Directive: 26-2 Electrical Power System Study

State University Construction Fund Responsible Office: Design & Construction

Last Revised Date: June 2022

SUMMARY

This Directive provides the consultants with the requirements of the State University Construction Fund (SUCF) for SUNY projects. The requirements detailed within are to be implemented into the project's specifications and/or drawings. The intent is not for the specifications or drawings to reference back to this document for compliance nor is it intended to override or amend the applicable laws or codes where either is more stringent.

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Section 1–REQUIREMENTS

A. GENERAL

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- 1. The purpose of this directive is to ensure that electrical equipment is rated for the available short circuit current, electrical distribution systems are selectively coordinated, and arc flash warning labels are provided on electrical equipment.
- 2. During Concept Phase, the specific scope of the Electrical Power System Study (EPSS) shall be determined with SUCF input, and if required, a proposal for additional services shall be submitted to SUCF.
- 3. A separate EPSS shall be completed during the Design and the Construction Phases of the project.
- 4. The EPSS shall be completed by a Registered Professional Engineer having a minimum of five (5) years of experience performing Power System studies.
- The EPSS shall be developed utilizing computer software that is industry recognized and consistent with latest engineering standards, such as software by SKM System Analysis, Inc. or ETAP.

B. EPSS REPORT

- 1. Content
 - a. Executive Summary
 - b. Short Circuit Study
 - c. Protective Device Coordination Study
 - d. Arc Flash Study
 - e. Distribution System One-Line Diagram
- 2. Format
 - a. Electronic Format (PDF)

C. DESIGN PHASE RESPONSIBILITIES

- 1. Design Manual
 - a. Provide a Distribution System One Line Diagram that defines the portion of the electrical power system to be included in the studies.
- 2. Pre-bid
 - a. Provide the preliminary copy of the EPSS report for review by SUCF and the Campus.
- 3. Bid
 - a. Provide a final copy of the EPSS report with all comments addressed from SUCF and/or the Campus.
- 4. Develop Technical Specifications for the Construction Phase EPSS which includes the following requirements:
 - a. The overall content required in the EPSS report and the content of the individual sections as detailed per this Directive.
 - b. The Contractor must provide the EPSS Report as a submittal concurrent with the related equipment's submittals.



- c. The Contractor will resubmit the EPSS report upon requested changes of either related equipment submittals or the EPSS report.
- d. The Contractor will submit the electronic files from SKM or ETAP used to create the EPSS.
- e. The Contractor shall utilize and implement the recommended protective device adjustment and settings in the Protective Device Coordination Study from the Construction Phase EPSS report.
- f. The Contractor shall provide printed combination arc flash and shock hazard warning equipment labels in compliance with any Campus standards, NFPA 70, NFPA 70E, and ANSI Z535.4 and apply such labels to power distribution equipment as directed by the SUCF Consultant.

D. CONSTRUCTION PHASE RESPONSIBILITIES

- 1. After award of the contract provide a copy of the Design Phase EPSS report to the Contractor to utilize in completion of the Construction Phase EPPS.
- 2. The Consultant shall review and provide comments on the EPSS report issued by the Contractor concurrent with the related equipment's submittals.
- 3. Provide electronic copy of the EPSS report to SUCF and the Campus for review.

Section 2 – EPSS REPORT CONTENT REQUIREMENTS

A. DISTRIBUTION SYSTEM ONE LINE DIAGRAM

- 1. The SUCF Design Consultant shall develop a software generated Distribution System One-Line Diagram to be used as the basis for the studies during Design and Construction Phases. Include the following information:
 - a. The utility company's overcurrent protective device(s) that provides the electrical service to the campus.
 - b. Campus-owned medium Voltage main and feeder breakers(s) that supply power to the building substation transformer.
 - c. Building substation transformer primary overcurrent protection
 - d. Building substation and low voltage transformer. Include information on:
 - 1) Base and any higher kVA ratings
 - 2) Transformer winding configuration
 - 3) Transformer primary and secondary rated voltages
 - 4) Transformer design or nameplate %Z
 - e. Building substation transformer secondary main and secondary main distribution equipment. Include information on breaker amp frame and amp trip ratings.
 - f. All medium and low voltage cables. Include
 - 1) Conductor quantities per phase
 - 2) Conductor material and sizes
 - 3) Cable lengths
 - 4) Conduit construction
 - g. Generators Include
 - 1) kVA and Power Factor

- 2) Voltage rating
- 3) %X_d (% subtransient reactance)
- h. Automatic transfer switches, including amp ratings
- i. Motors 50 HP or greater
- j. Panelboards and switchboards
 - 1) Voltage ratings
 - 2) Available Interrupting Capacity (AIC)
 - 3) Amp Ratings
 - 4) Main overcurrent protection, if any
- k. Identify the available short circuit at each equipment bus (switch, transformer, switchgear, switchboard, panelboard, generator, etc.)
- I. Alternate operating modes that could affect short circuit levels, protective device coordination, or arc flash energy levels, such as:
 - 1) Operation under generator power
 - 2) Operation under an alternate primary source of power
 - 3) Key or electric interlocks

B. SHORT CIRCUIT STUDY

- 1. Include 3-phase and as applicable phase-to-ground fault current calculations for all possible modes of operation anticipated to produce the highest levels of short circuit currents.
- 2. Incorporate appropriate short circuit contributions from all sources, to produce the maximum expected short circuit levels equipment may be subjected to during a fault.
- 3. Provide a written explanation of all assumptions made to perform the short circuit calculations and a summary of short circuit results.
- 4. Tabulate calculated short circuit duties against all new and existing equipment ratings and identify any equipment whose short circuit ratings are exceeded.
- 5. Provide computer printouts of system data used for short circuit calculations and calculated short circuit currents.

C. PROTECTIVE DEVICE COORDINATION STUDY

- 1. Provide a Protective Device Coordination Study for purposes of the development of recommended settings for new and possibly existing protective devices for the power distribution system as referenced on the One Line Diagram.
- 2. Include evaluations and recommended settings for both overcurrent and other protection devices, such as reverse power and undervoltage relays that although not strictly related to overcurrent's must be properly set for added system coordination and protection.
- 3. Include appropriate compromises between system protection and service continuity with system protection and service continuity considered to be of equal performance.
- 4. Provide a sufficient number of computer-generated time versus current log-log plots to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices. Time-current plots shall be extended to the maximum fault current to which each overcurrent protective device plotted is expected to operate.
- 5. The log-log plots shall include the following benchmarks:



- a. Transformer damage curves
- b. Transformer full load amps
- c. Cable damage curves
- d. Transformer inrush
- e. Motor starting curves
- f. Maximum short circuit for which each overcurrent protective device must respond
- g. Generator fault current decay curve
- 6. Represent currents at an appropriate system voltage, preferably the voltage at which a majority of the protective devices plotted operate.
- 7. Provide a partial One Line Diagram depicting the location of all protective devices plotted with devices labeled on the one line.
- 8. Provide device identification by the manufacturer, model, range of settings, and recommended settings for each device plotted.
- 9. Provide a table summary of all adjustable protective devices and their recommended, or existing settings. Clarify what settings are new versus existing.
- 10. Include a discussion describing the intended approach to protective device coordination.
 - a. Any special considerations in developing the recommended settings
 - b. Assumptions made in performing the study
 - c. An evaluation of the degree of system protection and service continuity
 - d. Identify compliance with the National Electrical Code selective coordination requirements for emergency power systems, legally required standby power systems, fire pumps, and elevators.
 - e. Recommendations for addressing system protection or device coordination deficiencies

D. ARC FLASH STUDY

- The Arc Flash Study shall be performed in compliance with the latest edition of the IEEE Standard 1584, the IEEE *Guide for Performing Arc Flash Calculations* and shall calculate Arc Flash Incident Energy (AFIE) levels and flash protection boundary distances and aid in the preparation of Arc Flash Warning label in conformance with NFPA 70 and NFPA 70E requirements.
- 2. The Arc Flash Study shall be performed in conjunction with the Short Circuit Study and Protective Device Coordination Study.
- 3. Results of the Study shall be submitted in tabular form, and shall include equipment evaluated, location, bolted fault, and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
- 4. The Study shall be performed under worst-case Arc Flash conditions, and the Report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
- 5. The Arc Flash study shall include recommendations for reducing AFIE levels and enhancing worker safety.