Electrical Equipment Inspection Program
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The SLAC National Accelerator Laboratory Electrical Equipment Inspection Program (EEIP) used as its model for this document Lawrence Livermore National Laboratory’s (LLNL) “Authority Having Jurisdiction (AHJ) Requirements for Approving Electrical Equipment, Installations, and Work”. Many concepts and elements from LLNL’s program were used with no modification in this document and program. The authors would like to thank the LLNL AHJ staff for their help in this project.
Executive Summary

The purpose of the electrical equipment inspection program (EEIP) is to ensure that electrical equipment not listed or labeled by a nationally recognized testing laboratory (NRTL) meets federal Occupational Safety and Health Administration (OSHA) regulations (29 CFR 1910.303 and 29 CFR 1910.399) and the other codes and standards listed in Section 1.4.

In addition, the EEIP process provides the following:

- Electrical safety resources to assist in mitigating potential hazards
- Guidance in code compliance and safety design standards
- Lower project costs by providing an ongoing review process

The program covers unlisted and unlabeled equipment, modifications to NRTL-listed or labeled equipment, and design, fabrication, installation, and inspection of custom electrical equipment.

Note   Legacy equipment at SLAC designed before the implementation of this program must be accepted for use subject to a future inspection and/or engineering safety analysis. Available spares for legacy equipment that currently exist and are maintained can be placed into service when required and will also be subject to future inspections and/or engineering safety analysis.

This program applies to SLAC management, project managers, EEIP field representatives, the EEIP program manager, electrical safety officer (ESO), and the Electrical Safety Committee (ESC).
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Definitions

authority having jurisdiction (AHJ) (electrical). A person who interprets the requirements of electrical codes and standards, approves electrical equipment for use, and coordinates the activities of staff. The SLAC electrical safety officer is the AHJ.

EEIP field report. 1) A written report verifying that a piece of electrical equipment or an installation is acceptable for use, or 2) a written report describing the reasons why electrical equipment does not comply with a mandatory standard. It may include recommendations to achieve equivalent safety criteria. The report consists of two documents, a field report record and a completed EEIP checklist; both are available at the Electrical Equipment Inspection Program Site (SharePoint).

electrical equipment. Equipment that uses electrical energy for electronic, electromechanical, heating, lighting, or similar purposes. Electrical equipment includes equipment used in laboratory research and development (R&D) as well as utility, facility, and shop equipment.

examination. A process performed by a person qualified to evaluate electrical equipment to determine if it is free from recognized hazards and meets code requirements

field evaluated. A thorough evaluation of nonlisted or modified equipment in the field that is performed by persons or parties acceptable to the authority having jurisdiction. The evaluation approval ensures that the equipment meets appropriate codes and standards, or is similarly found suitable for a specified purpose (per NFPA 70E).

labeled. A nationally recognized testing laboratory (NRTL) label, symbol, or other identifying mark that is affixed to equipment or materials

listed. Electrical equipment and materials listed by an organization concerned with product evaluation that have been examined against designated standards and found to be suitable for use in specified operations. The means of identifying electrical equipment may vary among listing organizations, some of which do not recognize equipment as listed unless it is also labeled.

nationally recognized testing laboratory (NRTL). An organization that is recognized by the federal Occupational Safety and Health Administration (OSHA) as an acceptable laboratory for product evaluation and maintains records of periodic examinations of equipment and materials. The NRTL ensures that equipment and materials comply with designated standards or are tested to determine their suitability for use.
1 Introduction

1.1 Purpose

The purpose of the electrical equipment inspection program (EEIP) is to ensure that electrical equipment not listed or labeled by a nationally recognized testing laboratory (NRTL) meets federal Occupational Safety and Health Administration (OSHA) safety codes and the codes and standards listed in Section 1.4 below.

In addition, the EEIP process provides the following:

- Electrical safety resources to assist in mitigating potential hazards
- Guidance in code compliance and safety design standards
- Lower project costs by providing an ongoing review process

1.2 Scope

The program covers unlisted and unlabeled equipment, modifications to NRTL-listed or labeled equipment, and design, fabrication, installation, and inspection of custom electrical equipment.

Note Legacy equipment at SLAC designed before the implementation of this program must be accepted for use subject to a future inspection and/or engineering safety analysis. Available spares for legacy equipment that currently exist and are maintained can be placed into service when required and will also be subject to future inspections and/or engineering safety analysis.

1.3 Applicability

This program applies to SLAC management, project managers, EEIP field representatives, the EEIP program manager, electrical safety officer (ESO), and the Electrical Safety Committee (ESC).

1.4 Standards

This procedure is designed to meet the following directives and standards:


Electrical Equipment Inspection Program

- National Fire Protection Association (NFPA) 70, National Electrical Code (NEC) (NFPA 70)
- National Fire Protection Association (NFPA) 70E, “Standard for Electrical Safety in the Workplace” (NFPA 70E)

For more information see the SLAC Environment Safety and Health Manual, Chapter 8, “Electrical Safety”, or the Electrical Equipment Inspection Program Site (SharePoint).

2 Roles and Responsibilities

2.1 SLAC Management

Management must ensure the following:

- Electrical installations and work performed at SLAC are examined in accordance with the requirements in this document.
- Unlisted or unlabeled electrical equipment fabricated, manufactured, or installed after the implementation of this program are examined in accordance with the requirements in this document. Non-NRTL approved electrical equipment in storage or not in use must be examined before activation except for maintained spares for in-use legacy equipment. Safety issues identified during a review must be addressed and any potentially imminently dangerous situation must be corrected immediately.
- Adequate resources are allocated to mitigate electrically hazardous conditions and to ensure compliance with applicable codes and standards. Consideration should be given to the priorities of other hazardous conditions that might also have to be addressed.
- Deficiencies found during EEIP examinations are corrected before the electrical equipment is placed into operation
- Drawings of all electrical systems and equipment (including utility, facility, and programmatic systems; equipment single-line diagrams; and panel board, switchboard, control, ladder network, schematic, layout, and interconnection diagrams) are current.
- A program is developed to ensure legacy equipment and maintained spares are subjected to EEIP inspection and approval in a timely manner.

2.2 EEIP Program Manager

The EEIP program manager

- Interprets NEC and other electrical standards, approving electrical equipment and materials for use. May permit alternate methods and work practices where it can be assured that equivalent safety objectives have been met.
- Has authority to accept for use, with respect to electrical safety, programmatic electrical equipment and installations
• Delegates to EEIP field representatives the authority to interpret NEC and other electrical standards and to examine and approve electrical equipment. Determinations made by EEIP personnel will stand unless overturned by the EEIP program manager.

• Develops protocol for EEIP personnel to
  – Interpret NEC and other electrical requirements in the field
  – Approve electrical equipment, wiring methods, electrical installations, and materials for use
  – Permit alternate methods if equivalent safety protection can be provided

• Ensures electrical equipment is in compliance with electrical codes and standards

• Reviews and validates NEC and OSHA permitted alternate methods

• Maintains all documentation of EEIP activities, including EEIP field reports, interpretations of NEC and OSHA codes, approvals of electrical equipment and materials, permitted alternate methods, and any other related documentation

• Establishes limits of authority for EEIP field representatives

• Assesses overall program effectiveness on a periodic basis and makes improvements as appropriate

2.3 SLAC Electrical Safety Committee

Historically the Electrical Safety Committee (ESC) provided the following:

• Advises on electrical safety matters to promote electrical safety

• Works to resolve disputes between a user and the EEIP

• Review ESO interpretations on matters of code to ensure personnel safety, as needed

These responsibilities are currently assigned to and performed by the SLAC electrical safety officer (ESO). The ESC may be convened from time to time as the need arises to review major electrical safety program changes or to provide advice on unique, unusual or particularly complex electrical safety concerns.

2.4 EEIP Field Representative

An EEIP field representative must be a SLAC employee and may be an engineer, electrician, or technician approved by the EEIP program manager. Approval will be based of the nominee’s knowledge of electrical codes, training, and experience. The approval of the nominee will be made by the EEIP program manager. Organizations that do not have a qualified person to serve as an EEIP field representative should contact the EEIP program manager.

• Must be trained as an EEIP field inspector

• Interprets OSHA regulations, NEC, and other relevant standards

• Examines/inspects and approves/rejects for use
  – Electrical equipment (such as electronic panel boards, switchboards, shop-built extension cords, power supplies, and research and development [R&D] equipment) and installations
  – Recommend modifications to unapproved electrical equipment that, if implemented, will result in approval
Electrical Equipment Inspection Program

- Permits, with EEIP program manager approval, alternate methods from the NEC and other standards, if it can be assured that equivalent safety objectives are met
- Verifies that all modifications meet or exceed established codes and standards
- Participates in design reviews, as requested
- Labels approved electrical equipment
- Prepares EEIP field reports

3 Training

The EEIP program manager and the field representative must have the following training:

- Training requirements for electrical workers and electrical work performed at SLAC as described in ESH Manual Chapter 8, “Electrical Safety”
- Training in application of the NEC (ESH Course 260 and ESH Course 260R) and NFPA 70E
- Site-specific electrical safety training
- EEIP-specific field representative training (ESH Course 158)
- Training in the administration of the EEIP and database operation

Other training as deemed appropriate to carry out requirements of the program.

4 Approval Requirements

4.1 Equipment and Installations Subject to Review and Approval

Note: In accordance with OSHA (29 CFR 1910 Subpart S) and the DOE Electrical Safety Handbook (DOE-HDBK-1092), Appendix C, NRTL-listed equipment must be purchased if available. If NRTL-listed equipment is not available then non-listed equipment may be procured. The non-listed equipment must pass SLAC EEIP inspection before first energization.

This section describes requirements for approving unlabeled or unlabeled electrical equipment, installation, and work. EEIP personnel must review and approve electrical equipment and installations at SLAC based on at least one of the following four criteria before placing the equipment into service:

1. Electrical equipment inspected and approved for use at another DOE laboratory must pass SLAC EEIP inspection before first energization at SLAC.

2. Electrical equipment, including custom-made SLAC electrical equipment that is not NRTL listed or labeled, will be acceptable if examined by EEIP personnel in accordance with the provisions of this program. The equipment must either meet code requirements or it must be demonstrated that equivalent safety can be achieved. If the electrical equipment is not acceptable but can be modified, EEIP personnel may recommend the necessary modifications as described below.
3. All modifications to NRTL-listed electrical equipment must be examined and approved by EEIP personnel.

Section 4.2 describes the three methods for review and approval. For documentation requirements, see Section 4.2.2. In all instances EEIP personnel must prepare an EEIP report. This report will be entered into the EEIP database.

### 4.2 Review and Approval Methods

Options to achieve OSHA-compliant electrical equipment (as defined in 29 CFR 1910.399) are listed below. The individual or project manager will chose the method appropriate to the project or program.

#### 4.2.1 NRTL Field Evaluation

A NRTL field evaluation may be performed at the manufacturer’s facility prior to shipment. In some cases the manufacturer may prefer that the field evaluation be performed after installation at SLAC, but before the equipment is energized for the first time.

#### 4.2.2 SLAC EEIP Inspection

A SLAC EEIP inspection may be performed after the equipment is delivered to SLAC and before first energization, or at the manufacturer’s facility prior to shipment to SLAC.

### 4.3 Acceptance Criteria

#### 4.3.1 Equipment Acceptance: Areas of Consideration

Equipment is accepted for use if it meets the following requirements. Equipment should be examined for safety as extensively as possible. Areas of consideration include the following:

- Failure modes
- Heat effects
- Magnetic effects
- Grounding and bonding

  Ground bond tester settings and acceptance criteria:
  - General (use for enclosure bonding): 0.1 ohms (maximum) at 10 amps (minimum)
  - Cord and plug equipment: 0.2 ohms (maximum) at 10 amps (minimum)
  - Magnet core to grounding electrode system: 0.1 ohms (maximum) at 30 amps (nominal)
  - Test duration: 10 seconds (minimum)

- Guarding of live parts
- Leakage currents
- Dielectric testing
- Access to serviceable parts
- Over current and over temperature protection
- Clearances and spacing
- Interlocks
- Design and procedural documentation
- Signage, labels, and administrative controls
- Mechanical motion
- Stored energy
- Low hazard thresholds:
  - AC: < 5 mA (short circuit output at any voltage, but if input is hazardous then inspection is required)
    - OR
      - < 50 V and < 1000 VA (short circuit output)
  - DC: < 40 mA (short circuit output at any voltage, but if input is hazardous then inspection is required)
    - OR
      - < 100 V and < 1000 VA (short circuit output)
  - Capacitors: < 100 V and < 100 J

4.3.2 Documentation Requirements

Documentation should be developed to substantiate the acceptance of any equipment. Documentation should include the following:

- Tests performed
- Conditions of acceptability
- Applicable standards to which the equipment was evaluated
- Limitations of approved use, if any
- Pictures
- Description of remediation required
- Documentation of remediation completed

EEIP inspection forms and inspection guidance may be found on the Electrical Equipment Inspection Program Site (SharePoint). The completed inspection forms and related documentation must be uploaded to the online EEIP report database. (See the EEIP Program Site.)
5 Related Documents

The following table lists documents related to this program.

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