SECTION 26 05 73 – SHORT CIRCUIT AND OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

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 nameplates 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. Contractor shall retain a 3rd party independent consultant to perform the study indicated in this section.

C. This coordination study shall include the existing distribution equipment that feeds the new equipment and is in addition to the short circuit study performed by the Electrical Engineer of Record during the course of preparing his design.

D. 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.

E. 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.

F. The short circuit portion of the study shall be submitted prior to or along with the switchgear submittal, and shall include all equipment which has an AIC rating. The short circuit study shall reflect that all equipment with an AIC rating is properly rated for its specific application. The submitted switchgear (including all equipment which has and 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). Series ratings are not acceptable.

1.2 DESIGN REQUIREMENTS

A. Report Preparation:

1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.

2. Perform study with aid of computer software program.
3. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:
    a. Utility supply bus.
    b. Medium voltage air interrupter switchgear.
    c. Automatic transfer switch.
    d. Manual transfer switch.
    e. Engine generator.
    f. Medium voltage motor controllers.
    g. Low-voltage switchgear.
    h. Switchboards.
    i. Motor control centers.
    j. Distribution panelboards.
    k. Branch circuit panelboards.
4. Each other significant equipment location throughout system.

B. Report Contents (similar to SKM Power Tools):
1. Include the following:
    a. Calculation methods and assumptions.
    b. Base per unit value selected.
    c. One-line diagram, with short circuit values, arc flash values, feeder values and lengths.
    d. Source impedance data including power company system available power and characteristics.
    e. Typical calculations.
        1) Fault impedance.
        2) X to R ratios.
        3) Asymmetry factors.
        4) Motor fault contribution.
        5) Short circuit kVA.
        6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
        7) Tabulations of calculation quantities and results.
    f. One-line diagram revised by adding actual instantaneous short circuits available.
    g. State conclusions and recommendations.

1) Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.

2) Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.

3) Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

4) Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:

h. Power company relay characteristics.

i. Power company fuse characteristics.

j. Medium voltage equipment protective relay characteristics.

k. Medium voltage equipment protective fuse characteristics.

l. Low voltage equipment circuit breaker trip device characteristics.

m. Low voltage equipment fuse characteristics.

n. Cable damage point characteristics.

o. Pertinent transformer characteristics including:
   1) Transformer full load current.
   2) Transformer magnetizing inrush.
   3) ANSI transformer withstand parameters.
   4) Significant symmetrical fault current.

p. Pertinent motor characteristics.

q. Generator characteristics including:
   1) Phase and ground coordination of generator protective devices.
   2) Decrement curve and damage curve.
   3) Operating characteristic of protective devices.
   4) Actual impedance value.
   5) Time constants.
   6) Current boost data.
   7) Do not use typical values for generator.

r. Transfer switch characteristics.

s. Other system load protective device characteristics.

1.3 SUBMITTALS

A. Qualifications Data: Submit the following for review prior to starting study.

1. Submit qualifications and background of firm.
2. Submit qualifications of Professional Engineer performing study.

B. Software: Submit for review information on software proposed to be used in performing study.

C. Product Data: Submit the following:

1. Report: Summarize results of study in report format including the following:
   a. Descriptions, purpose, basis, and scope of study.
   b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
   c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
   d. Fault current calculations including definition of terms and guide for interpretation of computer printout.

D. Submit copies of final report signed by Professional Engineer. Make additions or changes required by review comments.

E. 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. Entire system shall be modeled under both normal and emergency power. If any closed transition transfer switches are used, normal and emergency power shall be combined.
3. The short circuit study shall incorporate the actual feeder types, sizes and lengths proposed to be used by the Professional Engineer.
4. The calculations may be prepared by means of a digital computer. All pertinent data and the rationale employed in developing the calculations shall be incorporated in the introductory remarks of the study.
5. Present the data determined by 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, indicating worst-case fault current incorporating all system models as outlined above.

F. Coordination Curves:

1. Prepare the coordination curves to determine the required settings of protective devices to assure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists (where possible) 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 will be clearly depicted on one sheet. Where a switchboard or panelboard has multiple devices of different sizes, it is not necessary to plot curves for each device when coordination for one device is demonstrated graphically and it is intuitively obvious that the other devices coordinate as well.
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 inrush points.
    g. Maximum short circuit cutoff point.
    h. Short-time withstand capability of main 480V circuit breakers.
    i. Coordination between the directional overcurrent relays and the main 480V breaker.
3. Develop a table to summarize the settings selected for the protective devices. Include in the table the following:
    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.

1.4 QUALIFICATIONS

A. Study Preparer: Company specializing in performing work of this section with minimum five years documented experience and having completed projects of similar size and complexity within the past three years.

B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed at in State of California with minimum of five years experience in power system analysis.

1.5 SEQUENCING

A. The short circuit portion of the study shall be submitted prior to or along with the switchgear submittal, and shall include all equipment which has an AIC rating. The short circuit study shall reflect that all equipment with an AIC rating is properly rated for its specific application. The submitted switchgear (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.). No series rated devices will be allowed.

B. When formal completion of study will cause delay in equipment manufacturing, obtain approval from LAWA for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

C. All short circuit calculated values shall be tabulated and added to the Bid drawing's feeder schedule

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Provide assistance to electrical distribution system equipment manufacturer during startup of electrical system and equipment.

B. Delta-wye connected transformers: to provide secondary Line-To-Ground fault protection select a primary protective device operating band within transformer’s characteristic curve, including a point equal to 58 percent of ANSI withstand point.

C. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.

D. Separate medium-voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

E. 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 curve characteristics of induction relays, CT ranges, etc.).

F. After developing the coordination curves, highlight areas lacking coordination. Present a technical valuation with a discussion of the logical compromises for best coordination.

3.2 ADJUSTING

A. Protective devices shall be set based on the results of the protective device coordination study.

B. 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.

C. Settings and adjustments of the relays shall be performed by and 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.

D. Accomplish necessary field settings, adjustments, and minor modifications to conform with the study without cost to LAWA.

END OF SECTION 26 05 73