacted Mike Osborne and he is to send me some data. IU assisted Josh with his repair in-between my attempts.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

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Entry Made By: Marvin	**Date: 11-02-2017**	**Visit Start Time 4:00 PM**	**Visit Stop Time: 6:15 PM**
Condition: Temperature 48-73 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0.0”		**Wind: (mph): 3-6 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I worked on getting the Basin Pumps primed and finally was able to get them(I thought) both pumping I ran pumps and blower for a little over an hour. I shut down the right pump and found that the left one was not sucking from the basin but pulling off the right pump. O Well back to the Try Try and Try again

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Marvin	**Date: 11-03-2017**	**Visit Start Time 2:30 PM**	**Visit Stop Time: 4:30 PM**
Condition: Temperature 48-73 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0.0"		**Wind: (mph): 3-6 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I worked on getting the Basin Pumps to work no luck I will read and study over the weekend and try again on Monday

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	Date: 11-06-2017	Visit Start Time 7:45 AM	Visit Stop Time: 12:30 PM
Condition: Temperature 48-73 F	☐ Clear	☒ Cloudy spitting rain	☐ Balmy
Precip Past 24 hours: 0.15"		Wind: (mph): 3-6 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I worked on getting the Basin Pumps to working I pumped and ran the Blower for about 3.5 to 4 hrs. The digester {Only one was working) is clogged Kevin and I will work on it tomorrow. I found a small snag {may have come from Mower} in the cover at the ground /cover edge on the North side. I taped it and if we have time we might weld it tomorrow. I shut the MT down to save the gas for tomorrow.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	

Anaerobic			
Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin/Kevin	Date: 11-07-2017	Visit Start Time 7:45 AM	Visit Stop Time: 12:00PM
Condition: Temperature 48-73 F	☐ Clear	☒ Cloudy raining	☐ Balmy
Precip Past 24 hours: Trace"		Wind: (mph): 3-6 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: Kevin and Marvin met with Jeff C. and the testing team from Duke. The Chiller failed, and we were unable to do gas test. Kevin called in for service on the chiller and conditioner and they are scheduled to come to LRF tomorrow. Kevin and I were able to flush out the crossover line Digester to Basin and flush out the Digester pump. The basin Pumps are still not working properly. We will try again tomorrow.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	

Anaerobic			
Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 11-08-2017**	**Visit Start Time 7:30 AM**	**Visit Stop Time: 12:30PM**
Condition: Temperature 48-58 F	☐ Clear	☒ Cloudy raining	☐ Balmy
Precip Past 24 hours: 0.15"		**Wind: (mph): 3-6 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I met with service man to find out about the chiller and after checking everything and consulting with all the Tech discovered a bad heat exchanger and all the coolant had leaked out. They are ordering the needed parts and will return to complete the service call as soon as possible. The basin Pumps are still not working properly. I was able to remove the Vacuum gauge and will get parts to re-install. We will try again tomorrow to get them running.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 11-09-2017**	**Visit Start Time 2:30 PM**	**Visit Stop Time: 5:30PM**
Condition: Temperature 48-58 F	☐ Clear	☒ Cloudy raining	☐ Balmy
Precip Past 24 hours: 0.15"		**Wind: (mph): 3-6 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I picked up parts for Digester pump and Basin pump. I installed parts and got both Digester pumps running I installed parts for Vacuum meter but pumps just will not work I plan to call in Mike Osborne tomorrow. I did a site inspection of cover and I believe we have a leak at the NW anchor point. I took pictures and sent to Kevin who will share with PPF. It seems as long as we keep water over the area we are OK for now since we do not have pressure but volume.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	**Operational Status**
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	**Set Point**	**Current**	**Modified Set Pt**	**Notes**
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**180**	**180**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	**Run Time**	**Set Speed**	**Notes**
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

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Entry Made By: Marvin	**Date: 11-10-2017**	**Visit Start Time 11:00 AM**	**Visit Stop Time: 6:30PM**
Condition: Temperature 46-58 -47 F	☐ Clear	☒ Cloudy raining	☐ Balmy
Precip Past 24 hours: Trace in late afternoon 11-09-17”		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I met with service Tech and installed heat exchanger and loaded Glycol. I worked on Basin Pumps and got them running for 6 hours with blower running 3 tried to restart them but failed time for the man MT is running and I reattached cable for Flush Pump the crossover pipe is flowing great. I am going home.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	

Anaerobic			
Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Marvin	**Date: 11-14-2017**	**Visit Start Time 11:00 AM**	**Visit Stop Time: 2:00PM**
Condition: Temperature 46-58 -47 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0 ”		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I worked with Basin pumps and worked with Andrew on flushing

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Marvin	**Date: 11-16-2017**	**Visit Start Time 11:00 AM**	**Visit Stop Time: 1:15PM**
Condition: Temperature 46-58 -47 F	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0 "		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit: I worked with Basin pumps and worked with Andrew on flushing pumped surface water
Worked with Dr. Marc Talked with Andrew we are still clogged

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	**Operational Status**
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	**Set Point**	**Current**	**Modified Set Pt**	**Notes**
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**180**	**180**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	**Run Time**	**Set Speed**	**Notes**
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

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Entry Made By: Kevin	**Date: 11-21-2017**	**Visit Start Time 9:30 AM**	**Visit Stop Time: 12:15 PM**
Condition: Temperature 49	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0 ”		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Took water samples.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Kevin and Marvin	Date: 11-28-2017	Visit Start Time 8:30AM	Visit Stop Time: 4:45PM
Condition: Temperature 28-62	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0 ”		Wind: (mph): 4-8 mph	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to meet with Unison for skid service flushed barn 9 and ran water through 6-7-8 Got the Basin pumps running and the ran from11:00-4:00 with Blower of and on. Started the Auto surface pump

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	

Anaerobic			
Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

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Entry Made By: Kevin	**Date: 11-29-2017**	**Visit Start Time 8:30AM**	**Visit Stop Time: 4:00PM**
Condition: Temperature 28-62	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0 ”		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to meet with Unison for skid service flushed barn 9 and ran water through 6-7-8 Surface water check and System check

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	**Operational Status**
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	**Set Point**	**Current**	**Modified Set Pt**	**Notes**
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**180**	**180**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	**Run Time**	**Set Speed**	**Notes**
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

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Entry Made By: Kevin and Marvin	**Date: 11-30-2017**	**Visit Start Time 8:15AM**	**Visit Stop Time: 3:30PM**
Condition: Temperature 30-62	☒ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0 ”		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to pump from LAGOON to Digester. We pulled the Plug and are flushing # 9 and overflowing barns 6 and 8. We finally have enough water in Digester to flow across to Basin keeping the cross over pipe open, we put the Boat in the Basin and Kevin unclogged the overflow holes bringing water from Lagoon to the Basin.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	60	60		
Anoxic	90	90		
Aerobic	180	180		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		60Hz	
Jet Motive Pump # 2		60Hz	
Blower		30Hz	

Anaerobic			
Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Marvin	**Date: 12-05-2017**	**Visit Start Time 10:00AM**	**Visit Stop Time: 2:30PM**
C46ondition: Temperature 44-	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0 "		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit to meet with Mike Osborne for service of basin pumps and installing of back flow flappers washed my boat out and found the plug broken and will need replacing, Basin pumps are now back on automatic and Andrew is flushing

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	Operational Status
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	Set Point	Current	Modified Set Pt	Notes
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**180**	**180**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	Run Time	Set Speed	Notes
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

LOYD RAY FARMS INSPECTION, OPERATIONS & MAINTENANCE LOG SHEET

IMPORTANT: AN INSPECTION, OPERATIONS & MAINTENANCE LOG SHOULD BE COMPLETED FOR EVERY SITE VISIT; PLEASE REVIEW PREVIOUS LOG ENTRY AND PROVIDE INFORMATION TO UPDATE OR RESOLVE ANY ON-GOING ISSUES NOTED (INCLUDING BUT NOT LIMITED TO MAINTENANCE, REPAIRS, OR CORRECTIVE ACTIONS).

Entry Made By: Marvin	**Date: 12-14-2017**	**Visit Start Time 12:30PM**	**Visit Stop Time: 3:15PM**
C46ondition: Temperature 44-	☐ Clear	☒ Cloudy	☐ Balmy
Precip Past 24 hours: 0 ”		**Wind: (mph): 4-8 mph**	

PURPOSE OF VISIT/ITEMS INSPECTED, OPERVATIONS

Site visit Basin pumps failed and soft ware failed to prevent blower from running and poses a treat of rupture of airline left pumps on auto and cut blower off.

ENVIRONMENTAL SYSTEM OBSERVATIONS:

Equipment Observed:	**Operational Status**
Fluidyne Aeration System, Including:	
Jet Motive Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Blower	☒ Auto ☐ Hand On ☐ Off ☐ In Fault:
CP-1 (Control Panel)	☒ Auto ☐ Hand On ☐ Off ☐ In Fault
Flush Pumps	☐ Auto ☒ Hand On ☐ Off ☐ In Fault
Digester Mixing Pumps	☒ Auto ☐ Hand On ☐ Off ☐ In Fault

CP-1 DATA & SET POINTS;

Cycles	**Set Point**	**Current**	**Modified Set Pt**	**Notes**
Static	**60**	**60**		
Anoxic	**90**	**90**		
Aerobic	**180**	**180**		
Blower	☐ Continuous ☒ Cycle			
Jet Motive Pumps	☐ Continuous ☒ Both ☐ Pump #1 ☐ Pump # 2			
Digester Pumps	☐ Continuous ☒ Both ☐ Sequential			

MOTOR DATA:

Aerobic	**Run Time**	**Set Speed**	**Notes**
Jet Motive Pump # 1		**60Hz**	
Jet Motive Pump # 2		**60Hz**	
Blower		**30Hz**	
Anaerobic			

Mixing Pump 4A		**60 Hz**	
Mixing Pump 4B		**60 Hz**	

BIOGAS & POWER SYSTEMS OBSERVATIONS:

Equipment Observed:	**Operational Status**				
Unison Gas Skid	Flow Rate	Total Flow	Comp. Press.	Outlet Press.	Gauge Press.
Fault? ☐ Yes ☒ No	20.9				
Microturbine	Speed	Exit Temp	Inlet Pressure	Inlet Temp	Power Out
Fault? ☐ Yes ☒ No	95852	1174		99	43.7 kw
Biogas System	BlueSens%	Flare On	Flare Flow	Total Flow	Flare Temp
		☒ Y ☐ N	31.2	29.1	301

UNISON GAS CONDITIONING LOG

Pressure Data	**PIT 311** -5 to 10 inWC -0.1	**PIT 331** 88 to 110psig 97.39	**PIT 351** 88 to 110 psig 91.8	**Pressure Differential** **2.0**	**Panel Door**	**HM 331** Hours 7060	
Temperature Data	**TE 141** 32 to 45 F 35.1	**TE 311** 40 to 115 F 83.1	**TE 321** 35 to 75 F 46.6	**TE 331** 80 to 220 F 186.5	**TE 341** 33 to 45 F 35.2	**TE 342** 65 to 90 F 88.3	**TE 31** 35 to 115 F
Glycol Piping	**TI 141** 32 to 45 F	**PI 141** 35 to 52 psig	**FI 141** 2.5 to 3.5 gpm	**TI 142** 35 to 50 F	**PI 142** 33 to 50 psig	**TI 111** 38 to 52 F	**PI 111** 30 to 48 psig
Oil Piping	**PI 231** 90 to 110 psig	**TI 231** 178 to 215 F	**PI 232** 85 to 105 psig	**TI 232** 130 to 180 F	**PI 233** 80 to 100 psig	**TI 233** 168 to 185 F	**PI 234** 78 to 100psig
Gas Piping	**PIT 311** -10 to10inWC	**TI 311** 40 to 115 F	**TI 321** 35 to 75 F	**PDI 321** 0 to 6 inWC	**PI 331** 90 to 110 psig	**TI 331** 80 to 220 F	**PI 332** 90 to 110psig
Gas Piping	**TI 341** 80 to 220 F	**PI 341** 90 to 110 psig	**TI 342** 115 to 155 F	**PI 342** 90 to 110 psig	**TE 343** 33 to 45 F	**PI 343** 90 to 110 psig	
Gas Piping	**TI 351** 65 to 90 F	**PI 351** 88 to 15 psig	**Check Indicators**	**LI 721**	**LI 231**	**LI 741**	

PERSONNEL PRESENT:

Name	***Affiliation***	***Phone Number/Email***

Appendix B.

Wastewater Sample Reports

RESEARCH & ANALYTICAL LABORATORIES, INC.

Report of Analysis

9/5/2017

RESEARCH & ANALYTICAL LABS. SIDNEY L. CHAMPION NC #34 NC #37701 DIRECTOR CERTIFIED ANALYSIS

For: **Cavanaugh & Associates**
530 N. Trade Street, Suite 205
Winston-Salem, NC 27101

Attn: Kevin Harward

Client Sample ID: Influent | **Lab Sample ID:** 38790-01
Site: Cavanaugh & Assoc | **Collection Date:** 8/16/2017 11:00

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Ammonia Nitrogen	SM 4500 NH3 D-1997	1550	mg/L	0.1	MZ	8/24/2017
Copper, Total	EPA 200.7	0.973	mg/L	0.005	KL	8/20/2017
Fecal Coliform - MPN	SM 9221 C E-2006	2400000	MPN/100ml	2	LP	8/16/2017 1530
Nitrate + Nitrite	SM 4500 NO3 E-2000	<0.05	mg/L	0.05	DW	8/31/2017 1020
pH	SM 4500 H+B-2000	7.46	Std. Units		AP	8/18/2017
Total Kjedjahl Nitrogen	SM 4500 N Org B (NH3 D-1997)	2220	mg/L	0.1	MZ	8/25/2017
Total Nitrogen	Calc	2220	mg/L	1		
Total Phosphorous	SM 4500 P E-1999	128	mg/L	0.05	LP	8/28/2017
Total Suspended Solids (TSS)	SM 2540 D-1997	5020	mg/L	5	AA	8/18/2017
Zinc, Total	EPA 200.7	6.83	mg/L	0.01	KL	8/20/2017

Client Sample ID: Digester | **Lab Sample ID:** 38790-02
Site: Cavanaugh & Assoc | **Collection Date:** 8/16/2017 11:15

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Ammonia Nitrogen	SM 4500 NH3 D-1997	1320	mg/L	0.1	MZ	8/24/2017
Copper, Total	EPA 200.7	8.92	mg/L	0.005	KL	8/20/2017
Fecal Coliform - MPN	SM 9221 C E-2006	110000	MPN/100ml	2	LP	8/16/2017 1530
Nitrate + Nitrite	SM 4500 NO3 E-2000	<0.05	mg/L	0.05	DW	8/31/2017 1020
pH	SM 4500 H+B-2000	7.72	Std. Units		AP	8/18/2017

Research & Analytical Laboratories, Inc.

Report of Analysis

9/5/2017

Client Sample ID: Digester
Site: Cavanaugh & Assoc

Lab Sample ID: 38790-02
Collection Date: 8/16/2017 11:15

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Total Kjedjahl Nitrogen	SM 4500 N Org B (NH3 D-1997)	1590	mg/L	0.1	MZ	8/25/2017
Total Nitrogen	Calc	1590	mg/L	1		
Total Phosphorous	SM 4500 P E-1999	1430	mg/L	0.05	LP	8/28/2017
Total Suspended Solids (TSS)	SM 2540 D-1997	33600	mg/L	5	AA	8/18/2017
Zinc, Total	EPA 200.7	73.1	mg/L	0.01	KL	8/20/2017

Client Sample ID: Effluent
Site: Cavanaugh & Assoc

Lab Sample ID: 38790-03
Collection Date: 8/16/2017 11:30

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Ammonia Nitrogen	SM 4500 NH3 D-1997	854	mg/L	0.1	MZ	8/24/2017
Copper, Total	EPA 200.7	0.144	mg/L	0.005	KL	8/20/2017
Fecal Coliform - MPN	SM 9221 C E-2006	110000	MPN/100ml	2	LP	8/16/2017 1530
Nitrate + Nitrite	SM 4500 NO3 E-2000	0.143	mg/L	0.05	DW	8/31/2017 1020
pH	SM 4500 H+B-2000	8.23	Std. Units		AP	8/18/2017
Total Kjedjahl Nitrogen	SM 4500 N Org B (NH3 D-1997)	1040	mg/L	0.1	MZ	8/25/2017
Total Nitrogen	Calc	1040	mg/L	1		
Total Phosphorous	SM 4500 P E-1999	30.4	mg/L	0.05	LP	8/28/2017
Total Suspended Solids (TSS)	SM 2540 D-1997	582	mg/L	5	AA	8/18/2017
Zinc, Total	EPA 200.7	0.704	mg/L	0.01	KL	8/20/2017

NA = not analyzed

RESEARCH & ANALYTICAL LABORATORIES, INC.

Analytical / Process Consultations
Phone (336) 996-2841

CHAIN OF CUSTODY RECORD

COMPANY: Cavanaugh & Assoc.	JOB NO.
STREET ADDRESS: 530 N. Trade St. Suite 302	PROJECT: LRF
CITY, STATE, ZIP: W-S NC 27101	SAMPLER NAME (PLEASE PRINT): Kevin Harvard
CONTACT: Kevin Harvard PHONE: 336-759-9001	SAMPLER SIGNATURE

WATER / WASTEWATER: 2L G (BNA, Herb. / Pest.); 2 40ml Vials (VOA) HCL; 250ml G (TOX); 250ml P (TOC) H_2SO_4; 1L P, G (BOD, TSS, Unpreserved, etc.); 1L G (Phenol, Oil & Grease) H_2SO_4; 1L P, G (COD, N, P) H_2SO_4; 1L P, G (Metals, Hardness) HNO_3; 1L P, G (CYANIDE) NaOH; Sterile P, G (Coliform)

MISC.

SAMPLE NUMBER (LAB USE ONLY)	DATE	TIME	COMP	GRAB	TEMP °C	RES Cl (mg/L)	CHLORINE REMOVED (Y or N)	SAMPLE MATRIX (S or W)	SAMPLE LOCATION / I.D.	NO. OF CONTAINERS	REQUESTED ANALYSIS
33790-01	8/16/17	11:00							Influent	5	Tot N
											TK N
02		11:15							Digester		NO2 + NO3
											Phosphorous T
03		11:20							Effluent		NH-3-N
											Fec Coli (MPN)
											Copper T
											Zinc T
											TSS
											PH

RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	8/16/17 12:55	[signature]
RELINQUISHED BY	DATE/TIME	RECEIVED BY

REMARKS:

omn

SAMPLE TEMPERATURE AT RECEIPT 3.1 °C

Jennings Exhibit No. 12
Docket No. E-7, Sub 1162

Research & Analytical Laboratories, Inc.

Report of Analysis

10/9/2017

RESEARCH & ANALYTICAL LABS. SIDNEY L. CHAMPION NC #34 NC #37701 DIRECTOR CERTIFIED ANALYSIS

For: **Cavanaugh & Associates**
530 N. Trade Street, Suite 205
Winston-Salem, NC 27101

Attn: Kevin Harward

Client Sample ID: Effluent A -LBF
Site: Cavanaugh & Assoc
Lab Sample ID: **40760-01**
Collection Date: 10/2/2017 11:45

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Fecal Coliform - MPN	SM 9221 C E-2006	5350	MPN/100ml	2	LP	10/2/2017 1605

Client Sample ID: Effluent B -LBF
Site: Cavanaugh & Assoc
Lab Sample ID: **40760-02**
Collection Date: 10/2/2017 11:45

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Fecal Coliform - MPN	SM 9221 C E-2006	11000	MPN/100ml	2	LP	10/2/2017 1605

NA = not analyzed

RESEARCH & ANALYTICAL LABORATORIES, INC.
Analytical / Process Consultations
Phone (336) 996-2841

CHAIN OF CUSTODY RECORD

COMPANY: Cavanaugh & Assoc.
STREET ADDRESS: 530 N. Trade St. Suite 302
CITY, STATE, ZIP: W-S NC 27101
CONTACT: Kevin Harward
PHONE: 830-0162

JOB NO.:
PROJECT: LBF
SAMPLER NAME (PLEASE PRINT): Kevin Harward
SAMPLER SIGNATURE:

WATER / WASTEWATER: 2L G (BNA, Herb. / Pest.); 2 40ml Vials (VOA) HCL; 250ml G (TOX); 250ml P (TOC) H_2SO_4; 1L P,G (BOD, TSS, Unpreserved, etc.); 1L G (Phenol, Oil & Grease) H_2SO_4; 1L P, G (COD, N, P) H_2SO_4; 1L P, G (Metals, Hardness) HNO_3; 1L P, G (CYANIDE) NaOH; Sterile P, G (Coliform)

MISC.

SAMPLE NUMBER (LAB USE ONLY)	DATE	TIME	COMP	GRAB	TEMP °C	RES Cl (mg/L)	CHLORINE REMOVED (Y or N)	SAMPLE MATRIX (S or W)	SAMPLE LOCATION / I.D.	REQUESTED ANALYSIS
40760-01	10-2-17	11:45							Efflent A	Fecal - MPN
-02									" B	Fecal - MPN

RELINQUISHED BY	DATE/TIME	RECEIVED BY
	10/2 1145	
RELINQUISHED BY	DATE/TIME	RECEIVED BY

REMARKS:

SAMPLE TEMPERATURE AT RECEIPT 3.1 °C ON ICE

Jennings Exhibit No. 12
Docket No. E-7, Sub 1162

Mar 07 2018 OFFICIAL COPY

Research & Analytical Laboratories, Inc.

Report of Analysis

12/14/2017

For: Cavanaugh & Associates
530 N. Trade Street, Suite 205
Winston-Salem, NC 27101

Attn: Kevin Harward

RESEARCH & ANALYTICAL LABS. SIDNEY L. CHAMPION NC #34 NC #37701 DIRECTOR CERTIFIED ANALYSIS

Client Sample ID: Influent
Site: Cavanaugh & Assoc

Lab Sample ID: 43189-01
Collection Date: 11/21/2017 9:45

Parameter	Method	Result	Units	Analyst	Analysis Date/Time	
Total Nitrogen	Calc	7800	mg/kg			
Copper, Total	EPA 200.7	284	mg/kg	JC	12/5/2017	
Zinc, Total	EPA 200.7	2160	mg/kg	JC	12/5/2017	
Nitrate + Nitrite	Hach 10206	15.9	mg/kg	DW	12/4/2017	1600
Total Solids	SM 2540 B-1997	7.53	%	AA	11/28/2017	
pH	SM 4500 H+B-2000	7.35	Std. Units	AP	11/21/2017	
Total Kjedjahl Nitrogen	SM 4500 N Org B (NH3 D-1997)	7780	mg/kg	SK	11/30/2017	
Ammonia Nitrogen	SM 4500 NH3 D-1997	3840	mg/kg	SK	11/30/2017	
Total Phosphorous	SM 4500 P E-1999	24400	mg/kg	LP	11/27/2017	
Fecal Coliform - MPN	SM 9221 C E-2006	23900000	mpn/g TS	LP	11/21/2017	1610

NA = not analyzed

Jennings Exhibit No. 12
Docket No. E-7, Sub 1162

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Mar 07 2018

Research & Analytical Laboratories, Inc.

Report of Analysis

12/14/2017

For: Cavanaugh & Associates
530 N. Trade Street, Suite 205
Winston-Salem, NC 27101

Attn: Kevin Harward

RESEARCH & ANALYTICAL LABS. SIDNEY L. CHAMPION NC #34 NC #37701 DIRECTOR CERTIFIED ANALYSIS

Client Sample ID: Digester
Site: Cavanaugh & Assoc

Lab Sample ID: 43189-02
Collection Date: 11/21/2017 10:00

Parameter	Method	Result	Units	Analyst	Analysis Date/Time	
Total Nitrogen	Calc	3600	mg/kg			
Copper, Total	EPA 200.7	236	mg/kg	JC	12/5/2017	
Zinc, Total	EPA 200.7	1680	mg/kg	JC	12/5/2017	
Nitrate + Nitrite	Hach 10206	78.2	mg/kg	DW	12/4/2017	1615
Total Solids	SM 2540 B-1997	3.81	%	AA	11/28/2017	
pH	SM 4500 H+B-2000	7.43	Std. Units	AP	11/21/2017	
Total Kjedjahl Nitrogen	SM 4500 N Org B (NH3 D-1997)	3520	mg/kg	SK	11/30/2017	
Ammonia Nitrogen	SM 4500 NH3 D-1997	2110	mg/kg	SK	11/30/2017	
Total Phosphorous	SM 4500 P E-1999	13400	mg/kg	LP	11/27/2017	
Fecal Coliform - MPN	SM 9221 C E-2006	367000	mpn/g TS	LP	11/21/2017	1610

NA = not analyzed

Jennings Exhibit No. 12
Docket No. E-7, Sub 1162

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Mar 07 2018

Research & Analytical Laboratories, Inc.

Report of Analysis

12/14/2017

RESEARCH & ANALYTICAL LABS.
SIDNEY L. CHAMPION
NC #34
NC #37701
DIRECTOR
CERTIFIED ANALYSIS

For: **Cavanaugh & Associates**
530 N. Trade Street, Suite 205
Winston-Salem, NC 27101

Attn: Kevin Harward

Client Sample ID: Effluent
Site: Cavanaugh & Assoc

Lab Sample ID: 43189-03
Collection Date: 11/21/2017 10:15

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Ammonia Nitrogen	SM 4500 NH3 D-1997	1480	mg/L	0.1	SK	11/30/2017
Copper, Total	EPA 200.7	0.089	mg/L	0.005	JC	11/27/2017
Fecal Coliform - MPN	SM 9221 C E-2006	9200	MPN/100ml	2	LP	11/21/2017 1610
Nitrate + Nitrite	Hach 10206	38.3	mg/L	0.3	DW	12/4/2017 1530
pH	SM 4500 H+B-2000	8.33	Std. Units		AP	11/21/2017
Total Kjedjahl Nitrogen	SM 4500 N Org B (NH3 D-1997)	2050	mg/L	0.1	SK	11/30/2017
Total Nitrogen	Calc	2090	mg/L	1		
Total Phosphorous	SM 4500 P E-1999	428	mg/L	0.05	LP	11/27/2017
Total Suspended Solids (TSS)	SM 2540 D-1997	472	mg/L	5	AA	11/27/2017
Zinc, Total	EPA 200.7	0.283	mg/L	0.01	JC	11/27/2017

NA = not analyzed

RESEARCH & ANALYTICAL LABORATORIES, INC.
Analytical / Process Consultations
Phone (336) 996-2841

CHAIN OF CUSTODY RECORD

COMPANY: Cavanaugh & Assoc.
STREET ADDRESS: 530 N. Trade St. Suite 302
CITY, STATE, ZIP: W-S NC 27101
CONTACT: Kevin Harward
PHONE: 336-759-9001
JOB NO.:
PROJECT: LRF
SAMPLER NAME (PLEASE PRINT): Kevin Harward
SAMPLER SIGNATURE:

SAMPLE NUMBER (LAB USE ONLY)	DATE	TIME	COMP	GRAB	TEMP °C	RES Cl (mg/L)	CHLORINE REMOVED (Y or N)	SAMPLE MATRIX (S or W)	SAMPLE LOCATION / I.D.	NO. OF CONTAINERS
4318901	11/21/17	9:45							Influent	5
02		10:00							Digester	
03		10:15							Effluent	

WATER / WASTEWATER: 2L G (BNA, Herb. / Pest.); 2 40ml Vials (VOA) HCL; 250ml G (TOX); 250ml P (TOC) H_2SO_4; 1L P, G (BOD, TSS, Unpreserved, etc.); 1L G (Phenol, Oil & Grease) H_2SO_4; 1L P, G (COD, N, P) H_2SO_4; 1L P, G (Metals, Hardness) HNO_3; 1L P, G (CYANIDE) NaOH; Sterile P, G (Coliform)

MISC.

REQUESTED ANALYSIS:
- Tot N
- TKN
- NO2 + NO3
- Phosphorous T
- NH-3-N
- Fec Coli
- Copper T
- Zinc T
- TSS
- PH

RELINQUISHED BY	DATE/TIME	RECEIVED BY
	11/21/17 12:40	
RELINQUISHED BY	DATE/TIME	RECEIVED BY
	17	

REMARKS:

SAMPLE TEMPERATURE AT RECEIPT 3.3 °C

RESEARCH & ANALYTICAL LABORATORIES, INC.

Report of Analysis

1/26/2018

For: **Cavanaugh & Associates**
530 N. Trade Street, Suite 205
Winston-Salem, NC 27101

Attn: Kevin Harward

RESEARCH & ANALYTICAL LABS. SIDNEY L. CHAMPION NC #34 NC #37701 DIRECTOR CERTIFIED ANALYSIS

Client Sample ID: #1 **Lab Sample ID:** 45493-01
Site: Cavanaugh & Assoc **Collection Date:** 1/22/2018 13:15

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Fecal Coliform - MPN	SM 9221 C E-2006	92000000	MPN/100ml	2	LP	1/22/2018 1600

Client Sample ID: #2 **Lab Sample ID:** 45493-02
Site: Cavanaugh & Assoc **Collection Date:** 1/22/2018 13:15

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Fecal Coliform - MPN	SM 9221 C E-2006	35000	MPN/100ml	2	LP	1/22/2018 1600

Client Sample ID: #3 **Lab Sample ID:** 45493-03
Site: Cavanaugh & Assoc **Collection Date:** 1/22/2018 13:15

Parameter	Method	Result	Units	Rep Limit	Analyst	Analysis Date/Time
Fecal Coliform - MPN	SM 9221 C E-2006	>160000000	MPN/100ml	2	LP	1/22/2018 1600

NA = not analyzed

Research & Analytical Laboratories, Inc.

Analytical / Process Consultations
Phone (336) 996-2841

CHAIN OF CUSTODY RECORD

COMPANY: CAVANAUGH & ASSOC
STREET ADDRESS: 530 N TRADE ST SUITE 302
CITY, STATE, ZIP: WINSTON SALEM NC 27101
CONTACT: KEVIN HARWARD / MARVIN CAVANAUGH
PHONE: 336418-4204
JOB NO.:
PROJECT: LRF
SAMPLER NAME (PLEASE PRINT): MARVIN CAVANAUGH
SAMPLER SIGNATURE: M—

SAMPLE NUMBER (LAB USE ONLY)	DATE	TIME	COMP	GRAB	TEMP °C	RES Cl (mg/L)	CHLORINE REMOVED (Y or N)	SAMPLE MATRIX (S or W)	SAMPLE LOCATION / I.D.	NO. OF CONTAINERS	2L G (BNA, Herb. / Pest.)	2 40ml Vials (VOA) HCL	250ml G (TOX)	250ml P (TOC) H_2SO_4	1L P, G (BOD, TSS, Unpreserved, etc.)	1L G (Phenol, Oil & Grease) H_2SO_4	1L P, G (COD, N, P) H_2SO_4	1L P, G (Metals, Hardness) HNO_3	1L P, G (CYANIDE) NaOH	Sterile P, G (Coliform)	MISC.			REQUESTED ANALYSIS
4S493-01	1-22-18	13:15							#1															f/c mpn
02	↓	↓							#2															
03									#3															

RELINQUISHED BY	DATE/TIME	RECEIVED BY
M—	1-22-18 1430	[signature]
RELINQUISHED BY	DATE/TIME	RECEIVED BY

REMARKS:

SAMPLE TEMPERATURE AT RECEIPT 3.1 °C

JENNINGS CONFIDENTIAL EXHIBIT NO. 13

DOCKET NO. E-7, SUB 1162

CONFIDENTIAL – FILED UNDER SEAL

JENNINGS CONFIDENTIAL EXHIBIT NO. 14

DOCKET NO. E-7, SUB 1162

CONFIDENTIAL – FILED UNDER SEAL

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1162

In the Matter of Application of Duke Energy Carolinas, LLC for Approval of Renewable Energy and Energy Efficiency Portfolio Standard (REPS) Compliance Report and Cost Recovery Rider Pursuant to N.C. Gen. Stat. § 62-133.8 and Commission Rule R8-67	))))))))	**DIRECT TESTIMONY OF VERONICA I. WILLIAMS**

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Veronica I. Williams, and my business address is 550 South Tryon Street, Charlotte, North Carolina.

Q. WHAT IS YOUR POSITION WITH DUKE ENERGY CAROLINAS, LLC?

A. I am a Rates and Regulatory Strategy Manager for Duke Energy Carolinas, LLC ("Duke Energy Carolinas" or the "Company"). Duke Energy Carolinas is a wholly-owned subsidiary of Duke Energy Corporation ("Duke Energy").

Q. PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND, BUSINESS BACKGROUND AND PROFESSIONAL AFFILIATIONS.

A. I received a Bachelor of Science degree in Business from the University of North Carolina at Charlotte. I am a certified public accountant licensed in the state of North Carolina. I began my career with Duke Power Company ("Duke Power") (now known as Duke Energy Carolinas) as an internal auditor and subsequently worked in various departments in the finance organization. I joined the Rates Department in 2001.

Q. WHAT ARE YOUR PRESENT RESPONSIBILITIES AT DUKE ENERGY CAROLINAS?

A. I am responsible for providing regulatory support for retail and wholesale rates and providing guidance on Renewable Energy and Energy Efficiency Portfolio Standard ("REPS") compliance and cost recovery for Duke

Energy Carolinas and Duke Energy Progress, LLC ("Duke Energy Progress" or "DEP").

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE NORTH CAROLINA UTILITIES COMMISSION?

A. Yes. I most recently provided testimony in Docket No. E-2, Sub 1144 regarding Duke Energy Progress' 2016 REPS compliance report and application for approval of its REPS cost recovery rider, and in Docket No. E-7, Sub 1131 regarding Duke Energy Carolinas' 2016 REPS compliance report and application for approval of its REPS cost recovery rider.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to describe the calculation of and present the support for the REPS rider proposed by Duke Energy Carolinas under N.C. Gen. Stat. ("G.S.") § 62-133.8 and to present the information and data required by Commission Rule R8-67 as set forth in Williams Exhibit Nos. 1 through 4. The test period used in supplying this information and data is the twelve months beginning on January 1, 2017 and ending on December 31, 2017 ("Test Period" or "EMF Period"), and the billing period for the REPS rider requested in the Company's application is the twelve months beginning on September 1, 2018 and ending on August 31, 2019 ("Billing Period").

Q. PLEASE DESCRIBE THE EXHIBITS TO YOUR TESTIMONY.

A. Williams Confidential Exhibit No. 1 (“Williams Exhibit No. 1”) identifies the total REPS compliance costs for which the Company seeks recovery from Duke Energy Carolinas’ North Carolina Retail (“NC Retail”) customers and from the Company’s wholesale customers that receive REPS compliance services from the Company (“Wholesale”). Williams Confidential Exhibit No. 2 (“Williams Exhibit No. 2”) shows the allocation of the total REPS compliance costs, identified in Williams Exhibit No. 1, to the Company’s NC Retail customers for the Test Period. Williams Confidential Exhibit No. 3 (“Williams Exhibit No. 3”) shows the allocation of the total expected REPS compliance costs, identified on Williams Exhibit No. 1, to the Company’s NC Retail customers for the Billing Period. Williams Exhibit No. 4 shows the total REPS rider amounts proposed, including the REPS Experience Modification Factor (“EMF”), by customer class, compared to the cost cap for each customer class. Williams Exhibit No. 5 is the tariff sheet for the proposed REPS Rider. Williams Exhibit No. 6 is a worksheet detailing the Company’s energy efficiency certificate (“EEC”) inventory balance as of December 31, 2017. Finally, Williams Confidential Exhibit No. 7 (“Williams Exhibit No. 7”) is a summary cost recovery worksheet related to the Company’s two solar facilities – the Monroe solar facility (“Monroe Solar Facility”) and the Mocksville solar facility (“Mocksville Solar Facility”)- recently placed into service.

Q. WERE THESE EXHIBITS PREPARED BY YOU OR AT YOUR DIRECTION AND UNDER YOUR SUPERVISION?

A. Yes.

Q. WHAT COSTS ARE INCLUDED IN DUKE ENERGY CAROLINAS' PROPOSED REPS RIDER?

A. The proposed REPS rider intends to recover Duke Energy Carolinas' incremental costs of compliance with the renewable energy requirements pursuant to G.S. § 62-133.8. The rider includes the REPS EMF component to recover the difference between the compliance costs incurred and revenues realized during the Test Period. The costs incurred during the Test Period are presented in this filing to demonstrate their reasonableness and prudency as provided in North Carolina Utilities Commission ("Commission") Rule R8-67(e). The proposed rider also includes a component to recover the costs expected to be incurred for the Billing Period.

Q. PLEASE DESCRIBE THE METHODOLOGY DUKE ENERGY CAROLINAS USED TO CALCULATE THE INCREMENTAL COSTS OF COMPLIANCE WITH THE REPS REQUIREMENTS.

A. Company Witness Jennings describes the costs Duke Energy Carolinas incurred during the Test Period and the costs the Company projects to incur during the Billing Period to comply with its REPS requirements. G.S. § 62-133.8(h)(1) provides that "incremental costs" means "all reasonable and prudent costs incurred by an electric power supplier" to comply with the REPS requirements "that are in excess of the electric power supplier's avoided costs other than those costs recovered pursuant to N.C. Gen. Stat. § 62-133.9."

For purchased power agreements with a renewable energy facility, Duke Energy Carolinas subtracted its avoided cost from the total cost associated with the renewable energy purchase to arrive at the incremental cost for the renewable energy purchase during the period in question.

Consistent with Rule R8-67(e)(2), which provides that the cost of an unbundled renewable energy certificate ("REC") "is an incremental cost and has no avoided cost component," the total costs incurred during the Test Period for REC purchases are included in incremental costs. Further, the projected costs for REC purchases during the Billing Period are included as incremental costs.

As described in detail by Company Witness Jennings in her direct testimony filed in this docket, the REPS EMF and Billing Period components of the proposed REPS rider also include compliance-related incremental administration costs, labor costs, and costs related to research incurred during the 2017 EMF Period and estimated to be incurred during the Billing Period, respectively. Additionally, as further detailed in the testimony of Witness Jennings, an amount equal to the annual amortization of Solar Rebate Program costs incurred pursuant to G.S. § 62-155(f) applicable to the Billing Period is also included for recovery in the proposed REPS rider.

Q. PLEASE FURTHER EXPLAIN THE CALCULATION OF INCREMENTAL COST OF COMPLIANCE WITH RESPECT TO THE COMPANY'S SOLAR GENERATION FACILITIES.

A. The revenue requirements for recovery of capital and operating costs for the Duke Energy North Carolina Solar Photovoltaic Distributed Generation Program ("Duke Energy PV DG Program" or "Solar PVDG Program") are levelized and then reduced by avoided costs to determine incremental costs. The incremental costs for which the Company seeks recovery through the REPS rider are limited, in compliance with the Commission's May 6, 2009 *Order on Reconsideration* in Docket No. E-7, Sub 856 and the Commission's August 23, 2011 *Order Approving REPS and REPS EMF Riders and 2010 REPS Compliance* in Docket No. E-7, Sub 984 ("*2011 REPS Order*").

As described by Company Witness Jennings in her Direct Testimony, the Company recently completed and placed in service two solar photovoltaic facilities. The 15 MW Mocksville Solar Facility located in Davie County was placed in service in December 2016, and the 60 MW Monroe Solar Facility was placed in service in April 2017. An annual revenue requirement, including capital costs and operations and maintenance costs, is calculated for each project for all years of the expected service life of the project. The present value of the total project revenue requirement is levelized over the project life to produce a levelized annual revenue requirement, which is compared to avoided cost to determine any annual incremental cost subject to recovery through the REPS rider.

In addition to the Monroe and Mocksville Solar Facilities already in service, the Woodleaf solar facility ("Woodleaf Solar Facility") is expected to commence construction in the second quarter of 2018 and be in service by year-end 2018, as noted by Witness Jennings in her testimony. The Company also calculated an estimated annual levelized revenue requirement for the Woodleaf Solar Facility applicable to the Billing Period.

The annual levelized revenue requirement, along with the actual and projected number of RECs produced, for each solar facility for the EMF and Billing Periods are shown on Jennings Confidential Exhibit No. 2. The total annual revenue requirements for the facilities are combined and are included, with the associated calculated avoided cost and incremental cost components and number of RECs, on Williams Exhibit No. 1, Pages 1 and 2, Line No. 2.

Q. DOES THE COMPANY PROPOSE INCLUDING RECOVERY OF THE INCREMENTAL COSTS OF DEC'S NEW SOLAR FACILITIES IN ITS REPS RIDERS?

A. Yes. Orders approving the transfers of the certificates of public convenience and necessity to DEC were issued by the Commission on May 16, 2016 for both the Mocksville (Docket No. E-7, Sub 1098) and the Monroe (Docket No. E-7, Sub 1079) Solar Facilities. An order approving the certificate of public convenience and necessity ("CPCN") for construction of the Woodleaf Solar Facility was issued on June 16, 2016 (Docket No. E-7, Sub 1101). Collectively, these orders are referred to herein as the "*DEC Solar PV Orders*." (Collectively, the Mocksville, Monroe, and Woodleaf Solar Facilities are referred to herein as the "DEC Solar PV facilities".) In its *DEC Solar PV Orders*, the Commission limited cost recovery for the DEC Solar PV facilities through the Company's REPS riders to the equivalent of the standard REC offer price that DEC was offering to new renewable energy facilities at the time the purchase agreements were executed for the facilities. The current annual levelized total revenue requirement per megawatt hour ("MWh") for each facility, computed based on updated tax benefit assumptions and actual completed project cost, as available, is greater than the applicable levelized avoided cost per MWh, as was the case when each project was submitted for approval in the applicable CPCN proceeding. Accordingly, the Company is including for cost recovery in this REPS rider only the percentage of annual levelized total cost equivalent to the standard REC offer price as approved by the Commission in its *DEC Solar PV Orders*.

Q. WHAT OTHER CONDITIONS DID THE COMMISSION INCLUDE IN ITS APPROVAL OF THE CPCN FOR EACH OF THE DEC SOLAR PV FACILITIES?

A. During its investigation of the Company's applications for the CPCNs, the Public Staff expressed concern about DEC's ability to realize certain tax benefits projected at the time the Company applied for approval of the facilities, citing the potential effect on the cost-effectiveness of the facilities as REPS compliance resources. To address this concern, the Company agreed to certain conditions, which the Commission included in its orders.

First, the Company agreed to the condition noted above, limiting the cost recovery amount in REPS to the standard offer REC price. In addition, the Company agreed to a condition related to DEC's ability to monetize the following four tax benefits:

(a) The federal Section 199 deduction;

(b) The federal Investment Tax Credit ("ITC") of 30% of the cost of eligible property;

(c) The five-year Modified Accelerated Cost Recovery System ("MACRS") tax depreciation; and

(d) A property tax abatement of 80% on solar property.

The condition provides that, in the appropriate REPS rider and general rate case proceedings, DEC will separately itemize the actual monetization of all the tax benefits listed above within its calculation of the levelized revenue requirement per MWh for each facility so that it may be compared with the monetization of such tax benefits within the Company's revenue requirement analysis of the facility. To the extent the Company fails to fully realize the tax benefits it originally assumed in its estimated revenue requirements, the costs associated with the increased revenue requirements related to (a), (c), and (d) will be presumed to be imprudent and unreasonably incurred. DEC may rebut this presumption with evidence supporting the reasonableness and prudence of its actual monetization of the tax credits. With respect to (b), no presumption of unreasonableness or imprudence is created, but DEC must recover any increase in the revenue requirement associated with (b) in its base rates.

Q. DID THE COMPANY ANALYZE THE MONETIZATION OF THE ESTIMATED TAX BENEFITS ASSOCIATED WITH THE DEC SOLAR PV FACILITIES TO COMPLY WITH THE RELATED CONDITION?

A. Yes. For the Mocksville and Monroe Solar Facilities, the Company updated its original models of estimated annual revenue requirements to reflect its actual experience to date and estimated future timing of the realization of tax benefits. In performing these updates, the originally estimated project costs were retained and the tax benefit assumptions were updated in order to isolate the impact on revenue requirements of the change in tax benefits achieved or expected to be achieved. The Woodleaf Solar Facility is not yet under construction, and a complete analysis of tax benefit assumptions specific to the project is not yet available. Thus, for the Woodleaf Solar Facility, the Company only included in its Billing Period a forecast of levelized cost limited to the approved avoided cost plus the incremental cost calculated at the cap specified by the Commission in its *DEC Solar PV Orders*.

Q. PLEASE ELABORATE ON THE MONETIZATION OF THE FOUR INDIVIDUAL TAX BENEFITS ADDRESSED BY THE CONDITIONS IMPOSED.

A. The Federal Tax Cuts and Jobs Act (the "Tax Act") was enacted on December 22, 2017. Among other provisions, the Tax Act reduced the corporate federal income tax rate to 21% from 35% and eliminated the federal Section 199 manufacturing deduction, both of which affect the revenue requirement calculations for the DEC Solar PV facilities. The Tax Act also eliminated bonus depreciation; however, this does not affect the Mocksville and Monroe facilities because both were in service prior to the expiration deadline established by the Tax Act.

In its original revenue requirements analyses of the Mocksville and Monroe Solar Facilities, the Company assumed that they would qualify for five-year MACRS tax depreciation. At the time the applications for CPCNs were made, federal bonus depreciation was not available for these solar facilities. In late 2015, however, Congress extended bonus depreciation such that both DEC-owned solar projects qualified for bonus depreciation. The result is a depreciation deduction equal to 50% of the tax basis of the solar asset in year one of its tax life. The Company expects to take the five-year MACRS depreciation on the adjusted basis of the solar asset after first taking bonus depreciation at 50%. The ability to take bonus depreciation in conjunction with the five-year MACRS depreciation results in a decrease in total project cost per MWh. Realizing the tax benefit of bonus depreciation has, however, resulted in creating tax net operating losses, which in turn delay the Company's ability to monetize ITC and alters the basis on which MACRS depreciation is calculated. As I discussed in DEC's previous REPS cost recovery proceeding, Docket No. E-7, Sub 1131, separately identifying the monetary effect of any delay in realizing any of the other tax benefits itemized below is not useful because the delay is inextricably linked to, and the result of, the ability to utilize favorable bonus depreciation.

The Company's assumption regarding realization of the federal Section 199 tax deduction for production activities continues to reflect utilization for the year 2017. Beginning in 2018, the Tax Act eliminates the Section 199 deduction, and, accordingly, the associated reduction is removed from the composite tax rate utilized in the revenue requirements calculations. Federal ITC benefits were originally assumed to be realized in 2018 for the Mocksville Solar Facility and 2021 for the Monroe Solar Facility. However, DEC expects to experience a delay in realizing the federal ITC benefits because it anticipates lacking sufficient taxable income against which it can take the tax credit. The Company currently estimates realizing the federal ITC benefits beyond the current forecast window of year 2022. The Company's ability to take federal bonus depreciation related to many of its assets placed in service prior to the deadline established by the Tax Act, combined with the updated forecast timing of utilization of other tax credits, contribute to the estimated lack of taxable income for utilization of ITC.

In its original revenue requirements analysis, the Company assumed that the solar facilities would qualify for five-year MACRS tax depreciation. The Company expects to take the five-year MACRS depreciation on the adjusted basis of the solar asset after first taking bonus depreciation at 50%. Finally, the Company expects to realize the 80% property tax abatement as originally assumed in its estimated revenue requirements analysis.

Q. ARE THERE ANY ADDITIONAL EFFECTS OF THE TAX ACT ON THE REVENUE REQUIREMENT CALCULATIONS FOR THE DEC SOLAR PV FACILITIES?

A. Yes. The reduction in the corporate federal tax rate from 35% to 21% affects the calculation of deferred taxes, and the rates used to calculate the return on rate base as well as the levelization of the annual revenue requirement. These effects are reflected in revenue requirement calculations beginning in year 2018. In addition, the accumulated deferred income tax ("ADIT") balances as of year-end 2017 are reduced in the revenue requirement calculations by an estimate of the excess associated with the reduction in the federal income tax rate. The revenue requirement calculations beginning in year 2018 incorporate the adjusted ADIT balance.

The Company's proposal for changes in the treatment of the excess ADIT balances associated with these and all other applicable Company assets are outlined in the comments filed by the Company in Docket No. M-100, Sub 148. The issues are also being addressed in Docket No. E-7, Sub 1146, the Company's pending general rate case.

Q. HOW DOES THE COMPANY INTERPRET THESE RESULTS IN TERMS OF AMOUNTS TO BE RECOVERED THROUGH THE REPS RIDER?

A. In summary, although DEC expects to experience some delay in realizing the ITC, the accelerated benefits of bonus depreciation and the overall benefit of a lower federal tax rate mitigate the effect of the delay. In compliance with the Commission's *DEC Solar PV Orders*, the Company has limited the amounts included for recovery in this REPS rider to the portion of annual levelized cost equivalent to the standard REC offer price established in the CPCN proceedings. Williams Exhibit No. 7 summarizes levelized cost recovery amounts reflecting original assumptions, as well as updated tax monetization estimates, and updated project capital expenditures.

Q. HOW DID DUKE ENERGY CAROLINAS DETERMINE THE AVOIDED COST ASSOCIATED WITH REPS COMPLIANCE COSTS?

A. In all cases where Duke Energy Carolinas has determined incremental compliance costs as the excess amount above avoided cost, the Company has applied an avoided cost rate in cents per kilowatt-hour ("kWh") to the expected kWh of renewable energy for each compliance initiative. In determining the avoided costs associated with purchased power agreements, Rule R8-67(a)(2) provides that:

> "Avoided cost rates" mean an electric power supplier's most recently approved or established avoided cost rates in this state, as of the date the contract is executed, for purchases of electricity from qualifying facilities pursuant to Section 210 of the Public Utility Regulatory Policies Act of 1978. If the Commission has approved an avoided cost rate for the electric power supplier for the year when the contract is executed, applicable to contracts of the same nature and duration as the contract between the electric power supplier and the seller, that rate shall be used as the avoided cost. Therefore, for example, for a contract by an electric public utility with a term of 15 years, the avoided cost rate applicable to that contract would be the comparable, Commission-approved, 15-year, long-term, levelized rate in effect at the time the contract was executed. In all other cases, the avoided cost shall be a good faith estimate of the electric power supplier's avoided cost, levelized over the duration of the contract, determined as of the date the contract is executed, taking into consideration the avoided cost rates then in effect as established by the Commission. In any event, when found by the Commission to be appropriate and in the public interest, a good faith estimate of an electric public utility's avoided cost, levelized over the duration of the contract, determined as of the date the contract is executed, may be used in a particular REPS cost recovery proceeding. Determinations of avoided costs, including estimates thereof, shall be subject to continuing Commission oversight and, if necessary, modification should circumstances so require.

Duke Energy Carolinas' approved avoided cost rates are set forth in its Purchased Power Non-Hydroelectric, Schedule PP-N, Purchased Power Hydroelectric, Schedule PP-H, and Schedule PP rate schedules (collectively "Schedule PP"). For executed purchased power agreements, where the price of the REC and energy are bundled, the Company used annualized combined capacity and energy rates as shown on the Company's Exhibit No. 3, filed in Docket No. E-100, Sub 106; Exhibit No. 3 in Docket No. E-100, Sub 117; Exhibit No. 3 in Docket No. E-100, Sub 127; Exhibit No. 3 in Docket No. E-100, Sub 136; Exhibit No. 3 in Docket No. E-100, Sub 140; or Attachment H in Docket No. E-100, Sub 148 (depending on the execution date of the contract). For those purchased power agreements with terms that did not correspond with the durational terms for which rates were established in the avoided cost proceeding (i.e., two, five, ten, or fifteen year durations), Duke Energy Carolinas computed avoided cost rates for the particular term of the purchased power agreements using the same inputs and methodology used for the Schedule PP rates approved in Docket Nos. E-100, Sub 106, E-100, Sub 117, E-100, Sub 127, E-100, Sub 136, E-100, Sub 140 or E-100, Sub 148, respectively. The avoided cost components of energy and REC purchased power agreements effective during the prospective billing period were estimated in the same manner.

For the Duke Energy Carolinas PVDG Program, the Company determined the avoided cost using a process similar to that described above for a purchased power agreement with a non-standard duration. The inputs and methodology used for the Schedule PP rates approved in Docket No. E-100, Sub 117 were used to determine the annualized combined capacity and energy rates for a twenty-year term, corresponding to the expected life of the solar facilities. The Company estimated its avoided cost and incremental cost in a similar fashion for its new DEC Solar PV facilities.

Q. DOES DUKE ENERGY CAROLINAS PROVIDE SERVICES TO WHOLESALE CUSTOMERS TO MEET THEIR REPS REQUIREMENTS?

A. Yes. As part of its 2017 REPS Compliance Plan, Duke Energy Carolinas continues to provide services to native load priority wholesale customers that contract with the Company for REPS compliance services, including delivery of renewable energy resources and compliance planning and reporting. These Wholesale customers, including distribution cooperatives and municipalities, rely on Duke Energy Carolinas to provide this renewable energy delivery service in accordance with G.S. § 62-133.8(c)(2)e. The Company provides renewable energy resources and compliance reporting services for the following native load priority wholesale customers: Blue Ridge Electric Membership Corporation ("Blue Ridge EMC"), Rutherford Electric Membership Corporation ("Rutherford EMC"), City of Concord, Town of Dallas, Town of Forest City, Town of Highlands, and City of Kings Mountain.

Q. PLEASE EXPLAIN HOW THE COMPANY ALLOCATES INCREMENTAL REPS COSTS BETWEEN ITS RETAIL CUSTOMERS AND ITS WHOLESALE CUSTOMERS RECEIVING THIS SERVICE.

A. The incremental cost of REPS compliance represents the cost to meet the combined total MWh requirement for native load customers, based on the sum of Duke Energy Carolinas' NC retail sales and Wholesale NC retail sales. To properly allocate incremental costs between Duke Energy Carolinas and its Wholesale customers, the class allocation methodology was performed using a combined aggregate cost cap as shown in Williams Exhibit Nos. 2 and 3 for the EMF Period and the Billing Period, respectively. The class allocation methodology combines the number of accounts subject to a REPS charge by customer class for both Duke Energy NC retail accounts and Wholesale NC retail accounts. In the cases where a Wholesale customer self-supplied a portion of its annual REPS requirement (for example, using its Southeastern Power Administration allocation to partially meet the requirement as provided in G.S. § 62-133.8(c)), or where the Company met its compliance requirement by reduced energy consumption through implementation of energy efficiency ("EE") measures, the combined total number of accounts on which the cost allocation is based was adjusted on a pro-rata basis. This adjustment recognizes that a portion of the compliance requirement was not supplied by RECs generated or acquired by Duke Energy Carolinas as part of the combined total requirements. The adjusted totals by class were multiplied by the per-account cost caps to determine the combined total cost cap dollar amounts by customer class and in total. Each customer class is allocated its share of the incremental costs based on its pro-rata share of the customer cost cap dollar amounts. The cost allocated to each customer class is divided by the total adjusted number of accounts within each customer class to arrive at an annual per-account charge. The annual per-account charge for each customer class is multiplied by the Company's NC Retail adjusted number of accounts within each customer class and totaled to arrive at the incremental cost to be allocated to Duke Energy Carolinas' NC Retail customers.

Q. PLEASE ALSO DESCRIBE HOW DUKE ENERGY CAROLINAS ALLOCATES ITS EE SAVINGS AMONG ITS CUSTOMER CLASSES FOR REPS AND REPS EMF RIDER PURPOSES.

A. Incremental costs assigned to Duke Energy Carolinas' NC Retail customers are separated into two categories: costs related to solar, poultry and swine compliance requirements, and research, other incremental and Solar Rebate Program costs ("Set-Aside and Other Incremental Costs"); and costs related to the General Requirement[1] ("General Incremental Costs"). This separation is based on the percentage of Set-Aside and Other Incremental Costs and General Incremental Costs calculated on Williams Exhibit No. 1.

Set-Aside and Other Incremental Costs are allocated among customer classes based on per-account cost caps. General Incremental Costs are allocated among customer classes in a manner that gives credit for EE RECs (for which there are no General Incremental Costs)

[1] The Company generally refers to the "General Requirement" as its overall REPS requirement, set forth in G.S. § 62-133.8(b), net of the three set-asides.

according to the relative energy reduction contributed by each customer class. As a result, General Incremental Costs are allocated among customer classes based on each class' pro-rata share of requirements for non-EE general RECs. The calculations for allocating General Incremental Costs are updated to reflect the modifications recommended by the Public Staff, and accepted by the Commission in its November 17, 2017 *Order Approving REPS and REPS EMF Rider and Approving REPS Compliance Report*, in DEP's most recent REPS rider filing in Docket No. E-2, Sub 1144. The Company notes that any deviation from allocating costs according to the statutory per-account cost cap ratios creates the potential for the resulting charges computed for one or more classes to exceed the per-account cost cap(s). If that occurs, the Company would continue to reallocate the costs in excess of the cap for the affected customer class to the other customer classes to the extent required to produce charges for all classes that do not exceed the respective caps.

Q. PLEASE DESCRIBE HOW DUKE ENERGY CAROLINAS CALCULATED THE PROJECTED PORTION OF THE REPS RIDER THAT THE COMPANY PROPOSES FOR THE BILLING PERIOD.

A. Using the allocation methods described above, and as shown on Williams Exhibit No. 3, the Set-Aside and Other Incremental Costs and the General Incremental Costs are calculated by customer class for the Company's NC Retail customers. The Set-Aside and Other Incremental Costs and

General Incremental Costs are summed for the Billing Period by customer class to arrive at a total REPS cost to be collected from the Company's NC Retail customers. On Williams Exhibit No. 4, the cost allocated to each customer class is then divided by the total projected number of Duke Energy Carolinas NC Retail accounts within each customer class to arrive at the total annual cost to be recovered from each account over the Billing Period. The monthly NC Retail REPS rider for each customer class is one-twelfth of the total annual cost.

Q. PLEASE EXPLAIN THE CALCULATION OF THE PROPOSED REPS EMF.

A. Using the allocation methods described above, and as shown on Williams Exhibit No. 2, the Set-Aside and Other Incremental Costs and the General Incremental Costs are calculated by customer class for the Company's NC Retail customers. The Set-Aside and Other Incremental Costs and General Incremental Costs are summed for the Test Period by customer class to illustrate the total REPS cost assigned to the Company's NC Retail customers. The actual NC Retail revenues realized during the Test Period by customer class are then subtracted from the total REPS costs by customer class to arrive at the EMF for each class. On Williams Exhibit No. 4, the total EMF over/under collection to be recovered from each customer class is adjusted to include any credits to customers not considered a refund of amounts advanced by customers, and then divided by the total projected number of Duke Energy Carolinas' NC Retail accounts within each customer class to arrive at the total EMF to be recovered from each account over the Billing Period. The monthly EMF for each customer class is one-twelfth of the total EMF.

Q. HOW DOES DUKE ENERGY CAROLINAS DEFINE A CUSTOMER ACCOUNT FOR PURPOSES OF REPS BILLING?

A. In its December 15, 2010 *Order Approving REPS Riders*, in Docket No. E-7, Sub 872, the Commission approved Duke Energy Carolinas' proposed method of determining the number of customer accounts. The Company defines "account" as an "agreement" or "tariff rate" between Duke Energy Carolinas and a customer in order to determine the per-account REPS charge with certain exceptions, which are listed below. The following service schedules are not considered accounts for purposes of the per-account charge because of the near certainty that customers served under these schedules already will pay a per-account charge under another residential, general service, or industrial service agreement and because they represent small auxiliary service loads. The following agreements fall within this exception:

- Outdoor Lighting Service (Schedule OL)
- Floodlighting Service (Schedule FL and FL-N)
- Street and Public Lighting Service (Schedule PL)
- Yard Lighting (Schedule YL)
- Governmental Lighting (Schedule GL)
- Nonstandard Lighting (Schedule NL)
- Off-Peak Water Heating (Schedule WC is a sub-metered service)
- Non-demand metered, nonresidential service, provided on Schedule SGS, at the same premises, with the same service address, and with the same account name as an agreement for which a monthly REPS charge has been applied.

Within Wholesale, Blue Ridge EMC, Rutherford EMC, Town of Forest City, and City of Concord have a methodology for determining Wholesale year-end number of accounts that is generally consistent with that used by Duke Energy Carolinas. The modifications and exclusions are similarly intended to avoid charging customers twice, as in the case of customers with additional lighting accounts, or to exclude small auxiliary service loads. Town of Highlands, Town of Dallas, and City of Kings Mountain define an account in the manner the information is reported to the Energy Information Administration for annual electric sales and revenue reporting.

Q. DOES DUKE ENERGY CAROLINAS PROJECT THE REPS CHARGE TO EACH CUSTOMER ACCOUNT FOR THE BILLING PERIOD TO BE WITHIN THE ANNUAL COST CAPS DEFINED IN G.S. § 62-133.8?

A. Yes. In NC House Bill 589, the General Assembly revised G.S. § 62-133.8(h)(4) to lower the annual cost cap for the Residential customer class from $34.00 to $27.00 in years subsequent to 2014, for cost recovery proceedings initiated on or after July 1, 2017. Accordingly, the Company has applied that revision to the cost caps in this cost recovery proceeding. As shown in Williams Exhibit No. 4, the annual charges for each customer class are below the per-account caps defined in G.S. § 62-133.8(h)(4).

Q. HOW DOES DUKE ENERGY CAROLINAS PROPOSE TO COLLECT THE REPS CHARGES FROM EACH CUSTOMER CLASS?

A. Duke Energy Carolinas proposed Renewable Energy Portfolio Standard Rider ("REPS-NC") is attached as Williams Exhibit No. 5. As shown on the rider, Duke Energy Carolinas proposes that a fixed monthly charge be added to the bill for each class of customer.

Q. WHAT IS THE MONTHLY REPS CHARGE PROPOSED BY THE COMPANY FOR EACH CUSTOMER CLASS?

A. The Company proposes the following monthly REPS charges to be effective September 1, 2018.

Customer class	Per Month – excluding regulatory fee	Per Month – including regulatory fee	Total annual REPS charge – including regulatory fee	Annual per-account cost cap
Residential	$ 0.21	$ 0.21	$ 2.52	$ 27.00
General	$ 1.57	$ 1.57	$ 18.84	$ 150.00
Industrial	$ (3.23)	$ (3.23)	$ (38.76)	$ 1,000.00

Q. PLEASE DESCRIBE THE EEC INVENTORY DETAILS PRESENTED IN WILLIAMS EXHIBIT NO. 6.

A. Williams Exhibit No. 6 shows a reconciliation of the Company's EEC inventory balance available for REPS compliance as of December 31, 2017, as well as references to the evaluation, measurement and verification ("EM&V") reports the results of which are incorporated into current EEC balances. The Company annually determines the level of EECs generated and available for REPS compliance, and this update includes the results of any periodic EM&V performed to-date, adjustments identified in the course of the Company's ongoing analysis of energy efficiency program effectiveness, as well as any other corrections. The updated cumulative level of EECs generated to date is compared to the number of EECs previously reported for compliance, less any EECs used for compliance, to determine the EECs to be added to inventory for the most recent calendar year. Williams Exhibit No. 6 shows the calculation for EECs added to inventory for 2017, including details of the adjustments incorporated therein.

Q. HOW DID THE COMPANY INCORPORATE THE COMMISSION'S RECENT ORDER ADDRESSING THE DURATION OF ENERGY EFFICIENCY SAVINGS AS CALCULATED FOR REPS COMPLIANCE PURPOSES?

A. In its January 17, 2017 *Order Approving REPS and REPS EMF Rider and REPS Compliance Report* ("DEP REPS Order") in the Duke Energy Progress REPS Docket No. E-2, Sub 1109, the Commission directed DEP to limit its continued recognition of EE savings initiated in a particular EE program year to the life of the measure or program as established in DEP's energy efficiency rider proceedings held pursuant to G.S. § 62-133.9. Consistent with that Order, in this rider filing the Company calculated EE savings only for the duration of the established measure life of each program or measure.

In its DEP REPS Order, the Commission directed, in part, that "DEP shall create a separate active sub-account for EECs earned based upon the perpetual savings methodology and continue to file in all future REPS Rider applications a worksheet detailing its EEC inventories, including the separate accounting for EECs that were based on recognizing perpetual savings after the established life of the measure or program." The Company respectfully submits that its EEC inventory reconciliation shown on Williams Exhibit No. 6 continues to provide the previously required worksheet detailing its EEC inventory. In addition, the Company's accounting of EEC inventory for 2016, as presented in Williams Exhibit No. 6 filed in last year's DEC REPS Docket No. E-7, Sub 1131, included a one-time adjustment eliminating all savings previously recognized that were attributable to the perpetual savings assumption, essentially truing up its EEC inventory to reflect savings through program or measure life only. Since then, the database tool used to track and report EE savings for REPS calculates EECs only for the duration of the life of each measure or program. The Company accounted for its one-time adjustment in its filing in Docket No. E-7, Sub 1131 and does not intend to seek to use the previously eliminated amounts attributable to the perpetual savings assumption in any future REPS proceeding. The Company respectfully requests relief from the requirement to account for the eliminated EECs in a separate NC-RETS sub-account, as they were accounted for and reported and savings are no longer calculated or tracked beyond the duration of program or measure life.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

REDACTED VERSION

DUKE ENERGY CAROLINAS, LLC
Docket No. E-7, Sub 1162
Compliance Costs for the EMF Period January 1, 2017 to December 31, 2017

Williams Exhibit No. 1
Page 1 of 2
March 7, 2018

Line No.	Renewable Resource	RECs	MWh (Energy)	Total Cost	Avoided Cost	Incremental Cost	Avoided Cost Recovered in Fuel Cost Adjustment Rider	
[redacted]								
[redacted]						$ 17,838,199		
9	Other Incremental			$ 797,661	Jennings Exhibit No. 2	$ 797,661		(g)
10	Solar Rebate Program			$ -		$ -		(h)
11	Research			$ 565,791		$ 565,791		(i)
12	**Total**			[redacted]		**$ 19,201,651** (below)		
				Jennings Exhibit No. 2				

	Incremental cost category	Incremental Cost	Percent of Total Incremental Cost
[redacted]			
15	**Total**	**$ 19,201,651** (above)	

Allocate incremental cost of solar resources between solar compliance requirement and general compliance requirement:

16 [redacted]
17
18

19
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REDACTED VERSION

DUKE ENERGY CAROLINAS, LLC
Docket No. E-7, Sub 1162
Projected Compliance Costs for the Billing Period September 1, 2018 to August 31, 2019

Williams Exhibit No. 1
Page 2 of 2
March 7, 2018

Line No.	Renewable Resource	RECs	MWh (Energy)	Total Cost	Avoided Cost	Incremental Cost	Avoided Cost Recovered in Fuel Cost Adjustment Rider	
[redacted]								
[redacted]						$ 27,654,651		
10	Other Incremental			$ 1,155,500		$ 1,155,500		(g)
11	Estimated receipts related to contract performance			$ (1,000,000)	Jennings Exhibit No. 2	$ (1,000,000)		(q)
12	Solar Rebate Program			$ 844,000		$ 844,000		(h)
13	Research			$ 755,000		$ 755,000		(i)
14	**Total**			[redacted]		**$ 29,409,151** (below)		
				Jennings Exhibit No. 2				

	Incremental cost category	Incremental Cost	Percent of Total Incremental Cost
[redacted]			
17	**Total**	**$ 29,409,151** (above)	

Allocate estimated incremental cost of solar resources between solar compliance requirement and general compliance requirement:

18 [redacted]
19
20
21
22
23

Allocate Incremental Cost per Customer Class - EMF Period

		Combined North Carolina Retail and Wholesale							
Line No.	Customer Class	Total Unadjusted Number of Accounts(1)	Adjustment for Self-supplied Requirements(1)	Total Adjusted Number of Accounts(1)	Annual Rider Cap per Customer Class Account	Annual Adjusted Revenue Cap	Cost Cap Allocation Factor	Actual Incremental Costs for REPS Recovery	Annual Per Account Charge (2)
1	Residential	1,855,382	457,381	1,398,001	$ 27	$ 37,746,027	53.13%	$ 10,201,838	$ 7.30
2	General	260,469	64,034	196,435	$ 150	$ 29,465,250	41.48%	$ 7,964,845	$ 40.55
3	Industrial	5,082	1,253	3,829	$ 1,000	$ 3,829,000	5.39%	$ 1,034,969	$ 270.30
4	**Total**	**2,120,933**	**522,668**	**1,598,265**		**$ 71,040,277**	**100.00%**	**$ 19,201,651**	(b)
								Williams Exhibit No. 1, page 1 Line No. 12	

Calculate NC Retail-only annual REPS cost per Customer Class - EMF Period:

		North Carolina Retail Only					
Line No.	Customer Class	Total Adjusted Number of Accounts - DEC Retail(1)	Annual Per Account Charge(2)	Incremental Costs Allocated to DEC Retail	Percent of Incremental Cost	NC Retail Percent of Total Incremental Cost	
5	Residential	1,269,531	$ 7.30	$ 9,267,576			
6	General	180,791	$ 40.55	$ 7,331,075			
7	Industrial	3,610	$ 270.30	$ 975,783			
8	**Total**	**1,453,932**		**17,574,434** (a)		91.53%	(a) / (b)
9	Set-aside, Other Incremental, Solar Rebate, and Research			$ 8,375,975	47.66%	Williams Exhibit No. 1, page 1 Line Nos. 13,14	
10	General RECs			$ 9,198,459	52.34%		
11	Total Incremental Cost for Retail			17,574,434			

Notes:
(1) Average number of accounts subject to REPS charge during EMF Period.
(2) Annual per account charges are the result of the allocation of REPS costs between Duke Energy Carolinas Retail customers and the Company's Wholesale REPS customers, and are used only for calculating the total cost obligations of Duke Energy Carolinas Retail customers and the wholesale REPS customers, respectively. Proposed REPS rider charges per account are instead calculated using unadjusted REPS account totals by class - see Williams Ex. No. 4.

REDACTED VERSION

DUKE ENERGY CAROLINAS, LLC
Docket No. E-7, Sub 1162
For the Period January 1, 2017 to December 31, 2017

Calculate Set-aside and other incremental costs per customer class - EMF Period:

North Carolina Retail Only

Line No.	Customer Class	Total Unadjusted Number of Accounts(1)	Annual Rider Cap per Customer Class Account	Calculated Annual Revenue Cap	Cost Cap Allocation Factor	Allocated Annual Set-aside, Other Incremental, Solar Rebate Program, and Research Cost
1	Residential	1,692,708	$ 27	45,703,116	52.73%	$ 4,416,625
2	General	241,055	$ 150	36,158,250	41.72%	$ 3,494,235
3	Industrial	4,813	$ 1,000	4,813,000	5.55%	$ 465,115
4	**Total**	**1,938,576**		**86,674,366**		**$ 8,375,975**
						Williams Ex. No. 2 Pg 1 Line No. 9

Calculate General costs per customer class - EMF Period:

North Carolina Retail Only

Line No.	Customer Class	Number of RECs for General compliance (3) (a)	% of EE REC supplied by Class(2)	REC Requirement supplied by EE by class (b)	Number of General RECs net of EE (c) = (a) - (b)	General Cost Allocation Factor (e) = (c) / (d)	Allocated Annual General Incremental Costs
5	Residential	[redacted]	40.90%	[redacted]	[redacted]	59.94%	$ 5,513,557
6	General	[redacted]	44.10%	[redacted]	[redacted]	40.27%	$ 3,704,219
7	Industrial	[redacted]	15.00%	[redacted]	[redacted]	-0.21%	$ (19,317)
8	**Total**	[redacted]	**100.00%**	[redacted]	[redacted]	**100.00%**	**$ 9,198,459**
							Williams Ex. No. 2 Pg 1 Line No. 10

Total cost allocation by customer class - EMF Period:

		Total Incremental REPS cost by class	% Incremental REPS cost by class
9	Residential	$ 9,930,182	56.50%
10	General	$ 7,198,454	40.96%
11	Industrial	$ 445,798	2.54%
12	**Total**	**$ 17,574,434**	100.00%
		Williams Ex. No. 2 Pg 1 Line No. 11	

(1) Average number of accounts subject to REPS charge during 2017.
(2) EE allocated to account type according to actual relative contribution by customer class of EE RECs.
(3) Total General RECs per note (5) * "Cost Cap Allocation Factor" by class per line Nos. 1-3 above.

[redacted]

Calculate Incremental Cost Under/(Over) Collection per Customer Class - EMF Period:

North Carolina Retail Only

Line No.	Account Type	Allocated Annual Set-aside, Other Incremental, Solar Rebate Program, and Research Cost	Allocated Annual General Incremental Costs	Total Incremental Costs	Actual NC Retail REPS Revenues Realized - EMF Period	Annual REPS EMF Under/(Over)-Collection, before Interest	Interest on Over-collection[1]	Annual REPS EMF - Under/(Over)-Collection
1	Residential	$ 4,416,625	$ 5,513,557	$ 9,930,182	$ 18,864,141	$ (8,933,959)	$ (1,488,993)	$ (10,422,952)
2	General	$ 3,494,235	$ 3,704,219	$ 7,198,454	$ 12,476,569	$ (5,278,115)	$ (879,685)	$ (6,157,800)
3	Industrial	$ 465,115	$ (19,317)	$ 445,798	$ 1,192,210	$ (746,412)	$ (124,402)	$ (870,814)
4	**Total**	**$ 8,375,975**	**$ 9,198,459**	**$ 17,574,434**	**$ 32,532,920**	**$ (14,958,486)**	**$ (2,493,080)**	**$ (17,451,566)**
		Williams Exhibit No. 2, Pg 2, Line No. 4	Williams Exhibit No. 2, Pg 2, Line No. 8	Williams Exhibit No. 2, Pg 2, Line No. 12				

Notes:

(1) Interest calculated at annual rate of 10% for number months from mid-point of EMF period to mid-point of prospective rider billing period.

Allocate Incremental Cost per Customer Class - Billing Period

		Combined North Carolina Retail and Wholesale							
Line No.	Customer Class	Total Unadjusted Number of Accounts(1)	Adjustment for Self-supplied Requirements(1)	Total Adjusted Number of Accounts(1)	Annual Rider Cap per Customer Class Account	Annual Adjusted Revenue Cap	Cost Cap Allocation Factor	Projected Incremental Costs	Annual Per Account Charge(2)
1	Residential	1,857,088	455,699	1,401,389	$ 27	$ 37,837,503	53.30%	$ 15,675,077	$ 11.19
2	General	259,861	63,649	196,212	$ 150	$ 29,431,800	41.46%	$ 12,193,034	$ 62.14
3	Industrial	4,927	1,210	3,717	$ 1,000	$ 3,717,000	5.24%	$ 1,541,040	$ 414.59
4	**Total**	**2,121,876**	**520,558**	**1,601,318**		**$ 70,986,303**	**100.00%**	**$ 29,409,151**	
								Williams Exhibit No. 1, page 2 Line No. 14	

Calculate NC Retail-only annual REPS cost per Customer Class - Billing Period

		North Carolina Retail Only		
Line No.	Customer Class	Total Adjusted Number of Accounts - Duke Retail(1)	Annual Per Account Charge(2)	Incremental Costs Allocated to Duke Retail
5	Residential	1,285,164	$ 11.19	$ 14,380,985
6	General	182,648	$ 62.14	$ 11,349,747
7	Industrial	3,536	$ 414.59	$ 1,465,990
8	**Total**	**1,471,348**		**27,196,722**

9	Set-aside, Other Incremental, Solar Rebate, and Research	$ 15,276,399	56.17%	Williams Exhibit No. 1, page 2 Line Nos. 15, 16
10	General RECs	$ 11,920,323	43.83%	
11	Total Incremental Cost for Retail	27,196,722		

Notes:

(1) Projected number of accounts subject to REPS charge during the billing period.

(2) Annual per account charges are the result of the allocation of REPS costs between Duke Energy Carolinas Retail customers and the Company's Wholesale REPS customers, and are used only for calculating the total cost obligations of Duke Energy Carolinas Retail customers and the wholesale REPS customers, respectively. Proposed REPS rider charges per account are instead calculated using unadjusted REPS account totals by class - see Williams Ex. No. 4.

REDACTED VERSION

DUKE ENERGY CAROLINAS, LLC
Docket No. E-7, Sub 1162
For the Period September 1, 2018 to August 31, 2019

Williams Exhibit No. 3
Page 2 of 3
March 7, 2018

Calculate Set-aside and other incremental costs per customer class - Billing Period:

North Carolina Retail Only

Line No.	Customer Class	Total Unadjusted Number of Accounts(1)	Annual Rider Cap per Customer Class Account	Calculated Annual Revenue Cap	Cost Cap Allocation Factor	Allocated Annual Set-aside, Other Incremental, Solar Rebate Program, and Research Cost
1	Residential	1,713,552	$ 27	46,265,904	52.87%	$ 8,076,484
2	General	243,530	$ 150	36,529,500	41.74%	$ 6,376,833
3	Industrial	4,715	$ 1,000	4,715,000	5.39%	$ 823,082
4	**Total**	**1,961,797**		**87,510,404**	**100.00%**	**$ 15,276,399**
						Williams Ex. No. 3 Pg 1 Line 9

Calculate General costs per customer class - Billing Period:

North Carolina Retail Only - Billing Period

	Customer Class	Number of RECs for General compliance (3) (a)	% of EE REC supplied by Class(2)	REC Requirement supplied by EE by class (b)	Number of General RECs net of EE (c) = (a) - (b)	General Cost Allocation Factor (e) = (c) / (d)	Allocated Annual General Incremental Costs
5	Residential	[redacted]	40.90%	[redacted]		60.73%	$ 7,239,212
6	General		44.10%			40.19%	$ 4,790,778
7	Industrial		15.00%			-0.92%	$ (109,667)
8	**Total**		**100.00%**			**100.00%**	**$ 11,920,323**
							Williams Ex. No. 3 Pg 1 Line 10

Total cost allocation by customer class - EMF Period:

		Total Incremental REPS cost by class	% Incremental REPS cost by class
9	Residential	$ 15,315,696	56.31%
10	General	$ 11,167,611	41.06%
11	Industrial	$ 713,415	2.62%
12	**Total**	**$ 27,196,722**	100.00%
		Williams Ex. No. 3 Pg 1 Line 11	

(1) Projected number of accounts subject to REPS charge during the billing period.
(2) EE allocated to account type according to actual projected contribution by customer class of EE RECs.
(3) Total General RECs per note (4) * "Cost Cap Allocation Factor" by class per line Nos. 1-3 above.

[redacted]

Calculate Incremental Cost to Collect by Customer Class - Billing Period:

		North Carolina Retail Annual Rider Cost by Account Type		
Line No.	**Customer Class**	**Allocated Annual Set-aside and Other Incremental costs**	**Allocated Annual General Incremental Costs**	**Total Incremental Costs**
1	Residential	$ 8,076,484	$ 7,239,212	$ 15,315,696
2	General	$ 6,376,833	$ 4,790,778	$ 11,167,611
3	Industrial	$ 823,082	$ (109,667)	$ 713,415
4	**Total**	**$ 15,276,399**	**$ 11,920,323**	**$ 27,196,722**
		Williams Exhibit No. 3, Pg 2, line 4	**Williams Exhibit No. 3, Pg 2, line 8**	**Williams Exhibit No. 3, Pg 2, line 12**

Calculate Duke Energy NC Retail monthly REPS rider components:

		North Carolina Retail						
Line No.	**Customer Class**	**Total Projected Number of Accounts -Duke Retail[1]**	**Annual REPS EMF Under/(Over)-Collection**	**Receipts for Contract Amendments, Penalties, Change-of-control, Etc. [3]**	**Total EMF costs/(credits)**	**Monthly EMF Rider[2]**	**Projected Total Incremental Costs**	**Monthly REPS Rider[2]**
1	Residential	1,713,552	$ (10,422,952)	$ (563,773)	$ (10,986,725)	$ (0.53)	$ 15,315,696	$ 0.74
2	General	243,530	$ (6,157,800)	$ (408,683)	$ (6,566,483)	$ (2.25)	$ 11,167,611	$ 3.82
3	Industrial	4,715	$ (870,814)	$ (25,310)	$ (896,124)	$ (15.84)	$ 713,415	$ 12.61
4		**1,961,797**	**$ (17,451,566)**	**$ (997,766)**	**$ (18,449,332)**		**$ 27,196,722**	
			Williams Ex. No. 2, Pg 3				Williams Ex. No. 3, Pg 3	

Compare total annual REPS charges per account to per-account cost caps:

		North Carolina Retail						
Line No.	**Customer Class**	**Monthly EMF Rider[2]**	**Monthly REPS Rider[2]**	**Combined Monthly Rider[2]**	**Regulatory Fee Multiplier**	**Total Monthly REPS Charge including Regulatory Fee**	**Total Annual REPS Charge including Regulatory Fee**	**Per-Account Cost Cap**
5	Residential	$ (0.53)	$ 0.74	$ 0.21	1.001402	$ 0.21	$ 2.52	$ 27.00
6	General	$ (2.25)	$ 3.82	$ 1.57	1.001402	$ 1.57	$ 18.84	$ 150.00
7	Industrial	$ (15.84)	$ 12.61	$ (3.23)	1.001402	$ (3.23)	$ (38.76)	$ 1,000.00

Notes:

(1) Projected number of accounts subject to REPS charge during the billing period.

(2) Per account rate calculations apply to Duke Energy Carolinas NC Retail customers only.

(3) Forward 2017 receipts for contract amendments, penalties, change-of-control, etc

Customer Class	Contract receipts credited by customer class	NC retail portion of EMF Period costs - Williams Exhibit No. 2, Pg 1	Allocation to customer class - Williams Exhibit No. 2, Pg 2	Receipts for contract amendments, penalties, change-of-control, etc.
Residential			56.50%	$ (563,773)
General			40.96%	$ (408,683)
Industrial			2.54%	$ (25,310)
Total contract payments received - EMF Period	$ (1,090,096)	$ (997,766)		$ (997,766)
		91.53%		

Duke Energy Carolinas, LLC Electricity No. 4
North Carolina Tenth Revised Leaf No. 68
Superseding North Carolina Ninth Revised Leaf No. 68

REPS (NC)
RENEWABLE ENERGY PORTFOLIO STANDARD RIDER

APPLICABILITY (North Carolina Only)

Service supplied to the Company's retail customer agreements is subject to a REPS Monthly Charge. This charge is adjusted annually, pursuant to North Carolina General Statute 62-133.8 and North Carolina Utilities Commission Rule R8-67 as ordered by the North Carolina Utilities Commission. This Rider is not applicable to agreements for the Company's outdoor lighting rate schedules, OL, PL, FL, GL, NL, nor for sub metered rate Schedule WC, nor for services defined as auxiliary to another agreement. An auxiliary service is defined as a non-demand metered, nonresidential service, provided on Schedule SGS, at the same premises, with the same service address, and with the same account name as an agreement for which a monthly REPS charge has been applied.

APPROVED REPS MONTHLY CHARGE

The Commission has ordered that a REPS Monthly Charge, which includes an Experience Modification Factor (EMF), be included in the customers' bills as follows:

RESIDENTIAL SERVICE AGREEMENTS	
REPS Monthly Charge	$ 0.74
Experience Modification Factor	($ 0.53)
Net REPS Monthly Charge	$ 0.21
Regulatory Fee Multiplier	1.001402
Total REPS Monthly Charge per agreement per month	$ 0.21
GENERAL SERVICE AGREEMENTS	
REPS Monthly Charge	$ 3.82
Experience Modification Factor	($ 2.25)
Net REPS Monthly Charge	$ 1.57
Regulatory Fee Multiplier	1.001402
Total REPS Monthly Charge per agreement per month	$ 1.57
INDUSTRIAL SERVICE AGREEMENTS	
REPS Monthly Charge	$ 12.61
Experience Modification Factor	($ 15.84)
Net REPS Monthly Charge	($ 3.23)
Regulatory Fee Multiplier	1.001402
Total REPS Monthly Charge per agreement per month	($ 3.23)

USE OF RIDER

The REPS Billing Factor is not included in the Company's current rate schedules and will apply as a separate charge to each agreement for service covered under this Rider as described above, unless the service qualifies for a waiver of the REPS Billing Factor for an auxiliary service. An auxiliary service is a non-demand metered nonresidential service, on Schedule SGS for the same customer at the same service location.

To qualify for an auxiliary service, not subject to this Rider, the Customer must notify the Company and the Company must verify that such agreement is considered an auxiliary service, after which the REPS Billing Factor will not be applied to qualifying auxiliary service agreements. The Customer shall also be responsible for notifying the Company of any change in service that would no longer qualify the service as auxiliary.

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Worksheet detailing energy efficiency certificate ("EEC") inventory

EEC inventory reconciliation - as of December 31, 2017	EECs [1]	Reference
EEC balance at Dec 31, 2011	887,076	2011 Compliance Report - Docket No. E-7, Sub 1008
EECs generated for 2012 per Company's annual update	1,120,265	E-7, Sub 1052, Williams Exhibit No. 6
Less: EECs used for compliance for 2012	419,745	2012 Compliance Report - Docket No. E-7, Sub 1034
EECs carried forward at Dec 31, 2012	1,587,596	2012 Compliance Report - Docket No. E-7, Sub 1034
EECs generated for 2013 per Company's annual update	1,530,891	E-7, Sub 1052, Williams Exhibit No. 6
Less: EECs used for compliance for 2013	409,169	2013 Compliance Report - Docket No. E-7, Sub 1052
EECs carried forward at Dec 31, 2013	2,709,318	2013 Compliance Report - Docket No. E-7, Sub 1052
EECs generated for 2014 per Company's annual update	2,011,450	E-7, Sub 1074, Williams Exhibit No. 6
Less: EECs used for compliance for 2014	415,459	2014 Compliance Report - Docket No. E-7, Sub 1074
EECs carried forward at Dec 31, 2014	4,305,309	2014 Compliance Report - Docket No. E-7, Sub 1074
EECs generated for 2015 per Company's annual update	2,310,608	E-7, Sub 1106, Williams Exhibit No. 6
Less: EECs used for compliance for 2015	855,980	2015 Compliance Report - Docket No. E-7, Sub 1106
EECs carried forward at Dec 31, 2015	5,759,937	2015 Compliance Report - Docket No. E-7, Sub 1106
EECs generated for 2016 per Company's annual update	2,152,597	E-7, Sub 1131, Williams Exhibit No. 6
Less: EECs used for compliance for 2016	866,492	2016 Compliance Report - Docket No. E-7, Sub 1131
EECs carried forward at Dec 31, 2016	7,046,042	2016 Compliance Report - Docket No. E-7, Sub 1131
EECs generated for 2017 per Company's annual update	2,531,010	Company workpapers [a]
Less: EECs used for compliance for 2017	863,135	2017 Compliance Report - Docket No. E-7, Sub 1162
EECs carried forward at Dec 31, 2017	8,713,917	2017 Compliance Report - Docket No. E-7, Sub 1162

Summary workpapers - EECs generated

	Program year							
Update for 2017 EECs generated - as of year-end 2017:	**2009 - 2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Current view at year-end 2017	873,944	1,143,648	1,561,044	1,881,130	2,194,959	2,291,703	2,597,468	12,543,896
Previously reported current view at year-end 2016	873,944	1,143,648	1,561,040	1,883,617	2,217,639	2,332,998		10,012,886
Total Adjustments to previously reported results	0	0	4 (b)	(2,487) (c)	(22,680) (d)	(41,295) (e)		
Updated EECs created and available for 2017								**2,531,010** (a)

detail of adjustments at page 2 of 2

Footnote:

[1] Calculated EECs originate from details contained in the databases supporting Duke Energy Carolinas' energy efficiency filings, and are specific to North Carolina, calculated at the generation station level, are inclusive of free-ridership EE savings, and assume savings initiated in a program year continue for the duration of the life of the applicable measure.

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Detail for adjustments to previously reported results through program year 2016:

Adjustment type	Program	Program year 2008-2011	2012	2013	2014	2015	2016	Total
Program pilot termination - Business Energy Reports (BER)		-	-	-	-	-	(4,492)	(4,492)
Evaluation, Measurement, & Verification ("EM&V"):								
	Smart Energy in Offices (SEiO)	-	-	-	(2,495)	(22,007)	(26,267)	(50,769)
	Non Residential Smart Saver Energy Efficient Food Service	-	-	-	-	(697)	(8,369)	(9,066)
	Non Residential Smart Saver Energy Efficient Lighting Products	-	-	-	-	(80)	(1,558)	(1,638)
	Multi-Family Energy Efficiency (MF EE)	-	-	-	-	-	(536)	(536)
	EnergyWise for Business (EWB)	-	-	-	-	-	(310)	(310)
	Energy Efficient Appliances and Devices (EEAD)	-	-	-	(8)	(10)	(10)	(28)
	Energy Efficient Appliances and Devices (EEAD)	-	-	-	1	99	280	380
Total EM&V adjustments		-	-	-	(2,502)	(22,695)	(36,770)	(61,967)
Participation updates/adjustments								
	Non-Residential Smart Saver Custom Incentives	-	-	-	-	-	(52)	(52)
	Residential Smart Saver Energy Efficiency Program	-	-	-	-	-	(1)	(1)
	Energy Efficient Appliances and Devices (EEAD)	-	-	-	-	-	4	4
Total participation adjustments		-	-	-	-	-	(49)	(49)
Line loss correction		-	-	4	15	15	16	50
Total adjustments to prior program years incorporated into 2017 current view -		**0**	**0**	**4**	**(2,487)**	**(22,680)**	**(41,295)**	**(66,458)**
				(b)	(c)	(d)	(e)	

EM&V reports applicable to results reported above - filed as exhibits to the testimony of DEC witness Robert Evans in DEC's energy efficiency rider Docket No. E-7, Sub 1164:

Evans Exhibit	Program	Report Finalization Date	EM&V Report	Evaluation Type
L	Smart Energy in Offices (SEiO)	12/15/2017	Duke Energy Carolinas Smart Energy in Offices Evaluation Report (December 15, 2017)	Process & Impact
I	Non Residential Smart Saver Energy Efficient Food Service Products (NRFS)	8/4/2017	Duke Energy Carolinas Smart $aver Prescriptive Incentive	Impact
I	Non Residential Smart Saver Energy Efficient Lighting Products (NRLTG)	8/4/2017	Duke Energy Carolinas Smart $aver Prescriptive Incentive	Impact
H	Multi-Family Energy Efficiency (MF EE)	6/27/2017	EM&V Report for the Duke Energy Multifamily Energy Efficiency Program (June 27, 2017)	Process & Impact
G	EnergyWise for Business (EWB)	6/12/2017	Duke Energy Carolinas and Progress EnergyWise for Business	Impact
J	Energy Efficient Appliances and Devices (EEAD)	11/29/2017	Save Energy and Water Kits 2016 Program Year Evaluation Report (November 29, 2017)	Process & Impact
K	Energy Efficient Appliances and Devices (EEAD)	12/8/2017	Duke Energy Carolinas Energy Efficient Appliances and Devices Program Final Evaluation Report (December 8, 2017)	Process & Impact
E	Small Business Energy Saver (SBES)	6/6/2017	EM&V Report for the Small Business Energy Saver Program Duke Energy Progress and Duke Energy Carolinas (June 6,	Process & Impact

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DEC REPS 2017 Compliance Report 2018 Rider

REDACTED VERSION

Summary cost recovery worksheet - DEC utility-owned solar projects

Project:	**Mocksville (Toprak)**	**Monroe (Rocky River)**	**Woodleaf** (see Note 1)
Project size:	15.4 MWac	59.4 MWac	6 MWac
CPCN docket No.	E-7, Sub 1098	E-7, Sub 1079	E-7, Sub 1101
CPCN filing date:	December 15, 2015	December 15, 2015	March 2, 2016
NCUC Order date:	May 16, 2016	May 16, 2016	June 16, 2016
Original CPCN estimate:			
Total capital expenditure ($000s)	[redacted]		
Total annual levelized revenue requirement ($000s)			
Updated tax benefit monetization estimates:			
Total capital expenditure ($000s)	[redacted]		
Total annual levelized revenue requirement ($000s)			
Updated tax benefit monetization estimates and actual capital expenditures:			
Total capital expenditure ($000s)	[redacted]		
Total annual levelized revenue requirement ($000s)			

Levelized cost recovery summary - annual:

	$./MWH	Percent to total	Annual Levelized cost ($000s)
Mocksville (Toprak)	[redacted]		
Total cost - original estimate			
Avoided cost			
Incremental cost			
Cap for REPS cost recovery			
Total cost - updated tax benefit monetization estimates			
Avoided cost			
Incremental cost			
Cap for REPS cost recovery			
Total cost - updated tax benefit monetization estimates and actual capital expenditures			
Avoided cost			
Incremental cost			
Cap for REPS cost recovery			
Monroe (Rocky River)			
Total cost - original estimate			
Avoided cost			
Incremental cost			
Cap for REPS cost recovery			
Total cost - updated tax benefit monetization estimates			
Avoided cost			
Incremental cost			
Cap for REPS cost recovery			
Total cost - updated tax benefit monetization estimates and actual capital expenditures			
Avoided cost			
Incremental cost			
Cap for REPS cost recovery			

Note 1: The Woodleaf project is not yet under construction and an update of tax benefit assumptions specific to the project is not yet available. Thus, for the Woodleaf project, the Company only included in its Billing Period a forecast of levelized cost limited to the approved avoided cost plus the incremental cost calculated at the cap specified by the Commission in its order approving the CPCN in this docket.