SECTION 26 05 71
ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes computer-based, fault current and overcurrent protective devices coordination including ground fault protection and arc fault hazard analysis studies to be performed by the contractor. Protective devices shall be set based on the result of the protective device coordination study. Arc fault hazard analysis warning labels shall be printed and affixed to the electrical system equipment after the final protective relay settings have been applied and confirmed operational. Settings and adjustments of the relays shall be performed by an independent qualified agency familiar with this work and the agency is to be retained by the contractor. The person performing this work shall have a minimum of five years experience.

B. The contractor shall have a short circuit and coordination study prepared for the electrical over-current devices to be installed under this project to assure proper equipment and personnel protection. The study shall be for the new electrical equipment as shown on single line diagram.

C. It is the responsibility of the entity performing the Short Circuit and Coordination Study to collect all data to fully perform the study, including but not limited to engine generator data, motor data, circuit breakers, utility company short circuit, available new and existing device ratings, conductor data, transformer ratings, etc.

D. The study shall present an organized time-current analysis of each protective device in series from the individual device back to the source. The study shall reflect the operation of each device ratings, conductor data, transformer ratings, etc.

E. The short circuit portion of the study shall be submitted prior to or along with the switchboard/panels and shall include all equipment which has an AIC rating. The short circuit study shall reflect that all equipment with an AIC rting is properly rated for its specific application. The submitted switchboard/panel (including all equipment which has an AIC rating) shall reflect the findings of short circuit study (i.e., the AIC ratings of the equipment shall exceed the available short circuit current and any required derating factors at each point in the system.

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 24 11, DISTRIBUTION SWITCHBOARDS: Low-voltage distribution switchboards.

C. Section 26 24 16, PANEL BOARDS: Low-voltage panelboards.

D. Section 26 24 19, MOTOR CONTROL CENTERS: Low-voltage motor control centers.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. The protective device study shall be prepared by the equipment manufacturer's qualified engineers or an approved consultant. The contractor is responsible for providing all pertinent information required by the preparers to complete the study.

1.4 SUBMITTALS

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. 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 drawings, (similar to SKM Power Tools).

C. Complete short-circuit and coordination study as described in paragraph 1.6.

D. Protective equipment shop drawings shall be submitted simultaneously with or after the protective device study. Protective equipment shop drawings will not be accepted prior to protective device study.

E. Certification: Two weeks prior to final inspection, submit four copies of the following to the Project Engineer:
Certification by the contractor that the protective devices have been adjusted and set in accordance with the approved protective device study.

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

SPEC WRITER NOTE: On small renovation projects, modify the scope to describe the proper extent of the study.

1.6 REQUIREMENTS

A. The complete study shall include a system one line diagram, short-circuit and ground fault analysis, and protective coordination plots for all overcurrent protective devices.

B. One Line Diagram:

1. On the one line diagram, show all electrical equipment and wiring to be protected by the overcurrent devices installed under this project.
2. On the one line diagram, also show the following specific information:
   a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
   b. Breaker and fuse ratings.
   c. Generator kW and Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
   d. Voltage at each bus.
   e. Identification of each bus, matching the identification on the construction drawings.
   f. Conduit, cable, and busway material and sizes, length, and X/R ratios.

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:
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.

1.7 ANALYSIS

A. Analyze the short-circuit calculations, and highlight any equipment 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.

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.

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