

SECTION 26 01 26 – MAINTENANCE TESTING OF ELECTRICAL SYSTEMS**PART 1: GENERAL****1.01 Scope of Standard**

- A. This standard provides general guidance concerning the specific preferences of Texas State University for Maintenance Testing of Electrical Systems.
- B. Texas State University recognizes that project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification, it is expected that these guidelines will govern the design and specifications for Texas State University projects.
- C. After equipment installation and before testing, contractor shall inspect and label all systems, cables and equipment and verify it to follow the exact layout and terminal locations as prescribed in the project drawings.

1.02 DESCRIPTION

General: This section specifies that the CONTRACTOR prepare a short circuit and coordination study for the electrical power system including all existing and newly installed electrical equipment.

The analysis and study shall include all power distribution systems, beginning at the main 12 kV feeder breaker at the Owner's Power Plant to the secondary buses of each panel board as described hereafter. The short circuit and coordination study reports shall provide an evaluation of the electrical power systems and the model numbers and settings of the protective devices for setting by the CONTRACTOR.

- B. Scope:
 - 1. Provide a complete short circuit study, equipment interrupting or withstand evaluation, and a protective device coordination study for the power distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly addressed in the study. The study shall assume all motors operating at rated voltage. Electrical equipment bus impedance shall be assumed zero. Short circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at the switchboard busses and motor control centers.
 - 2. A protective device coordination study shall be performed to determine appropriate relay settings. The study shall include all distribution switchboards, motor control centers, and panel board main circuit

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breakers. Panel board branch circuit devices need not be considered. The phase over current and ground-fault protection shall be included as well as settings for all other adjustable protective devices.

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3. An equipment evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents.
4. Any problem areas or inadequacies in the equipment shall be promptly brought to the ENGINEER'S attention.

1.03 REFERENCES

- A. This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
IEEE 141-86	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 242-86	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

1.04 SCHEDULE

- A. The approved reports shall be completed and a copy sent to the electrical distribution equipment manufacturer 45 days before the equipment is shipped to the Work site. The report shall be provided to the ENGINEER 90 days before the equipment is shipped to the Work site.

PART 2: PRODUCTS**2.01 REPORTS**

- A. The product shall be a certified report summarizing the short circuit, coordination study, arc flash hazard analysis and conclusions or recommendations which may affect the integrity of the electric power distribution system. As a minimum, the report shall include the following:
1. The equipment manufacturer's information used to prepare the study.
 2. Assumptions made during the study.

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3. Short circuit calculations listing short circuit levels at each bus.
4. Coordination study time-current curves including the instrument transformer ratios, model numbers of the protective relays, and the relay settings associated with each breaker.
5. Comparison of short circuit duties of each bus to the interrupting capacity of the equipment protecting that bus.
6. All data which was used as input to the report. This data shall include cable impedances, source impedances, equipment ratings, etc.

PART 3: EXECUTION**3.01 GENERAL**

- A. Provide a short circuit, coordination study, and arc flash hazard analysis on the electrical power distribution system, as specified. The study shall be performed in accordance with IEEE Standards 141 and 242 and shall utilize the ANSI method of short circuit analysis in accordance with ANSI C37.010. The study shall be performed using actual equipment data for all equipment. The coordination study shall use the data from the manufacturer of protective devices.

3.02 QUALIFICATIONS

- A. The short circuit and coordination report shall be performed by the manufacturer of the supplied equipment. The studies shall be signed by a Professional Engineer with proficiency in electrical engineering. The Professional Engineer shall be licensed to practice engineering in the State of Texas.

3.03 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

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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 over current protective devices supplied.
2. Where necessary, an appropriate compromise shall be made between system protection and service continuity with 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

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the time-current characteristics of series connected over current 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 over current 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 over current 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 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,

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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 3 years.
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-2005 section 110 and ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes.

END OF SECTION 26 01 26