SECTION 16950

ELECTRICAL ACCEPTANCE TESTING

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SPECIFIER: Use this Section for large electrical projects that include complex equipment such as unit substations, switchboards or large motor control centers. FSS-9 will perform acceptance testing for smaller, less complex projects. Coordinate with FSS-9.

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PART 1 GENERAL

1.1 SECTION INCLUDES

A. Test, inspect and calibrate electrical equipment and material installed and connected under Division 16. The purposes of these inspections, tests and calibrations are to assure that the installed electrical systems and equipment, both contractor and owner-supplied, are:

1. Installed in accordance with design specifications and manufacturer's instructions,

2. Ready to be energized,

3. Operational and within industry and manufacturer's tolerances.

B. Provide all material, equipment, labor, and technical supervision to perform specified tests, inspections, studies and calibration.

C. Provide the services of an independent electrical testing firm (ETF) to perform the acceptance testing, inspection and calibration of electrical systems as specified in this Section.

D. Perform short circuit and coordination studies based on the installed electrical system and equipment.

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Edit paragraph E. to suit project requirements. Add other major electrical system components as needed. List the specific electrical equipment designations for <u>this</u> project.

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E. The following is a list of equipment and systems to be inspected, tested and calibrated by the ETF; refer to Part 3 of this Section for detailed requirements:

1. Secondary Unit Substations SUS-A and SUS-B

2. Ground Fault Protection Systems in SUS-A and SUS-B

3. Low Voltage Power Panelboards PP-A, PP-B, PP-1 and PP-2

4. Dry-Type Transformers TR-1 and TR-2

5. Low Voltage Motor Control Center MCC-A

6. Low Voltage Lighting Panelboards LP-A and LP-1

7. Circuit breakers 150 amps and larger

8. Metering to include kWH/Demand, kW, volt, ampere, power factor, and frequency meters.

9. Medium Voltage Power Circuits and Connections

10. Low Voltage Power Circuits and Connections

11. Grounding System and Connections

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Edit paragraph F. to suit project requirements.
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F. The following systems will be inspected and tested by either the installing firm or the University and are excluded from the scope of this Section:

1. Fire Alarm System

2. Telephone/Data System

3. Lightning Protection System

4. Security System

5. Voice Paging System

1.2 REGULATORY REQUIREMENTS

A. Make inspections and tests in accordance with the applicable codes and standards of the following agencies except as provided otherwise herein:

1. InterNational Electrical Testing Association - NETA ATS-1991 *Acceptance Testing Specifications*

2. National Fire Protection Association - NFPA

a. ANSI/NFPA 70: *National Electrical Code*

b. ANSI/NFPA 70B: *Recommended Practice for Electrical Equipment Maintenance*

c. NFPA 70E: *Electrical Safety Requirements for Employee Workplaces*

B. Use the following references:

1. Project design specifications.

2. Project design drawings.

3. Project short-circuit and coordination study.

4. Manufacturer's instruction manuals applicable to each particular apparatus.

5. Project list of equipment to be inspected and tested.

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Edit paragraph C. to suit project requirements.
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C. Provide cleared escorts for uncleared ETF employees as required for access into security areas. Obtain appropriate security badge for each ETF employee. Comply with LANL procedures for escorting uncleared workers.

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Edit paragraph D. to suit project requirements.
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D. [Provide escorts with site specific safety or radiological training for ETF employees as required for short term access into specific facilities; comply with DOE RADCON manual and site-specific requirements.] (or) [Schedule site specific training for ETF employees as required by specific facility operating procedures.]

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Edit paragraph E. to suit project requirements.
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E. Schedule General Employee Training (GET) and General Employee Radiological Training (GERT) for ETF employees who will work at LANL for 10 or more consecutive days.

1.3 QUALITY ASSURANCE

A. The ETF shall be a corporately and financially-independent testing organization which shall function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The ETF shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The ETF shall have successfully completed not less than five acceptance testing, inspection and calibration projects of similar scope to this project.

D. The ETF shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, 1910, and 1936 or be a Full Member company of the InterNational Electrical Testing Association.

E. The ETF lead, on-site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

F. The ETF shall only utilize engineers and technicians who are regularly employed by the firm for testing services.

G. Submit certification of the above qualifications; refer to SUBMITTALS Paragraph of this Section.

1.4 DIVISION OF RESPONSIBILITY

A. Perform routine insulation-resistance, continuity, and rotation tests for distribution and utilization equipment prior to and in addition to tests performed by the ETF specified in this Section.

B. Supply a suitable and stable source of electrical power to each test site. Coordinate specific power requirements with the ETF.

C. Schedule project to allow adequate time for electrical acceptance testing. Notify the ETF when equipment becomes available for acceptance tests. Coordinate work to expedite inspection and test scheduling.

D. The Contract Administrator will supply one set of the following for use in conjunction with electrical acceptance testing: preliminary short-circuit analysis, preliminary coordination study, preliminary protective device setting table, complete set of electrical Drawings, Specifications, and any pertinent Change Orders.

E. Notify the Contract Administrator not less than 24 hours prior to commencement of any testing. If requested by the Contract Administrator, tests will be witnessed by designated University personnel.

F. Report to the Contract Administrator any system, material, equipment or workmanship which is found defective on the basis of acceptance tests or inspections by the ETF.

G. Within 15 days of direction from the Contract Administrator, rework, repair or replace any system, material, equipment or workmanship which is found defective on the basis of acceptance tests or inspections.

H. Upon direction from the Contract Administrator, re-test any system, material, equipment or workmanship which did not pass acceptance tests or inspections.

I. Maintain a written record of all tests and, upon completion of project, assemble and submit a certified final test report that includes the test procedures and test results for each system and equipment item.

1.5 SAFETY AND PRECAUTIONS

A. Comply with required safety practices which include, but are not limited to, the following:

1. Occupational Safety and Health Act

2. Accident Prevention Manual for Industrial Operations, National Safety Council

3. Applicable state and local safety operating procedures

4. LANL Health and Safety permits and procedures

5. LANL procedure LP 106-01.2*Lockout/Tagout for Control of Hazardous Energy Sources for Personnel Safety*.

6. National Fire Protection Association - NFPA 70E,*Standard for Electrical Safety Requirements for Employee Workplaces*.

7. American National Standards for Personnel Protection

B. Perform tests with apparatus de-energized. Work on energized equipment only under an Energized Work Permit approved by the LANL electrical Authority Having Jurisdiction.

C. Provide a designated safety representative on the project to supervise testing operations with respect to safety.

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Edit paragraph D. to suit project requirements.

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D. Test equipment must be monitored and released by LANL ESH-1 personnel before removal from a radiological area.

1.6 TEST EQUIPMENT

A. SUITABILITY OF TEST EQUIPMENT

1. Use only test equipment that is in good mechanical and electrical condition.

2. Use true RMS measuring meters.

3. Field test metering used to check power system meter calibration shall have an accuracy higher than that of the instrument being checked.

4. Use test equipment with accuracy of metering that is appropriate for the test being performed.

5. Use test equipment with waveshape and frequency output that are appropriate for the test and tested equipment.

B. TEST INSTRUMENT STANDARDS

1. Use only equipment for testing and calibration procedures that has the following characteristics:

a. Maintained in good visual and mechanical condition.

b. Maintained in safe operating condition.

2. Use test equipment having operating accuracy equal to, or better than, the following limits:

a. Portable multimeters: true RMS measuring.

b. Multimeters shall have the following accuracy limits, or better:

1) AC voltage ranges: .75% ± 3 last single digits @ 60 Hz.

2) AC current ranges: .90% ±3 last single digits @ 60 Hz, including adapters, transducers.

3) DC voltage ranges: .25% ± 1 last single digit.

4) DC current ranges: .75% ± 1 last single digit.

5) Resistance ranges: .50% ± 1 last single digit.

6) Frequency range: .10% ± 1 last single digit @ 60 Hz.

c. Clamp-on ammeters: AC current ± 3% of range ± 1 last single digit @ 60 Hz.

d. Dissipation/power factor field equipment:

1) ± 0.1% power factor for power factor values up to 2.0%.

2) 5% of the reading for power factor values above 2.0%.

e. Low-range DC resistance equipment: 1.0% of reading, ± 2 last single digits.

f. Transformer turns-ratio test equipment: 0.5% or better @ 60 Hz.

g. Ground electrode test equipment: ± 2% of range.

h. Insulation Test sets: 0-1000V DC ± 20% of reading at mid-scale.

i. Electrical load survey equipment:

1) ± 5% total error, including sensors.

2) 1% resolution.

3) Current transformers ± 2% of range @ 60 Hz.

4) Voltage transformers ± 0.5% of range @ 60 Hz.

j. Liquid dielectric strength test equipment: ± 2% of scale.

k. Infrared scanning equipment: sensitivity of 2C.

l. Phase shifting equipment: ± 1.0° over entire range.

m. High-current test equipment: ± 2% of range.

n. DC high potential test equipment: ± 2% of full scale.

o. AC high potential test equipment (60 Hz): ± 2% of full scale.

C. TEST INSTRUMENT CALIBRATION

1. Establish and maintain a calibration program which assures that all applicable test instruments are maintained within rated accuracy which is directly traceable to the National Institute of Standards and Technology.

2. Calibrate instruments in accordance with the following schedule:

a. Field instruments: 6 months maximum.

b. Laboratory instruments: 12 months.

c. Leased specialty equipment: 12 months (where accuracy is guaranteed by lessor)

3. Place dated calibration labels at visible locations on all test equipment.

4. Keep up-to-date records which show date and results of instruments calibrated or tested; have such records available for review by the Contract Administrator.

5. Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

6. Use calibration standards of higher accuracy than the accuracy of the test instrument being calibrated.

1.7 POWER SYSTEM STUDIES

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Edit to 1.7 suit project requirements.

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A. Provide power system studies that include a complete short-circuit study, equipment evaluation study and protective device coordination study based on the installed electrical distribution system.

B. Include in the study all portions of the electrical distribution system from the utility substation circuit breaker(s) and from alternate sources of power in the electrical distribution system under study.

C. Cover normal system operating configuration plus any plausible alternate configurations and operations that could result in maximum fault condition.

D. Short-Circuit Study

1. Perform short circuit study using methods outlined in ANSI/IEEE Std. 141, *IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants*.

2. Include the following study input data: the utility source short-circuit single- and three-phase contribution, with the X/R ratio, the resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and other circuit parameters as applicable.

3. Calculate the short-circuit momentary and interrupting duty on the basis of maximum available fault current at each bus in the distribution system down to the following points in the low-voltage system:

a. 480 volt system busses where available short circuit current is less than 14,000 amperes RMS symmetrical.

b. 208 or 240 volt system busses where available short circuit current is less than 10,000 amperes RMS symmetrical.

E. Equipment Evaluation Study

1. Perform an equipment evaluation study to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches and fuses.

2. Tabulate and compare the short-circuit ratings of the devices with the available fault currents.

3. Notify the Contract Administrator of any problem areas or inadequacies in the electrical distribution system equipment.

F. Protective Device Coordination Study

1. Perform protective device coordination study to select or to check the selections of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and settings.

2. Perform protective device coordination study using methods outlined in ANSI/IEEE Std. 141,*IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants*.

3. Include in the coordination study all voltage classes of equipment from the utilities incoming line protective device down to and including each low voltage load protective rated 100 amperes and larger.

4. Provide time-current characteristic plots of the specified protective devices on 11"x17" log-log coordination paper.

   a. Provide coordination plots for both phase and ground protective devices on a complete system basis.

   b. Include on plots complete titles, representative one-line diagram and legend, associated utility relay or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of circuit breaker trip curves, and fuse curves.

   c. Indicate on the plots the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, ANSI transformer magnetizing inrush and withstand curves per ANSI C37.91, cable damage curves, symmetrical and asymmetrical fault currents.

   d. Comply with NFPA-70,*National Electrical Code*. Maintain reasonable coordination intervals and separation of characteristic curves.

   e. Use sufficient curves to clearly indicate the coordination achieved to each utility breaker or fuse, primary feeder breaker or fuse, transformer primary protective device, main and tie secondary breakers, low-voltage feeder breakers, and load protective device rated 100 amperes or more. Use a maximum of eight protective device characteristic curves per plot.

5. Provide the selection and settings of the protective devices in a separately tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings.

6. Alert the Contract Administrator to coordination discrepancies, problem areas, or inadequacies.

7. Submit a final report power system studies as described in the SUBMITTALS article of this Section.

1.8 SUBMITTALS

A. Make submittals in accordance with the provisions of Sections 01300 and 01700.

B. Within 30 days after Notice to Proceed, submit certification of the qualifications of the ETF and personnel as described in the QUALITY ASSURANCE paragraph of this Section.

C. Submit a final report of the power system studies. Sign the final report and include the following information: description, purpose, basis, written scope, and a single-line diagram of the portion of the power system which is included within the scope of the study.

D. Submit copies of field reports, test data, calculations, plots and evaluations within 48 hours of the completion of each test for information and project coordination.

E. Submit a final report of testing and inspection at the completion of the project. Include the following information:

1. Summary of the project
2. Description of the equipment tested
3. Visual inspection report
4. Description of the tests
5. Test results
6. Conclusions and recommendations
7. Appendix including appropriate test forms
8. Identification of the test equipment used and calibration date
9. Signature of test engineer

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

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Edit Part 3 to suit project requirements. Add and delete electrical equipment to match project equipment

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3.1 GENERAL

A. Test, inspect and calibrate the following electrical equipment in strict accordance with applicable sections of NETA ATS-1991, including applicable optional tests:

1. Electrical equipment specified in Division 16 of the Specifications.
2. Electrical equipment shown on the electrical Drawings.
3. Electrical equipment furnished under other Divisions of the Specifications and connected under Division 16.

B. Perform acceptance tests and inspections prior to energizing equipment.

C. Final acceptance will not occur before completion of the electrical acceptance tests, inspections and calibrations specified in this Section.

D. Detailed requirements for electrical acceptance tests, inspections and calibrations are specified in the following paragraphs.

3.1 UNIT SUBSTATIONS

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Edit to suit project requirements.
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A. Test and inspect medium-voltage interrupter switchgear in accordance with NETA ATS-1991 Chapters 7.1 and 7.5.2, and manufacturer's instructions.

B. Test and inspect medium-voltage, dry-type transformer(s) in accordance with NETA ATS-1991 Chapter 7.2.1, and manufacturer's instructions.

C. Test and inspect metal enclosed low voltage power circuit breaker switchgear in accordance with NETA ATS-1991 Chapter 7.1, and manufacturer's instructions.

D. Test and inspect low voltage power circuit breakers in accordance with NETA ATS-1991, Chapter 7.6.1.2, and manufacturer's instructions.

E. Test and inspect instrument transformers in accordance with NETA ATS-1991 Chapter 7.10, and manufacturer's instructions.

F. Test, inspect and calibrate metering and instrumentation in accordance with NETA ATS-1991 Chapter 7.11, and manufacturer's instructions.

G. Test and inspect surge arresters in accordance with NETA-ATS-1991 Chapter 7.19.

H. Perform system function tests for automatic source transfer controls.

3.2 GROUND-FAULT PROTECTION SYSTEMS

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Edit to suit project requirements.
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Test and inspect ground fault protection systems in accordance with NETA ATS-1991 Chapter 7.14, and manufacturer's instructions.

3.3 SWITCHBOARDS AND POWER PANELBOARDS

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Edit to suit project requirements.
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A. Test and inspect low voltage switchboards and power panelboards in accordance with NETA ATS-1991 Chapter 7.1, and manufacturer's instructions.

B. Test and inspect 150 ampere and larger circuit breakers and all main circuit breakers in accordance with NETA ATS-1991 Chapter 7.6.1.1, and manufacturer's instructions.

3.4 DRY-TYPE TRANSFORMERS

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Edit to suit project requirements.
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Test and inspect low voltage dry-type transformers in accordance with NETA ATS-1991 Chapter 7.2.3, and manufacturer's instructions.

3.5 LIGHTING PANELBOARDS

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Edit to suit project requirements.
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A. Inspect low voltage lighting panelboards in accordance with NETA ATS-1991 Chapter 7.1.1, and manufacturer's instructions.

B. Test and inspect 150 ampere and larger circuit breakers and all main circuit breakers in accordance with NETA ATS-1991 Chapter 7.6.1.1, and manufacturer's instructions.

3.6 MOTOR CONTROL CENTERS

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Edit to suit project requirements.
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A. Test and inspect low voltage motor control centers in accordance with NETA ATS-1991 Chapter 7.16.2, and manufacturer's instructions.

B. Test and inspect 150 ampere and larger circuit breakers and all main circuit breakers in accordance with NETA ATS-1991 Chapter 7.6.1.1, and manufacturer's instructions.

3.7 MEDIUM VOLTAGE POWER CABLE

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Edit to suit project requirements.
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Test and inspect medium voltage power cable and terminations in accordance with NETA ATS-1991 Chapter 7.3.2, and manufacturer's instructions.

3.8 LOW VOLTAGE POWER CABLE

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Edit to suit project requirements.
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Test and inspect low voltage power cable in accordance with NETA ATS-1991 Chapter 7.3.1.

3.9 INSTRUMENTATION CABLE

After instrumentation cable installation and conductor termination, test that instrumentation cable shields are grounded only at the designated ground point.

3.10 GROUNDING SYSTEMS

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Edit to suit project requirements.
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Test and inspect grounding systems in accordance with NETA ATS-1991 Chapter 7.13.

3.11 SYSTEM FUNCTION TESTS

A. Perform function tests on each system provided in this contract and covered by this Section to ensure total system operation.

B. Perform the system functional tests upon satisfactory completion of equipment acceptance tests. It is the intent of system functional tests to prove the proper interaction of all sensing, processing, and action devices to effect the designed end product or result.

C. Test interlocks, safety devices, fail-safe functions, and design functions.

END OF SECTION

END OF SPECIFICATION