SECTION 26 0574 – ARC FLASH PROGRAM

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

A. The General Conditions, Special Conditions, Instruction to Bidders and all applicable portions of Division 26 – Electrical, apply to the work of this section.

1.02 DESCRIPTION:

A. The Contractor shall provide a Short Circuit Study, Protective Device Evaluation Study, Protective Device Coordination Study, and Arc Flash Hazard Analysis for the electrical distribution system as shown and/or described on the one-line drawings or narrative scope including their loads.

B. The intent of the Arc Flash Hazard Analysis is to determine the hazards that exist at all 3-phase equipment in order to supply information which will aid in the protection of individuals, working on the premises, from electrical hazards.

C. This Arc Flash Hazard Analysis will include all 3-phase equipment listed in Section 3.01 (B) including their loads. The Contractor shall collect all required data to perform the analysis and shall verify the accuracy of any owner provided one-line electrical power drawings.

D. The study will include the creation of Arc Flash Hazard Warning labels specific to each individually identified piece of equipment. These labels serve as a guide to technicians and others in the selection of proper Personal Protective Equipment (PPE) when working near exposed energized equipment. The Contractor shall provide all labels conforming to the BGSU label standard. (See Appendix B)

E. The Arc Flash Hazard Analysis shall consider operation during normal conditions, alternate operations, emergency power conditions, and any other operating condition that could result in maximum arc flash hazard conditions. The Arc Flash Hazard Warning labels shall list the “worst case” arc flash hazard condition at each location.

F. The SKM Data block formatting information in the software required by Bowling Green State University shall be provided to the Contractor. (See Appendix A)

G. A start-up meeting is required between the Contractor, Engineer performing the study, and Bowling Green State University prior to the start of the project.
1.03 REFERENCES:

4. ANSI/NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
5. Bowling Green State University’s safety practices and procedures.

1.04 CODES AND STANDARDS:

A. Occupational Safety and Health Administration: OSHA 29 CFR 1910 Subpart S 1910.331-335
B. National Fire Protection Association: NFPA 70E-2012
C. Institute of Electrical and Electronic Engineers: IEEE 1584, 141 (Red Book), 242 (Buff Book)
D. American National Standards Institute: ANSI Z535.4

1.05 QUALIFICATIONS:

A. The Arc Flash Program shall be prepared and stamped by an electrical engineer that is a licensed Professional Engineer in the State of Ohio.

B. Contractor and Engineer performing the study shall have completed a minimum of six (6) such studies on facilities of similar size, scope.

C. The Contractor shall employ certified journeyman electrician(s) to perform data collection. The contractor is responsible for supplying lifts, ladders or any other required equipment necessary for electrical data collection survey. Personnel performing the arc flash data collection shall be trained and experienced with apparatus and systems being evaluated. These individuals shall be capable of conducting the tasks of data collection in a safe manner and with complete knowledge of the hazards involved.

D. The contractor shall provide proof (written documentation) that its employees working on Bowling Green State University’s campus are electrically qualified. The contractor shall assure that their employees have been properly trained in the use and application of Arc Flash personal protective equipment (PPE) and the hazards of working on or near energized equipment if required.

E. The contractor shall provide proof (written documentation) that its Subcontractors working on Bowling Green State University’s campus working on energized electrical equipment are electrically qualified. The Contractor shall ensure that the Subcontractors have been properly trained in the use and application of Arc Flash...
personal protective equipment (PPE) and the hazards of working on or near energized equipment if required.

F. Contractor shall supply barricades as required in the specification.

G. This contract work scope shall be performed in compliance with BGSU safety policies and procedures.

1.06 **SUBMITTALS:**

A. **Qualifications Submittal:** Prior to commencing the study the following items shall be submitted for approval:

1. Qualifications statements of Contractor and Engineer performing the study.
2. Sample study report.
3. Sample of Arc Flash Hazard Energized Electrical Work Permit, as required by NFPA 70E Electrical Safety Requirements for Employee Workplaces, for identified field data on electrical equipment which is energized during data collection.
4. Proof of contractor employee participation in a company sponsored NFPA 70E and OSHA Electrical Safe Work Practice Program.

B. **Study Submittal:**

1. A Final Study Report as described in Section 3.02 shall be submitted to the design engineer for review. Design Engineer review is limited to evaluating report for completeness and compliance with specification requirements.

2. Upon completion of the Final Study Report, the Contractor and Engineer performing the study shall schedule the Owner review meeting to present and review the Final Study Report findings.

C. When submitted electronically in PDF format, one (1) copy of all required items shall be submitted. For paper submittals provide the quantity of copies required, as stated in this specification (3.03C).

PART 2 – PRODUCTS

2.01 **ANALYSIS SOFTWARE:**

A. The study shall be performed utilizing the latest version of SKM Power Tools Software. No other software packages shall be accepted.
2.02 ARC FLASH HAZARD LABELS:

A. Based on the results of the Arc Flash Study, warning labels shall be produced for each piece of equipment (bus, device, etc.) in accordance with ANSI Z535.4-2002, and the owner's design requirements. The Electrical Contractor shall install all field labels and give Bowling Green State University the option to accompany them during this installation process.

B. Arc Flash Label color, size, and material numbers:  (See Appendix B)
   - Warning Orange with Green leader 4” x 4”, Material B483, Brady #Y1227797
   - Warning Orange with Yellow leader 4” x 4”, Material B483, Brady #Y1227799
   - Warning Orange with Orange leader 4” x 4”, Material B483, Brady #Y1227798
   - Danger Red and White 4” x 6”, Material B483, Brady #Y400843

C. All outdoor labels shall be covered with Clear Polyester Brady B-674 overlayment.

D. Surface preparation: Use alcohol wipes to clean the surface and then let dry thoroughly before applying the label. If the surface is greasy, use a degreaser first and then go over the area with an alcohol wipe afterwards. Labels should always be applied with firm, even pressure starting at one side of the label and working across the surface of the label with multiple passes. This ensures that the entire adhesive has good contact with the surface. Full adhesion strength will be reached after 24 hours.

E. WARNING LABELS (See Appendix B)

   Warning labels shall contain the following information:
   • ARC FLASH AND SHOCK HAZARDS ARE PRESENT! APPROPRIATE PPE REQUIRED. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH.
   • NOTICE: No Changes may be made to this equipment’s settings, sizes or system configuration without the expressed written permission of a BGSU Campus Operations official.

   - Incident Energy
   - Voltage
   - Required PPE
   - Available Fault Current
   - Fault Clearing Time
   - Glove Class
   - Equip. Name
   - Barricade Boundary
   - Hazard Class Category
   - Engineer
   - Date

F. DANGER LABEL (See Appendix B)

   Danger labels shall contain the following information:
   • DANGER
   • ENERGIZED WORK PROHIBITED
   • HAZARD CLASS: DANGEROUS!
   • NOTICE: No Changes may be made to this equipment’s settings, sizes or system configuration without the expressed written permission of a BGSU Campus Operations official.

   • FLASH HAZARD
   • SHOCK HAZARD
   • Equip. Name
G. The analysis shall be conducted calculating the incident energy using formulas from IEEE-1584. The resulting hazard categories shown on the labels are associated with incident energy levels. The levels are described as follows:

“Hazard Class: Level 0” (Less than or equal to 1.2 cal/cm²)

“Hazard Class: Level 1” (Greater than 1.2 cal/cm² but less than or equal to 4 cal/cm²)

“Hazard Class: Level 2” (Greater than 4 cal/cm² but less than or equal to 8 cal/cm²)

“Hazard Class: Level 3” (Greater than 8 cal/cm² but less than or equal to 25 cal/cm²)

“Hazard Class: Level 4” (Greater than 25 cal/cm² but less than or equal to 40 cal/cm²)

“Hazard Class: Dangerous!” (Greater than 40 cal/cm²)

PART 3 – EXECUTION

3.01 REQUIREMENTS:

A. Equipment Naming:

1. Equipment naming shall follow Bowling Green State University’s standards. Coordinate with BGSU naming standards.

B. Data Collection:

1. The contractor shall survey the facility electrical power distribution system for the purposes of recording and documenting all data required to complete engineering studies and one-line diagrams.

2. Survey shall record data such as: utility information, equipment nameplate/ratings, cable sizes/lengths, overcurrent device nameplates, settings, etc. The contractor will be supplied electronic full size data collection sheets by Bowling Green State University (See Appendix C). Informational training for the contractor on the use of the data collection sheets will be provided by Bowling Green State University prior to the start of the project. Once the electrical equipment field data is gathered, the contractor shall forward a copy of the data collection sheets to its Engineer for processing and a record copy to Bowling Green State University. Any discrepancies identified during the data entry shall be field verified and corrected by the contractor. Engineering judgment shall be used for any equipment data that was unable to be collected and/or that is not within the software component
library. All engineering judgments or assumptions shall be noted on the one-lines. No general assumptions of overcurrent device types or sizes shall be accepted. Visual inspection and documentation of all overcurrent devices is mandatory unless inaccessible.

3. A device point can be described as all 3-phase electrical equipment that will receive an Arc-Flash label as described below. Note: Items listed as additional don’t receive a label but are considered as a data point.

**Example Electrical Equipment 600V or Less:**
- Panel Board
- Main Distribution Panel
- Sub Distribution Panel
- Switchgear
- Substation
- Transformer (3-Phase, All Sizes)
- Starter (Combination / Manual)
- Generator
- Uninterruptable Power Supply
- Each Utility Feed (Additional Item)
- 3-Phase Motors ≥40Hp (Additional Item)

**Example Electrical Equipment Above 600V:**
- Automatic Transfer Switch
- HV Switch
- HV Transformer
- Medium or High Voltage Breaker Compartment
- 3-Phase Motors ≥40Hp (Additional Item)
- Fused Cutout (Additional Item)
- Reclosure (Additional Item)

**Note 1:** Wire-ways, pull-boxes and junction-boxes will not receive a label under normal circumstances (therefore these items are not a data point unless a label is required).

**Note 2:** Single phase distribution is not included as a data point.

**Note 3:** Equipment whose distributed power is from a panelboard served by a 208V, 112.5 kVA transformer and smaller is not included as a data point. (The panelboard and transformer are still included.)
**Extra Labels**

Extra labels are areas that are not data points but will receive an arc-flash label. Examples of possible extra label areas are:
- Bus Ducts (Count the total number of 10’ buss sections for each bus duct)
- Motor Control Centers (Count total number of sections present for each MCC)
- Main/Sub Distribution Panels (Count total number of sections present for each panel)
- Substation Rack-out Breakers (Count total number of feeder breaker cubicles). Labels are required on the rear of any cabinets which have removable covers or doors.

4. Existing one-line diagrams and building layout drawings to help facilitate the survey are provided, if available. However, the existing one-lines are not guaranteed to be accurate or complete and all information must be verified during the data collection phase.

5. On newly designed or renovated electrical systems, the project one-line drawings are included with the bid documents.

6. The data collection may require removal of barriers, opening of front panels, etc. while equipment is energized; an energized work permit is required in such cases. Contractor shall supply a barricade such as tapes, cones or A-frame wood or metal structures intended to provide a warning about limited access to a hazardous area. The barricade shall serve as a physical obstruction that is intended to prevent contact with equipment or energized electrical conductors and circuit parts or to prevent unauthorized access to that specific work area.

7. If data collection work being performed is located over existing equipment, the data collection contractor shall take precautions to limit the exposure of any equipment or production products from falling dirt, dust or other hazards.

8. While collecting data, the contractor shall document on the data collection sheets, all breaker and fuse positions (section/position) for panelboards, MCCs, and bus ducts whether they are 1-phase, 3-phase, spare or space.

9. During the field data collection, the contractor shall not deenergize any electrical equipment without written permission from Bowling Green State University.

C. **System Analysis:**

1. Perform a comprehensive analysis of facility electrical systems for all 3-phase equipment 240V and higher and 208V served by a 125kVA or larger transformer. The analysis will continue down to all 208V panelboards served by a 112kVA transformer or smaller. However, no 3-phase loads from these panels are required. The studies shall consider operation during normal
conditions, alternate, and emergency conditions which could result in a maximum arc flash hazard. Complete the following engineering studies:

a. **Short Circuit Study** – A short circuit fault current analysis (three phase bolted fault and single line-to-ground fault) shall be performed in accordance with ANSI standard C37 and IEEE standard 141 (Red Book) for each bus location that will be receiving an Arc Flash Label.

b. **Protective Device Evaluation Study** – This study shall be performed to determine whether circuit breakers or fuses have an adequate kAIC rating for the available fault current they must withstand. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. Any problem areas or inadequacies in equipment ratings found shall be listed in table format comparing existing AIC rating to the available fault current.

c. **Coordination Study** – A coordination study for devices flagged as miscoordinated by the SKM software shall be performed in accordance with IEEE 242 (“Buff” Book) to determine the proper overcurrent device settings that will provide system reliability through selective coordination while minimizing the magnitude of an electrical arc flash hazard incident. Provide time current curves which graphically indicate the coordination of devices. Any devices that are identified as miscoordinated shall be noted in the study report, and where possible, recommendations shall be made to obtain the required coordination. All settings for relays and circuit breakers or fuse sizes (including manufacturer and type) shall be listed in tabular format or on the TCC curve. Any recommendations given shall include existing and final settings.

d. **Arc Flash Study** – An arc flash study shall be done for each bus location (calculation node) as identified in short circuit study. It shall be done in accordance with the applicable standards IEEE 1584-2004a - IEEE Guide for Performing Arc Flash Hazard Calculations, as referenced in NFPA 70E, “Standard for Electrical Safety in the Workplace”, 2012 Revision, in order to quantify the hazard for selection of personal protective equipment (PPE). Tables that assume fault current levels and clearing time for proper PPE selection are not acceptable. Pertinent data, rationale employed and assumptions shall be provided with calculations.

e. Engineering judgment shall be used for any equipment data that was unable to be collected or that is not within the software component library. All engineering judgments shall be noted on the one-lines and shall also be listed in spreadsheet format in Study Report.
D. Analysis Review:

1. The contractor shall provide mitigation recommendations ahead of delivering the Study Report. This will give Bowling Green State University an opportunity to address problem areas prior to printing labels. The recommendations shall be separated into three areas as described below.

a. **Arc Flash Analysis**: These mitigation recommendations shall list all areas where the existing incident energy is above 8cal/cm² (Hazard Class = “Level 3” and higher) whether it can be lowered or not, with the goal of mitigating incident energy levels below 8cal/cm² (Hazard Class = “Level 2” or less). Include TCC curves showing before and after settings of breakers that can be adjusted to reduce the hazard. These mitigation recommendations shall include the following:

   1) Adjustments to existing current limiting devices (e.g. relay settings, substation breaker electronic trip settings, molded case breaker instantaneous adjustment). The recommendation should include existing and new settings.
   2) Replacement of current limiting devices (e.g. fuse replacement).
   3) Replacement of obsolete substation breaker (e.g. solenoid style trip units) or molded case breakers.
   4) Where hazard levels of “Dangerous” (above 40cal/cm²) could not be lowered by the above means, then an attempt shall be made where possible to relocate the hazard away from the bus location to allow worker access by adding a fused disconnect or enclosed circuit breaker.

b. **Coordination Study**: These mitigation recommendations shall list all areas where a miscoordination exists and shall indicate if the miscoordination is acceptable or cannot be fixed. If it can be fixed, include existing and new settings of the protective devices. Also include TCC curves showing before and after settings of miscoordinated breakers that can be adjusted to remove the issue.

c. **Protective Device Evaluation Study**: These mitigation recommendations shall document all protective devices which have an inadequate AIC rating. Include existing device AIC rating and available fault current at location. Specify minimum AIC rating required for replacement.
3.02 **FINAL STUDY REPORT:**

A. Supply a Comprehensive Report with all engineering materials for review that includes:

1. The original field data collection sheets.

2. Report Summary with analysis methodology, findings and recommendations:
   a. A summary of all assumed components used in the analysis in spreadsheet format or shown on the one-line drawing. Other assumptions made in analysis that are separate from components shall also be listed.
   b. A summary of all input data for utility source, equipment, protective devices, transformers and cables in spreadsheet format.
   c. A summary of the Arc Flash Analysis in spreadsheet format which gives at a minimum, the available fault current, incident energy level (cal/cm²), hazard category at each equipment (bus) location and its protective device.
   d. Overcurrent device coordination curves (TCC) including related section of the single-line diagram for any miscoordination issues or recommendations.
   e. The one-line diagram created from the data collected shall be separated to fit onto D-Size drawings and exported to AutoCAD format. These one-lines will be included in the Final Study Report on 11 x 17 sheets. (All information shall be legible on 11 x 17 sheets.) Information, including the component or bus name, shall be shown on the one-line diagram.
   f. A copy of the Analysis Review.
   g. The Contractor shall supply (1) CD which includes a back-up file of the SKM program in PDF format, in addition to supplying all information listed above in items “a” through “g”.
   h. The Contractor shall provide a method for tracking future changes to the power distribution system and a cost per point or hourly fee for the maintenance of the assessment and a detailed listing of what is included in that cost. It is Bowling Green State University’s intent to maintain the assessment.
   i. The Contractor shall provide a copy of the original field data collection sheets.

3.03 **OWNER REVIEW MEETINGS:**

A. These review meetings shall be scheduled with the Owner at the Owner’s location.

B. The contractor / electrical engineer shall meet with the Owner to explain the findings of the Analysis Review. Supply two copies of the Analysis Review report and ½ size drawings of the associated one-lines. During this review, the label design shall be discussed or finalized. No labels shall be printed without final approval from owner as indicated by 2.02 B.
C. The contractor / electrical engineer shall meet with the Owner to explain the Study Report (3.02). This meeting shall be separate from the one required for the Analysis Review unless there would be no recommendations to reduce hazard levels in that review. Supply two (2) copies of the Final Study Report at the review meeting during which the electrical engineer shall review all sections of the report in detail. With the Final Study Report, the contractor / electrical engineer shall supply two (2) sets of D-Size (at a minimum) drawings of the electrical one-lines exported to AutoCAD. These will be used by the Owner to track future changes to the distribution system.

3.04 LABEL INSTALLATION:

A. The contractor shall clean area on equipment prior to installing label.

B. The contractor shall install all labels on equipment. For equipment that is outside, the contractor shall install an additional clear laminate to protect the label from UV as required by 2.02.

C. The contractor shall provide verification that all provided labels have been attached to the proper equipment via the Contractor/Engineer Label Verification Report (see document at end of this specification). The Label Verification Report with all required equipment names will be provided with the “Final Study Report” and shall be completed by the contractor. The completed Contractor Label Verification Report shall be given to the engineer and owner for insertion into the “Final Study Report”.

D. The engineering firm that performed the arc flash study shall provide field verification of 10% (minimum of 10) of provided labels to assure they have been installed on the proper equipment. If labels are found to be installed improperly, the contractor shall review all label locations and replace all misapplied labels. The owner shall not incur any additional costs as a result of misapplied labels. The same Contractor/Engineer Label Verification Report (see document at end of this specification) that the contractor filled out shall be used for the 10% field verification by the Engineer.

END OF SECTION 26 0574
**NOTE:** Multiple sheets may be needed depending on project size.

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<th>Contractor Verification Label Attached to Proper Equipment</th>
<th>Engineer 10% Verification Label Attached to Proper Equipment</th>
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<td>Yes or No</td>
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I certify that as of _______________ that all provided Arc Flash Labels have been installed on the proper equipment.

**Date**

**NAME**  

**SIGNATURE**

**NAME OF CONTRACTOR COMPANY**

**NAME**  

**SIGNATURE**

**NAME OF ENGINEER COMPANY**
APPENDIX A – SKM Data Block Settings

The information given below are lists of available attributes which Bowling Green State University wants to see displayed in the data blocks for components shown on the Arc Flash one-lines.

**Buses:**
- Component Name
- System Nominal Voltage
- InitSymRMS 3P
- AF_PPE Category
- AF_Incident Energy

**Induction Motor:**
- ComponentName
- NumMotors
- RatedSize
- Raged Amps

**Cable:**
- Component Name
- QtyPerPhase
- CableSize
- ConductorType
- Conductor Desc
- Length
- DuctMaterial
- Installation
- Ampacity

**Protective Device:**
- ComponentName
- Manufacturer
- Frame/Model
- SelCoor Downstream Function
- InterruptingRating
- Frame/Rating
- Sensor/Trip
- Plug
- CT Ratio
- Settings

**2-Winder Transformer:**
- Component Name
- Nominal kVA
- FullLoad kVA
- Pri RatedVoltage
- Sec Rated Voltage
- Z%

**Transmission Line:**
- Component Name
- Rpos Ohms/Length
- Xpos Ohms/Length
- Xc pos MOhms/Length
- Length

**Utility:**
- Component Name
- Rated Voltage
- SC Contribution 3P
- SC Contribution SLG

**Generator:**
- Component Name
- Rated kV
- X"d
WARNING label is 4” x 4” and DANGER label is 4” x 6”

**WARNING**

ARC FLASH AND SHOCK HAZARDS ARE PRESENT!
APPROPRIATE PPE REQUIRED!
FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH!

- Incident Energy:
- Fault Clearing Time:
- Barricade Boundary:
  (Arc Flash/Shock Boundary)
- Voltage:
- Glove Class:

**NOTICE!**

No changes may be made to this equipment’s settings, sizes or system configuration without the expressed written permission of a BGSU Campus Operations official.

**Hazard Class: Level 0**

- Required PPE: Refer to BGSU’s Electrical Safe Work Program
- Equip. Name:
- Prot. Device:
- Available Fault Current:

**WARNING**

ARC FLASH AND SHOCK HAZARDS ARE PRESENT!
APPROPRIATE PPE REQUIRED!
FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH!

- Incident Energy:
- Fault Clearing Time:
- Barricade Boundary:
  (Arc Flash/Shock Boundary)
- Voltage:
- Glove Class:

**NOTICE!**

No changes may be made to this equipment’s settings, sizes or system configuration without the expressed written permission of a BGSU Campus Operations official.

**Hazard Class: Level 1**

- Required PPE: Refer to BGSU’s Electrical Safe Work Program
- Equip. Name:
- Prot. Device:
- Available Fault Current:

**WARNING**
WARNING label is 4” x 4” and DANGER label is 4” x 6”

Hazard Class: Level 2

Required PPE: Refer to BGSU’s Electrical Safe Work Program

Hazard Class: Level 3

Required PPE: Refer to BGSU’s Electrical Safe Work Program
WARNING label is 4” x 4” and DANGER label is 4” x 6”

ARC FLASH AND SHOCK HAZARDS ARE PRESENT!
APPROPRIATE PPE REQUIRED!
FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH!

Incident Energy: 
Fault Clearing Time: 
Barricade Boundary: 
(Arc Flash/Shock Boundary) 
Voltage: 
Glove Class: 

NOTICE!

No changes may be made to this equipment’s settings, sizes or system configuration without the expressed written permission of a BGSU Campus Operations official.

Hazard Class: Level 4

Required PPE: Refer to BGSU’s Electrical Safe Work Program

Engineer Date
WARNING label is 4” x 4” and DANGER label is 4” x 6”

![DANGER Label](image)

**ENERGIZED WORK PROHIBITED**

**FLASH HAZARD**
- Incident Energy:
- Fault Clearing Time:
- Barricade Boundary:
  (Arc Flash/Shock Hazard)

**NOTICE!**
No changes may be made to this equipment's settings, sizes or system configuration without the expressed written permission of a BGSU Campus Operations official.

**Hazard Class: Dangerous!**

**SHOCK HAZARD**
- Voltage:
- Glove Class:

**Equip. Name:**

**Prot. Device:**

**Available Fault Current:**

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*APPENDIX B – Labels*

*Bowling Green State University*

*ARC FLASH PROGRAM*

*November 14, 2014*
### Substation/Distribution Panel

**Substation/Distribution Panel Name:**

**Bus Rating:**

**Substation/Distribution Panel Type:**

**Fed From:**

**Voltage:**

**Feeder Size:**

**Load Name:**

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<th>Manufacturer</th>
<th>Type</th>
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<th>Frame</th>
<th>Ratio</th>
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<th>Inst.</th>
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<th>Cu/Al</th>
<th>M/NM</th>
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<td>NA</td>
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<td>N Cu M</td>
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<td>CW-1(Disc)</td>
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### Feeder Breakers/Switches

**Note:** The Sheet # is from the overall data collected (ex: 3 of 80) while the page # is for continuation of data (ex: 1 of 2). M - Magnetic Conduit Cu - Copper Conductors NM - Non-Magnetic Conduit Al - Aluminum Conductors

### Control Panel

**Control Panel Name:**

**Bus Rating:**

**Distribution block or Bussing:**

**Fed From:**

**Voltage:**

**Feeder Size:**

**Load Name:**

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<th>Size G</th>
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### Main Breaker/Switch

**Feeder Breakers/Fuses**

**Control Panel Name:**

**Bus Rating:**

**Distribution block or Bussing:**

**Fed From:**

**Voltage:**

**Feeder Size:**

**Load Name:**

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<th>Manufacturer</th>
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</tbody>
</table>

### Panelboard

**Panelboard Name:**

**Bus Rating:**

**Panelboard Type:**

**Fed From:**

**Voltage:**

**Feeder Size:**

**Load Name:**

<table>
<thead>
<tr>
<th>Section</th>
<th>Breaker/Fuse</th>
<th>Manufacturer</th>
<th>Amp Rating</th>
<th>Bkr Inst.</th>
<th>Set</th>
<th>AIC Rating</th>
<th>Sets Qty/Set</th>
<th>Size G</th>
<th>Cu/Al</th>
<th>M/NM</th>
<th>Length</th>
<th>(Description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1,3,5</td>
<td>Square D</td>
<td>QO</td>
<td>60</td>
<td>N/A</td>
<td>10K</td>
<td>1 3</td>
<td>6</td>
<td>Y/N</td>
<td>Cu M</td>
<td>150'</td>
<td>MCC-1 (MCC)</td>
<td></td>
</tr>
</tbody>
</table>

### MCC

**MCC Name:**

**Bus Rating:**

**Motor Control Center Type:**

**Fed From:**

**Voltage:**

**Feeder Size:**

**Load Name:**

<table>
<thead>
<tr>
<th>Section</th>
<th>Breaker/Fuse</th>
<th>Manufacturer</th>
<th>Amp Rating</th>
<th>Bkr Inst.</th>
<th>Set</th>
<th>AIC Rating</th>
<th>Sets Qty/Set</th>
<th>Size G</th>
<th>Cu/Al</th>
<th>M/NM</th>
<th>Length</th>
<th>(Description)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1,3,5</td>
<td>Square D</td>
<td>QO</td>
<td>60</td>
<td>N/A</td>
<td>10K</td>
<td>1 3</td>
<td>6</td>
<td>Y/N</td>
<td>Cu M</td>
<td>150'</td>
<td>MCC-1 (MCC)</td>
<td></td>
</tr>
</tbody>
</table>

### Main Breaker/Switch

**Feeder Breakers/Switches**

**Note:** The Sheet # is from the overall data collected (ex: 3 of 80) while the page # is for continuation of data (ex: 1 of 2). M - Magnetic Conduit Cu - Copper Conductors NM - Non-Magnetic Conduit Al - Aluminum Conductors

### Example Area

**Cable/Conduit to Load**

**MCB/MS or MLO:**

**Main Breaker/Switch**

**Feeder Breakers/Switches**

**Note:** The Sheet # is from the overall data collected (ex: 3 of 80) while the page # is for continuation of data (ex: 1 of 2). M - Magnetic Conduit Cu - Copper Conductors NM - Non-Magnetic Conduit Al - Aluminum Conductors

**Example Area**
**APPENDIX C – Data Collection Sheets**

**Bowling Green State University**

<table>
<thead>
<tr>
<th>Bus Duct Name: ___________________________________</th>
<th>Bus Rating: ___________</th>
<th>Total Number Of Bus Sections: _____________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fed From: ______________________</td>
<td>Voltage: ___________</td>
<td>Feeder Size: ___________________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section/Position</th>
<th>Manufacturer</th>
<th>Type</th>
<th>Amp Rating</th>
<th>Breaker Inst.</th>
<th>Breaker Inst.</th>
<th>Phase</th>
<th>Cu/Al</th>
<th>M/NM</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>Littlefuse</td>
<td>FLSR</td>
<td>175A</td>
<td>N/A</td>
<td>200k</td>
<td>1</td>
<td>YN</td>
<td>Cu</td>
<td>100'</td>
</tr>
</tbody>
</table>

Note: The Sheet # is from the overall data collected (ex: 3 of 80) while the page # is for continuation of data (ex:1 of 2).

Add notes to the side or on the line below when necessary.

**Example Area**

**Transformer Name**

<table>
<thead>
<tr>
<th>Transformer Name</th>
<th>kVA Rating</th>
<th>Primary Voltage</th>
<th>Secondary Voltage</th>
<th>% Imp</th>
<th>Type</th>
<th>Load Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>XF-Sub (Example)</td>
<td>10000 / 13300</td>
<td>13.8kV</td>
<td>12.47kV</td>
<td>8.05</td>
<td>Delta Wye</td>
<td>Sub-1A Main Bkr (SUB)</td>
</tr>
</tbody>
</table>

Note: The sheet # is from the overall data collected (ex:3 of 80) while the page # is for continuation of data (ex:1 of 2).

Add additional notes to the line below when necessary.

**Example Area**

**Relay Name**

<table>
<thead>
<tr>
<th>Relay Name</th>
<th>Manufacturer</th>
<th>Type</th>
<th>Device No.</th>
<th>Style</th>
<th>CT Ratio</th>
<th>Settings</th>
<th>HV Breaker</th>
<th>Cable/Conduit to Load</th>
<th>Load Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-01 (Example)</td>
<td>Westinghouse</td>
<td>CO-8</td>
<td>50/51</td>
<td>40/50/5A</td>
<td>40</td>
<td>4</td>
<td>40</td>
<td>Westinghouse</td>
<td>GMB</td>
</tr>
</tbody>
</table>

Note: The sheet # is from the overall data collected (ex:3 of 80) while the page # is for continuation of data (ex:1 of 2).

Add additional notes to the line below when necessary.

**Example Area**
### APPENDIX C – Data Collection Sheets

#### Capacitor Name Description Individual Cap Ratings Cap Bank Additional Notes

<table>
<thead>
<tr>
<th>Capacitor Name</th>
<th>Description</th>
<th>Individual Cap Ratings</th>
<th>Cap Bank</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAP-1A</td>
<td>13.8 kV Filter Bank No. 1</td>
<td>8.4 kV 300 wye 8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The Sheet # is from the overall data collected (ex: 3 of 80) while the page # is for continuation of data (ex: 1 of 2). Add additional notes to the side or on the line below when necessary.

---

### Generator Name Description

<table>
<thead>
<tr>
<th>Generator Name</th>
<th>Manufacturer</th>
<th>Cont KW</th>
<th>Stdby KW</th>
<th>FLA</th>
<th>RPM</th>
<th>Voltage</th>
<th>P.F.</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen-1</td>
<td>Caterpillar</td>
<td>1200</td>
<td>1380</td>
<td>NA</td>
<td>3600</td>
<td>277/480</td>
<td>0.8</td>
<td>wye Y/N</td>
</tr>
</tbody>
</table>

#### Example Area

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
<th>Trip Unit</th>
<th>Frame/Plug</th>
<th>CT</th>
<th>Ratio</th>
<th>Interrupt Rating</th>
<th>Breaker Settings</th>
<th>Cable/Conduit to Load</th>
<th>Load Name/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westinghouse</td>
<td>DB-25</td>
<td>AC-Pro (URC)</td>
<td>800</td>
<td>400/5</td>
<td>22kA</td>
<td>7 20 8 .07 out 6</td>
<td>N/A N/A</td>
<td>250 Cu M 200' CW-1 (Disc)</td>
<td></td>
</tr>
</tbody>
</table>

Note: The Sheet # is from the overall data collected (ex: 3 of 80) while the page # is for continuation of data (ex: 1 of 2). Add additional notes to the side or on the line below when necessary.

---

**Example Area**

**Example Area**