NORTH CAROLINA
PUBLIC STAFF
UTILITIES COMMISSION

June 30, 2023

Ms. A. Shonta Dunston, Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, North Carolina 27699-4300

Re: Docket No. E-7, Sub 1282 – Application of Duke Energy Carolinas, LLC, Pursuant to N.C.G.S. § 62-133.2 and Commission Rule R8-55 Relating to Fuel and Fuel-Related Charge Adjustments for Electric Utilities

Dear Ms. Dunston:

Attached for filing on behalf of the Public Staff in the above-referenced docket is the public version of the supplemental testimony and exhibits of Evan D. Lawrence, Engineer with the Energy Division of the Public Staff – North Carolina Utilities Commission.

By copy of this letter, we are forwarding a copy of the redacted version to all parties of record by electronic delivery. Confidential information is located on page 12 of the testimony. The confidential version of the testimony will be provided to those parties that have entered into a confidentiality agreement.

Sincerely,

Electronically submitted
/s/ William S.F. Freeman
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/s/ William E. H. Creech
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Attachments

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CERTIFICATE OF SERVICE

I certify that a copy of this Testimony has been served on all parties of record or their attorneys, or both, in accordance with Commission Rule R1-39, by United States Mail, first class or better; by hand delivery; or by means of facsimile or electronic delivery upon agreement of the receiving party.

This the 30th day June, 2023.

Electronically submitted
/s/ William S.F. Freeman
Staff Attorney

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1282

In the Matter of Application of Duke Energy Carolinas, LLC, Pursuant to N.C.G.S. § 62-133.2 and Commission Rule R8-55 Relating to Fuel and Fuel-Related Charge Adjustments for Electric Utilities	))))))	**SUPPLEMENTAL TESTIMONY OF EVAN D. LAWRENCE PUBLIC STAFF – NORTH CAROLINA UTILITIES COMMISSION**

June 30, 2023

Q. Please state your name, business address, and present position.

A. My name is Evan D. Lawrence. My business address is 430 North Salisbury Street, Dobbs Building, Raleigh, North Carolina. I am an engineer with the Energy Division of the Public Staff – North Carolina Utilities Commission.

Q. Are you the same Evan D. Lawrence who filed direct testimony on behalf of the Public Staff in this proceeding on May 9, 2023?

A. Yes.

Q. Are your qualifications and duties the same as in your direct testimony?

A. Yes.

Q. What is the purpose of your supplemental testimony in this proceeding?

A. The purpose of my supplemental testimony is to present the results of my investigation and recommendations in the Duke Energy Carolinas, LLC (DEC, or the Company) 2023 fuel rider proceeding regarding the outage extension on Unit 2 (U2) at the Belews Creek Steam Station (BCSS) beginning on April 22, 2022, and ending on May 8, 2022 (the April 22 Outage), and to present the Public Staff's proposed experience modification factor (EMF) rates.

Q. Are you providing any exhibits with your testimony?

A. Yes. I am including two exhibits, identified below:

1. Lawrence Supplemental Exhibit 1: RRE Foreign Material Exclusion document

2. Lawrence Supplemental Exhibit 2: Public Staff's proposed EMF Rates

Q. Please state the topics of your testimony.

A. During my oral testimony before the Commission on May 31, 2023, I indicated that at the time I filed my direct testimony there were only three outages where my investigation was incomplete: (1) an outage at Belews Creek in April, 2022; (2) an outage at Belews Creek in August, 2022; and (3) an outage related to Winter Storm Elliott at W.S. Lee which started in 2022 and concluded in 2023 (Tr. vol. 2, 323-327).

I informed the Commission I would file the results of my investigation into the first one – the Belews Creek April outage – in June. This testimony is the fulfillment of my promise to the Commission.

Q. Please summarize the results of your investigation and your recommendations.

A. The April 22 Outage was caused by a series of errors and oversights by Company personnel and its contractors that occurred during a previous outage which occurred September 8, 2018, until December 13, 2018 (Fall 2018 Outage). A subsequent planned maintenance

outage in 2022 discovered foreign material and this discovery necessitated an additional 16-day extension of that 2022 planned maintenance outage. It is only the additional 16-day extension that is referred to as the April 22 Outage. The April 22 Outage was necessary to remove that foreign material from the turbine to prevent potentially catastrophic damage. The Company was correct to institute the April 22 Outage to remove the foreign material; however, this does not absolve the Company of its initial failure to ensure that no foreign material was left behind. As such, I recommend that the Commission find that the Company's actions, which ultimately caused the need for the April 22 Outage, were imprudent. Accordingly, I further recommend the replacement power costs incurred as a result of the April 22 Outage be disallowed.

Q. Please provide your proposed fuel and fuel-related cost factors.

A. Lawrence Supplemental Exhibit 2 shows the proposed fuel and fuel-related cost factors, taking into account my recommended disallowance. The Public Staff recommends approval of the fuel components and total fuel factors shown in Lawrence Supplemental

Exhibit 2 (shown without the regulatory fee), effective for the 16-month period[1] beginning September 1, 2023.

Public Staff witnesses Zhang and Brown, who previously filed testimony in this case, have reviewed the resulting EMF rates.

Q. How does this adjustment impact the stipulation between the Company and the Public Staff?

A. DEC and the Public Staff's Agreement and Stipulation of Partial Settlement (Stipulation) was filed in this docket on May 31, 2023. Beginning on page 3, the Stipulation provides:

> The Stipulating Parties have not reached a compromise on either the outages at the Company's Belews Creek Plant and the W. S. Lee Steam Station or the timing of filing of the results of the Public Staff's investigation into same ("Unresolved Issues") and agree that such issues should be litigated and determined by the Commission.

The Public Staff continues to support the Stipulation. The items that the parties agreed upon in the Stipulation are not altered as a result of my recommendations in this supplemental filing. My recommendations necessarily result in a modification to the EMF balance, which also impacts the total amount of calculated interest,

[1] As part of the settlement reflected in the Stipulation, the period of recovery for fuel was spread over an additional 4 months in an effort to reduce the bill increase; hence the 16-month recovery period instead of the typical 12-month recovery period.

resulting in a total interest payment of $6,589,498 million by North Carolina Retail Customers.

Q. Can you provide further context into the 2022 planned outage and extension you mentioned earlier?

A. Yes. Beginning on March 17, 2022, BCSS U2 entered a planned outage to conduct routine maintenance. Part of this maintenance was an inspection of the intermediate pressure (IP) turbine. During this inspection, the Company discovered foreign material in the turbine which necessitated the extension of the planned outage to remove the foreign material. This extension is what I have previously referred to as the April 22 outage.

Q. Have you previously presented information regarding this outage to the Commission?

A. Yes. In my initial testimony, filed on May 9, 2023, beginning on line 11 of page 11, I presented the limited results of my investigation up to that time as follows:

> From March 17, 2022, through April 22, 2022, Belews Creek 2 was in a planned outage, as listed in my Exhibit 1. On April 22, 2022, DEC was unable to restart Belews Creek Unit 2 due to foreign material found in the intermediate pressure (IP) turbine, which required removal of the IP turbine shell according to DEC's April 2022 Power Plant Performance Report. The foreign material discovered was a bladder valve, which is a type of balloon that is inflated inside of a pipe to close the pipe and prevent foreign material ingress while work is performed.

> In response to discovery, the Company stated that it believes that the bladder valve, an inflation tube, and the metal fitting were left in inlet piping during a 2018 turbine outage, but it could find no records indicating when or where this occurred. This foreign material forced a removal of the turbine shell and the unit to be removed from service for 16 days. Based on the Company's discovery responses, it appears that the temperature associated with the high-pressure steam where the bladder valve was originally located would have destroyed both the bladder valve and inflation tube; thus, it is unclear whether a full or partial bladder was left in the inlet piping. I believe that this outage was preventable and was likely caused because someone working on the turbine did not follow proper procedures for using and removing a bladder valve.

Q. Based on information you have received after the filing of this testimony, do you still believe this testimony to be accurate?

A. Yes, I do. The information I have received has further confirmed my initial conclusion.

Q. Why does the Company not know exactly when the foreign material made its way into the turbine?

A. According to the Company's records, the foreign material (the bladder, including the valve and fitting), was not left in a location where it would have been able to enter the turbine and all controls were properly followed during previous outages. Therefore, to determine when this bladder would have been left behind, the Company used the process of elimination to develop an estimate. The most recent outage when a bladder would have been used was the Fall 2018 outage, and the metal fitting for the bladder that caused

the April 22 outage should have been noticeable had it been lodged in the turbine blades during that outage. Next, because of the high temperatures in the piping and turbine, the bladder and hose would have likely disintegrated between the Fall 2018 outage and the prior outage when a bladder would have been used. Without the bladder, it is unlikely that the fitting would have been able to move through the piping into the turbine.

Q. Do you believe that pinpointing the exact outage when the bladder was left in the piping is necessary to make a recommendation?

A. I do not. While it would be helpful to know exactly when the bladder was left in the piping, I do not believe that materially impacts the circumstances of this case – that the bladder was erroneously left behind at some prior outage and caused the April 22 Outage. I do not have reason to disagree with the Company's assumptions of when the bladder was left in the turbine piping, but if the bladder had been left in during an outage prior to the Fall 2018 outage, the severity of the Company's actions and inability to recognize the presence of the foreign material increases greatly. Additionally, the Company's lack of records providing insight as to when and how this happened should not absolve the Company of the responsibility to manage outages in a prudent manner, but rather calls in to question why the records did not account for all bladders that were used.

Q. What processes and controls does the Company have in place to prevent foreign material ingress?

A. The Company's Regulated & Renewable Energy (RRE) division has a document which governs the practices and controls to prevent foreign material ingress titled "RRE Foreign Material Exclusion" (FME Document). The Company provided this document in response to Public Staff data request (PSDR) 21, question 5, which I have included as Lawrence Supplemental Exhibit 1.

Q. Does the FME Document lead you to believe that the written processes were adequate to prevent this situation?

A. Generally, yes. The FME Document outlines the process which employees and contractors are required to be trained in and adhere to. However, two items are unclear with these processes. When a protection device is using an interference fit (i.e., the FME device is being held in place by the friction produced from the device pushing out against the inside of the equipment it is protecting), there is a risk that the pressure exerted on the FME device to keep it in place may change the physical characteristics of the device and cause it to fail, as was the case in this situation. The failure itself is not necessarily an issue (although it can be in some situations), but if the Company does not notice the failure of the device, foreign materials can be introduced into the system.

Regarding documentation, section 10.4.2 of the FME Document, in part, states:

> FME Control Fundamentals include:
>
> [a - e omitted]
>
> f. For system or component openings, when work is suspended or unattended, temporary covers shall meet the following criteria:
>
> [1 – 3 omitted]
>
> 4. Dams, plugs or caps shall be secured if they cannot be easily retrieved. Removal tape should be used in lieu of adhesives in contact with bare metal surfaces.
>
> 5. Hard covers required on vertical openings.

Further, Section 10.4.2(h) requires the "[s]ecuring of tools, materials and equipment with approved lanyards prior to entry into the FME-1 area."

FME-1 areas are defined in "Enclosure 2" of the FME Document and includes the LP turbine. My interpretation of the quoted sections leads me to believe that the bladder should have been secured with a lanyard as a potential layer of protection should it fall.

Additionally, the "FME Area Requirements" include the following: "Items secured by lanyards are **NOT** considered to be "fail-safe" and are required to be logged." (FME Document, Enclosure 5 ("FME Area Requirements"), Item 4, page 2; capitalization, underlining, and bold

in original). Further, the FME Document notes as follows: "Control Logs shall contain sufficient information to ensure accountability of tools and equipment. Items with missing parts or damage could result in questionable accountability." (FME Document, page 21 of 31, note 1).

Additional information is found in discovery responses. In response to PS DR 21-5(c) the Company stated:

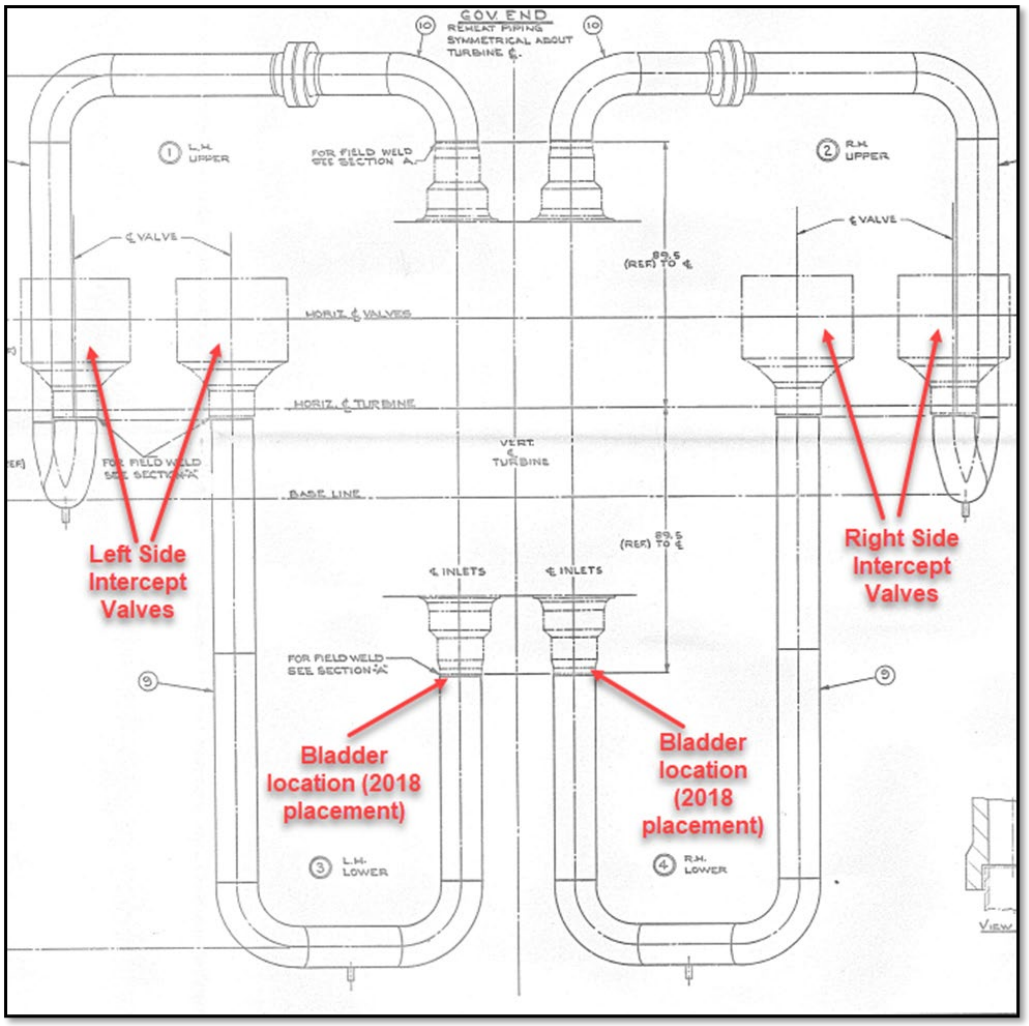
> There are two types of logs produced by using the FME procedure. The first log is used to track the material and tools that are moved into and out of the controlled areas are reconciled at the end of each shift (Procedure Enclosure 4 example). The log that tracks the use of foreign material control devices, such as the bladders in question, are logged in a separate log and are reconciled as they are removed from the component/area they are protecting. The type of device used and the method for tracking them is part of the job specific plan, which is developed for each outage. The daily log entries made by the craft team and the specialist onsite indicate the process was followed.

And finally, in response to PS DR 21-5(i), the Company stated:

> Processes for tracking foreign material exclusion devices (bladders) include logging of the installation and removal. As demonstrated above that was completed. Processes also include inspection of lines, visual and via borescope, and verification of their removal by the onsite technical direction. As demonstrated above that was also completed.

Q. Please discuss the location of the foreign material and your evaluation of same.

A. The Company does not know **[BEGIN CONFIDENTIAL]** [redacted] **[END CONFIDENTIAL]**



1 Figure 1: Turbine Steam Piping Diagram

2 The bladder is white and highly contrasts with the metal pipe. It
3 should have been clearly visible in the borescope inspection had the
4 lower portion of the piping been inspected. The Company's failure to
5 ensure the bottom portion of the piping was properly inspected was
6 an unacceptable oversight and introduced unnecessary risk to
7 ratepayers. If the FME exclusion device failed or any foreign material

entered into this piping, it would have settled into the lower part of the piping. The inspection should have included this section of piping to properly close out the project.

Q. Please summarize your findings.

A. The outage I describe above was caused by both equipment and multiple process failures which include the following:

1. Neither the Company nor its contractor used a secure tether to prevent the bladder from falling should it deflate.

2. The contractor's closeout inspection process did not include the bottom portion of the piping where foreign material, if present, would be found.

3. The contractor did not record the number of FME control devices it installed, making it impossible to verify that it had removed all devices at the end of the project.

The lack of controls in this outage made it impossible for the Company to know when the contractor left the device in the piping and difficult to determine how it happened. Multiple layers of redundancy are built into the process to prevent this failure, and each layer proved to be inadequate.

Q. What are your recommendations to the Commission?

A. Because of the loss of control, including the inability to follow necessary written procedures, and the inability of the Company to determine who failed to remove the bladder and when this occurred, I recommend that the Commission find that the Company's actions were imprudent and disallow the replacement power costs incurred due to this outage extension from April 22, 2022, through May 8, 2022, in the amount of $15,003,681.50 for the DEC system.

Q. Does this conclude your testimony?

A. Yes.

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Document No.	Revision No.
RREMP/NA/TBD/0002	000
RRE Foreign Material Exclusion	Effective Date: 12/14/2016
	Issued Date: 12/14/2016

Reference Only

Panashy, F **Author**	Panashy, F **Approver - Director- FHO Fleet Maintenance & Governance**

DOCUMENT REVISION DESCRIPTION

REVISION no.	**Pages or sections revised and description**
000	Rebranding Effort

Table of Contents

1. Purpose

1.1 To establish the Regulated & Renewable Energy (RRE) Foreign Exclusion (FME) Program in order to:

1.1.1 Prevent introduction of foreign material into systems and components that could degrade plant equipment.

1.1.2 Develop focus on prevention of foreign material intrusion into plant systems and components through effective behaviors by all plant workers.

1.2 To provide guidelines for inspection of work areas, establishing cleanliness and control requirements to prevent introduction of foreign material into open systems or components.

1.3 To provide guidelines for use of FME Project Plans for major projects and modifications.

1.4 To provide guidelines for recovering from an intrusion of foreign material.

1.5 To provide guidelines for the prevention of foreign material intrusion into plant systems/components which help prevent:

1.5.1 Damage to equipment (equipment reliability).

1.5.2 Degradation of heat transfer capability.

1.5.3 Degradation of system flow.

1.5.4 Unscheduled plant outages and outage extensions.

1.6 The FME program applies to equipment in the following states or status:

1.6.1 Spare parts or components in storage.

1.6.2 Items which are in service or in standby.

1.6.3 Items out of service (e.g., grounds installed in cabinet with doors open, etc.)

1.6.4 Items undergoing repair (e.g., valves, pumps, breakers, instrumentation, etc.).

1.6.5 Items which are being fabricated (e.g., piping, tubing, tanks).

1.6.6 Items in transport (e.g., from shop to field, Stores to job, Stores to Stores, etc.).

1.6.7 Vendor skids and/or vendor-installed components (including temporarily and permanently installed equipment).

1.6.8 Training devices and mock-ups.

1.6.9 Off-site fabrication or repairs of critical components (appropriate expectations to be included in Purchase Order or in Contract as determined by the Contract Designated Representative).

1.7 Items and activities that are EXCLUDED from the scope of the FME program include:

1.7.1 Routine work activities in electrical/electronic panels, components, or equipment when the activity consists solely of placement or removal of LOTO Tags on breakers and fuses.

1.7.2 Temporary removal of battery flame arrestor and/or sample tube cap to allow maintenance activities, as long as the battery cell is continuously attended and the flame arrestor or sample tube cap is immediately restored.

1.7.3 Loop/instrument calibration activities or preventive maintenance, when the activity is not performed in FME-1 areas that require:

- Removal and re-installation of circuit cards.
- De-termination or re-termination of leads.
- Installation of test equipment such as temporary pressure gauges or pressure sources.

1.7.4 Vents and drains that have a hose or suitable cover (i.e., screen, etc.) installed or that do NOT allow foreign material entry due to their orientation (i.e., entry from above) and the system is NOT under a vacuum when the drain is opened.

1.7.5 Storage of raw material and components that can be 100% visually inspected or otherwise verified to be free of foreign material before fabrication (i.e., pipe, tubing, valves, and conduit).

1.7.6 Items which are clearly identified as scrap material are exempt from FME requirements.

1.7.7 If equipment is removed from a system and is to be completely disassembled and rebuilt (i.e., a circ. water pump that was removed and is being taken to the shop for complete overhaul):

- FME controls do not need to be applied during disassembly.
- During the reassembly process, FME controls shall be in place.

1.8 High risk equipment areas where foreign material can be introduced that can adversely impact equipment reliability and integrity:

Steam Turbine

- Steam Turbine HP
- Steam Turbine IP
- Steam Turbine LP
- Boiler Feed Pumps
- Boiler Feed Pump Turbines

Steam Turbine Generator

- Rotating Exciter
- Generator Collector
- Potential Transformer Cabinets
- Rectifier Cabinets
- Generator Bushing Box

Steam Boiler Systems

- Steam Drum
- FW Regulator Valve (Internal)
- FW Regulator Bypass Valve (Internal)
- FW Piping from BFP Outlet
- De-aerator
- FW Storage Tank
- Motor Operated Valves
- Upper Water Wall Header
- Lower Water Wall Header
- Primary SH Header
- Secondary SH Header
- Cold RH Header
- Hot RH Header
- Attemporator Loop
- Attemporator Spray Header
- Economizer Inlet Header

Flue Gas Desulfurization

- Nutrient Pump
- Oxidation Air Blower
- Limestone B/M Classifiers
- Filtrate Tanks and Pumps
- Slurry Storage Tanks and Pumps
- Filter Feed Tanks and Pumps
- LSBM Slurry Tanks and Pumps
- Service Water Tank and Pumps
- Make Up Water Pumps
- Primary Hydrocyclone Overflow Tanks and Pumps
- Quench Water Pump
- Secondary Hydroclone Overflow Tanks and Pumps
- Vacuum Filter Feed Seal Water Tanks and Pumps
- Vacuum Filter Feed Receiver Tanks and Pumps
- Vacuum Pumps
- Bioreactor Air Compressor
- Oxidation Air Blower Inlet Filter Compartments
- Limestone Ball Mill Slurry Pumps
- Seal Air Fans
- Truck Wash Pump
- Filtrate M/E Service Water Pumps
- Emergency Storage Tanks and Pumps
- Primary Seal Air Fans
- Secondary Seal Air Fans
- Make Up Water Pump Discharge Valve Inspection
- Vacuum Filter Feed & L/S Slurry Feed Pumps
- AR Pump Seal Water Strainers
- Dart Valves
- Primary Hydroclone Strainer
- Seal Air & Boiler Isolation Dampers

- Bioreactor Nutrient Pumps
- Dust Collector
- Blow-Down Piping Flush to WWT Pond
- Primary Hydroclone
- Secondary Hydrocyclone
- Absorber Bleed Pumps
- AR Pump Seal Flush Water Piping
- Instrument Air Dryer
- WW Bioreactor Feed Pump
- Filtrate Pumps
- Piping Between Waste Water Wet Well & Flush Pumps
- Discharge Pipe from Absorber Sump Pump
- Limestone Ball Mill Filtrate Piping
- Alternate Make Up Water Strainers
- Mist Eliminator Wash Water Strainers
- Bioreactor Pumps
- Upper and Lower Doors To Reaction Tank
- Limestone Pile Silo Hopper and Feeder
- Limestone Mill Feeders and Silos

Heat Recovery Steam Generator (HRSG)

- HP, IP and LP Drums; FME-1 Area until FME Covers installed on Downcomers. Downgrade to FME-2 Area once FME Covers are in place.
- HP, IP and LP Drums; FME-1 Area while inspection plugs are removed from “belly pans”.
- HP, IP, LP and Reheater Upper Headers.
- Combustion Turbine Exhaust Area upstream of Bearing Struts. Downgrade to FME-2 Area for periods of inspection at discretion of Supervisor of Work.

Electrical

- Medium Voltage Switchgear
- High Voltage Switchgear
- Transformers

Other

- Any other area of the plant or piece of equipment where FME procedural requirements should be implemented to prevent the introduction of foreign material into open vents, inlets, exhausts, pipes, hatches, components, equipment, systems, etc.’

2. References

2.1	EPRI TR-106756,	NMAC Foreign Material Exclusion Guidelines.
2.2	**RRE-PRG-NA-0001**	Work Management Process Program

3. Definitions

3.1 Clean Enclosure

A temporary structure erected around a work area to reduce the possibility of introducing foreign material into a system or component. Enclosure may be used to prevent entry of dirt, and debris into an FMEA, as well as to prevent spread of these items to other areas of the station. Examples include glove bags, temporary tents, and temporary buildings.

3.2 Cleanliness Requirements

Plant procedures, industry standards, and regulatory positions that address cleanliness standards to be maintained for systems and associated components in a power plant.

3.3 Close-Out Inspection

A thorough inspection performed PRIOR to system/component restoration for the purpose of ensuring (inspection results should be documented in the work package):

3.3.1 All foreign material has been removed.

3.3.2 All tools and materials have been removed.

3.3.3 All FME cover devices have been removed.

3.4 Component Degradation

Degradation of components due to internal failures, age, environmental conditions, and design issues.

3.5 Fail-Safe

Material too large to fit into a system or component or any item that, when introduced into a system or component, should not result in damage and can be easily (immediately) retrieved.

3.6 Flush

Process used to remove known or suspected residue generated during performanceof an operations or maintenance activity from a system or component by introduction of a liquid or gas, such as water or air, sufficient to entrain foreign material and remove it from the system along with the expelled liquid or gas.

3.7 Foreign Material (FM)

Any material that is not part of a system or component as designed. Examples include: dirt, debris, broken or missing parts, oil, slag, tools, rags, chemicals, machine tailings, lapping compounds, grinding particles, paint chips, leak sealing components (such as FURMANITE), and any other items that could adversely affect the intended operation, components, or chemistry of the system.

3.8 Foreign Material Exclusion (FME)

The processes and practices used to prevent introduction of foreign material into a system or component.

3.9 FME-1 Controls

Precautions used if foreign material entering a system or component is NOT "immediately retrievable," or when final close-out inspection of internal areas is extremely difficult or NOT possible upon completion of work. Adds material accountability to the controls requirements of FME-2 controls.

3.10 FME-2 Controls

Precautions used if foreign material entering a system or component is "immediately retrievable," or when final close-out inspection of internal areas is possible upon completion of work.

3.11 FME Area (FMEA)

A work area requiring specific controls to prevent introduction of foreign materials into systems or components during performance of maintenance, modification, test or inspection activities.

3.12 FME Barrier (Internal Block or Pipe Dam)

Temporary and retrievable internal barriers installed in open systems or piping to prevent spread of foreign material. (see Step 3.15 FME Device)

3.13 FME Boundary

A physical boundary around a task, generally consisting of a barrier and appropriate signage (see **ENCLOSURE 3**) that visibly identifies a specific area as a Foreign Material Exclusion Area. Barriers can consist of rope, fabric curtains, tents, temporary metal walls, wire fencing, FME tape markers, or other similar materials.

3.14 FME Covers

Temporary external covers, which are securely attached and are used to seal and protect open systems or components from the introduction of foreign material. (see Step 3.15 FME Device)

3.15 FME Device

An internal, retrievable barrier device or external opening cover installed to prevent foreign material intrusion. (see Step 3.12 FME Barrier)

3.16 FME Control Log

A chronological listing used to account for items introduced into a Foreign Material Exclusion Area (FMEA) (see **ENCLOSURE 4**).

3.17 FME Monitor (FMEM)

Individual responsible for controlling an FMEA when personnel or material control is established, maintaining applicable logs, monitoring work activities, correcting FME problems and notifying the Supervisor of the Work of any unresolved problems.

3.18 FME Significant Event

A FME related event which resulted in personnel injury, significant plant equipment damage, or loss of generation. [EPRI TR-106756]

3.19 FME Vulnerability

A FME related implementation error or as found condition which if not detected could pose a risk of personnel injury, plant equipment damage, loss of generation or is the result of inappropriate human behavior during a work activity. This includes events that required evaluations in lieu of retrieval. [EPRI TR-106756]

3.20 Foreign Material Intrusion (FMI)

An incident where foreign material has been introduced into a system or component.

3.21 High Risk Area

Systems, structures, components or activities where debris can be introduced that can adversely impact equipment integrity.

3.22 Housekeeping

Maintaining material condition of station areas, equipment, and systems at high standards, such that open systems or components are less likely to be subjected to foreign material incidents or events.

3.23 Immediately Retrievable

Foreign material with which visual contact can be maintained and which can be promptly recovered at once after it enters a system or component.

3.24 Intrusive Work

An activity that breaches a plant system or component.

3.25 Lanyard

A device used to hold or fasten a tool, material or other object for the purpose of preventing the loss of said tool, material or object.

- Usually takes the form of a rope, string, cord or other type of restraint.
- Can be attached to any secure object that adequately supports the weight of the tool, material or object.

3.26 Legacy or Latent Foreign Material

Foreign material that was introduced prior to implementation of FME standards.

3.27 Loss of Control (Integrity)

A condition deemed to exist when (foreign) material enters an open system or FMEA and is not controlled by anyone. Also exists when:

3.27.1 Material logged into an FME-1 area cannot be accounted for during FME Log reviews or closure activities and is deemed to be lost in the system/component.

3.27.2 Material is found within an FME-1 area that was not logged into the area on the FME Log during the time in which that log entry was required.

3.27.3 Material which CANNOT be immediately retrieved is introduced into the system or component.

3.27.4 Internal barriers fail or external covers become damaged or missing while the FMEA is unattended.

3.27.5 An assembled or disassembled component used within an FMEA is found to be missing parts.

3.28 Maintenance Residue

Any by-product of maintenance activity, such as chemical deposits from solvents, particles from grinding or filing, wood chips from scaffolding, tape adhesive, and welding or soldering residue.

3.29 Mandatory FME-1 Areas

Work areas or activities where Foreign Material Exclusion control practices requiring the highest level of FME controls are mandatory.

3.30 “Stop Work” Authority

The act of stopping a program, process, or activity that presents a threat to the integrity of an FMEA, or when necessary to resolve an FME concern.

All personnel have the authority and responsibility to order a specific program, process, or activity stopped when a condition presents a threat to the integrity of an FMEA or when necessary to resolve an FME concern.

- Communication of “Stop Work”

  The communication of the “Stop Work” should be implemented by verbal notification to the appropriate supervisor/personnel at the scene.

  When a “Stop Work” has been invoked, no work should be allowed in the affected area except as required to place the area in a safe condition.

  Minimum actions required to allow resumption of work should be clearly communicated to all individuals involved.

- Termination of “Stop Work”

A "Stop Work" can be terminated based on evidence that the condition that required "Stop Work" has been adequately resolved. The "Stop Work" may be terminated verbally by the Supervisor of the Work and should be documented appropriately (ex. outage log, event report, e-mail, etc.).

3.31 Supervisor of the Work

The designated Duke Energy person in charge of the specific work task(s) being performed at any given time; with approval, delegation and change authority.

3.32 Supplemental Personnel

Non-permanent employees, such as contractors, vendors, and temporary outage workers.

3.33 System or Component

Any equipment such as pumps, valves, heat exchangers and vessels, piping, tubing, instruments, electronic and electrical devices.

3.34 Temporary Cover

A device for sealing and protecting a system or component from introduction of foreign material when the system or component is unattended or during periods of operation with temporary system modifications in use.

4. Roles and Responsibilities

4.1 All Personnel

4.1.1 This procedure is designated as "Reference Use". All personnel shall comply with the following when implementing this Reference Use Procedure:

4.1.1.1 Review and understand all aspects of the procedure prior to its use.

4.1.1.2 Have a copy of the procedure available during implementation (having the procedure in-hand or available for consultation via the Control Room (or suitable reference location/source) satisfies this responsibility).

4.1.1.3 Perform each step as written and in the sequence specified or as the procedure allows.

4.1.1.4 Deviation from Reference Use procedures shall only occur under approved processes, as stated in the procedure, or with management approval.

4.1.1.5 Refer to the procedure as necessary to complete the task in accordance with the procedure requirements.

4.1.1.6 Verify and document completion of certain tasks as stated by the procedure.

4.2 All RRE Personnel

4.2.1 Must comply with this procedure.

4.2.2 Must perform plant housekeeping to reduce the amount of foreign material available to be introduced into the system.

4.2.3 Upon completion of a work assignment, or at the end of the work shift, must ensure work areas are in as clean as or cleaner than found prior to start of work activities. This is applicable to all FME Area.

4.2.4 Must NOT remove FME covers/barriers unless directly associated with the job or task.

4.3 FME Worker

4.3.1 Possesses a thorough understanding of FME requirements and adheres to FME fundamentals in accordance with Section 10.4.

4.3.2 Prior to performing work in an FME area, verifies FME training/qualification is current.

4.3.3 Prior to being assigned work in an FME area, receives a Pre-Job Brief.

4.3.4 Inspects component internals for foreign material upon breaching a system or component.

4.3.5 Performs inspections and flushing of component internals prior to installation to ensure cleanliness.

4.3.6 Participates in a Post-Job Review, as needed, to capture lessons learned.

4.3.7 Conducts pre-breach cleaning and maintains housekeeping using clean-as-you-go methodology.

4.3.8 Uses work practices that minimize introduction of Foreign Material into the FMEA.

4.3.9 Keeps parts, tools, and materials not being used a safe distance from the breach areas.

4.3.10 Ensures personal items not required for the work activity are NOT taken into FME-1 areas.

4.3.11 Unpacks parts, tools, material, etc., prior to entering the FMEA, when possible.

4.3.12 Obtains resolution of FME questions or concerns from the Supervisor of the Work prior to commencing work in an FEMA.

4.3.13 Notifies appropriate supervision of activities that threaten FME integrity, including activities in surrounding areas that may result in foreign material entering an open system or component.

4.3.14 Ensures FME discrepancies are reported to the Supervisor of the Work.

4.3.15 Minimizes, to the extent possible, the time a system or component is breached without an FME cover installed.

4.3.16 Inspects parts, materials, assemblies and tools for loose, broken, or missing parts and cleanness (residues, dirt and debris) before items are taken into an FMEA.

4.3.17 Ensures the designated FME Monitors are aware of parts, tools, and materials taken into and removed from the FME-1 areas.

4.3.18 Uses Human Performance Tools to prevent errors.

4.3.19 Exercises “Stop Work” authority when necessary to resolve an FME concern.

4.3.20 Evaluates the FME level assigned in work package to ensure it is appropriate and resolves issues prior to entry into the FMEA.

4.3.21 Provides feedback related to FME controls to the Supervisor of the Work or Planner.

4.3.22 Controls debris generating activities (welding, grinding, machining) in FMEA.

4.3.23 Inspects FME covers for debris, holes, and tears PRIOR to placement or removal on an open system/component.

4.3.24 Ensures that FME cover devices are securely installed to prevent loss.

4.3.25 Performs a thorough close-out inspection of component PRIOR to reassembly to ensure that all FME cover devices, tools, parts, and materials have been properly removed and accounted for.

4.3.26 Ensures that the Opening / Closing cleanliness requirements and acceptance criteria have been instituted during the performance of maintenance or modifications on systems or components and **ENCLOSURE 7**, Opening / Closing Cleanliness Data Sheet, has been completed.

4.3.27 Performs all duties of FMEM when entering self-monitored FMEAs.

4.4 Work Management Specialist/Planner

4.4.1 Plans work packages in accordance with **RRE-PRG-NA-0001** to determine the appropriate level of FME control for the job.

4.4.2 Includes applicable FME precautions in work packages in accordance with this procedure.

4.4.3 Includes additional guidance in work packages such as cleanliness standards, possible need to flush systems, and additional work restrictions, as necessary.

4.4.4 Reviews RRE and industry operating experience when determining FME requirements.

4.4.5 Performs field walk downs, as necessary, to determine level of FME control required.

4.4.6 Analyzes feedback to improve future work packages for FME control requirements.

4.5 Supervisor of the Work

4.5.1 Prior to assigning work in an FME area, verifies FME training for workers is current.

4.5.2 Provides oversight and coaching to ensure FME controls and practices are implemented for activities within their area of responsibility.

4.5.3 Provides feedback to work planning regarding FME problems or effective practices.

4.5.4 Reviews work package FME requirements to ensure they are appropriate to the task and to local conditions at the work site.

4.5.5 Prior to performing work in an FME area, ensure workers receive a Pre-Job Brief.

4.5.6 Ensures required FME controls are addressed at the Pre-Job Brief, when specified in the work package.

4.5.7 Ensures appropriate FME boundaries and postings are established if the affected system/component or other systems/components located within the FMEA are:

- Critical to personnel safety and/or station operations or,
- Will be left unattended for extended periods of time during work task performance.

4.5.8 Verifies housekeeping for work in FME areas is maintained to excellent standards.

4.5.9 Ensures a Post-Job Review is completed upon completion of work in an FME area.

4.5.10 Ensures corrective actions are initiated, if FME requirements have NOT been met.

4.5.11 Monitor responsible area(s) on a periodic basis to ensure compliance with the FME Program; coach and provide positive reinforcement as appropriate. Implement a recovery plan to resume work after loss of FME Control.

4.5.12 Approves FMEA Terminations using **Enclosure 6** FMEA Termination/Suspension Approval form

4.6 FME Monitor

4.6.1 Understands and ensures requirements for the FMEA are implemented.

4.6.2 Ensures FME-1 requirements/work practices are implemented for work to be performed in FMEA(s) requiring equipment accountability log keeping.

4.6.3 Prior to authorizing entry into an FME-1 area, inspects all personnel and material for conditions that could result in a loss of FME controls.

4.6.4 Authorizes personnel entry into FME-1 area at the control point.

4.6.5 Logs all material on **ENCLOSURE 4**.

4.6.6 Exercises “Stop Work” authority to notify appropriate supervision. Work in the FMEA will be suspended until the “Stop Work” issue is resolved.

4.6.7 Notifies the appropriate Supervisor of the Work of activities that threaten FME integrity.

4.6.8 Performs an accurate turnover to oncoming shift FME Monitor.

4.6.9 Reconciles the FME Control Log immediately upon completion of each shift and at the completion of all work to ensure that all tools, parts, FME cover devices, and materials have been properly removed and accounted for.

4.7 Members of Management

4.7.1 Members of Site Management

a. Foster an environment that focuses on the prevention of foreign material introduction into plant systems and components.
b. Communicate and reinforce expected worker behavior relative to foreign material control.
c. Instill a sense of responsibility in personnel for program adherence and ownership.
d. Conduct periodic work site observations to ensure their organizations and supplemental work force adhere to and properly implement FME expectations and standards.
e. Ensures station and supplemental personnel are trained in FME requirements.

4.7.2 Maintenance Manager/Maintenance Program Owner

a. Implements the FME Program.
b. Secures FME Staffing, as required.
c. Monitors the quality of the FME training and assesses effectiveness of FME Program.
d. Investigates root cause of FME incidents

4.7.3 Shift/Production Supervisor

Assists with evaluation of material recovery techniques, their effectiveness, and their impacts on system performance in the event of a loss of FME integrity.

4.8 Training Services

4.8.1 Designs, develops, and delivers training to support implementation of the RRE FME Program.

4.8.2 Ensures training scenarios incorporate and address the use of the following:

a. Pre-Job Briefs.
b. Inspection of component internals for foreign material upon breaching system or component.
c. FME cover devices.
d. FME dams and internal barriers.
e. Lanyards and other means of securing tools, material, ID badges, glasses, etc.
f. Stress that personal items NOT required for the job are NOT taken into FME-1 areas.
g. Personnel and material accountability.
h. FME retrieval practices, methods, and applicable procedures.

4.8.3 Reviews and incorporates RRE and industry operating experience into training for FME.

4.8.4 Reviews and updates training based upon feedback from maintenance.

4.8.5 Maintains accurate personnel training records.

4.9 Warehouse, Receiving, and Procurement Personnel

4.9.1 Ensures material in warehouse storage is maintained in a condition consistent with this procedure.

4.9.2 Ensures all openings in equipment or parts susceptible to introduction of foreign material are covered, and covers are consistent with the requirements of Section 10.

4.9.3 Ensures received materials associated with critical components are free of foreign material by performing necessary receipt inspections of accessible internal and external areas.

4.10 Contract Designated Representative

4.10.1 Ensures vendors are aware of FME expectations established in procurement documents.

4.10.2 Ensures that all contract content and activities associated with on-site services comply with the current Supply Chain, RRE and/or all other applicable requirements.

5. Precautions and Limitations

5.1 Customized manual or electronic control plans, control logs, and signs may be used if they contain the same type of information and are used in the same manner.

6. Health and Safety

6.1 At Duke Energy, Health and Safety is a Core Company Value. Employees are responsible for maintaining the highest regard for safety while planning and conducting work. Employees are also responsible for ensuring a safe work environment exists for themselves and their coworkers.

7. Safety Systems and Functions

7.1 N/A

8. Prerequisites/Initial Condition

8.1 N/A

9. Tools, Materials, Special Equipment

9.1 N/A

10. Procedure

10.1 Work Order Planning

10.1.1 **DETERMINE** area classifications per **ENCLOSURE 1**.

10.1.2 **DETERMINE** applicable FME requirements per **ENCLOSURE 5**) **AND INCORPORATE** appropriate instructions in the work package.

10.1.3 **INCLUDE** FME applicable operating experience in work packages.

10.2 Expectations for Pre-Job Briefs for Work in the FME Areas

10.2.1 **CONDUCT** Pre-Job Briefs in accordance with site-specific procedures.

10.2.2 **DISCUSS** the following items, as applicable, during Pre-Job Briefs to ensure workers understand the FME controls for the job.

a. FME Controls for Job (e.g., permit assigned, lanyards, cover devices, control of badges and personal items, housekeeping, log keeping, inspections, postings and boundaries, and close-out inspections).

b. FME Monitor responsibilities.

c. FME Project Plans, as applicable.

10.3 FME Project Plans

10.3.1 **ENSURE** an FME Project Plan is utilized for ALL major projects and major modifications.

10.4 FME Fundamentals

10.4.1 **ENSURE** FME fundamentals are implemented to **PREVENT** intrusion of foreign material into systems or components.

10.4.2 FME Control Fundamentals include:

a. Pre-cleaning of work area, as needed.
b. "As-found" conditions of systems/components, when opened, are documented in the work package including any foreign material found.
c. Establishing appropriate boundaries and signage (**ENCLOSURE 3**) prior to breaching a system/component.
d. Pre-service inspections and cleaning/flushing of replacement components are conducted, when possible, to ensure that NO debris is introduced into plant systems during installation.
e. Work area cleanliness (housekeeping) is kept at excellent level.
f. For system or component openings, when work is suspended or unattended, temporary covers shall meet the following criteria:

    1. Clean and free of visible contamination such as, but not limited to, dirt or debris.

    2. Non-brittle, non-splitting, non-melting (if applicable), thick enough to avoid damage to underlying surfaces.

    3. Brightly colored or contrast with the item they are used on.

    4. Dams, plugs or caps shall be secured if they cannot be easily retrieved. Removal tape should be used in lieu of adhesives in contact with bare metal surfaces.

    5. Hard covers required on vertical openings.

g. FME cover devices do NOT obstruct the designed function of in-service system vents.
h. Securing of tools, materials and equipment with approved lanyards prior to entry into the FME-1area.
i. Inspection of all items prior to entry into the FME area for loose, missing or broken parts (consider photographing items as part of inspections).
j. Use of the appropriate tool(s) for the job (e.g., wire wheels and wire brushes should be restricted from use in FME-1 areas and high risk systems due to potential for wire strands to separate from the tool).
    1. The use of wire brushes in FME-1 areas and high risk systems should be considered as a last resort.
    2. If wire brushes are determined to be the appropriate tool, then their use shall be approved by the implementing supervisor with special consideration given to mitigating the effects of lost strands.
    3. Wire brushes may be used in FME-2 and non-FME areas where retrieval of stray bristles does not have an effect on the component/system.
k. Remove or secure personal items such as jewelry, contents of pockets, wireless telephones, body piercing(s), medical alert bracelets/necklaces, etc., prior to entering FME area.
l. Safety glasses should be inspected for integrity and secured with an approved lanyard.

m. Limit and control use of transparent materials (e.g., face shields, tubing, plastic) in FME areas.
n. Precautions taken to protect adjacent equipment from debris such as, welding slag, cutting or grinding debris, or dust.
o. Human Performance tools are used to anticipate results of actions and to anticipate the unexpected.
p. Control of welding rods in FME-1 areas (accountability of unused rods and used rod stubs).
q. The use of tie wraps with metal locking tabs in FME-1 areas and high risk systems (reference Section 1.8) should be considered as a last resort.
    1. If tie wraps with metal locking tabs are determined to be the appropriate tool, then their use shall be approved by the implementing supervisor with special consideration given to mitigating the effects of loss of metal locking tabs.
    2. Tie wraps with metal locking tabs may be used in FME-2 and non-FME areas where retrieval of metal locking tabs does not have an effect on the component/system.
r. "Clean-as-you go" methodology is utilized for work area.
s. Control of documents for FME-1 areas (staples, paperclips and binder clips may become foreign material, and should be removed).
t. Accountability for tools and materials via use of **ENCLOSURE 4** to document items entering and exiting the FME-1 area.
u. Inspections of cranes and lifting/rigging for foreign material prior to use over open systems or components.
v. FME controls required for equipment being sent off site for service or repairs.
w. FME areas should be large enough to allow unrestricted access for the workers, yet small enough to maintain control of the FMEA. Single point access is recommended.
x. Pre-closure inspections to ensure tools, materials, and FME cover devices have been removed from the system or component prior to restoration. Results of inspection should be documented in the work package.

10.5 Application of FME Controls

NOTE:	It is prohibited to remove FME covers/barriers unless directly involved in the job with the FME controls in place or unless authorization has been granted by the responsible implementer.

10.5.1 **IMPLEMENT** FME-1 Mandatory Controls for the equipment/systems listed in **ENCLOSURE 2**.

10.5.2 **WHEN** a system/component is open, **APPLY** FME controls.

NOTE:

1. Control Logs shall contain sufficient information to ensure accountability of tools and equipment. Items with missing parts or damage could result in questionable accountability.
2. When an FMEA requires material accountability and an independent FMEM is not required for the area, an FME Worker may enter the FMEA independently to perform work. The FME Worker shall be qualified in accordance with the site FME procedure and act as the FMEM.

10.5.3 **WHEN** work is to be performed within a system/component boundary, **APPLY** FME controls.

10.5.4 **WHEN** FME-1 controls are in place, **ENSURE** material accountability logging is implemented.

10.5.5 FME Control Logs (**ENCLOSURE 4**) shall be reconciled while the FMEA is active as follows:

a. Log reconciled during each shift if work is in progress and immediately upon completion of job.

10.6 Identification and Physical Properties of FME Device

10.6.1 **WHEN** vendor-supplied parts are located in Stores, **ENSURE** plugs, caps, protective packaging, or other appropriate devices are in place to prevent FM intrusion.

10.6.2 **ENSURE** that FME devices:

a. DO NOT introduce foreign material into systems or components during installation or removal.
b. Prevent dropped foreign material from entering systems or components.
c. Resist tearing, splitting (e.g., as does plywood), and melting.
d. Are made of fire retardant or fire resistant materials, when possible.
e. Are made to be chemically and physically compatible with the equipment.
f. Are constructed of material that permits system venting and confined space ventilation, if required
g. Are NOT to obstruct the designed function of the vent while system or component is in service.
h. Are evaluated by Engineering to ensure it is capable of supporting the weight of employees, if it may be walked on, to ensure personnel safety.
i. Are properly secured to prevent accidental displacement by wind, equipment movement, ventilation systems, or employees.
j. **WHEN** protection from environmental contamination is necessary, **ENSURE** the FME covers/barriers prevent the intrusion of foreign material.

10.6.3 **ENSURE** that FME devices are either labeled ‘FME’ or tagged appropriately.

10.6.4 FME devices on spare parts are NOT required to be labeled “FME.”

10.7 Upgrading/Downgrading FME Conditions

NOTE:	Changes within the requirements of this procedure require concurrence of the Supervisor of the Work. Changes are noted in the work package.

10.7.1 UPGRADING

- **IF** at any time an FME-2 area becomes such that material intrusion is NOT "immediately retrievable," or **IF** a final inspection of the internal area is NOT, possible **THEN PERFORM** the following:

a. **UPGRADE** to an FME-1 area and **APPLY** FME-1 controls.
b. **CHANGE** signs and postings to reflect FME-1 controls.

10.7.2 DOWNGRADING

- **IF** it is desired to downgrade an FME-1 area to an FME-2, **THEN PERFORM** the following:

a. **ENSURE** appropriate FME covers or internal barriers/dams are installed.
b. **REMOVE** FME-1 postings.

NOTE:	Downgrading from an FME-1 to FME-2 area does not eliminate the requirement for reconciliation of the FME Control Log upon job completion.

10.7.3 Prior to removal of FME covers or internal barriers/dams, **RESTORE** all FME-1 controls.

10.8 Suspension of Work Having FME Controls

10.8.1 **WHEN** work with FME controls is NOT actively being performed or is suspended, **TAKE** the following actions:

a. **COVER** system openings, if practical.
b. **ENSURE** each cover device is securely attached and labeled to identify it as an FME cover device.
c. **ESTABLISH AND MAINTAIN** FME boundaries a safe distance from the opening if it is NOT practical to cover large openings.
    1. **COMPLETE** ENCLOSURE 6 FMEA Termination/Suspension Approval form.
d. **WHEN** multiple system/component breaches exist within an FMEA boundary:
    1. **ENSURE** the FMEA boundary is adequate to restrict access to ALL of the system/component breaches.

2. **ENSURE** an appropriate FME Cover is installed on **EACH** system/component breach within the FMEA.

10.9 Debris Controls for All FME Areas

10.9.1 Supervisor of the Work

a. **REVIEW** the work management system for other planned/scheduledwork that may affect FMEA integrity or environment.
b. **IDENTIFY** other tasks in progress that may produce conditions potentially damaging to the FMEA, such as grinding and welding in the area.
c. **CONSIDER** rescheduling work or stopping other activities to prevent threats to FMEA integrity.
d. **USE** work plans and established procedures to provide FME requirements appropriate to the job, to include:
    1. Special work practices.
    2. Tool, personnel and material controls.
    3. Post-work cleanup and inspection requirements.
    4. Applicable system or component flushing stipulations.
    5. Required procedures for documentation of system or component cleanliness prior to release.

10.9.2 All FME Workers, **APPLY** the following guidelines to minimize the spread of debris:

a. **CONTROL** debris of any size generated near an FMEA such that spread of the debris beyond the immediate area of the work site is prevented.
b. **REMOVE** debris generated from the work area during work performance using “clean as you go” as well as the completion of the work.
c. **CONTROL** debris of any size generated inside an FMEA during the following work activities:
    1. Grinding and welding, exercising care to capture all rod stubs and slag.
    2. Machining/cutting.
    3. Installation/removal of insulation that produces debris.
    4. Debris that could fall through deck gratings, including wire and cable ties is contained.
    5. Welding rods and tungsten must be inventoried prior to entering an FME-1 area. Upon removal, rods and stubs should account for the total number of rods that were taken into the area.
d. **EVALUATE** the need for temporary covers, containment devices, or barriers to isolate debris that could spread to areas adjacent to the work location.
e. **PERFORM** cleanup during task performance and upon task completion.
f. **PERFORM** a thorough vacuuming of FME areas, where accessible.
g. **USE** VELCRO and elastic cords in FME-1 areas instead of cable ties and duct tape where practical.
h. **IF** temporary use of cable ties is necessary for debris control within FME-1 areas, **THEN USE** cable ties, sized appropriately to prevent failure.

1. **IF** cable ties are used, **THEN MINIMIZE** the possibility of dropping the cable tie by NOT cutting the tail (end); providing a means of firmly grasping the tie when removed.
2. **RESTRICT** use of cable ties with metal locking tabs during work in high risk safety significant systems.

i. **WHEN** entering FME-1 areas:

1. Do **NOT** take personal items that are NOT required for the task into FME-1 areas.
2. **ENSURE** security badges are properly secured.
3. **ENSURE** safety glasses are secured by a lanyard or other means.

10.9.3 All FME Workers, **APPLY** the following guidelines to prevent debris from entering open plant systems:

a. **USE** lint free towels/rags for wiping down systems/components.
b. **ENSURE** air intakes are provided with clean air filters to prevent debris being drawn into the equipment.
c. **PROHIBIT** use of duct tape as FME covers.
d. **IF** clear plastic or glass must be used in FME areas, **THEN ENSURE** it is securely affixed to other items which are clearly visible underwater (i.e., NOT clear); **OR MARK** clear items in such a manner to make the items visible underwater.
e. Prior to initial use of cranes over open systems or FMEA (Turbine Building, etc.), **PERFORM** a walk down inspection in order to minimize FME intrusions due to dirt and debris accumulation falling off the cranes.
f. **RESTRICT** flight of equipment and boxes over FME-1 areas in to the extent possible.
    1. **IF** items must be flown over FME-1 areas, **THEN** thoroughly **INSPECT** for loose debris, parts, and tools prior to being moved.
    2. Prior to movement of item, **ENSURE** the posted FME Monitor is informed that the inspection has been completed.

10.10 Non-Maintenance Activities

10.10.1 **IF** FME-1 or FME-2 areas are created and/or entered during the following activities or routine tasks, **THEN ENSURE** appropriate FME controls are established and maintained.

a. Operations Activities

1. Venting and draining
2. Racking breakers in and out
3. Changing fuses
4. Resin additions
5. Operator rounds/inspections
6. Chemistry additions

b. Engineering Activities

1. Walk downs of plant equipment

2. Equipment inspections

10.11 Loss of FME Integrity

10.11.1 **IF** loss of FME integrity or FME controls exists (i.e., when material enters an open system/component or FMEA and is not controlled), **THEN PERFORM** the following:

a. **STOP** work in progress.
b. **PLACE** the system/component in a safe or secured status.
c. **NOTIFY** plant supervisory personnel, as required, including:

1. FME Monitor (if posted)

2. Supervisor of the Work or Project Coordinator

d. **ASSIST** management and engineering in developing a recovery plan.
e. **DOCUMENT** information related to the foreign material intrusion, legacy debris, and loose/missing components in the following circumstances:

1. When load effecting equipment operation is impacted to support retrieval.

2. When critical path is extended to support retrieval.

3. When additional cost is incurred to support retrieval.

4. When retrieval is unsuccessful and material is left in the system.

f. **RECORD** information related to occurrences listed in Section 10.11.1e 1, 2, 3, and 4 using PlantView Event Reporting tool. Include the following:

1. Date and time work was stopped.

2. Foreign material type and extent of intrusion.

3. Impact to system or component.

4. Details of the recovery, including considerations taken into account before initiating recovery.

5. Name and title of individual approving the recovery plan.

6. Steps taken to prevent recurrence.

10.12 FME Integrity Recovery Plan

10.12.1 **IF** item can be immediately retrieved, **THEN PERFORM** the following:

a. **IDENTIFY** personnel safety hazards **AND CONTACT** Supervisor of the Work if hazards exist.
b. **IF** item is located in or near a radiological hazard, **THEN CONTACT** Radiation Protection for guidance.

10.12.2 **IF** item CANNOT be immediately retrieved, **THEN PERFORM** the following:

a. System Engineer, Work Planner, Project Coordinator, and Supervisor of the Work (as applicable): **EVALUATE** retrieval options, with consideration of the following possible impacts to the system/ component:

1. Mechanical impact
2. System chemistry
3. Instrumentation.
4. Electrical

b. System Engineer, Work Planner, Project Coordinator and Supervisor of the Work: **DEVELOP** a retrieval plan to include the following elements:

1. Personnel safety.
2. Subsequent analysis of recovered materials.
3. Determination of source, quantity and location of foreign materials.
4. Measures to limit further spread or introduction of foreign materials.
5. Subsequent inspection requirements or equipment disassembly.
6. Process for material location and recovery as it concerns plant procedures for safety, confined spaces, etc.
7. Evaluation of possible equipment damage already sustained.
8. Assessment of potential impact of material not yet accounted for that remains in the system or component.
9. Monitoring methods to identify unacceptable consequences of foreign material intrusion upon a return to service.
10. Measures to prevent recurrence, further equipment damage or degradation.
11. **IF** direct visual inspection for retrieval and final cleanliness CANNOT be accomplished, **THEN CONSIDER** the following options:

i. Boroscopes, fiber optics
ii. Remotely operated video cameras
iii. Radiography
iv. Infrared thermography

v. Mirror
vi. Additional lighting

12. **IF** item(s) CANNOT be retrieved directly by hand, **THEN CONSIDER** the following options:
    i. Grapple, disc or cone equipped snakes
    ii. Adhesives
    iii. Magnets
    iv. Reach rods
    v. Vacuum systems
    vi. Flushing systems, with temporary screens and strainers

10.12.3 **IF** item is determined to be non-recoverable foreign material **AND** the system is to be returned to service, **THEN PERFORM** the following:

a. **PERFORM** an engineering evaluation in accordance with appropriate procedure for items not completely retrieved.
b. **DETERMINE** the probable cause and extent of the foreign material intrusion based on immediately available plant information related to the event.
c. **INFORM** the Plant Manager of findings and **OBTAIN** approval for leaving foreign material in the system or component.

10.13 Electrical Maintenance

NOTE:	Performance of electrical maintenance requires work planners, supervisors, and craft personnel to consider potential FME concerns for planning and performance of each work task.

10.13.1 Electric Motors

a. Prior to disassembly, **PERFORM** a thorough visual inspection to detect any obvious foreign material.
b. **CLEAN** or otherwise remove foreign material using appropriate means, using care to NOT inadvertently introduce foreign material during cleaning.
c. **PAY** particular attention to screen/filters which cover the motor air intakes.
d. **USE** appropriate FME covers to preclude foreign material intrusion during transport if the motor is transported to another location.
e. **PERFORM** a thorough visual inspection of the motor prior to reassembly.
f. **LOOK** for indications of foreign materials during testing – increased vibration, noise, abnormal operating current or temperature.
g. **PERFORM** a final visual inspection of the following to ensure no obvious foreign material has been introduced prior to returning the motor to service:
    1. The work area
    2. The motor coupling
    3. The electrical connection junction box
    4. Motor ventilation openings

10.13.2 Electrical Enclosures, Cabinets, Panels, Boxes, Trays, Conduit

a. **VISUALLY INSPECT** the surrounding area, particularly the overhead, for potential sources of foreign material before opening the cabinet.
b. **PLACE** all mounting screws, wire nuts, or other miscellaneous fasteners into a container immediately upon their removal while working in electrical cabinets.
c. **USE** special tools or catch barriers, as necessary, to minimize the chance of dropping screws or other fasteners upon their removal.
d. **PLACE** wire end strippings, cable ties, and other incidental debris immediately into a container for removal from the work area.
e. **ENSURE** that parts lost during the maintenance activity do NOT remain in the cabinet upon completion of the work task.
f. **ENSURE** equipment or materials are NOT stored in electrical enclosures.
g. **DETERMINE** actions necessary to avoid intrusion of foreign material generated in the drilling process if drilling into an electrical enclosure.
h. **PERFORM** a cleanliness inspection prior to task closeout.

10.13.3 Switchgear

a. **VISUALLY INSPECT** the surrounding area, particularly the overhead, for potential sources of foreign material before opening a switchgear cubicle or transformer cabinet.
b. **ENSURE** foreign material is not introduced by using thorough pre-cleaning, visual inspection and parts accountability.
c. **ENSURE** an alternate cover is installed if the equipment cover cannot be immediately restored to prevent moisture and contamination intrusion.
d. **PLACE** incidental waste in an appropriate container immediately upon generation for later disposal.
e. **ENSURE** spare switchgear is covered when not in use.

10.13.4 Transformers

a. **VISUALLY INSPECT** the surrounding area, particularly the overhead, for potential sources of foreign material before opening a transformer cabinet or switchboard panel.
b. **ENSURE** foreign material is not introduced by using thorough pre-cleaning, visual inspection and parts accountability.
    1. Clean shoes and wear plastic covers over shoes to keep contamination out of transformer.
    2. Walk on structures not insulation and windings.
c. **REPORT** to the Supervisor of the Work;
    1. Fallen debris found inside transformer.
    2. Signs of carbon on winding and lead insulation.
    3. Signs of copper particles or excessive sludge formation.
d. **ENSURE** an alternate cover is installed if the equipment cover cannot be immediately restored to prevent moisture and contamination intrusion.
e. **PLACE** incidental waste in an appropriate container immediately upon generation for later disposal.

f. **ENSURE** spare transformer openings are covered when not in use.

10.14 Instrument and Control Maintenance

10.14.1 **FOLLOW** applicable FME guidelines when planning or performing I&C maintenance activities with special considerations of the following:

a. Air Actuated Components
   1. Thoroughly **COLLECT** debris generated by cutting supply hoses, tubing or piping to air-actuated components such as valve actuators and solenoid valves.
   2. **FLUSH** supply hoses, tubing, or pipes to dislodge and remove any particles that may have entered them.
   3. **INSTALL** a cap or plug when a line is disconnected or removed.

b. Tank or Sump Mounted Level Instrumentation
   1. **UTILIZE** caution to avoid dropping tools, loose parts, etc., into tanks or sumps, especially when using a tool such as a reach rod to move the sump float in order to check instrument calibration and response.

c. Instrument Cabinets
   1. **USE** catch screens when removing screws.
   2. **VACUUM** accumulated dust and debris from card frames and cabinet bottoms using a non-conductive nozzle, as power supplies are frequently located in the bottom of cabinets.
   3. **TAKE** care to prevent debris from entering the power supply case through the ventilation openings while working in the cabinet.

d. In-Line Flow Elements and Meters
   1. **USE** appropriate FME controls to prevent loss of tools, loose parts, etc., into the exposed piping system during maintenance.
   2. **BEFORE** opening the system or removing FME barriers, carefully **INSPECT** area for potential foreign material.

10.15 Training of Personnel

10.15.1 Training on Foreign Material Exclusion shall be provided to all hands-on personnel.

10.15.2 The Supervisor of the Work may permit trainees or short-term employees to work under the direct supervision of qualified personnel. The qualified personnel shall ensure appropriate FME controls.

10.15.3 A general knowledge of Foreign Material Exclusion shall be provided to personnel who have access to work areas.

10.15.4 Group specific training can be a useful tool for areas such as the refuel floor, turbine or primary containment. These groups often encounter special FME needs.

11. Recordkeeping

11.1 Pertinent information resulting from Foreign Material Exclusion incidents or events should be used to improve or revise work procedures, improve or revise model work, populate the lessons learned database or the PlantView Event reporting tool.

11.2 Documentation supporting the final foreign material closeout inspection shall be maintained with the work package, project report or outage report.

11.3 Execution of this procedure results in the creation of the following record(s):

Record Description	Record Series Number
Pre-Job Brief	SAF-049
Equipment Accountability Log	ADM-044
FME Control Log	ADM-044
As Found Conditions	ADM-044
Pre-Closure Inspection	ADM-044
Event Report	ADM-044
Opening/Closing Cleanliness Data Sheet	ADM-044

11.4 Execution of this procedure **can** result in the creation of the following record(s):

Record Description	Record Series Number
Procedure Deviation Form (RRE-FRM-NA-0127)	ADM-043
Post Job Review	SAF-049
Corrective Action	ADM-044
FMEA Termination/Suspension Approval	ADM-044
Recovery Plan	ADM-044

11.5 This procedure has identified the records above. These records are found listed in a document known as the Records Management Instructions (RMI). The RMI is a list of business records and it contains all the important recordkeeping information such as; the file classification, retention timeframe, recommended storage locations, etc. The associated Record Series Number for each record is the unique indexing identifier within the RMI. The following is the link to the RMI where you will find the identified Record Series and the corresponding information. (RMI).

12. Procedure Deviation Documentation

12.1 Any deviation from this procedure and its associated templates is unacceptable without approval from the appropriate management. Feedback on this procedure or associated templates should be provided to the procedure owner or Corporate Compliance. Utilize the Procedure Deviation Form to document any deviation from the approved document.

12.2 Contingency Plan

Critical Documents – Customers are encouraged to identify document(s) critical to work processes. A current hardcopy collection of such documents should be maintained by the customer (owner) to support the work flow during times of criticality and inaccessibility to electronic documents due to a complete system failure.

13. Enclosures

13.1 **ENCLOSURE 1** FME Controls Planning Flow Chart

13.2 **ENCLOSURE 2** FME-1 Controls Mandatory Areas

13.3 **ENCLOSURE 3** Foreign Material Exclusion Control Sign

13.4 **ENCLOSURE 4** Foreign Material Exclusion Control Log

13.5 **ENCLOSURE 5** FME Area Requirements

13.6 **ENCLOSURE 6** FMEA Termination/Suspension Approval

13.7 **ENCLOSURE 7** Opening / Closing Cleanliness Data Sheet

13.8 **ENCLOSURE 8** Example FME Repair and Modification Plans – Steam Boiler

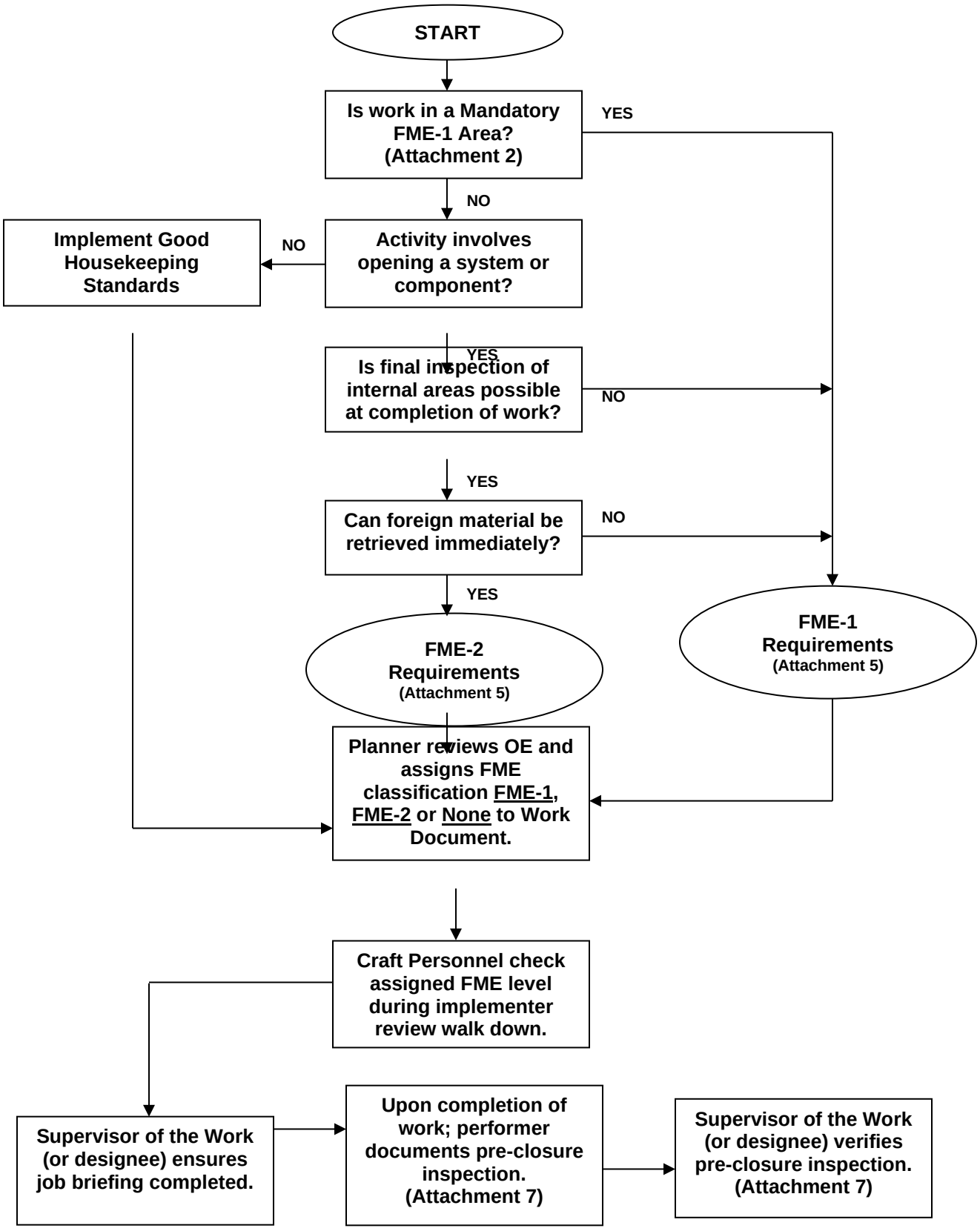
13.9 **ENCLOSURE 9** Example FME Repair and Modification Plans – Precipitator

13.10 **ENCLOSURE 10** Example FME Repair and Modification Plans – Duct Work over ID & FD Fans

13.11 **ENCLOSURE 11** Example FME Repair and Modification Plans – Air Heater

Enclosure 1

FME Controls Planning Flowchart



Enclosure 2

FME-1 Mandatory Control Areas

Steam Turbine	***Combustion Turbine***	
Steam Turbine HP	Combustion Turbine – Compressor Inlet	
Steam Turbine IP	Combustion Turbine – Turbine Section	
Steam Turbine LP	Combustion Turbine – Inlet (downstream of any filtering devices up thru the compressor inlet)	
Boiler Feed Pumps	Combustion Turbine – Combustion Section	
Boiler Feed Pump Turbines		
	Heat Recovery Steam Generator (HRSG)	
Generator	HP, IP and LP Drums; FME-1 Area until FME Covers installed on Downcomers. Downgrade to FME-2 Area once FME Covers are in place	
Rotating Exciter		
Generator Collector	HP, IP and LP Drums; FME-1 Area while inspection plugs are removed from “belly pans”.	
Rectifier Cabinets	HP, IP, LP and Reheater Upper Headers.	
Generator Bushing Box	Combustion Turbine Exhaust Area upstream of Bearing Struts. Downgrade to FME-2 Area for periods of inspection at discretion of Supervisor of Work.	
Steam Boiler Systems	***Flue Gas Desulfurization***	
Steam Drum	Oxidation Air Blower	Filtrate M/E Service Water Pumps
FW Regulator Valve (Internal)	Limestone B/M Classifiers	Vac Filter Feed & L/S Slurry Feed Pumps
FW Regulator Bypass Valve (Internal)	Filtrate Tanks and Pumps	Blow Down Piping Flush to WWT Pond
FW Piping from BFP Outlet	Slurry Storage Tanks and Pumps	Primary Hydrocyclone
De-aerator	Filter Feed Tanks and Pumps	Secondary Hydrocyclone
FW Storage Tank	LSBM Slurry Tanks and Pumps	Absorber Bleed Pumps
	Service Water Tank and Pumps	Filtrate Pumps
Electrical	Make Up Water Pumps	Bioreactor Pumps
Medium Voltage Switchgear	Primary Hydrocyclone Overflow Tanks & Pumps	
High Voltage Switchgear	Quench Water Pumps	
Transformers (Breaching)	Second Hydrocyclone Overflow Tanks & Pumps	
	Limestone ball Mill Slurry Pumps	

Enclosure 3

Foreign Material Exclusion Area

Entry Contact Dayshift		***Phone***	
Entry Contact Nightshift		***Phone***	
Work Order (if applicable)		***Date Posted***	

FOREIGN MATERIAL EXCLUSION AREA

Control Point requirements (check each condition that applies)

[ ] Foreign Material Exclusion Monitor	[ ] Control Log	[ ] FME Project Plan

FME Controls (reference Attachment MNT-POGX-00020-5, FME Area Requirements)

[ ] Temporary covers while unattended
[ ] Pipe dams/barriers
[ ] Lanyards
[ ] Independent as-left inspections
[ ] Special inspection techniques (list)
[ ] Other (specify) _____

[ ] Good housekeeping
[ ] Particulate matter controls
[ ] Post-maintenance flush
[ ] Ventilation controls
[ ] Material transportation methods

Implementer		**Phone**	

Enclosure 4

Foreign Material Exclusion Control Log

Work Order (if applicable)		**FMEA Location**		Page ____ of _____
ITEM (Note 1, 2)	**Quantity**	**Enter** (Note-3) Date/Time Name	**Exit** (Note-3) Date/Time Name	**Remarks/Disposition**
				[ ] Removed [ ] Consumed
				[ ] Removed [ ] Consumed
				[ ] Removed [ ] Consumed
				[ ] Removed [ ] Consumed
				[ ] Removed [ ] Consumed
				[ ] Removed [ ] Consumed
				[ ] Removed [ ] Consumed
				[ ] Removed [ ] Consumed
				[ ] Removed [ ] Consumed

NOTE 1: Include size and description for materials such as cloth, plastic bags (yellow, 6” x 18”), and roll/tape (full or partial).
NOTE 2: For Permanent FME areas, record location of use.
NOTE 3: Record the name of the individual taking items in or out of the FMEA

Enclosure 5

FME Area Requirements

FME Area Requirements	FME-1 Areas	FME-2 Areas
Completion of Approved FME Training	**REQUIRED**	**REQUIRED**
Pre-Job Brief	**REQUIRED**	**REQUIRED**
FME Project Control Plan	**REQUIRED**	**Evaluate**
FME Monitor	**Evaluate**	**N/A**
FME Control Log (Log reconciled during each shift if work is in progress and immediately upon completion of job)	**REQUIRED**	**N/A**
Physical Boundaries for Pools (Boundaries on handrails to prevent loss of FM)	**REQUIRED**	**Evaluate**
Physical Barriers for Welding, Grinding, Machining Activities	**REQUIRED**	**Evaluate**
Inspections of Cranes Prior to Use Over FME Area	**REQUIRED**	**Evaluate**
Initial Breach Inspection	**REQUIRED**	**REQUIRED**
As-Found Inspections of Component Internals	**REQUIRED**	**REQUIRED**
Inspection of Tools, Parts, Materials for Loose, Broken, or Missing Parts Prior to Entry AND Upon Removal from FME Area	**REQUIRED**	**REQUIRED**
Removal of personal items prior to entry; (Jewelry, cell phones, pagers, keys, knives, contents of pockets)	**REQUIRED**	**Evaluate**
FME Cover Device (Use of approved properly labeled External or Internal devices)	**REQUIRED**	**REQUIRED**
Use of Approved Lanyards	**REQUIRED**	**N/A**
General Housekeeping	**REQUIRED**	**REQUIRED**
System Flush	**Evaluate**	**Evaluate**
Close-out Inspection Prior to Final Closure	**REQUIRED**	**REQUIRED**
Documentation of Close-out Inspection in Work Package	**REQUIRED**	**REQUIRED**
Post-Job Review	**Evaluate**	**Evaluate**

Enclosure 5

FME Area Requirements

Additional Information:

1. Cable ties with metal locking tabs are prohibited from use without prior evaluation and approval from the Supervisor of the Work.

2. Floatation devices are considered to be “fail-safe” and are not required to be logged.

3. Safety glasses secured with an approved strap are not required to be logged.

4. Items secured by lanyards are **NOT** considered to be “fail-safe” and are required to be logged.

5. The Control Logs are reviewed daily if work is in progress to ensure accountability is maintained AND immediately upon completion of work.

NOTE: Permanent covers shall remain in place at all times unless inspections are required inside/downstream of the strainers. Approved FME covers shall be installed any time sump openings are unattended.

6. Ensure tools, lights, and other equipment are sufficient distance from suction or discharge piping to prevent loss due to system flow.

NOTE: Changes within the requirements of this procedure require concurrence of the Supervisor of the Work.

Loss of FME Integrity Action

IF loss of FME integrity or FME controls exists (i.e., when material enters an open system/ component or FMEA and is not controlled, **PERFORM** the following:

a. **STOP** work in progress.
b. **PLACE** the system/component in a safe or secured status.
c. **NOTIFY** plant supervisory personnel, as required, including:
   i. FME Monitor (if posted)
   ii. Supervisor of the Work or Project Coordinator
d. **ASSIST** management and engineering in developing a recovery plan.
e. **NOTIFY** System Engineer **AND INITIATE** a PlantView Even to document information related to the foreign material intrusion, legacy debris, and loose/missing components.

Enclosure 6

FMEA Termination/Suspension Approval

W/O or Activity _____

FMEA may be terminated when all the following requirements have been met:
1) All required closeout inspections have been completed and the system or component has been reassembled to the extent necessary to ensure that foreign material cannot enter.
2) The Personal Log and the Material Log have been reviewed and any discrepancies resolved.
3) Log Reviews Completed By: _____ Date: _____

FMEA may be suspended when the following requirement has been met:
The system or component has been reassembled to the extent necessary to ensure that foreign material cannot enter. Reassembly may consist of the installation of temporary covers. The covers shall be rigid materials bolted or similarly secured in place. Taping of rigid covers or the use of flexible material such as Herculite is not sufficient for the suspension of foreign material exclusion controls.
Rigid covers secured in place:_____ Date:_____

Approval is granted for: ☐ Termination of the FMEA ☐ Suspension ☐ Log Closeout
Responsible Supervisor:_____ Date:_____

COMMENTS:

_____

_____

_____

_____

Return completed attachment to the Supervisor of the Work.

Enclosure 7

Opening/Closing Cleanliness Data Sheet

Unit/Area _____ Work Order _____ PM _____
System _____ Component _____

SECTION 1: OPENING INTERNAL INSPECTION (EXISTING SYSTEMS ONLY)

[ ]No Unusual Conditions
[ ] Acceptance Indeterminate:
[ ] Unusual Condition:
_____

_____

_____/_____
Responsible Lead Person Date

SECTION 2: EVALUATION OF INDETERMINATE ACCEPTANCE OR UNUSUAL CONDITION

[ ] Satisfactory
[ ] Condition corrected
[ ] Accept-As-Is:

_____/_____
Supervisor of the Work Date

SECTION 3: CLOSING INTERNAL INSPECTION (EXISTING OR NEW SYSTEMS)

[ ] Existing System: Tool, Material, and Personnel Access Controlled Properly and Job Cleanliness Maintained

_____/_____
Responsible Lead Person Date

[ ]No Unusual Conditions Noted
[ ] Acceptance Indeterminate:
[ ] Unsatisfactory Conditions: _____

_____/_____
Responsible Lead Person Date

SECTION 4: EVALUATION OF UNSATISFACTORY CONDITIONS

[ ] Condition corrected (See Section 5)
[ ] Accept-As-Is:

_____/_____
Supervisor of the Work Date

SECTION 5: REINSPECT (IF CONDITION CORRECT)

[ ] Satisfactory [ ] Unsatisfactory

_____/_____
Supervisor of the Work Date

Return completed attachment to the Supervisor of the Work.

Enclosure 8

Example FME Repair and Modification Plans - Steam Boiler

Steam Boiler:

1.0 Scope

1.1 This document establishes the procedure for facilitating good quality repairs with focus on eliminating the potential for tube blockage debris in the form of metal shavings, slag, torch cuttings, etc. from entering uncovered tube ends during repairs. The intent is elimination of overheating type failures caused by tube restriction or blockage.

1.2 These guidelines may not apply to every repair circumstance. Provision is granted to Outage Manager to exercise their best judgment using advice of technical advisors from both Duke Energy and Contractor to ensure internal tube cleanliness.

2.0 General

2.1 In the process of making, any pressure part repair or modification, caution must be taken to keep tube ends covered to prevent any debris entry.

2.2 Any debris that is known or suspected to have entered an open tube or header must be investigated and removed. Investigative methods, such as sponge blowing or "Fish" taping, should determine that entire tube is found free of debris.

3.0 Cutting Lower Tube Ends

3.1 Lower tube ends may be cut using:

- A pencil grinder thin cutting disc.
- On multiple tube end cuts a disc grinder circular saw may yield more productive results.

Note: During the cutting operations, care should be exercised in keeping metal fragments from entering tubes. After cutting remove all metal from surface.
A torch, carbon arc gouge, or oxylance are NOT to be used to perform any cuts on boiler tubes.

4.0 Installing Metal Shield

4.1 After bottom cuts are made, a metal shield shall be installed at the cut line to prevent debris entry during subsequent cutting operation (Exhibit A). This metal shield may consist of steel shim stock, or angle iron, or other thin steel material, and should be tacked in place.

4.2 In the event bottom tube ends are made on staggered or uneven cut line making the use of a single metal shield impractical, metal tube caps or suitable devices may be used to prevent the entry of debris. These must remain in place until milling operations begin, at which time the metal `cover will be removed from the tube to be milled. **All adjacent tubes will remained covered.**

Enclosure 8

**Example FME Repair and Modification Plans -
Steam Boiler**

Steam Boiler:

5.0 Cutting Membrane

5.1 Membrane shall be cut using a saw, or grinder with wafer disc. When using a saw, or grinder with wafer disc, precautions should be taken to ensure that:

- A craftsman who is experienced in the control and use of the equipment and in making tube repairs is used. No tube wall is damaged or penetrated by the equipment.

5.2 In isolated cases when a torch is used, precautions must be taken to ensure that:

- The craftsman does not damage or penetrate any tube wall while cutting membrane.
- An experienced craftsman is doing the torch cutting.
- There is no slab build-up on the furnace walls along the cut lines that would deflect the torch flame and thereby cut adjacent good tubing.
- There are no cold side attachments, such as buckstays or structural members, which would likewise deflect a torch flame, directed from inside the furnace onto good tubing on the cold side.
- The craftsman is aware that potential porosity in the longitudinal fusion welded membrane also creates the potential for torch flame deflection on to good tubing.

5.3 When using a torch where the membrane must be separated for the fit-up of the individual tubes, a cut may be made in the center of the membrane. This cut must be inspected by Supervisor or Quality Control Representative before any welding can begin.

5.4 Each area where torch cutting is done shall be inspected by appropriate personnel.

5.5 Where slotting of the tube membrane is necessary for the use of lifting or construction devices, the slotting is done by a grinding process. The final severe may be made with a cutting torch where the cutting process starts and ends in a grinding slot.

6.0 Cutting Upper Tube Ends

6.1 Upper tube end cuts will be made using the same method described in Section 3.1

6.2 Arc gouging, oxylance, or torch cutting below the top final cut line is ***not*** allowed.

6.3 Having removed the defective section of tubing from any boiler tube, the lower cut line must immediately be covered with metal caps, bolts, angles, or channels.
The use of duct tape or fire cloth as a primary cover is not acceptable.

Enclosure 8

Example FME Repair and Modification Plans - Steam Boiler

Steam Boiler:

7.0 Tube End Preparation for Welding

7.1 With lower tube ends shielded, bevel the upper tube ends. Milling tube mandrels should be the correct size for the application. After use, determine that no part of the mandrel has fragmented and remained inside the tube. Remove all metal shavings adhering to internal and external tube surfaces.

7.2 Temporarily remove the metal shield covering the lower tube ends only after the membrane preparation and Dutchman fit-up processes have been completed.

7.3 When beveling vertical to near horizontal tubes, sponges are to be used in lower tube ends to control mill shavings.

7.4 All adjacent tubes are to remain covered during milling operations.

7.5 All sponges, milling bits, mandrels, and other accessory equipment are issued from a controlled location and remain accounted for all times during use being documented on Milling/Prep Equipment Daily Sign-Out form.

7.6 Bevel the lower tube ends using tri-tool, pencil grinder, or other beveling equipment. Take special precaution to prevent metal shavings from falling into open tube ends, and to prevent any part of the mandrel from remaining inside the tube.

7.7 Tube ends should be cleaned to bright metal (both inside and outside surfaces) for about 1/2" from the lands. Remove any/all deposits of rust, scale, slag, etc., to prevent gas or slag inclusions in weld.

7.8 Remove all sponges and reinstall the lower covering over the open tube ends until ready for welding. Return all sponges, milling bits, mandrels, and other accessory equipment to controlled issue location. Document return on Milling/Prep Equipment Daily Sign-Out form.

8.0 Ensure Tube Circuit is Clear

8.1 All lower cut lines should be sounded and documented. Compressed air can be used to blow the tube circuit to the inlet and/or outlet headers. A sponge or steel ball can be used in addition to air if it can be retrieved from the boiler circuitry.
Accounting for all sponges or steel balls is essential to assure that non are left inside the boiler tubing.

8.2 If little or no air flow is received at the inlet or outlet header, suspected plugged locations should be chosen to begin pinpointing the pluggage.

8.3 The ability to blow air through tubes does not indicate that the tube is free of pluggage. However, it is a convenient way to begin isolating the location of a complete pluggage of the tube.

Enclosure 8

**Example FME Repair and Modification Plans -
Steam Boiler**

Steam Boiler:

8.4 All suspected debris should be investigated using spot radiography, remove viewing equipment, or tube removal.

8.5 All suspected debris should be reported to Quality Control Representative for disposition.

8.6 Immediately prior to fit-up, all tube inside diameters will be inspected by Supervisor, or Quality Control Representative. This will be documented on Sounding/Internal Cleanliness form.

8.7 It is critical that lower protection remain in position during the fit-up process and remain in position until the tubes have been permanently fit in position and we ready for welding.

9.0 Preparation for Welding

9.1 Once all of the tube beveling and fit-up cleanliness inspections have been completed and documented by either the Supervisor or Quality Control Representative, the welding can begin. Follow the applicable Welding Procedures for completing all welds

Enclosure 9

**Example FME Repair and Modification Plans -
Precipitator**

Precipitator:

1.0 Prior to Demolition

1.1 Unit will be vacuumed out as necessary for inspections

1.2. Ensure piping systems under hoppers are clean before beginning work.

2.0 Pipe Protection

2.1 Ash piping at base of hoppers will be valved off and blanked off at each drop.

3.0 Torch Burning

3.1 Any cut off scraps with burning torch inside new equipment will be removed and disposed of as soon as possible.

4.0 Welding

4.1 Welders are instructed to carry weld and stub cans as to control discarded materials from being scattered in new equipment areas, and from plugging bottom of hoppers.

5.0 Cable Trays and Unseen Protections

5.1 Fire blankets and plywood will be used to protect cable trays and any items of concern.

6.0 Inspection

6.1 Periodic inspections will be made by Duke Energy Personnel, Contractor Supervision, Contractor Safety, and Contractor Quality Control for housekeeping safety, work quality, and control of debris.

Enclosure 10

Example FME Repair and Modification Plans -
Duct Work over ID & FD Fans

Duct Work over ID & FD Fans:

1.0 Equipment Protection

1.1 Preventive measures such as scaffolding, barriers, plywood and fire blanket where needed to prevent any materials from being dropped inside to the fans.

2.0 Torch Burning

2.1 Any cut off scraps with burning torch inside ducting areas will be removed and disposed of as soon as possible.

3.0 Welding

3.1 Welders are instructed to carry rod stub cans as to control discarded materials from being dropped into ducting systems.

4.0 Unseen Protection

4.1 Where needed, fire cloth and/or plywood will be used for item protection.

5.0 Training

5.1 Employees are instructed in orientation as to material handling and keeping up with tools.

6.0 Inspection

6.1 Periodic inspections will be made by Duke Energy Personnel, Contractor Supervision, Contractor Safety, and Contractor Quality Control for housekeeping safety, work quality, and control of debris.

Enclosure 11

Example FME Repair and Modification Plans -
Air Heater

Air Heater:

1.0 Prior to Demolition

1.1 Unit will be vacuumed out in the hoppers.

1.2 Unit and drainage pipe will be washed out if the Air Heater is to be washed during outage.

2.0 Pipe Protection

2.1 Four each 8” drains in air heater will be covered and decked for protection from foreign materials.

3.0 Bearing Protection

3.1 A ground jumper cable will be used as to prevent any arching out on internal bearings.

4.0 Unseen Protection

4.1 Where needed, fire cloth & plywood will be used for item protection.

5.0 Torch Burning

5.1 Any cut off scraps with burn torch inside new equipment will be removed and disposed of as soon as possible.

6.0 Welding

6.1 Welders are instructed to carry rod stub cans to control discarded materials from being scattered in new equipment areas.

7.0 Inspection

7.1 Periodic inspections will be made by Duke Energy Personnel, Contractor Supervision, Contractor Safety, and Contractor Quality Control for housekeeping safety, work quality, and control of debris.

Lawrence Supplemental Exhibit 2: Public Staff's Proposed EMF Rates

Table 1: Proposed Fuel and Fuel-Related Cost Factors (cents per kWh)

Rate Class	Base & Prospective	EMF	EMF Interest	Total Fuel Factor
Residential	2.6287	1.2441	0.0083	3.8811
General Service/Lighting	2.2596	1.2219	0.0081	3.4896
Industrial	1.9328	1.2899	0.0086	3.2313