SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance requirements for overcurrent protective devices.

B. Short circuit study.

C. Coordination study and analysis.

1.02 RELATED REQUIREMENTS

A. Section 26 28 17 - Enclosed Circuit Breakers.

B. Section 26 24 13 - Switchboards: Overcurrent protective devices in switchboards.

C. Section 26 24 16 - Panelboards: Overcurrent protective devices in panelboards.

D. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

A. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

B. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.

C. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Study Report: Submit protective device studies as specified, prior to submission of product data submittals or ordering or fabrication of protective devices.
   1. Include stamp or seal and signature of preparing engineer.

C. Field Engineer Qualifications.

D. Field Inspection Report: Show final adjusted settings of protective devices.

1.05 PROTECTIVE DEVICE STUDY

A. Analyze the specific electrical and utilization equipment (according to NEC definition), the actual protective devices to be used, and the actual feeder lengths to be installed.
   1. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
   2. Report: State the methodology and rationale employed in making each type of calculation; identify computer software package(s) used.

B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with all electrical equipment and wiring to be protected by the protective devices; identify nodes on the diagrams for reference on report that includes:
   1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at the main switchboard bus and all downstream devices containing protective devices.

2. Breaker and fuse ratings.
3. Generator kW and voltage ratings, percent impedance, X/R ratios, and wiring connections.
4. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
5. Identification of each bus, with voltage.
6. Conduit materials, feeder sizes, actual lengths, and X/R ratios.

C. Short Circuit Study: Calculate the fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
1. Show fault currents available at key points in the system down to a fault current of 7,000 A at 480 V and 208 V.
2. Include motor contributions in determining the momentary and interrupting ratings of the protective devices.
3. Primary Fault Level Assumptions: Obtain data from utility company.
4. Report: Include all pertinent data used in calculations and for each device include:
   a. Device identification.
   b. Operating voltage.
   c. Protective device.
   d. Device rating.
   e. Calculated short circuit current, asymmetrical and symmetrical, and ground fault current.

D. Coordination Study: Perform an organized time-current analysis of each protective device in series from the individual device back to the primary source, under normal conditions, alternate operations, and emergency power conditions.
1. Graphically illustrate that adequate time separation exists between series devices, including upstream primary device.
2. Plot the specific time-current characteristics of each protective device on log-log paper.
3. Organize plots so that all upstream devices are clearly depicted on one sheet.
4. Also show the following on curve plot sheets:
   a. Device identification.
   b. Voltage and current transformer ratios for curves.
   c. 3-phase and 1-phase ANSI damage curves for each transformer.
   d. No-damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum short circuit cutoff point.
   h. Simple one-line diagram for the portion of the system that each curve plot illustrates.
   i. Software report for each curve plot, labeled for identification.

E. Analysis: Determine ratings and settings of protective devices to minimize damage caused by a fault and so that the protective device closest to the fault will open first.
1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
2. Identify any equipment that is underrated as specified.
3. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve a change to the contract sum.

4. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Red Clay Consolidated School District, provide a discussion of alternatives and logical compromises for best achievable coordination.
5. Do not order, furnish, or install protective devices that do not meet performance requirements unless specifically approved by Architect.

F. Protective Device Rating and Setting Chart: Summarize in tabular format the required characteristics for each protective device based on the analysis; include:
1. Device identification.
2. Relay CT ratios, tap, time dial, and instantaneous pickup.
3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
4. Fuse rating and type.
5. Ground fault pickup and time delay.
6. Input level and expected response time at two test points that are compatible with commonly available test equipment and the ratings of the protective device.
7. Highlight all devices that as furnished by Contractor will not achieve required protection.

1.06 QUALITY ASSURANCE

A. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
1. Acceptable Software Products:
a. Operation Technology, Inc; ETAP: www.etap.com.
b. SKM Systems Analysis, Inc; Power Tools for Windows: www.skm.com.

B. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.

C. Red Clay Consolidated School District's Responsibility: Provide data on relevant Red Clay Consolidated School District power distribution equipment.

PART 2 PRODUCTS

2.01 PROTECTIVE DEVICES

A. Provide protective devices of ratings and settings as required so that the protective device closest to the fault will open first.

B. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings in accordance with results of this analysis.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the installed protective devices to conform to requirements determined by the coordination analysis.

B. Adjust installed protective devices having adjustable settings to conform to requirements determined by the coordination analysis.

C. Adjust solid-state protective modules for motors prior to applying load to motor.

D. Submit report showing final adjusted settings of all protective devices.

END OF SECTION