SECTION 16025 –SHORT CIRCUIT AND PROTECTIVE DEVICE COORDINATION STUDY

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK:

A. Provide a short circuit and protective device coordination study for the electrical distribution systems. Verify specified and supplied equipment are properly rated, correctly applied, within industry and manufacturer's tolerances.

B. The short circuit study shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the distribution system down to the smallest protective device. The short circuit study shall consider operation during normal conditions, emergency power conditions, and any other operations which could result in maximum fault conditions.

C. The Coordination study will determine correct settings for protective devices which minimize damage caused by an electrical fault and allow for selective coordination between devices. The coordination study shall include closest upstream utility protective device down to panelboard main, branch, or feeder circuit breakers. Coordination study shall consider operation during normal conditions, and during emergency power conditions including emergency generator response.

D. Study is subject to review by engineer of record and may require revision/modification as directed by engineer without any additional cost.

1.2 QUALIFICATIONS:

A. Contractor shall have coordination study prepared by qualified engineers of an independent consultant. The consultant shall be a Registered Professional Electrical Engineer (licensed in the state where the project is completed) who has at least ten (10) years of experience and specializes in performing power system studies.

1.3 SUBMITTALS:

A. The contractor shall submit the power system studies within 30 days after the electrical equipment submittals have been received for review by the Engineer. The electrical submittals will be reviewed but will not be approved until the power system studies have been received and reviewed.

B. Submit three (3) copies of the power systems study.

PART 2 – EXECUTION

2.1 IMPEDANCE ONE-LINE DIAGRAM:

A. Create an impedance one-line diagram. All electrical equipment wiring to be protected by the overcurrent devices installed under this project and each location where the fault current will be calculated shall be shown. Clearly show, on the one-line, the schematic wiring of the electrical distribution system.

B. Show reference nodes on the one-line diagram referring to a formal report, to include the following specific information:

1. X/R ratios, utility contribution, and short circuit values (asymmetrical and symmetrical) at the bus of the main service, and all downstream equipment containing overcurrent devices.

2. Transformers kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.

3. Voltage at each bus.

4. Identifications of each bus.

5. Conduit material, feeder sizes and length.

2.2 SHORT CIRCUIT STUDY:

A. Pertinent data, rationale employed, and assumptions in developing the calculations shall be incorporated in the introductory remarks of the study.

B. The study shall be in accordance with applicable ANSI and IEEE Standards.

C. Determine the available 3 phase short circuit and ground fault currents at each bus. Incorporate the motor contribution in determining the momentary and interrupting ratings of the protective devices.

D. Present the data determined by the short circuit study in a table format. Include:

1. Node & Device identification.

2. Operating voltage.

3. Type of Protective device. (i.e. fuse, molded case circuit breaker, etc.)

4. Device short circuit rating.

5. Calculated maximum short circuit current, 3 phase and ground fault, asymmetrical and symmetrical, and X/R ratio.

6. De-rate the devices where the tested X/R ratio is less than the calculated X/R ratio.

7. Comments section indicating that device is underrated.

8. Preparer of study shall obtain all input data from utility, contractor or other manufacturers.

2.3 PROTECTIVE DEVICE COORDINATION STUDY:

A. Obtain available fault current from utility company or other manufacturers as required.

B. The study shall adhere to all requirements of the current National Electrical Code.

C. The coordination study shall include the closest upstream utility protective device down to the panelboard main, branch, or feeder circuit breakers. Prepare the coordination curves to determine the required settings of protective devices to assure selective coordination.

D. The phase and ground overcurrent protection shall be included, as well as settings for all other adjustable protective devices.

E. Graphically illustrate on log-log paper that adequate time separation exists between devices. Sufficient curves shall be used to clearly indicate the coordination achieved between devices. Reasonable coordination intervals and separation of characteristic curves shall be maintained. Plot the specific time-current characteristics of each protective device in such a manner that the upstream devices will be clearly depicted on the sheet.

F. The plots shall include complete titles, representative one-line diagram and legends, associated power company's relays or fuse characteristics, and complete parameters of transformers. There shall be a maximum of eight protective devices per sheet.

G. The following specific information shall also be shown on the coordination curves:

1. Device identifications.

a. Time and current ratio for curves.

b. Fuse, circuit breaker, and relay curves, showing complete operating bands of low-voltage circuit breaker trip curves. Cable damage curves.

c. ANSI transformer magnetizing in rush and withstand curves per ANSI C37.91 and transformer damage curves.

d. Motor starting curves.

e. Generator damage and decrement curves.

f. Significant maximum symmetrical or asymmetrical short circuit cutoff point.

g. Electric utility's relays and/or fuses including manufacturer's minimum melt, total clearing, tolerance and damage bands.

h. Medium voltage equipment relays.

i. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance and damage bands.

j. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.

k. Pertinent transformer full-load currents at 100 and 600 percent.

l. Ground fault protective device settings.

m. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center and panelboard.

H. Develop a table to summarize the settings selected for the protective devices. Include in the table the following:

1. Device identification.

2. Current transformer ratio, relay tap, time delay 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.

2.4 ARC FAULT STUDY:

A. From the approved short circuit study, calculate the arc fault hazard at each panel and disconnect.

B. The study shall adhere to all aspects of the National Electrical Code.

C. From the arc fault hazard analysis, provide labels at each panel and disconnect indicating the arc fault hazard and personal protective equipment required to maintain the equipment.

PART 3 – ANALYSIS

A. Analyze the short circuit calculations and highlight any equipment determined to be underrated or not coordinated. Propose approaches to effectively protect the underrated equipment or alter equipment.

B. Contractor and his supplies are responsible to provide a fully coordinated system including cost of equipment system modifications.

PART 4 – REPORT

A. The results of the power system study shall be summarized in a final report. The report shall include the following sections:

1. Introduction, executive summary and recommendations, assumptions, impedance one-line drawing, and copies of the project one-line drawings.

2. Tabulations of equipment ratings versus calculated short circuit values and X/R ratios, and commentary regarding same.

3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

4. Copies of the manufacturer’s time current curves for the devices studied and plotted on the time current curves.

PART 5 – ENGINEERS RESPONSE

A. Engineer of record will review report for compliance and approve, approve with comments or disapproved.

B. Should engineer disapprove study shall be reworked as required and resubmitted for review.

C. After approval, modifications to equipment shall be made at no cost to owner.

END OF SECTION 16025