SECTION 26 28 01.00 10

COORDINATED POWER SYSTEM PROTECTION
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 242	(2001) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE Std 399	(1997) Recommended Practice for Power Systems Analysis - Brown Book

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70E	(2004) Electrical Safety in the Workplace

1.2 GENERAL REQUIREMENTS

Section 26 08 00, APPARATUS INSPECTION AND TESTING applies to work specified in this section

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fault Current Analysis
Protective Device Coordination Study

The study along with protective device equipment submittals. No time extensions or similar contact modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed will be based on recommendations of this study. The Owner shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Study report

Data consisting of manufacturer's time-current characteristic curves for individual protective devices, recommended settings of

adjustable protective devices, and recommended ratings of non-adjustable protective devices.

System Coordinator

Verification of experience and license number, of a registered Professional Electrical Engineer in California with at least 3 years of current experience in the design of coordinated power system protection. Experience data shall include at least three references for work of a magnitude comparable to this contract, including points of contact, addresses and telephone numbers. This engineer must perform items required by this section to be performed by a registered Professional Engineer.

1.4 SYSTEM DESCRIPTION

The power system covered by this specification consists of: Electrical system equipment as shown on the drawings and described in the specifications.

1.5 QUALIFICATIONS

1.5.1 System Coordinator

System coordination, recommended ratings and settings of protective devices, and design analysis shall be accomplished by a registered professional electrical engineer, with a minimum of 3 years of current experience in the coordination of electrical power systems.

1.5.2 System Installer

Calibration, testing, adjustment, and placing into service of the protective devices shall be supervised by a manufacturer's product field service engineer with a minimum of two years of current product experience in protective devices.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Perform studies using one of the following electrical engineering software packages:

a. SKM Power Tools for Windows.

b. ETAP.

c. EDSA.

d. Easy Power.

2.2 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, a protective device coordination study, a harmonic study and an ArcFlash study. The studies shall be performed by a registered professional electrical engineer with demonstrated experience in

power system coordination in the last 3 years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.2.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for each building/facility 600 volt level buses.

2.2.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. For fault current availability at the site. The Contractor shall obtain and utilize the fault current availability from the Owner based on the future plant expansion.

2.2.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Location of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.2.4 Fault Current Analysis

2.2.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.2.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedance shall be those proposed. Data shall be documented in the report.

2.2.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution or utilization bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.2.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. A written narrative shall be provided

describing: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.2.6 Harmonic Analysis Study

2.2.6.1 Study Scope

A Harmonic Analysis Study shall be made to determine the levels of harmonic voltages and currents in the system. The point of common coupling (PCC) per IEEE 519 1992 shall be the 480 volt terminals of the power transformer feeding the site. Fault current values shall be obtained from the Owner. The type and level of compensation needed to achieve the desired power factor and acceptable levels of harmonics shall be considered. The study shall make appropriate recommendations in order to provide proper protection and operation of the electrical system.

2.2.6.2 Study Model

The study shall be based on the computer software system model used for the short circuit study in order to characterize system with data from equipment actually furnished. Harmonic source models shall be developed for each nonlinear load (drive, etc.) type. The load characteristics shall be based on equipment installed.

2.2.6.3 Frequency Scan

Frequency scan cases (impedance vs. frequency) shall be completed in order to determine the system frequency response characteristic for various system conditions. Application of indicated active harmonic filters shall be evaluated to determine the optimum filter size and configurations.

2.2.6.4 Simulations

Computer simulations shall be performed to determine the system harmonic voltage and current levels and voltage distortion levels.

2.2.6.5 Report Summaries

Study report shall include summaries of voltage and current distortions for each bus in the study. Complete parameter settings for active harmonic filters shall be included in tabular or spreadsheet form for use in fields startup and operation.

2.2.7 Arc Flash Study

Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.

2.2.7.1 Base Calculation

Base Calculation - For each part (lowest level shall be 120V Panelboard locations) of the electrical power system, determine the following:

a. Flash hazard protection boundary.

b. Limited approach boundary.

c. Restricted approach boundary.

d. Prohibited approach boundary.

e. Incident energy level.

f. Personal protection equipment (PPE) hazard/risk category.

g. Type of PPE required.

2.2.7.2 Warning Labels

Produce arc flash warning labels that list the items in Base Calculation and the following additional items:

a. Bus name.

b. Bus voltage.

2.2.7.3 Bus Detail

Produce bus detail sheets that list the items in Base Calculation and the following additional items:

a. Bus name.

b. Upstream protective device name, type, and settings.

c. Bus line to line voltage.

2.2.7.4 Evaluation Summary

Produce arc flash evaluation summary sheet listing the following additional items:

a. Bus name.

b. Upstream protective device name, type, settings.

c. Bus line to line voltage.

d. Bus bolted fault.

e. Protective device bolted fault current.

f. Arcing fault current.

g. Protective device trip/delay time.

h. Breaker opening time.

i. Solidly grounded column.

j. Equipment type.

k. Gap.

l. Arc flash boundary.

m. Working distance.

n. Incident energy.

n. Required protective fire rated clothing type and class.

2.2.7.5 Reduced Energy Levels

Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm2. Propose approaches to reduce the energy levels.

2.2.7.6 ArcFlash Study Summary

Prepare a section of the study report summarizing the arc flash study with conclusions and recommendations which may affect the integrity of electric power distribution system. As a minimum, include the following in the summary:

a. Equipment manufacturer's information used to prepare study.

b. Assumptions made during study.

c. Reduced copy of the one line drawing. Pages shall be no larger than 11-inches by 17-inches.

d. Arc flash evaluations summary spreadsheet.

e. Bus detail sheets.

2.2.7.7 Install Labels

Provide and install Arc flash warning labels printed in color on adhesive backed labels.

2.2.8 Study report

a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and

settings. Report shall include upstream device coordination as required by serving utility. Show upstream devices, with settings on phase and ground curves.

d. The report shall contain fully coordinated composite time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 ARC FLASH LABELS

3.1.1 ArcFlash Labels

Contractor shall apply ArcFlash labels produced by ArcFlash Study Software to all equipment as listed in study. Labels shall be visible and shall not cover any existing manufacturers applied labels or signs. One spare set of labels shall be supplied to Owner.

-- End of Section --