

**SECTION 26 05 71**

**ELECTRICAL PROTECTION SYSTEM STUDIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the requirements of the Electrical Protection System Studies - to include Short Circuit Calculations, Selective Coordination Device Settings, and Arc Flash Hazard Analysis indicated in the scope of work.
- B. The studies shall be prepared for the electrical distribution system using electrical devices intended to be installed under this project to implement the system protection in the drawings.
- C. The studies shall present an organized time-current characteristic analysis of protective devices within the emergency system in the building.
- D. The results of the studies shall be used to determine AIC ratings of equipment and breaker types for coordination, as well as calculated incident energy values for arc flash hazard labels identifying the incident energy present at each electrical device indicated as receiving power from the new generator.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 08 00, COMMISSIONING OF ELECTRICAL SYSTEMS:

**1.3 QUALIFICATIONS**

- A. Engineer Qualifications: The studies shall be performed by an electrical engineer meeting one of the following requirements:
  - 1. A professional electrical engineer licensed to provide services in the State of New York.
  - 2. An electrical engineer on the equipment manufacturer's staff with knowledge of the provided equipment.

- B. The Contractor shall submit engineer qualifications for Contracting Officer Representative (COR) approval prior to the initiation of the studies.
- C. The Contractor is responsible for providing all pertinent information required by the preparers to complete the study. The studies, if prepared by someone other than the equipment manufacturer, shall be certified and sealed by the preparing engineer licensed in the State of New York.

**1.4 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
  - 1. Product data on the software program to be used for the study. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current characteristic graphs.
  - 2. Complete short circuit, selective coordination, arc flash hazard, and other system protection studies as described in paragraph 1.6.
  - 3. Protective device equipment shop drawings shall be submitted simultaneously with or after the studies have been submitted. The protection, monitoring, and automation submittal will not be reviewed prior to submission of the studies.
- B. Certification: Two weeks prior to final inspection, submit four copies of the following to the Contracting Officer Representative (COR):
  - 1. Certification by the contractor that the protective devices have been adjusted and set in accordance with the approved studies and arc flash hazard labels have been attached to the equipment installed for this project.

**1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronics Engineers (IEEE):
  - 242-01.....Recommended Practice for Protection and  
Coordination of Industrial and Commercial Power  
Systems

399-97.....Recommended Practice for Power Systems Analysis  
1584a-04.....Guide for Performing Arc-Flash Hazard  
Calculations

## 1.6 REQUIREMENTS

- A. The complete studies shall include a system one line diagram, short circuit and ground fault analysis, protective coordination plots, protective device settings, and arc flash hazard incident energy analysis for all overcurrent protective devices installed as part of this project and those protective devices that are existing in each building and not being removed, replaced, or modified.
- B. One Line Diagram:
1. Show on the one line diagram, all electrical equipment and wiring to be protected by the overcurrent devices installed under this project. Clearly show on the one line diagram, the schematic wiring of the electrical distribution system.
  2. On the one line diagram, also show the following specific information:
    - a. Calculated fault impedance, X/R ratios, short-circuit, and arc flash values at each bus.
    - b. Breaker and fuse ratings.
    - c. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
    - d. Nominal voltage at each bus.
    - e. Identification of each bus, matching the identification on the construction drawings.
    - f. Conduit material, feeder insulation type, conductor material, size, length, and X/R ratio.
- C. Short Circuit Study:
1. Systematically calculate the fault impedance to determine the available short circuit and ground fault currents at each bus. Incorporate the motor contribution in determining the momentary and interrupting ratings of the protective devices.
  2. The study shall be calculated by means of a computer program. Pertinent data and the rationale employed in developing the

calculations shall be incorporated in the introductory remarks of the study.

3. Present the data conclusions of the short-circuit study in a table format. Include the following:

- a. Device identification.
- b. Operating voltage.
- c. Protective device.
- d. Device rating.
- e. Calculated short-circuit current.

D. Coordination Curves:

1. Prepare the coordination curves to determine the required settings of protective devices to ensure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between series devices, including the utility company upstream device. Plot the specific time-current characteristics of each protective device in such a manner that all upstream devices are clearly depicted on one sheet.
2. The following specific information shall also be shown on the coordination curves:
  - a. Device identification.
  - b. Voltage and current ratio for curves.
  - c. 3-phase and 1-phase ANSI damage points for each transformer.
  - d. No-damage, melting, and clearing curves for fuses.
  - e. Cable damage curves.
  - f. Transformer in-rush points.
  - g. Maximum short-circuit cutoff point.
3. Develop a table to summarize the settings selected for the protective devices. Include the following in the table for all of the overcurrent devices in the distribution system whether the devices are shown in the coordination curves or not:
  - a. Device identification.
  - b. Relay CT ratios, tap, time dial, and instantaneous pickup.
  - c. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
  - d. Fuse rating and type.

- e. Ground fault pickup and time delay.
- f. Resulting arc flash energy levels at protected equipment (to be included on a warning label and used in determining required personnel protective equipment (PPE) and extent of the exclusion zone).

C. Arc Flash Hazard Analysis:

1. Prepare a calculation of the available arc flash energy present at all major medium voltage electrical distribution equipment installed or supplied by the equipment in this project.
2. The study shall be calculated by means of a computer program. Pertinent data and rationale employed in developing the calculations shall be incorporated in the introductory remarks of the study.
3. Present the data determined by the arc flash study in a table format that includes the following:
  - a. Device identification.
  - b. Operating voltage.
  - c. Protective device limiting the arc flash energy.
  - d. Device rating.
  - e. Calculated arc flash energy level.
  - f. Working distance from arc flash hazard.
4. Provide permanent labeling for attachment to the equipment documenting the arc flash incident energy levels present. Detailed information required on the arc flash hazard warning labels is documented in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.7 ANALYSIS**

- A. Analyze the short circuit calculations, and highlight any equipment that is determined to be underrated as specified. Propose approaches to effectively protect the underrated equipment. Provide minor modifications to conform with the study (examples of minor modifications are trip sizes within the same frame, the time-current curve characteristics of induction relays, CT ranges, etc.).
- B. After developing the coordination curves, highlight areas lacking coordination. Present a technical evaluation with a discussion of the logical compromises for best coordination.

- C. After developing the arc flash incident energy levels, highlight the various levels of hazard and present a technical evaluation with discussion of the recommended levels of personnel protective equipment required and workable arrangements that could be used to mitigate the hazards present.

**1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS**

- A. Necessary final field adjustments, settings, and minor modifications shall be made to conform with the study without additional cost to the Government.
- B. All final circuit breaker and relay settings and fuse sizes shall be made in accordance with the recommendations of the study.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION - NOT USED**

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