Specification Number: 26 05 73.10
Product Name: ELECTRICAL POWER SYSTEM STUDIES

SECTION 26 05 73.10
ELECTRICAL POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SUMMARY

A. The electrical equipment manufacturer shall provide electrical power system studies for the project job. The type and content of each study is specified in the following articles.

1.02 SUBMITTALS

A. Completed electrical power system studies shall be bound and submitted to the engineer (architect).

PART 2 PRODUCT

2.01 MANUFACTURERS

A. The specified electrical power system studies shall be performed by Square D Company or approved equal.

2.02 ELECTRICAL POWER SYSTEM STUDIES

A. Short-Circuit Analysis

1. Calculation of the maximum rms symmetrical three-phase short-circuit current at each significant location in the electrical system shall be made using a digital computer.
2. Appropriate motor short-circuit contribution shall be included at the appropriate locations in the system so that the computer calculated values represent the highest short-circuit current the equipment will be subjected to under fault conditions.
3. A tabular computer printout shall be included which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment.
4. The study shall include a computer printout of input circuit data including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
5. Include a computer printout identifying the maximum available short-circuit current in rms symmetrical amperes and the X/R ratio of the fault current for each bus/branch calculation.
6. The system one-line diagram shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.
7. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.
8. The contractor shall be responsible for supplying pertinent electrical system conductor, circuit breaker, generator, and other component and system information in a timely manner to allow the short-circuit analysis to be completed prior to final installation.
9. Any inadequacies shall be called to the attention of the engineer (architect) and recommendations made for improvements as soon as they are identified.

B. Protective Device Time-Current Coordination Analysis

1. The time-current coordination analysis shall be performed with the aid of computer software intended for this purpose, and will include the determination of settings, ratings, or types for the overcurrent protective devices supplied.
2. Where necessary, an appropriate compromise shall be made between system protection and service continuity with [service continuity considered more important than system protection] [system protection considered more important than service continuity] [system protection and service continuity considered to be of equal importance].
3. A sufficient number of computer generated log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
4. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the

device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
5. The study shall include a separate, tabular computer printout containing the suggested device settings of all adjustable overcurrent protective devices, the equipment where the device is located, and the device number corresponding to the device on the system one-line diagram.
6. A computer generated system one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
7. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
8. Significant deficiencies in protection and/or coordination shall be called to the attention of the engineer (architect) and recommendations made for improvements as soon as they are identified.
9. The contractor shall be responsible for supplying pertinent electrical system conductor, circuit breaker, generator, and other component and system information in a timely manner to allow the time-current analysis to be completed prior to final installation.

C. Arc-Flash Hazard Analysis
1. The Arc-Flash Hazard Analysis shall be performed with the aid of computer software intended for this purpose in order to calculate Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances.
2. The Arc-Flash Hazard Analysis shall be performed in conjunction with a short-circuit analysis and a time-current coordination analysis.
3. Results of the Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
4. The analysis shall be performed under worst-case Arc-Flash conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
5. The Arc-Flash Hazard Analysis shall be performed by a registered professional engineer.
6. The Arc-Flash Hazard Analysis shall be performed in compliance with IEEE Standard 1584-2002, the IEEE *Guide for Performing Arc-Flash Calculations*.
7. The Arc-Flash Hazard Analysis shall include recommendations for reducing AFIE levels and enhancing worker safety.
8. The proposed vendor shall demonstrate experience with Arc-Flash Hazard Analysis by submitting names of at least ten actual Arc-Flash Hazard Analyses it has performed in the past year.
9. The proposed vendor shall demonstrate capabilities in providing equipment, services, and training to reduce Arc-Flash exposure and train workers in accordance with NFPA 70E and other applicable standards.
10. The proposed vendor shall demonstrate experience in providing equipment labels in compliance with NEC-2002 section 110 and ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes.

D. Load Flow and Voltage Drop Analysis
1. The Load Flow and Voltage Drop Analysis shall be made using a digital computer and include calculations of power flow in all three-phase branch and feeder circuits, calculated voltages at each bus and voltage drops of each feeder.
2. The analysis shall provide the calculated maximum values of kVA, kW, kVAr, power factor, and amperes for each power circuit.
3. The calculated power losses in each branch and total system losses shall be provided.
4. A computer printout listing all cables, transformers, loads, and other circuit data shall be included.
5. Provide tabular bus-to-bus computer printouts listing the calculated values.
6. The analysis shall include a computer generated system one-line diagram clearly identifying individual equipment buses, bus numbers, cable and bus connections, power flow

throughout the system, and other information related to the analysis.
7. A discussion section evaluating the loading and voltage levels for the system shall be provided and recommendations included as appropriate to improve system operation.
8. Significant deficiencies in loading or voltage levels shall be called to attention of the engineer (architect) and recommendations made for improvements at soon as they are identified.

E. Power Factor Correction Study
1. A Power Factor Correction Study shall be performed to determine the appropriate level of compensation needed to achieve the desired power factor.
2. Impacts on harmonic and transient concerns shall be evaluated in order to determine the optimum size and configuration of the equipment.
3. The study shall make appropriate recommendations in order to provide proper operation of the electrical system.
4. The study shall be based on [load data collected from on-site measurements] [load data collected from historical information provided by the power monitoring system] [from previous utility bills] in order to characterize the power factor of the system over a period of time and under varying load conditions.
5. System loading tables shall be provided which include power factor data and estimated levels of power factor compensation provided.
6. Evaluation of system operation using the estimated levels of compensation will be provided with consideration to harmonic and transient concerns.
7. Final levels of compensation will be determined and used as the base case condition for the harmonic and transient studies.
8. All conclusions, recommendations, and equipment specifications as a result of the Power Factor Correction Study will be summarized in the final report.

F. Harmonic Analysis Study
1. A Harmonic Analysis Study shall be made to determine the levels of harmonic voltages and currents in the system.
2. The type and level of compensation needed to achieve the desired power factor and acceptable levels of harmonics shall be considered.
3. Transient concerns shall be evaluated in order to determine the optimum equipment size, location in the system, and configuration.
4. The study shall make appropriate recommendations in order to provide proper protection and operation of the electrical system.
5. The study will shall be based on [load data collected from on-site measurements] [load data collected from historical information provided by the power monitoring system] [from previous utility bills] in order to characterize the power factor of the system over a period of time and under varying load conditions.
6. Harmonic measurements will be performed in order to provide nonlinear load (e.g. DC drive) characteristics, voltage distortion levels, and model verification. The measurements will be conducted over a 1-5 day period.
7. Harmonic source models will be developed for each nonlinear load (drive, etc.) type. The load characteristics [will be determined by measurement and used as harmonic sources for the computer simulations.] [shall be approximated based on the loads indicated on the project drawings.]
8. Frequency scan cases (impedance vs. frequency) will be completed in order to determine the system frequency response characteristic for various system conditions.
9. If required, the application of harmonic filters will be evaluated to determine the optimum filter size and configurations.
10. Computer simulations shall be performed to determine the system harmonic voltage and current levels and voltage distortion levels (and compared with measured values to determine the effect of various system conditions).
11. If required, harmonic filter specifications shall be developed with consideration to cost, filtering options, and effectiveness of harmonic filters.

G. Switching Transient Analysis Study

1. A Switching Transient Analysis Study shall be made to determine the transient overvoltages for various switching conditions and their effect on the operation of the electrical system.
2. Various system conditions (consistent with previously gathered data from the Power Factor Correction Study and Harmonic Analysis Study) shall be evaluated so that the proper overvoltage protection specifications may be developed.
3. Transient simulations shall be performed using a digital computer in order to determine transient voltage levels at the low voltage buses within the electrical system.
4. The electrical system parameters shall be varied to in order to determine their effect on the transient voltages.
5. Various solutions to excessive transient voltage levels shall be considered and additional computer simulations made to determine their validity.
6. The evaluation must consider solutions to power factor and harmonic concerns with respect to transient overvoltage levels.
7. Nuisance tripping of electronic power equipment (e.g., adjustable speed drives) shall be evaluated and corrective or preventive techniques suggested.

END OF SECTION