IMPROVING WWTP SAFETY BY COMPLYING WITH NFPA 820 & NFPA 70E

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Today’s Speakers

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Delaware County
Ohio’s Fastest Growing County

- Forecasts project 2035 population to be 54% greater than in the 2010 census, an average of 7% annual growth.
Delaware County
Regional Sewer District

OECC
Alum Creek
Lower Scioto
Northstar

4 WWTPs
5 Package Plants
27 Pump Stations
Are Our Facilities Safe?

- Identifying areas of concern
- Building code reviews
- Employee safety
- Equipment protection
- Reclassification of spaces
Well, Let’s See.

Project Goals:

- Comprehensive evaluation of Electrical Safety Program including Arc Flash Analysis at all facilities.
- Properly educate and train staff.
- Establish safe work environment.
NFPA 820 – Standard for Fire Protection in Wastewater and Collection Facilities
What is NFPA 820?

• **Purpose:**
  - Provide a degree of fire and explosion protection and reduce or eliminate the effects of fire or explosion at wastewater collection, transportation, and treatment facilities.

• **Application:**
  - New installations
  - Additions or modifications made to existing facilities
  - Used by owners to perform risk assessment in existing facilities
  - NFPA 820 is a standard referenced by the National Electric Code
What is NFPA 820?

- **Retroactive:**
  - Not retroactive for installation prior to effective date of standard (1995).
  - AHJ shall be permitted to retroactively apply standard.
  - AHJ can approve variations if AHJ considers requirements impractical and “reasonable degree of safety” is provided.

- **Annex A – Explanatory Material (Informational):**
  - NFPA 820 application not always practical if disproportionate effort or expense with little increase to fire protection
  - Note intended to modify conditions that do not pose a fire threat.
  - *AHJ needs to be satisfied that reasonable fire protection is ensured.*
What is NFPA 820?

- Provides Hazard Classification
- NEC establishes the requirements for equipment in various classifications
- WWTPs are covered under Class I – Flammable Gases/Vapors
  - Division 1 – Hazard present during *normal* operating conditions
  - Division 2 – Hazards present during *abnormal* operating conditions
  - Unclassified – Hazards not present during normal operating conditions

### NFPA 820 Table Example

<table>
<thead>
<tr>
<th>Row</th>
<th>Line</th>
<th>Location and Function</th>
<th>Fire and Explosion Hazard</th>
<th>Ventilation</th>
<th>Extent of Classified Area</th>
<th>NEC Area Electrical Classification (All Class I, Group D)</th>
<th>Materials of Construction</th>
<th>Fire Protection Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>a</td>
<td>WASTEWATER PUMPING STATION WET WELLS Liquid side of a pumping station serving a sanitary sewer or combined system</td>
<td>Possible ignition of flammable gases and floating flammable liquids</td>
<td>A</td>
<td>Entire room or space</td>
<td>Division 1</td>
<td>NC, LC, or LFS</td>
<td>CGD: Combustible gas detection</td>
</tr>
<tr>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>Entire room or space</td>
<td>Division 2</td>
<td>NC, LC, or LFS</td>
<td>CGD</td>
</tr>
</tbody>
</table>

A:<12 AC/Hr or NV
B:12 AC/Hr
Leading Non-Compliance Issues

• Sealing Fittings:
  – Prevents migration of gasses within the conduit system
  – Prevents spread of flame and gases from enclosures
  – Required when any conduit crosses boundary between D1 and D2 areas
  – Required between D1/D2 area and unclassified area
Terminal Box Installation Example
Leading Non-Compliance Issues

- **Combustible Gas Detection System:**
  - Required in residential pump station wet wells
  - Required in sanitary/combined sewers wet wells if mechanically ventilated
  - Required in screening and solids handling buildings
  - Auxiliary power source required
  - Alarming and monitoring required
  - Testing and Calibration
Leading Non-Compliance Issues

• **Ventilation Monitoring (reduce classification):**
  - Monitoring either not provided or not provided on both the supply and return air system when used to reduce the space classification.
  - Alarms not provided to signal ventilation failure, remote signal not provide, or alarm signaling not provided at correct locations.
Leading Non-Compliance Issues

• Inadequate Ventilation
  – Ventilation was found to be intermittent when required to be continuous.
  – Air change per hour rate was not enough to reduce space classification
  – Ventilation does not encourage removal of both heavier than and lighter than air gases/vapors.
  – Supply and exhaust fan not provided for regularly entered space.
DCRSD’s Approach to NFPA 820 Evaluation

1. Review Record Information
   - Review Process Flow
   - Review Drawings
   - Review HVAC Design Criteria & Controls
   - Review Electrical Design

2. Develop Area Classification Tables
   - Identify areas within a facility & their classification
   - Identify if ventilation is used to reduce classification
   - Identify AC/hr
   - Identify 820 Table-Row Reference

3. Perform Site Audits
   - Equipment rated for area classification
   - Electrical installation compliant with NEC
   - HVAC system operating per record information
   - Ancillary 820 requirements met

4. Develop Report
   - Summary List of Electrical/HVAC Issues & Proposed Solutions
   - Estimate of Probable Costs
   - Text supplemented with photos

5. Prioritization
   - Impact on Safety
     - Div 1 Areas
     - Div 2 Areas
     - Others
### Tools used to Support NFPA 820 Evaluation

#### NFPA 820 Inspection Electrical Checklist

<table>
<thead>
<tr>
<th>Area Classification from Table</th>
<th>Div. 1</th>
<th>Div. 2</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation Required</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Gas Monitoring Required</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Fire Extinguisher Required</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Fire Detection/Alarms Required</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Fire Suppression Required</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

#### Associated Evaluation Forms
- Electrical Evaluation:
- HVAC Evaluation:

#### Equipment

**Enclosure Rating:**
- GP - appropriate for or Switches, visual breakers, conduits, interconnections, etc.
- Enclosure Rating:

**Seal-offs at Enclosures:**
- The enclosure contains the terminal, splices, or enclosures.
- Seal-offs filled:

**Motors:**
- TECF (T-0044) identified for Class 1, Div. 1 area
- External visual alarm / strobe
- External audio alarm
- Alarm Setpoints: UEL
- Calibration Date:

**Gas Monitoring:**
- Internal visual alarm
- Internal audio alarm
- Acorn station
- Test station

**Luminaires:**
- Identified for Class 1, Div. 2 area
- Rated for Div. 1 or T-code coordinated with gas present
- Protected from physical damage
- Pendant mounted
- Enclosure rating shall be determined by testing through standard methods for combustible materials or noncombustible materials, and tested for the overvoltage, combustible materials, and temperature limitations.

**Notes:**
- 17
Tools used to Support NFPA 820 Evaluation

NFPA 820 Inspection HVAC Checklist
NFPA 70E – Standard for Electrical Safety in the Workplace
What is NFPA 70E?

• **Purpose:**
  - Provides a working area for employees that is safe from unacceptable risk associated with the use of electricity in the workplace.
  - NFPA 70E establishes safety processes that use policies, procedures, and program controls to reduce the risk associated with the use of electricity to an acceptable level.
  - The core objective is practical, accomplishable electrical safety that results in the employee going home safe at the end of the day.
Arc Flash Incident (Video)
NFPA 70E Compliance - Electrical Safety Program

- NFPA 70E is not just Arc Flash!
- De-energizing Policy
- Lockout/Tagout (LOTO)
- Energized Work Policies
- PPE
- Inspection, Testing and Care of PPE
- Training and Retraining
How Did We Get The Arc Flash Labels?

1. Review Record Information
   - Review Drawings
   - Review previous arc flash studies

2. Prepopulate Data Sheets
   - Minimize downtime
   - Equipment names
   - Equipment ratings
   - CB Amperage
   - Motor HP
   - Feeder Size & Type
   - Feeder Length

3. Perform Site Audits
   - Confirm one-line diagram
   - Collect data in de-energized state (OSHA)
   - Coordination with DCRSD staff
   - Collecting Data is Crucial

4. Develop Model & Run Analysis
   - Short Circuit Study
   - Equipment Evaluation
   - Coordination Study
   - Arc Flash Analysis
   - Arc Flash Mitigation
   - Workshops
   - Report

5. Install AF Labels & Update Settings
   - Critical that settings are verified and updated. Otherwise analysis is invalid
   - Outdoor label considerations
# Tools used to Support NFPA 70E Analysis

## Field Data Collection Worksheet

### Photos

### Shutdown/Startup Procedures

#### Alum Creek and Leather Lips
Pump Station Shutdown Procedures

<table>
<thead>
<tr>
<th>Step</th>
<th>Item</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pump Wet Well Drainage</td>
<td>DCRSD</td>
</tr>
<tr>
<td>2</td>
<td>LOTO Generator Circuit Breaker</td>
<td>DCRSD, CAT 2 PPE</td>
</tr>
<tr>
<td>3</td>
<td>Set-Up Portable Lights</td>
<td>Arcadis</td>
</tr>
<tr>
<td>4</td>
<td>Open Main Circuit Breaker</td>
<td>DCRSD, CAT 2 PPE</td>
</tr>
<tr>
<td>5</td>
<td>Confirm MCC is de-energized with non-contact test (verify, test, verify)</td>
<td>DCRSD</td>
</tr>
<tr>
<td>6</td>
<td>Collect Data within Main Circuit Breaker Bucket</td>
<td>Arcadis</td>
</tr>
<tr>
<td>7</td>
<td>Close Main Circuit Breaker Bucket Door &amp; LOTO</td>
<td>DCRSD</td>
</tr>
<tr>
<td>8</td>
<td>Monitor Wetwell Level (max duration of shutdown = 30 - 45mins)</td>
<td>DCRSD</td>
</tr>
<tr>
<td>9</td>
<td>Collect all other MCC Data</td>
<td>Arcadis</td>
</tr>
<tr>
<td>10</td>
<td>Collection Generator Data</td>
<td>Arcadis</td>
</tr>
<tr>
<td>11</td>
<td>Data Collection Finished</td>
<td>DCRSD/Arcadis</td>
</tr>
</tbody>
</table>

### Startup Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Item</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Confirm all MCC buckets are secured</td>
<td>Arcadis</td>
</tr>
<tr>
<td>2</td>
<td>Place each pump selector switch in &quot;on&quot; position</td>
<td>Arcadis</td>
</tr>
<tr>
<td>3</td>
<td>Remove Lock on Main Circuit Breaker and Close</td>
<td>DCRSD, CAT 2 PPE</td>
</tr>
<tr>
<td>4</td>
<td>Place each pump selector switch in &quot;auto&quot; position</td>
<td>Arcadis</td>
</tr>
<tr>
<td>5</td>
<td>Remove Lock on Generator Circuit Breaker and Close</td>
<td>DCRSD, CAT 2 PPE</td>
</tr>
<tr>
<td>6</td>
<td>Remove Portable Lights</td>
<td>Arcadis</td>
</tr>
<tr>
<td>7</td>
<td>Pump Station Back Online</td>
<td>DCRSD/Arcadis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MCC ID: MCC-08</th>
<th>MF/G Model: A2 CENTER PUMP (1509)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: 1st Floor</td>
<td>Rating: 500V, 800 A</td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Equipment Supplied</th>
<th>Circuit Breaker No.</th>
<th>Circuit Breaker Model</th>
<th>CB Trip Rating (kA)</th>
<th>Motor Trip Setting (kA)</th>
<th>Interruption Rating (kA)</th>
<th>Motor HP</th>
<th>Feeder Size &amp; Type</th>
<th>Feeder Length (Feet) &amp; Contact Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dry Well No.1/Well 1</td>
<td>CT-0001</td>
<td>HPD300D</td>
<td>30</td>
<td>65k</td>
<td>1.5</td>
<td>3810, 1410G</td>
<td>25</td>
<td>RCS</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Well No.2/Well 2</td>
<td>CT-0002</td>
<td>HPD300D</td>
<td>30</td>
<td>65k</td>
<td>2</td>
<td>3810, 1410G</td>
<td>25</td>
<td>RCS</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Splice Starter</td>
<td>CT-0003</td>
<td>HPD300D/A</td>
<td>15</td>
<td>A</td>
<td>65k</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Switch Gate 1</td>
<td>CT-0004</td>
<td>HPD3011</td>
<td>15</td>
<td>65k</td>
<td>0.47</td>
<td>3812, 1412G</td>
<td>25</td>
<td>RCS</td>
<td></td>
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<tr>
<td>5</td>
<td>Switch Gate 2</td>
<td>CT-0005</td>
<td>HPD3011</td>
<td>15</td>
<td>65k</td>
<td>0.47</td>
<td>3813, 1413G</td>
<td>25</td>
<td>RCS</td>
<td></td>
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<td>6</td>
<td>Switch Gate 3</td>
<td>CT-0006</td>
<td>HPD3011</td>
<td>15</td>
<td>65k</td>
<td>2</td>
<td>3813, 1413G</td>
<td>25</td>
<td>RCS</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Generator 1</td>
<td>CT-0007</td>
<td>HPD300D</td>
<td>20</td>
<td>65k</td>
<td>5</td>
<td>3810, 1410G</td>
<td>25</td>
<td>RCS</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Generator 2</td>
<td>CT-0008</td>
<td>HPD300D</td>
<td>20</td>
<td>65k</td>
<td>5.9</td>
<td>3810, 1410G</td>
<td>25</td>
<td>RCS</td>
<td></td>
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<tr>
<td>9</td>
<td>Lightning Control Panel</td>
<td>CT-0009</td>
<td>HPD300D</td>
<td>30</td>
<td>65k</td>
<td></td>
<td>3810, 1410G</td>
<td>25</td>
<td>RCS</td>
<td></td>
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<tr>
<td>10</td>
<td>XFER T-1/P</td>
<td>CT-0010</td>
<td>HPD300D</td>
<td>60</td>
<td>65k</td>
<td>45kVA</td>
<td>495, 1415G</td>
<td>25</td>
<td>RCS</td>
<td></td>
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<tr>
<td>11</td>
<td>Diesel Jacket Heaters</td>
<td>CT-0011</td>
<td>HPD300D</td>
<td>30</td>
<td>65k</td>
<td>10kW</td>
<td>3810, 1410G</td>
<td>25</td>
<td>RCS</td>
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<tr>
<td>12</td>
<td>Exhaust Fan 1</td>
<td>CT-0012</td>
<td>HPD3012</td>
<td>15</td>
<td>H</td>
<td>65k</td>
<td>3</td>
<td>3812, 1412G</td>
<td>25</td>
<td>RCS</td>
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<td>13</td>
<td>Exhaust Fan 2</td>
<td>CT-0013</td>
<td>HPD3012</td>
<td>7</td>
<td>G</td>
<td>65k</td>
<td>3</td>
<td>3812, 1412G</td>
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<td>14</td>
<td>Exhaust Fan 3</td>
<td>CT-0014</td>
<td>HPD3012</td>
<td>7</td>
<td>H</td>
<td>65k</td>
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<td>15</td>
<td>Exhaust Fan 4</td>
<td>CT-0015</td>
<td>HPD3012</td>
<td>7</td>
<td>H</td>
<td>65k</td>
<td>3</td>
<td>3812, 1412G</td>
<td>25</td>
<td>RCS</td>
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<td>16</td>
<td>Exhaust Fan 5</td>
<td>CT-0016</td>
<td>HPD3012</td>
<td>7</td>
<td>G</td>
<td>65k</td>
<td>3</td>
<td>3812, 1412G</td>
<td>25</td>
<td>RCS</td>
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<tr>
<td>17</td>
<td>Supply Fan 7</td>
<td>CT-0017</td>
<td>HPD3012</td>
<td>30</td>
<td>H</td>
<td>65k</td>
<td>20</td>
<td>385, 1415G</td>
<td>25</td>
<td>RCS</td>
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<tr>
<td>18</td>
<td>Makeup Air Unit 1</td>
<td>CT-0018</td>
<td>HPD300D</td>
<td>60</td>
<td>65k</td>
<td>20</td>
<td>385, 120G</td>
<td>25</td>
<td>RCS</td>
<td></td>
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<tr>
<td>19</td>
<td>Makeup Air Unit 2</td>
<td>CT-0019</td>
<td>HPD300D</td>
<td>30</td>
<td>65k</td>
<td>10</td>
<td>3810, 1410G</td>
<td>25</td>
<td>RCS</td>
<td></td>
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<tr>
<td>20</td>
<td>Warning Lamp 1/P</td>
<td>CT-0020</td>
<td>HPD3040</td>
<td>40</td>
<td>65k</td>
<td>12kV</td>
<td>295, 1415G</td>
<td>25</td>
<td>RCS</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>20&quot; M1 iso Valve</td>
<td>CT-0021</td>
<td>HPD300D</td>
<td>20</td>
<td>65k</td>
<td>1.67</td>
<td>3810, 1410G</td>
<td>25</td>
<td>RCS</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>30&quot; M1 iso Valve</td>
<td>CT-0022</td>
<td>HPD300D</td>
<td>20</td>
<td>65k</td>
<td>6.7</td>
<td>3812, 1412G</td>
<td>25</td>
<td>RCS</td>
<td></td>
</tr>
</tbody>
</table>
### Arc Flash Mitigation Changes

<table>
<thead>
<tr>
<th>ID</th>
<th>PROTECTIVE DEVICE</th>
<th>BUS</th>
<th>AF BEFORE</th>
<th>AF AFTER</th>
<th>SETTING</th>
<th>BEFORE</th>
<th>AFTER</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>SWG2-MA CB22</td>
<td>SWG2-MA-A</td>
<td>21.9</td>
<td>10.6</td>
<td>STD</td>
<td>0.5</td>
<td>0.2</td>
<td>CONFLICT WITH CB26 (tie) SO ACCEPTABLE</td>
</tr>
<tr>
<td>2.0*</td>
<td>SWG2-MA CB29</td>
<td>SWG2-MA-B</td>
<td>15.8</td>
<td>11.6</td>
<td>STD</td>
<td>0.3</td>
<td>0.2</td>
<td>COORD WITH CB29; CREATES CONFLICT WITH MCC1-SH MAIN; ACCEPTABLE</td>
</tr>
<tr>
<td>2.1*</td>
<td>SWG2-MA CB27</td>
<td>SWG2-MA-B</td>
<td>-</td>
<td>-</td>
<td>STD</td>
<td>0.2</td>
<td>0.1</td>
<td>COORD WITH CB29; CREATES CONFLICT WITH MCC2-SH MAIN; ACCEPTABLE</td>
</tr>
<tr>
<td>2.2*</td>
<td>SWG2-MA CB28</td>
<td>SWG2-MA-B</td>
<td>-</td>
<td>-</td>
<td>STD</td>
<td>0.2</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>SWG1-MA CB21</td>
<td>SWG1-MA B SWG2-MA A</td>
<td>32</td>
<td>-</td>
<td>STPU</td>
<td>-</td>
<td>-</td>
<td>SETTING ALREADY AT MINIMUM</td>
</tr>
<tr>
<td>4.0</td>
<td>ADMIN BLDG</td>
<td>MCC-AD lineside</td>
<td>42.1</td>
<td>5.54</td>
<td>STPU</td>
<td>S2(12)</td>
<td>6</td>
<td>MIS-COORD. WITH MCC-AD MAIN 5E BUT ACCEPTABLE SINCE IN SERIES</td>
</tr>
</tbody>
</table>

* These setting alterations must be performed as a unit; they cannot be applied separately.

---

**Finger area ~ 1cm²**

**Candle heat ~ 1Cal**
DCRSD ELECTRICAL SAFETY TRAINING
Educate employees to make safe “decisions”

Arc Flash

Lockout / Tagout
1. ALL DCRSD Staff Participated
2. Arc Flash Labels & PPE

Information from NFPA 70E 2018, Table 150.5(G).

**Level A PPE** - Incident energy exposures equal to 1.2 cal/cm² up to 12 cal/cm²:
- Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy
- Long-sleeve shirt and pants or coverall or arc flash suit (SR)
- Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR)
- Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN)
- Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors (SR)
- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection
- Leather footwear

**Level B PPE** - Incident energy exposures greater than 12 cal/cm²:
- Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy
- Long-sleeve shirt and pants or coverall or arc flash suit (SR)
- Arc-rated arc flash suit hood
- Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN)
- Arc-rated gloves or rubber insulating gloves with leather protectors (SR)
- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection
- Leather footwear

SR: Selection of one in group is required.
AN: As needed.
3. Lockout/Tagout Protocol

Warning: Only Authorized Employees who have been Trained and Authorized can perform the LOTO procedures below.

Equipment Diagram

Insert photos of equipment or schematic showing location of equipment to be locked out.

Adjacent & Associated Equipment

<table>
<thead>
<tr>
<th>Adjacent &amp; Associated Equipment</th>
<th>Location of Adjacent &amp; Associated Equipment and Action to be Taken</th>
</tr>
</thead>
</table>

Lockout Tagout (LOTO) Procedure

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Lockout Device</th>
<th>Isolation Location</th>
<th>Lockout Method</th>
<th>Zero Energy Check, Verification &amp; Testing</th>
</tr>
</thead>
<tbody>
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</table>
In Summary, We Encourage You to:

- Establish a culture of safety
- Incorporate electrical safety into all CIP projects & maintenance activities
- Perform continuous evaluation and training
QUESTIONS?