Audit Report

[redacted] 2024 Audit of Electrical Heat Trace Systems

Approvals	Signature	Date

Prepared For:

[redacted]

Prepared By:

HTS

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1.0 Problem/Issue

The audit addresses the health and operational integrity of the Electrical Freeze Protection (EFP) systems at the [redacted] site in [redacted]. This evaluation is necessitated by the potential for system deficiencies that can compromise process reliability during freezing conditions.

1.1 Project Description

The scope of work involves assessing the EFP systems by performing comprehensive testing and inspections. This includes Megger testing of circuits, inspection of individual heaters in instrument enclosures, and identification of potential deficiencies. HTS is responsible for providing a detailed report and recommendations for remediation, while ensuring safety compliance and accurate documentation updates.

1.2 Audit Goal and Objective

The primary goal of the audit is to ensure that the EFP systems are functioning correctly to prevent freeze-related failures. The objectives include:

- Visual inspection and functional testing of heat trace systems.
- Recording voltage, amperage, and performing Megger tests.
- Identifying deficiencies and recommending remediation strategies.
- Updating and providing accurate "As-Built" documentation.

1.3 Audit Methodology

Visual Inspection: This comprehensive assessment included a thorough walkthrough of the heat trace system. Attention was given to the meticulous examination of internal components, spanning from control panels and instrument enclosures to connection boxes. Key observations, consistent across the facility, along with specific findings, are identified in the attached audit report and pictures.

Function Testing: Each heat trace control panel was accessed, and every circuit within was operated to actual voltage and current values. After the voltage and current are taken, each circuit is megger tested. The Megger test, formally known as the insulation resistance test, is a potent diagnostic tool. Utilizing applied DC voltages, typically either 250 Vdc, 500Vdc or 1,000Vdc for low voltage equipment <600v and 2,500Vdc and 5,000 Vdc for high voltage equipment to measure insulation resistance in either kΩ, MΩ, or GΩ. The measured resistance is intended to indicate the condition of the insulation or dielectric between two conductive parts, where the higher the resistance, the better the condition of the insulation. This test is pivotal in identifying potential electrical short circuits and assessing any foreign contaminants like dust, debris, or moisture within the cable system. The measured value without thermal insulation should not be less than 20 MΩ. After the application of thermal insulation, the measured value should not be less than 5 MΩ.

2.0 Evaluation of Existing Systems/Component/Structure

2.1 Visual Inspection Findings

1. **Extensive System Wear:**
    - Significant wear compromising structural integrity and efficiency.
    - Various components show clear signs of aging and prolonged exposure to harsh conditions.
2. **Electrical and Insulation Breaches:**
    - Water ingress detected in electrical and insulation elements, leading to circuit failures.
    - Protective shielding on circuitry is notably damaged, raising safety concerns.
3. **Insulation Integrity Issues:**
    - Insulation components are deficient, allowing moisture penetration and compromising system efficiency.
    - Common issues include the need to repair insulation and cover up exposed heat trace (HT).
4. **Damage to Instrument Covers:**
    - Protective covers on process instruments are damaged due to thermal stress, UV radiation, and mechanical impacts.
    - Exposure to environmental factors has significantly impacted the durability of these covers.
5. **Exposure Risks in Heat Tracing:**
    - Inadequate insulation in heat tracing elements entering control panels poses risks to functionality and safety.
    - Issues such as exposed heat trace needing to be covered up and insulation needing repair are frequent.

2.2 Function Testing

The function and Megger testing process revealed a critical issue:

- Megger test results indicate values near the minimum acceptable limit, suggesting moisture ingress in heater cables.
- While cables remain operational, the presence of moisture presents a risk of future malfunctions.
- Comprehensive evaluation of conduits, apparatus, and machinery associated with these findings is necessary.

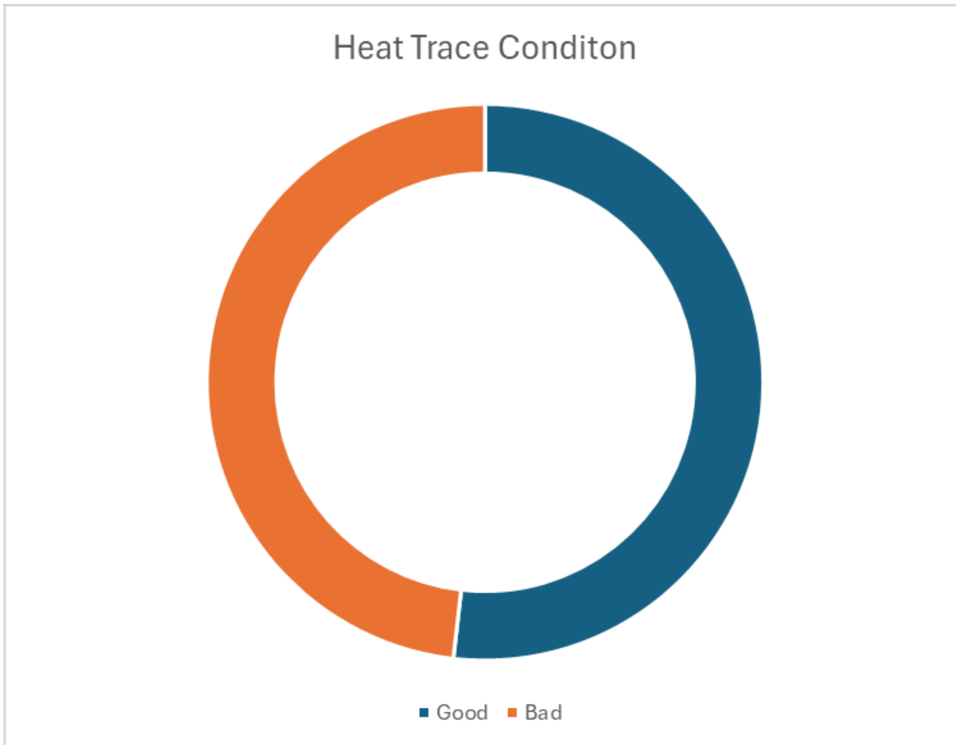
2.3 Plant-Wide Summary

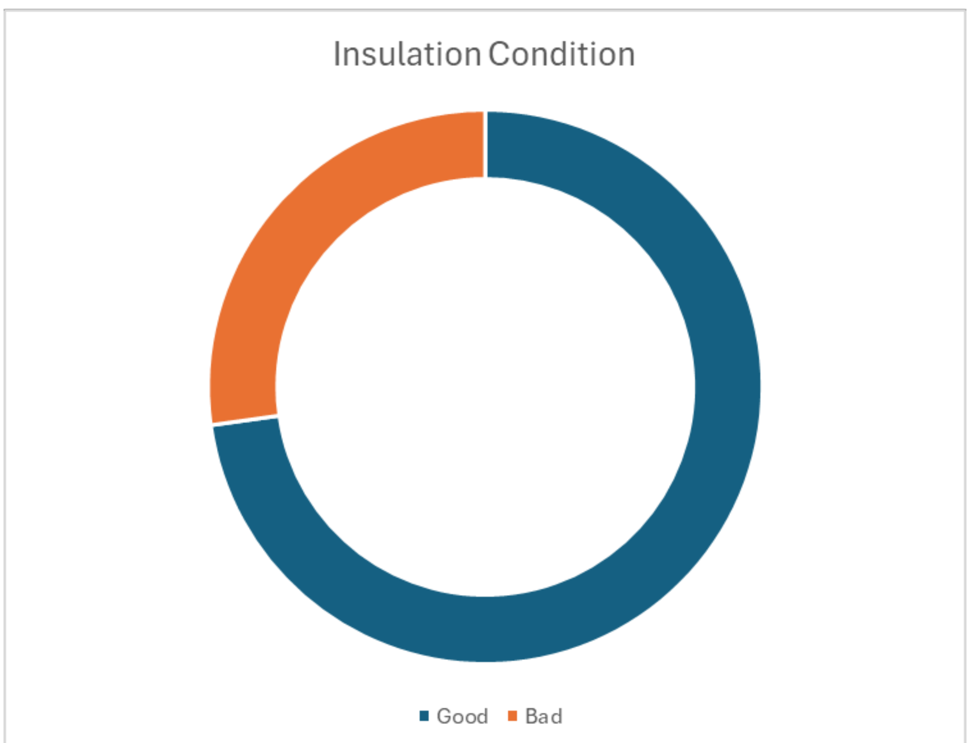
The Electrical Freeze Protection (EFP) system at the [redacted] site is currently facing significant challenges due to component wear and environmental impact. The compromised state of the system has resulted in operational disruptions and decreased efficiency. Frequent issues include the need to repair insulation, cover exposed heat trace, replace gland units (GUA) and terminators, and apply caulking. Moisture-related damage is prevalent, necessitating enhanced insulation integrity.

Immediate and targeted interventions for troubleshooting and repairs are essential to restore the system's reliability. A strategic approach involving continuous evaluation and proactive maintenance is critical to effectively address these issues. Prioritizing the maintenance and assessment of critical components is vital for ensuring the system's reliable functionality.

The evaluation indicates that 42% of the insulation elements are in good condition, while 22% are in bad condition. Additionally, 18% of the insulation elements are categorized as spares. For heat trace components, 28% are functioning as intended, 35% are in bad condition, and 18% are identified as spares.

These insights underscore the urgency of addressing the underperforming and deficient components to mitigate the risk of system failure. Prioritizing repairs and maintenance for the components in poor condition is crucial for enhancing the overall reliability and efficiency of the EFP system. Addressing these deficiencies will significantly improve the system's resilience against environmental challenges and restore its operational integrity.


Heat Trace Conditon
Good
Bad


Insulation Condition
Good
Bad

3.0 Recommendation

3.1 Design Basis

The recommendations are grounded in the ASHRAE 50 standards applicable to the region, ensuring that the system can withstand specific temperature extremes and wind conditions. These standards are critical for maintaining the integrity and functionality of the Electrical Freeze Protection (EFP) system at the [redacted] site during adverse weather conditions.

3.2 Recommendation

1. **Prioritize System Components:**

- Develop a comprehensive prioritization protocol for system components based on their necessity during cold spells. This protocol should categorize circuits into three levels:
    - **a. Priority 1:** Critical and non-bypassable circuits.
    - **b. Priority 2**: Important but bypassable circuits under critical conditions.
    - **c. Priority 3:** Non-critical circuits.
- Focus immediate repair and maintenance efforts on Priority 1 circuits to ensure operational reliability during extreme weather events.

2. **Documentation and Record-Keeping:**

- Maintain precise and current engineering records for all Priority 1 circuits. Detailed documentation should include specifications, maintenance history, and troubleshooting guides.
- Extend this rigorous documentation standard to Priority 2 and Priority 3 circuits to facilitate effective discovery, troubleshooting, and execution of necessary repairs or replacements.

3. **Strategic Repairs and Replacements:**

- Coordinate the maintenance of Priority 2 circuits to coincide with both unscheduled and scheduled outages, optimizing repair times and reducing operational disruptions.
- Prioritize the maintenance and replacement of heat trace circuits and insulation components identified as being in bad condition, ensuring the use of high-quality, durable materials.

4. **Predictive Maintenance Strategy:**

- Establish a predictive maintenance plan that regularly assesses the winterization system, focusing on the early detection of potential issues. This strategy should include:
- Routine inspections and testing of insulation and heat trace components.
- Use of diagnostic tools such as Megger tests to identify moisture ingress and insulation integrity issues before they lead to system failures.

5. **Component Material Advancements:**

- Upgrade the materials used in system components to options with greater durability and resistance to harsh weather conditions. Consider the use of advanced insulation materials and moisture-proof electrical components to enhance system resilience.

6. **Training and Protocol Development:**

- Enhance training programs for personnel on the operation and maintenance of the EFP system. Ensure that all staff members are proficient in the latest maintenance techniques and emergency response procedures.
- Develop comprehensive emergency response protocols to mitigate risks and minimize operational disruptions during adverse weather conditions.

7. **Ongoing System Evaluation:**

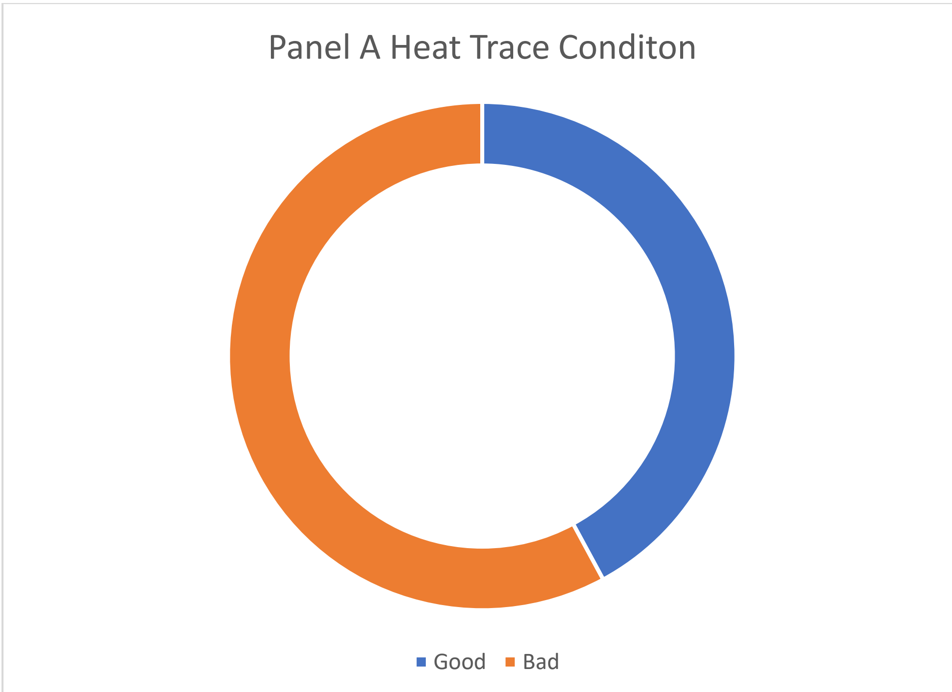
- Conduct regular reviews and updates of the winterization strategy to integrate cutting-edge technologies and adapt to evolving environmental trends. This ongoing evaluation should include:
    - Periodic assessments of the system's performance under different weather conditions.
    - Updates to maintenance and repair protocols based on the latest industry best practices and technological advancements.

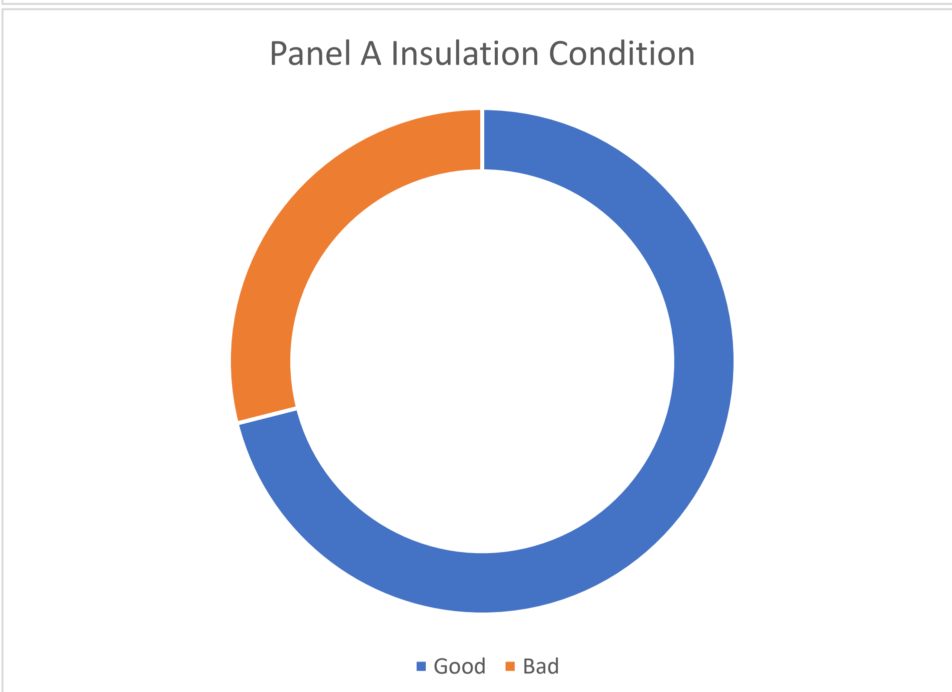
By implementing these recommendations, the [redacted] site can significantly improve the reliability and efficiency of its EFP system, ensuring operational integrity and resilience against environmental challenges.

4.0 Panel Specific Summaries and Recommendations

4.1 Panel A

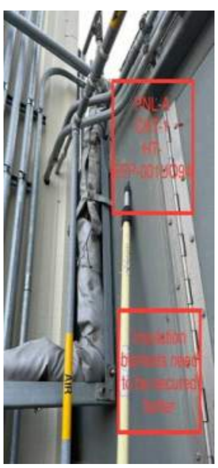
4.1.1 Audit Data

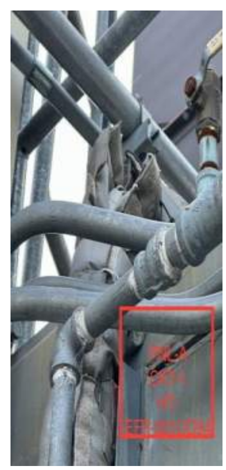




Only 28% of the heat trace components are in good condition, with 72% requiring immediate repair. The insulation components are mostly in good condition at 88%, but 12% need attention.
In summary, Panel A's heat trace system needs significant repairs, while the insulation system requires minor fixes to maintain overall efficiency.

4.1.2 Pictures






PNL-A
CKT-1
HT-
U3-96BH1


PNL-A
CKT-3
HT-28/B/E/D
tubing
Insulation
blanked
need to be
tightened
better







PNL-A
HT-185
Insulation

PNL-A
CKT-10

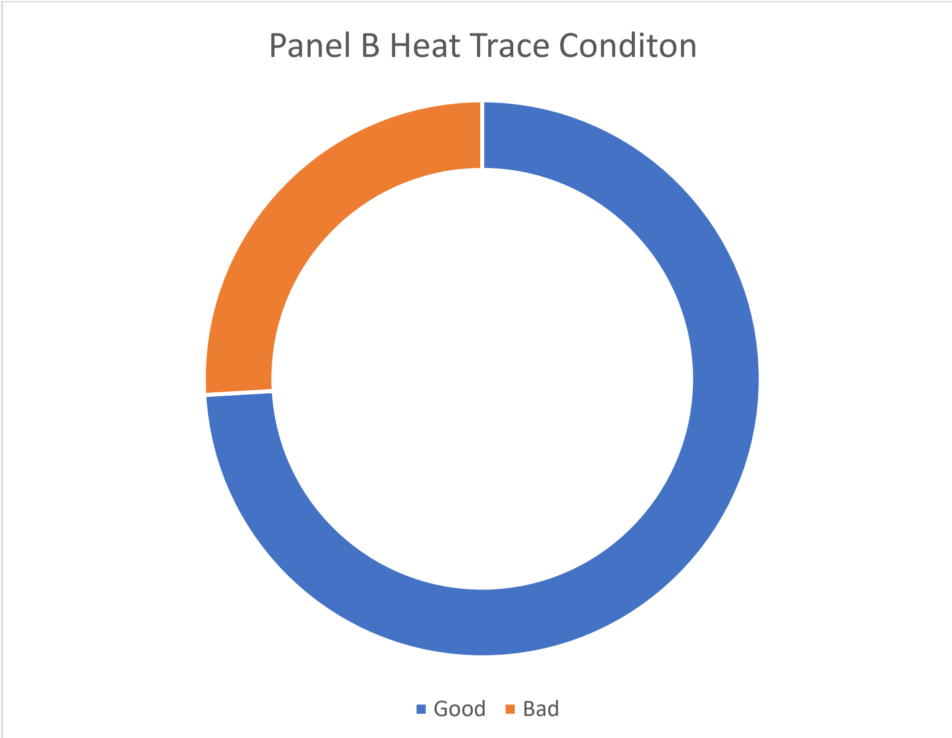

PNL-A
HT-210

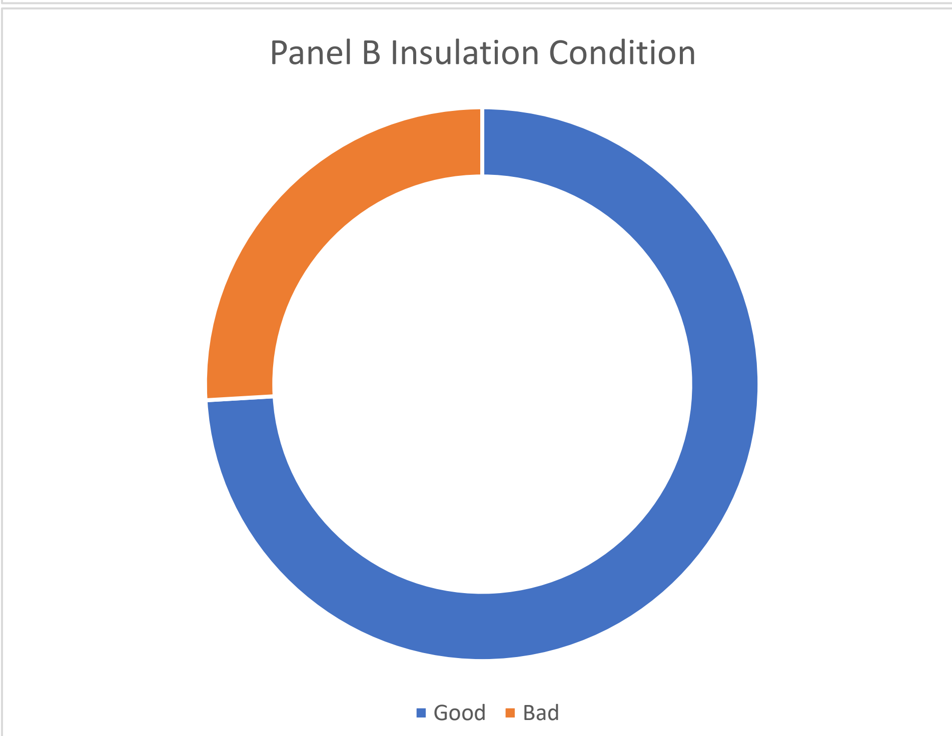


CKT 12 PNL A
NEED LOW POINT DRAIN

4.2 Panel B

4.2.1 Audit Data





Only 14% of the heat trace components are in good condition, with 86% requiring immediate repair. The insulation components are mostly in good condition at 86%, but 14% need attention.

In summary, Panel B's heat trace system needs significant repairs, while the insulation system requires minor fixes to maintain overall efficiency.

4.2.2 Pictures










CKT-131
HT-13
Insulation need to be tightened down,MI cable is being

CKT-29
HT-133
Insulation blanket not put on correctly,MI cable exposed

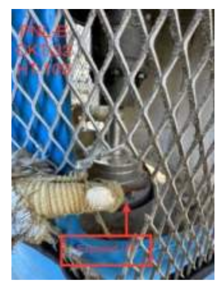
CKT-29
HT-135

PNL-B

PNL-B
CKT-30
Insulation blanket needs to be
down

CKT131
HT-140
Insulation

PNL-B

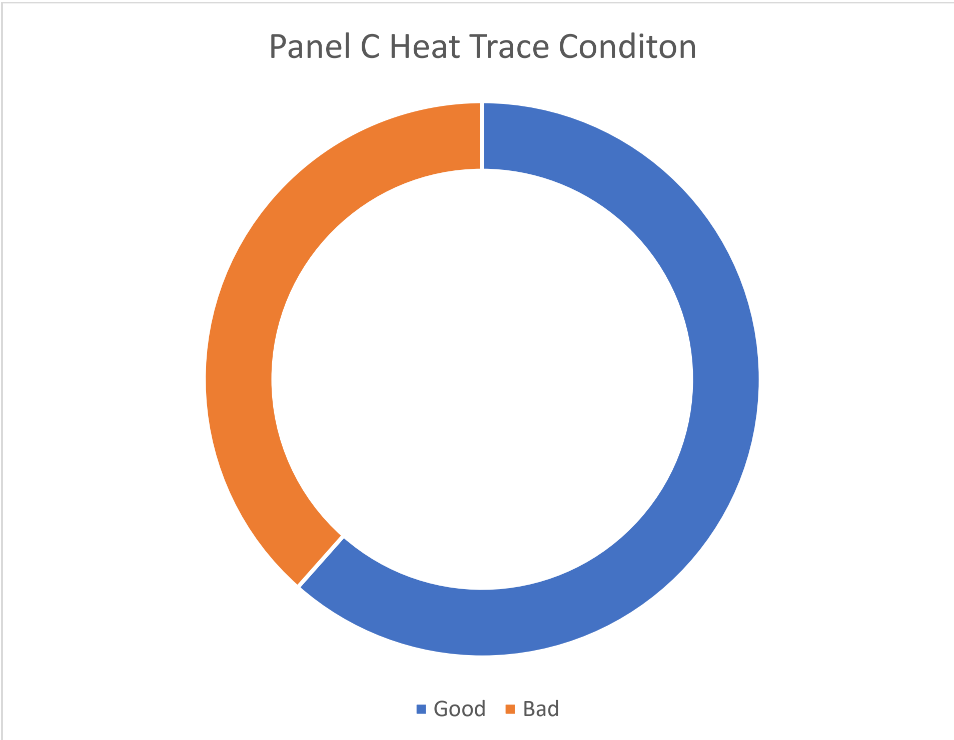

PNL-B

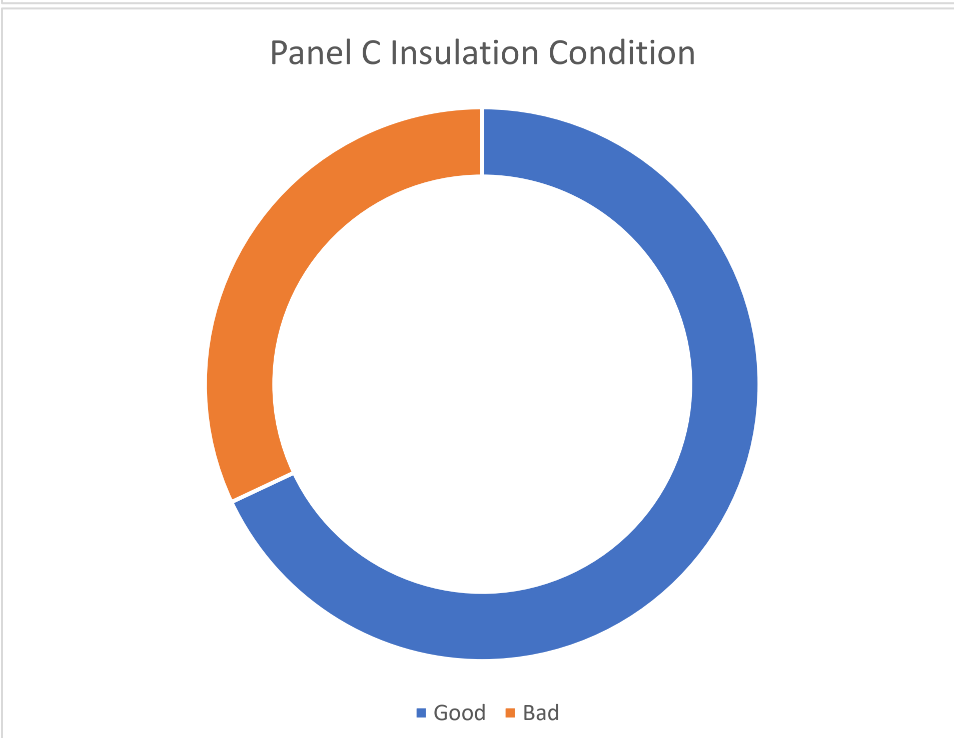

PNL-B
CKT-32
Insulation not properly

PNL-B

4.3 Panel C

4.3.1 Audit Data





Only 24% of the heat trace components are in good condition, with 76% requiring immediate repair. The insulation components are mostly in good condition at 86%, but 14% need attention.

In summary, Panel C's heat trace system needs significant repairs, while the insulation system requires minor fixes to maintain overall efficiency.

4.3.2 Pictures













PNL-C
HT-191


PNL-C


PNL-C
CKT-15
HT-249

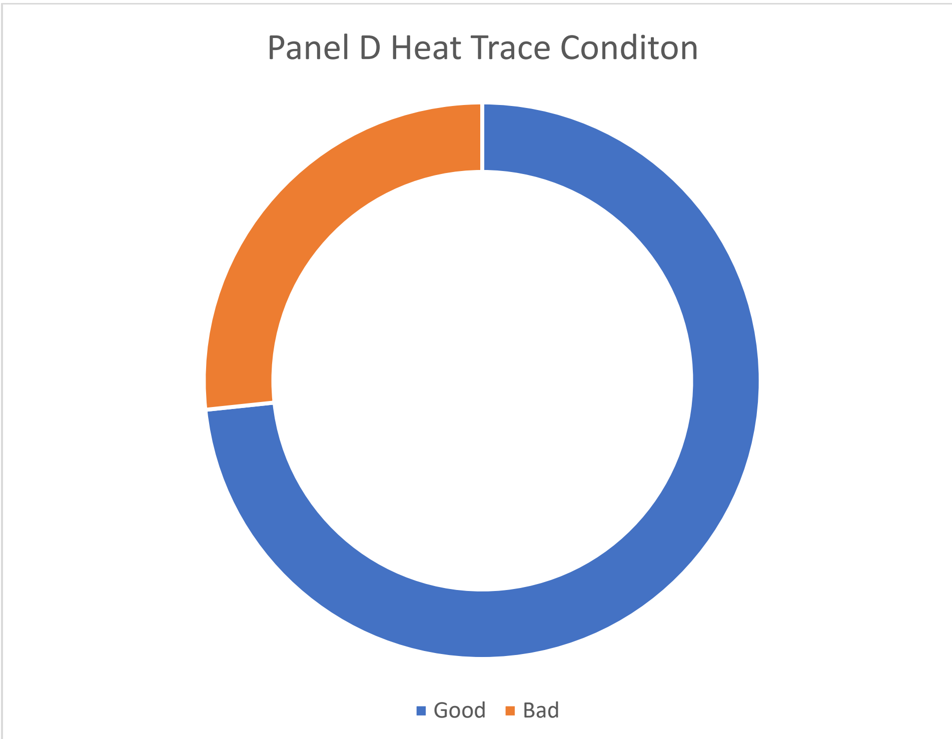

Insulation has
been removed

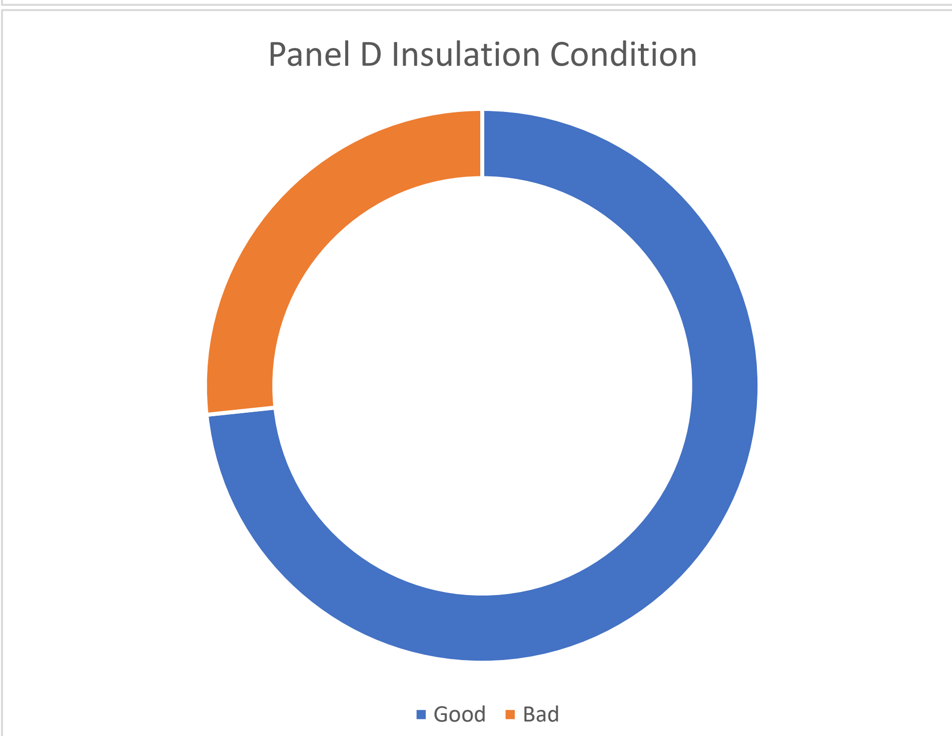

Insulation
blanked not tied
down


blankets not
CKT-27
HT-170A

4.4 Panel D

4.4.1 Audit Data





Only 18% of the heat trace components are in good condition, with 82% requiring immediate repair. The insulation components are mostly in good condition at 86%, but 14% need attention.

In summary, Panel D's heat trace system needs significant repairs, while the insulation system requires minor fixes to maintain overall efficiency.

4.4.2 Pictures

5.0 Conclusion

The Electrical Freeze Protection (EFP) system at the [redacted] site is currently under significant strain due to component wear, environmental impacts, and operational inefficiencies. The comprehensive evaluation reveals that a substantial portion of the system's insulation and heat trace components are in poor condition, necessitating immediate and targeted interventions. Key issues such as moisture ingress, damaged insulation, and exposed heat trace elements highlight the urgent need for improved insulation integrity and protective measures.

The evaluation underscores the critical importance of a strategic approach to system maintenance and repair. By prioritizing the assessment and upkeep of critical components, the [redacted] site can mitigate the risk of system failures and operational disruptions. The implementation of a robust predictive maintenance strategy, coupled with precise documentation and record-keeping, will enable early detection of potential issues and facilitate timely interventions.

Advancements in component materials, focusing on durability and weather resistance, will enhance the system's resilience against harsh environmental conditions. Additionally, enhancing training programs and developing comprehensive emergency response protocols will equip personnel with the necessary skills and knowledge to manage and maintain the EFP system effectively.

Ongoing evaluation and adaptation of the winterization strategy are paramount. Regular reviews and updates, incorporating the latest technological advancements and industry best practices, will ensure the system remains robust and efficient in the face of evolving environmental challenges.

In summary, addressing the identified deficiencies and implementing the recommended strategies will significantly improve the reliability and efficiency of the EFP system at the [redacted] site. A commitment to proactive maintenance, strategic prioritization, and continuous improvement will restore the system's operational integrity, ensuring a reliable and resilient performance even under extreme weather conditions. This comprehensive approach will ultimately safeguard the site's operations and contribute to the overall stability and reliability of the power generation infrastructure.

6.0 Appendices

6.1 Redlines

Attached

6.2 Audit Field Data

Attached