



Electrical Equipment Inspection Program

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Prepared by the
Electrical Safety Support Group

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1 Purpose

Occupation Safety and Health Administration (OSHA) through the National Electrical Code (NEC) specifies that all installations and equipment are acceptable for use only if approved by a National Recognized Testing Laboratory (NRTL) or the Authority Having Jurisdiction (AHJ). This is repeated in the Department of Energy (DOE) Electrical Safety Handbook. The Stanford Linear Accelerator Center (SLAC) Electrical Safety Officer (ESO) acts as the AHJ for this process. In order to meet this requirement SLAC will establish the Electrical Equipment Inspection Program (EEIP) to ensure electrical equipment that has not been labeled by a NRTL and electric installation activities meet the NEC and OSHA safety codes.

Also the EEIP is expected to provide the following benefits

- The EEIP will provide an electrical safety resource to assist in mitigating potential problems
- Provide guidance in terms of code compliance and safety design standards.
- Lower project costs by providing an ongoing review process
- Meet documentation requirements

2 Scope

This document will describe the EEIP and the responsibilities of those charged with its implementation and operation. It will also provide guidelines for the laboratory and designated EEIP personnel to ensure that electrical equipment complies with SLAC standards and safety codes

NOTE: Legacy Equipment at SLAC designed before the implementation of this program shall 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.

3 Acknowledgment

The SLAC Electrical Equipment Inspection Program (EEIP) has used the Lawrence Livermore National Laboratory (LLNL) “Authority Having Jurisdiction (AHJ) Requirements for Approving Electrical Equipment, Installations, and Work” as its model. The authors have modified and adapted the LLNL plan for use at SLAC. Many concepts and elements from that 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.

4 SLAC EEIP Structure

This section describes the EEIP organizational structure, selection criteria, and the roles and responsibilities of the EEIP Manager, the EEIP Field Representatives and the SLAC Electrical Safety Committee (ESC) concerning its relationship to the EEIP.

4.1 EEIP Manager

The EEIP manger is the individual who manages the EEIP and is assisted by the EEIP Field Representative and the ESC. This individual is the SLAC Electrical Safety Officer or his appointed representative. This office has authority to accept for use, with respect to electrical safety, programmatic electrical equipment and installations.

4.2 EEIP Field Representative

The EEIP Field Representative will be the individual who will be advising, assisting, inspecting and/or guiding the various projects on electrical safety and be issuing EEIP approvals. These individuals shall be persons who are SLAC employees and have been trained as field inspectors for the EEIP. They may be engineers, senior electricians, or senior technicians nominated by their organizations and approved by the EEIP Manager. The ESC may also nominate individuals. The approval will be based of their knowledge of electrical codes, training, education, and experience. The approval of the nominee will be made by the EEIP Manager with input from the EEIP staff and the ESC when requested. Organizations that do not have a qualified person to serve as an EEIP field representative may have one assigned to them by the EEIP manager.

4.3 SLAC Electrical Safety Committee

The Electrical Safety Committee (ESC) advises on electrical safety matters and promotes electrical safety at SLAC. The Charter for the Committee can be found at the following WEB address:

<http://www-group.slac.stanford.edu/esh/committees/escchart.html>

In addition, if there is a dispute between a user and the EEIP this group will hear and work to resolve that dispute. Additionally, the ESC may review ESO interpretations on matters of code to ensure personnel safety.

4.4 EEIP Training

The EEIP Manager and the Field Representative shall have the following training:

- Training requirements for electrical workers and electrical work performed at SLAC as described in [SLAC ES&H manual, Ch 8](#), Section 5
- Training in application of the NEC and NFPA 70E
- Site-specific electrical safety training
- EEIP specific Field Representative Training
- Training in the Administration of the EEIP and Database Operation
- Other training as deemed appropriate to carry out requirements of the program

5 Examining and Approving Electrical Equipment, Installation and Work

If the electrical equipment is listed or labeled by an NRTL, no examinations or other actions are required. EEIP personnel shall review and approve electrical equipment and installations at SLAC based on at least one of the following four criteria before being placed into service:

1. Electrical equipment manufactured at another DOE laboratory must be approved by that laboratory's AHJ program. If the other Laboratory does not provide the approval, then the equipment must be approved by the SLAC EEIP before the equipment is entered into service.
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 shall either meet code requirements or it shall 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. See sections 5.1.1 and 5.1.2 and 5.1.3
3. All modifications to NRTL-listed electrical equipment shall be examined and approved by EEIP personnel.
4. All electrical equipment installations and work shall be examined and approved by EEIP personnel or have an ESC review and approval.

For items 1 through 4, EEIP personnel shall prepare and maintain an EEIP report for review by the equipment supervisor. This report will be entered into the EEIP database.

5.1 Methods to Achieve OSHA Compliance

There will be three different methods to achieve OSHA compliant electrical equipment, as defined in OSHA Sec. 29 CFR 1910.399. The individual or project manager will have a choice of which method to use, each choice will lead to compliant electrical equipment. These three methods should also give SLAC management and project management greater flexibility in achieving compliance. These three methods are:

5.1.1 Active EEIP Involvement in the Engineering Cycle

If this option is chosen then at the onset of the program or project an EEIP representative will be assigned to the project. The EEIP Representative will attend all engineering and project reviews as well as conduct routine safety inspections during the construction phase. At the end the project, the project management with the EEIP field representative should document and summarize the application of the approved EEIP safety standards.

At the conclusion of this process the equipment or project will be certified as being compliant and accepted as AHJ approved. Prior to placing the equipment into service, a minor inspection must be completed by the EEIP field representative or representative of the SLAC AHJ. Once the inspection has been passed, the equipment will have a label affixed to it certifying compliance.

The ESC may also request a field inspection.

5.1.2 Engineering Safety Analysis – Self Assessment

At a stage when the system or equipment has reached a mature design, the project may chose to provide a detailed safety analysis of the equipment. This analysis must be documented and presented to the EEIP manager for review. The safety review should be conducted by a Registered Professional Engineer or Senior SLAC Staff Electronic/Electrical Engineer. The report should address the elements in the Acceptance Criteria in section 5.1.4.

At the conclusion of this process the equipment or project will be certified as being compliant and accepted as AHJ approved. Prior to placing the equipment into service, a minor inspection must be completed by the EEIP representative or representative of the SLAC AHJ. Once the inspection has been passed, the equipment will have a label affixed to it certifying compliance.

5.1.3 Equipment Inspection Program

The project may request a rigorous inspection prior to placing the equipment in service. This inspection shall comprise of all elements described below in section 5.1.4, Acceptance Criteria. In addition, the EEIP inspector may make interpretations of the NEC codes and other electrical requirements and grant special permission contemplated in a number of the codes. The Electrical Safety Officer (ESO) may waive specific requirements in the NEC or permit alternate methods and work practices where it can be assured that equivalent safety objectives have been met.

At the conclusion of this process the equipment or project will be certified as being compliant and accepted as AHJ approved.

5.1.4 Acceptance Criteria

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 but not limited to:**
 - Failure modes
 - Heat effects
 - Magnetic effects
 - Grounding and bonding
 - 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

This analysis to be documented

- **Documentation should be developed to substantiate the acceptance of any equipment. Documentation should include but not be limited to:**
 - Tests performed
 - Conditions of acceptability
 - Applicable standards to which the equipment was evaluated
 - Limitations of approved use, if any.

The EEIP inspection form may be used to capture this information.

Note: The engineering analysis must be submitted to the EEIP or ESC for review and approval. For additional information see Department of Energy (DOE) Electrical Handbook 2004 Ch. 10 Section 10.5.

<http://www.eh.doe.gov/techstds/standard/hdbk1092/hdbk10922004.pdf>

6 Responsibilities

All workers and organizations shall refer to SLAC Safety Values and Expectations, which can be found at:

<http://www-group.slac.stanford.edu/esh/eshvalues.html>.

Specific responsibilities under the SLAC EEIP are listed in the following subsections.

6.1 SLAC Management

Ensure the following:

- Electrical installations and work performed at the Laboratory are examined in accordance with the requirements in this document.
- Non-listed or unlabeled electrical equipment fabricated, manufactured, or installed after the implementation of this program, is examined in accordance with the requirements in this document. Non-NRTL approved electrical equipment in storage or not in use shall be examined before activation except for maintained spares for in use legacy equipment. Safety issues identified during this review must be addressed. Any potential imminently dangerous situations are 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, panel board, switchboard, control, ladder networks, schematic, layout, and interconnection diagrams are current.
- Develop a program to ensure legacy equipment and maintained spares are subjected to EEIP inspection and approval in a timely manner.

6.2 EEIP Manager

- Make interpretations of the NEC codes and other electrical standards, approve electrical equipment and materials for use, and grant special permission as contemplated in a number of the codes and standards. The ESO may waive specific requirements in the NEC or permit alternate methods and work practices where it can be assured that equivalent safety objectives have been met.
- Delegate to EEIP field representatives the authority to interpret NEC codes and other electrical standards and to examine and approve electrical equipment. Determinations made by EEIP personnel will stand unless overturned by the AHJ or ESC.
- Develop protocol for EEIP personnel to:
 - Interpret NEC codes 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.
- Ensure electrical equipment is in compliance with electrical codes and standards.
- Review and validate EEIP Field Reports.
- Review and validate all NEC and OSHA and permitted alternate methods arrange by EEIP personnel.
- Maintain all documentation of EEIP activities (e.g., interpretations of NEC and OSHA codes, approvals of electrical equipment and materials, permitted alternate methods) and EEIP Field Reports.
- Establish limits of authority for EEIP Field Representative
- Assess overall program effectiveness on a periodic basis and make improvements as appropriate.

6.3 EEIP Field Representative

- Interpret OSHA regulations, NEC codes, and other standards listed in this document, Section 7.0
- Examine/inspect and approve/disapprove for use electrical equipment (e.g., electronic panel boards, switchboards, shop-built extension cords, power supplies, R&D equipment) and installations or recommend modifications to unapproved electrical equipment that, if implemented, will result in approval.
- Permit, with ESO approval, alternate methods from the NEC and other standards, if it can be assured that equivalent safety objectives are met. Verify all modifications meet or exceed established codes and standards.
- Participate in design reviews as requested.
- Label approved electrical equipment.
- Prepare EEIP Field Reports.
- Perform EEIP functions (e.g., inspections) as requested by the EEIP Manager.

7 Electrical Work Standards

NFPA 70E

National Electrical Safety Code (NESC)

National Electrical Code (NEC)

Department of Energy, Handbook for Electrical Safety (DOE-HDBK-1092-2004)

NFPA 101, Life Safety Code

OSHA 1910 and 1926 (Applicable parts of)

SLAC ES&H Manual, Ch. 8

Current Electrical Safety related SLAC ES&H Bulletins

The “Interim SLAC Electrical Safety Design Reference Handbook” provides guidance to meet these standards

8 Appendix A - Terms and 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.
EEIP field report	<p>1. A written report verifying that a piece of electrical equipment or an installation is acceptable for use.</p> <p style="text-align: center;">or</p> <p>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.</p> <p>The report consists of two documents; A Field Report Record and a completed EEIP checklist, both are available at the EEIP web site.</p>
EEIP personnel	Program EEIP and EEIP inspector
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 whether or not electrical equipment is free from recognized hazards and meets code requirements.
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 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.