

Electrical Equipment Inspection

Table of Contents

INTRODUCTION.....	3
SUMMARY	3
SCOPE	3
PURPOSE	4
NRTL-LISTED EQUIPMENT	4
DEFINITIONS.....	4
SECTION 1—FIELD EVALUATION/DOCUMENTATION CRITERIA.....	6
1.1 NON-NRTL/MODIFIED NRTL-LISTED ELECTRICAL EQUIPMENT	6
1.2 FACILITY ELECTRICAL EQUIPMENT	8
1.3 REPUTABLE MANUFACTURER ELECTRICAL EQUIPMENT	9
1.4 MULTIPLE IDENTICAL MODEL UNITS	9
1.5 SYSTEM/INSTALLATION	10
SECTION 2—EQUIPMENT FIELD EVALUATION NUMBERING.....	11
2.1 MULTIPLE IDENTICAL MODEL UNITS	11
SECTION 3—LABELING APPROVED ELECTRICAL EQUIPMENT.....	12
3.1 NRTL-LISTED ELECTRICAL EQUIPMENT (RECOMMENDED PRACTICE).....	12
3.2 MULTIPLE IDENTICAL MODEL UNITS	12
3.3 SYSTEMS	12
SECTION 4—SPECIAL CIRCUMSTANCES FOR FIELD EVALUATED ELECTRICAL EQUIPMENT	13
4.1 SALVAGING/EXCESS/REMOVAL OF EQUIPMENT INSPECTOR APPROVED ELECTRICAL EQUIPMENT	13
4.2 SUBCONTRACTOR UNLISTED ELECTRICAL EQUIPMENT	13
4.3 EQUIPMENT ACQUIRED FROM EXCESS/SALVAGE	13
4.4 RENTAL EQUIPMENT	13
APPENDIX A: NON-NRTL /MODIFIED NRTL-LISTED ELECTRICAL EQUIPMENT APPROVAL FORM	15
THIS PAGE INTENTIONALLY LEFT BLANK	18
APPENDIX B: FACILITY ELECTRICAL EQUIPMENT APPROVAL FORM	19
APPENDIX C: INSTRUCTIONS FOR FACILITY ELECTRICAL EQUIPMENT APPROVAL FORM.....	21
<i>PART 1 – Equipment Identification.....</i>	<i>21</i>
<i>PART 2 – Example Guidelines for Equipment Approval.....</i>	<i>21</i>

APPENDIX D: REPUTABLE MANUFACTURER UNLISTED ELECTRICAL EQUIPMENT APPROVAL FORM.....	25
APPENDIX E: ELECTRICAL SYSTEMS APPROVAL FORM.....	27
APPENDIX F: EXAMPLE APPROVAL LABELS.....	30

Introduction

Summary

Hazardous electrical equipment used at a DOE site, **shall** be NRTL listed/labeled or approved by an Equipment Inspector prior to use.

Managers **shall**:

- Ensure that all employees working in areas they are responsible for use only NRTL-listed or Equipment Inspector-approved electrical equipment.
- Ensure NRTL-listed equipment is purchased and utilized if available.

This chapter provides the requirements for examining and approving unlisted electrical equipment at DOE sites.

Scope

Field Evaluation and approval of unlisted electrical equipment applies to electrical equipment used by employees and employees of subcontractors or organizations. All unlisted or modified NRTL-listed electrical equipment requires Field Evaluation and approval prior to use. These requirements apply as follows:

- New equipment approvals **shall** follow the provisions of this document.
- Equipment previously accepted as approved without field examination **shall** be approved following the provisions of this document.
- Re-approvals of equipment previously approved **should** follow the provisions of this document. Re-approvals may include previously approved equipment that has been modified or is used outside of its original intent.
- **Equipment that was previously evaluated, labeled and documented does not need to be approved again to meet these requirements.**
- *Note: Unlisted facility equipment **should** be examined and approved by a Registered Professional Electrical Engineer.*

The following types of electrical equipment **do not require field evaluation and approval**:

- Equipment that is not being used (e.g., in storage, staged for salvage/excess, etc.) Equipment that is not being used should be located or labeled so it is clear it is not in use.
- Nationally Recognized Testing Laboratory (NRTL) listed as defined in this document and used in accordance with such NRTL listing. Salvaged equipment is an exception and must be field evaluated (see section 4.4).
- Low Hazard (Class X.0 and X.1) equipment as defined in this document.
- Prototype equipment (e.g., test chassis, bench top experiment) built to test the validity of a design that is under the exclusive control of the designer if used for less than three months. An Equipment Inspector should be consulted at the beginning of the

development stage and as necessary to ensure that all appropriate electrical safety requirements are being met (e.g., guarding, work control (EEWP], etc.) Equipment being developed that exceeds a three-month period may be acceptable as long as a Equipment Inspector is informed of the equipment and the status of the design/development and safety continues to be covered by adequate work control.

The following equipment **does not need to be disassembled/opened for approval.**

However, no hazard should be present to the worker, as can best be determined by external Field Evaluation. Other evaluations shall be substituted for the inability to visual inspection e.g. review of schematics, assembly drawings etc.

- Equipment that will be rendered inoperative as a result of Field Evaluation.
- Equipment that will void the manufacturer's warranty upon opening.
- Equipment manufactured by a reputable manufacturer as defined in this document.
- Equipment that could present additional hazards to the EQUIPMENT INSPECTOR upon opening, e.g., radiological hazards.

Purpose

The purpose of this document is to provide standard criteria for: evaluation, labeling, and documentation of unlisted electrical equipment. The Occupational Safety & Health Administration (OSHA) requires explicit approval of all electrical equipment in the workplace so it is free from recognized hazards that are likely to cause death or serious physical harm to employees. To improve and maintain electrical safety at DOE Facilities, only electrical equipment that has been approved as safe for the intended use **shall** be utilized. Unlisted electrical equipment **shall** be examined for safety before use as required by [OSHA 29 CFR 1910.303\(b\)](#).

NRTL-Listed Equipment

NRTL-listed equipment **shall** be purchased and utilized if available. For new or replacement equipment, an NRTL-listed product **shall** be purchased instead of an unlisted product if both exist. All NRTL-listed equipment **shall** be used for its intended purpose in accordance with the manufacturer's instructions. **Otherwise the equipment shall be treated as unlisted and approved per the requirements in this document.**

Definitions

Approved Equipment – Equipment acceptable to the AHJ consisting of :(1) NRTL-listed equipment being used in accordance with its listing or labeling for the manufacturer's intended purpose; or (2) equipment that is approved by an Equipment Inspector as safe for its intended purpose.

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

Equipment Inspector – A qualified electrical worker who has been determined by his/her AHJ or designee to have the skill, knowledge, and abilities to safely perform the work to which they are assigned In addition they **shall** have knowledge of the applicable electrical safety requirements as well as demonstrated field experience in the design, installation, and/or operation of facility or R&D electrical systems. Performs field evaluations, approves, labels and documents electrical equipment installations and work.

Field Evaluation- The process used for one-of-a-kind, limited production, used, or modified products that are not listed or labeled under a full listing and certification program. The process is completed at the point of manufacturing, interim points of distribution, in the evaluating company's facilities or at the final installation site or a combination of the above.

In-House-Built Equipment – Electrical equipment designed and/or fabricated by employees of a DOE facility, including employees of subcontractors, other research organizations, including Universities, other labs, and other research institutions.

Low Hazard Equipment – Class X.0, X.1 equipment that contains only negligible or low hazards as defined in Chapter X of this document.

Modified Equipment – NRTL-listed or Approved electrical equipment that has been modified or is being used for a purpose other than intended by the manufacturer/builder. Modification means that a change has been made that affects the safety of the equipment or is not in accordance with the manufacturers/builders installation use or maintenance instructions.

Nationally Recognized Testing Laboratory (NRTL) – An organization (e.g., UL, CSA):

- That is recognized by OSHA in accordance with Appendix A of 29 CFR 1910.7;
- That tests for safety;
- That lists, labels, or accepts equipment or materials that meet all of the criteria in 29 CFR 1910.7(b)(1)-(b)(4);
- That is concerned with the evaluation of products or services;
- That maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services; and
- Whose listing states that the equipment, material, or services either meet appropriate designated standards or have been tested and found suitable for a specified purpose.

Non-Reputable Manufacturer – A manufacturer that does not meet the criteria for “Reputable Manufacturer” as defined in this document.

NRTL-Listed Equipment – Equipment, included in a list published by an NRTL and used in accordance with any instructions included in the listing/labeling for its intended purpose by the manufacturer.

Reputable Manufacturer – Manufacturers that meet the following criteria:

- At least two pieces of unlisted electrical equipment from the manufacturer have been examined and approved by a EQUIPMENT INSPECTOR. Field Evaluation should be done according to the requirements for in-house built/modified equipment as required in this document.
- The manufacturer has a North American office/distributor (e.g., [Thomas Register®](#))
- The manufacturer services their products and can provide technical support.
- The manufacturer provides adequate documentation in English (acceptable to the approving EQUIPMENT INSPECTOR).

Note: Manufacturers meeting this criteria should be no longer be considered reputable when the manufacturer no longer exists. The age of equipment should be considered when determining the level of field examination with equipment made by a reputable manufacturer.

System/Equipment installation – A combination of components integrated into a unit to perform a specific task that is unlikely to change.

Unlisted Equipment – Equipment that has not been listed by an NRTL.

Section 1—Field Evaluation/Documentation Criteria

Field Evaluation of unlisted electrical equipment **shall** be documented. The documentation and Field Evaluation criteria as applicable **shall** be done as specified in this section.

1.1 Non-NRTL/Modified NRTL-Listed Electrical Equipment

Documentation (See Example Appendix A) shall include as appropriate:

- Equipment Owner name (optional), Badge etc.#(optional), group/organization
- Equipment Name
- Equipment Manufacturer
- Equipment model number
- Equipment serial number and property number if applicable
- Equipment location (optional)
- Equipment status: new, modified, not previously approved, in-use, etc.
- Equipment Type(optional):
 - Stand-alone custom built, or non reputable
 - System
 - Powered rack
 - Appliances and electrical tools
 - Powered Workbench
 - Extension cords and relocatable power taps
 - Other
- Function
- Usage:
 - Operating Environment
- Conditions of Usage/comments
- EQUIPMENT INSPECTOR tracking number if equipment is approved.
- Date examined and approved/rejected
- Name of EQUIPMENT INSPECTOR who examined and approved/rejected the equipment

Non-NRTL/modified NRTL-listed electrical equipment **shall** be examined at a minimum, checking for the following items as appropriate:

- External Inspection:
 - Enclosure
 - § Operator not exposed to any hazard
 - § Not damaged
 - § Appropriate material
 - § Protects contents from operating environment
 - § Will contain any arcs, sparks, electrical explosion
 - Power Source
 - § Cords and Plugs
 - Proper voltage and ampacity rating for plug and cord
 - Grounding conductor included if required
 - Not frayed or damaged

- Proper wiring of plug
 - Strain relief on cord
 - § Direct wired into facility
 - Proper voltage and ampacity rating for wiring method
 - Installation according to NEC
 - Proper loading and overcurrent protection in branch circuit
- Grounding
 - § Ground from cord or other is properly terminated
 - § All non-current-carrying exposed metal is properly bonded
 - § All non-current-carrying internal subsystems are properly bonded
 - § Equipment ground is run with circuit conductors
 - § Auxiliary ground permitted
 - Check termination
- Foreign Power Supplies and Equipment
 - § Connected to facility power with appropriate NRTL listed adapters
 - § Correct voltage, frequency, and phasing
 - § Correct wire ampacity for U.S. use
- Overcurrent Protection
 - § Adequate overcurrent protection? in equipment, or branch circuit
- Marking Requirements
 - § Hazards, including stored energy
 - § Power requirements (Voltage, current, frequency, power)
 - § Make/model/drawing number
 - § Restrictions and limitations of use
- Other Requirements
 - § Documentation adequate
 - § Procedures to use (IWD)
- Secondary Hazards
 - § RF hazards
 - § DC electric or magnetic fields
 - § IR, visible or UV
 - § X-rays
 - § Fire, electrical explosion
- Internal inspection:
 - Internal Wiring
 - § Polarity
 - § Phasing
 - § Landing of ground
 - § Separate line voltage and high voltage from low voltage
 - § Wiring terminals and leads
 - § Wire size
 - § Proper dielectric
 - § Clearance/creepage distances for high voltage
 - § Listed conductors, if applicable

- Other Internal Issues
 - § Neat workmanship
 - § Listed components used, if applicable
 - § Free of sharp edges
 - § Proper cooling
 - § Automatic discharge of high voltage capacitor
- Tests performed as deemed appropriate by Equipment Inspector
 - Ground continuity (less than an ohm)
 - Polarization of cord and plug
 - Auto discharge of high voltage capacitor
 - Functional Tests (e.g. GFCI, emergency shut-off etc.)
- Failure Analysis
 - Effect of ground fault
 - Effect of short circuit
 - Effect of interlock failure
 - Effect of overload
 - Effect of incorrect setting
- Maintenance
 - Any safety issues with access and maintenance

1.2 Facility Electrical Equipment

Documentation (See Example Appendix B) **shall** include at a minimum:

- Equipment Owner name (optional), Badge etc.#(optional), group/organization
- Equipment name
- Equipment manufacturer
- Equipment model number
- Equipment serial number and property number if applicable
- Equipment location (optional)
- Equipment function
- The 8 items checked
- Conditions of use/comments
- EQUIPMENT INSPECTOR tracking number if equipment is approved.
- Date examined and approved/rejected
- Name of EQUIPMENT INSPECTOR who examined and approved/rejected the equipment

Facility unlisted electrical equipment **shall** be examined (See Appendix C, Part 2), at a minimum, checking for the following items:

- Suitability for installation and use in conformity with 29 CFR 1910 Subpart S and/or NEC
- Mechanical strength and durability, including for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided

- Wire bending and connection space
- Electrical insulation
- Heating effects under normal condition of use and also under abnormal conditions likely to arise in service
- Arcing effects
- Classification by type, size, voltage, current capacity, and specific use
- Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment

1.3 Reputable Manufacturer Electrical Equipment

Documentation (See Example Appendix D) **shall** include at a minimum:

- Equipment Owner name (optional), Badge etc.#(optional), group/organization
- Equipment name
- Equipment manufacturer
- Equipment model number
- Equipment serial number and property number if applicable
- Equipment location (optional)
- Equipment function
- The 6 items checked
- Conditions of use/comments
- Equipment Inspector tracking number if equipment is approved.
- Date examined and approved/rejected
- Name of Equipment Inspector who examined and approved/rejected the equipment

Electrical Equipment manufactured by a reputable manufacturer **shall** be examined, at a minimum, checking for the following items:

- The case is grounded through the power cord to the grounding pin on the plug, if applicable (less than one Ohm).
- The plug is polarized, if applicable.
- The equipment input voltage and frequency match those of the power source (e.g., building's electrical system, etc.).
- The equipment construction is suitable for the intended operating environment.
- The equipment is in its original, unmodified, and undamaged condition.
- The equipment has externally accessible over current protection (e.g., fuses) that are properly sized, if appropriate. (Equipment not having externally accessible over current protection needs evaluation to determine if the equipment is safe for use.)

1.4 Multiple Identical Model Units

For approving multiple units of identical model units the following may be done:

- At least two units shall be Field Evaluated and documented in accordance with the appropriate sections of this chapter as follows:
 - *For Non-NRTL/modified NRTL-listed electrical equipment*, follow in-house built/modified NRTL-listed electrical equipment requirements (Section 1.1).

- For reputable manufactured electrical equipment, follow reputable manufacturer requirements (Section 1.2).
- The remaining units may be assumed to be built identically and approval granted after visual Field Evaluation of the outside of each unit has been complete to ensure it is the same make and model and has not been damaged or modified. This Field Evaluation shall be performed by an EQUIPMENT INSPECTOR. Each identical unit approved shall be recorded in the original approval documentation.
- For Systems, see Section 1.5.

1.5 System/Installation

Documentation (See Example Appendix E) for the system should include at a minimum:

- The items required to be evaluated for system Field Evaluation in this section
- Conditions of use/comments
- System description
- Subsystems
- System name
- Manufacturer
- Date built
- Date last modified
- Number of pieces of equipment (e.g., 3 power supplies, 2 modulator racks)
- System status
- System Owner name (optional), Badge etc.#(optional), group/organization
- Equipment location (optional)
- Specific tests performed for approval
- Immediate improvements, required modifications (with a due date) and compensatory measures taken in the meantime.
- Name of Division and Group EQUIPMENT INSPECTORs who examined and approved/rejected the system.
- EQUIPMENT INSPECTOR tracking number if equipment is approved. Site organizations may approve unlisted electrical equipment as systems. Systems shall be examined at a minimum as follows:
- Hazard Assessment to include:
 - Electrical hazard classification (see Chapter X of this document)
 - Stored electrical energy in capacitors (E and V)
 - Batteries, including UPSs
 - Electromagnetic fields produced (dc to 300 GHz, pulsed)
 - Infrared, optical, and UV
 - X-rays
 - Heat and sparks
 - Acoustic energy
 - Other (e.g., chemical high pressure, cryogen, etc. This may require other SME review)
- Evaluation For Operation to include:
 - Enclosure, isolation. No exposed hazardous energized conductors, no unused openings.
 - Grounding. All conductive enclosures exposed to personnel that may become energized **shall** be properly grounded.
 - Over current protection. Overload protection, ground fault, and short circuit protection.

- Failure analysis. Adequate electrical and fire protection systems for failure modes. (e.g. wiring, component failures etc.)
- Operation safety analysis and controls documented. (e.g., IWD)
- System is labeled appropriately.
- Evaluation For Working on System to include:
 - Method(s) of energy isolation (e.g., plug control, LOTO, Kirk key)
 - Automatic methods of stored energy removal
 - Proper design for the manual removal and/or verification of capacitively stored energy
 - Documentation for entry and work on system (e.g., IWD)

Section 2—Equipment Field Evaluation Numbering

Approved electrical equipment **shall** be assigned a Field Evaluation document file number. (e.g. an approving assignment number, bar code etc.)

2.1 Multiple Identical Model Units

Multiple units from a manufacturer with identical models may have the Field Evaluation document file number assigned as follows:

- The same approving assignment number, bar code etc. may be used for multiple identical make and model units/systems.
- The serial number (if available) or other unique identifier of each identical model unit/system identified as approved **shall** be documented on the same approval form used to document the approval of the representative sample as specified in Section 1.4.

Section 3—Labeling Approved Electrical Equipment

Approved electrical equipment shall be labeled (See Examples Appendix F). The approval label shall be green. The label shall be placed in a conspicuous (clearly visible) location ***The Field Evaluation number shall be on the equipment or the label.*** (Note: Environmental considerations should be made to prevent label deterioration).

3.1 NRTL-Listed Electrical Equipment (Recommended Practice)

A label that indicates the equipment is NRTL listed **should** be applied to NRTL-listed electrical equipment under the following conditions:

- The NRTL symbol (See <http://www.osha.gov/dts/otpca/nrtl/nrtlmrk.html>) is not in a conspicuous location (e.g., you cannot readily view it because the item is inaccessible in a rack or you need to open/disassemble the equipment enclosure to see the NRTL symbol, etc.).
- The NRTL symbol(s) is difficult to read.

3.2 Multiple Identical Model Units

All multiple identical model units documented, tracked, and approved following the provisions of Sections 1 and 2 shall be labeled.

3.3 Systems

A system shall be labeled or documented in such a manner that it is obvious to workers who use, work on, or work around the system that the system has been approved for use.

3.4 Low Hazard Equipment

Equipment that is Low Hazard Equipment (as defined in this document) may be labeled as such e.g. “Low Hazard” or “Class X.0 X.1” to indicate it is equipment that does not require field evaluation and approval.

Note: It is acceptable to label equipment that has been field evaluated and not found acceptable as “Rejected” or “Not Approved” etc.

Section 4—Special Circumstances for Field Evaluated Electrical Equipment

4.1 Salvaging/Excess/Removal of Equipment Inspector Approved Electrical Equipment

The following applies to approved electrical equipment that is salvaged, excessed, or removed from site property:

- *For equipment that is salvaged or excessed*, the approval is no longer valid and is void. *Note: the label should be removed and the approval documentation updated to reflect removed equipment.*
- *For equipment going off site for use*, the approval is no longer valid and is void unless the site the equipment will be used at accepts the approval of the site the equipment came from. *Note: Acceptance of equipment that has been labeled by another site's AHJ without further examination is allowed provided that the receiving AHJ reviews and accepts the equipment approval procedures followed by the other site.*

4.2 Subcontractor Unlisted Electrical Equipment

Appropriate management shall ensure that all subcontractor unlisted electrical equipment used at a DOE site is approved. Subcontractors working on site property are responsible for assuring that all unlisted electrical equipment they use is listed or approved by an Equipment Inspector.

4.3 Equipment Acquired from Excess/Salvage

Electrical equipment that is acquired from excess/salvage **shall** be reviewed and approved following the Field Evaluation and documentation criteria for reputable manufacturer electrical equipment in Section 1.3, if applicable. Otherwise, follow the criteria listed in Section 1.1. If the equipment in storage is listed or previously approved, and is new and/or in good condition, requirements for Field Evaluation are at the discretion of the EQUIPMENT INSPECTOR.

4.4 Rental Equipment

All rental electrical equipment shall be evaluated and accepted by a EQUIPMENT INSPECTOR prior to use according to the Field Evaluation and documentation criteria for reputable manufacturer electrical equipment listed in Section 1.3

This Page Intentionally Left Blank

Appendix A: Non-NRTL /Modified NRTL-Listed Electrical Equipment Approval Form

PART 1

Group:	Responsible Person (optional):	Badge etc. # (optional):
---------------	---------------------------------------	---------------------------------

Equipment Name:
 Multiple Single

Manufacturer:

Model Number:

Serial Number of Piece Equipment Actually Evaluated (See Attached for Additional Serial Numbers of identical equipment):

Property Number of Piece of Equipment Actually Evaluated (See attached for additional Property Numbers of identical equipment):

Location (optional)	TA:	Bldg:	Room:
----------------------------	------------	--------------	--------------

Identify Equipment Status : New Modified Not Previously Approved In Use

Equipment Type: Stand-alone custom built or non-reputable System Powered rack Appliance/electrical tools
 Powered workbench Extension cord/relocatable power taps Other

Function:

Operating Environment: Indoor/Dry Outdoor/wet/damp Flammable vapor/dust/flyings Explosives powder/solid

PART 2

External Inspection	
Enclosure:	Foreign Power Supplies and Equipment:
Operator not exposed to any hazard: <input type="checkbox"/> NA: <input type="checkbox"/>	Connected to facility power with appropriate adapters: <input type="checkbox"/> NA: <input type="checkbox"/>
Not damaged: <input type="checkbox"/> NA: <input type="checkbox"/>	Correct voltage, frequency and phasing: <input type="checkbox"/> NA: <input type="checkbox"/>
Appropriate material: <input type="checkbox"/> NA: <input type="checkbox"/>	Correct wire ampacity for U.S. use: <input type="checkbox"/> NA: <input type="checkbox"/>
Protects contents fro operating environment: <input type="checkbox"/> NA: <input type="checkbox"/>	Overcurrent Protection:
Will contain any arcs, sparks, electrical explosions: <input type="checkbox"/> NA: <input type="checkbox"/>	Adequate Overcurrent protection: Equipment <input type="checkbox"/> Branch circuit <input type="checkbox"/> NA: <input type="checkbox"/>
Power Source-cord and plugs:	
Proper voltage and ampacity rating for plug and cord: <input type="checkbox"/> NA: <input type="checkbox"/>	Marking Requirements:
Grounding conductor included if required (to bond metallic enclosure etc.): <input type="checkbox"/> NA: <input type="checkbox"/>	Hazards, including stored energy: <input type="checkbox"/> NA: <input type="checkbox"/>
Not frayed or damaged: <input type="checkbox"/> NA: <input type="checkbox"/>	Power requirements (watts, voltage, current, frequency): <input type="checkbox"/>
Proper wiring of plug: <input type="checkbox"/> NA: <input type="checkbox"/>	Restriction and limitations of use: <input type="checkbox"/> NA: <input type="checkbox"/>
Strain relief on cord: <input type="checkbox"/> NA: <input type="checkbox"/>	
Power Source-Direct wire into facility:	Other Requirements:
Proper voltage and ampacity rating for wiring method: <input type="checkbox"/> NA: <input type="checkbox"/>	Documentation adequate: <input type="checkbox"/> NA: <input type="checkbox"/>
Installation according to NEC: <input type="checkbox"/> NA: <input type="checkbox"/>	Procedures to use (IWD): Yes <input type="checkbox"/> No <input type="checkbox"/>
Proper loading and overcurrent protection in branch circuit: <input type="checkbox"/> NA: <input type="checkbox"/>	Training and qualification to use: Yes <input type="checkbox"/> No <input type="checkbox"/>
Grounding External/Internal:	Secondary Hazards:
Ground from cord or other is properly terminated: <input type="checkbox"/> NA: <input type="checkbox"/>	Rf hazards: Yes <input type="checkbox"/> No <input type="checkbox"/>
All non-current carrying exposed metal is properly bonded: <input type="checkbox"/> NA: <input type="checkbox"/>	dc electric or magnetic fields: Yes <input type="checkbox"/> No <input type="checkbox"/>
All non-current carrying internal subsystems are properly bonded: <input type="checkbox"/> NA: <input type="checkbox"/>	IR, visible or UV: Yes <input type="checkbox"/> No <input type="checkbox"/>
Equipment ground is run with circuit conductors: <input type="checkbox"/> NA: <input type="checkbox"/>	X-rays: Yes <input type="checkbox"/> No <input type="checkbox"/>
Auxiliary ground permitted: <input type="checkbox"/> Check Termination: <input type="checkbox"/> NA: <input type="checkbox"/>	Fire, electrical explosion: <input type="checkbox"/> NA: <input type="checkbox"/>

PART 2 (Continued)

Internal Inspection)	
Internal Wiring:	Tests Performed:
Polarity correct: <input type="checkbox"/> NA: <input type="checkbox"/>	Ground continuity: <input type="checkbox"/> (less than 1 ohm)
Phasing correct: <input type="checkbox"/> NA: <input type="checkbox"/>	Polarization of cord and plug: <input type="checkbox"/> NA: <input type="checkbox"/>
Landing of ground correct: <input type="checkbox"/> NA: <input type="checkbox"/>	Auto discharge of high voltage capacitor: <input type="checkbox"/> NA: <input type="checkbox"/>
Separate line voltage and high voltage from low voltage: <input type="checkbox"/> NA: <input type="checkbox"/>	Function Test (e.g. GFCI, emergency shut-off): <input type="checkbox"/> NA: <input type="checkbox"/>
Wiring terminals and leads ok: <input type="checkbox"/> NA: <input type="checkbox"/>	
Wire size: <input type="checkbox"/> NA: <input type="checkbox"/>	
Proper dielectric: <input type="checkbox"/>	Failure Analysis:
Clearance/creepage distances for high voltage ok: <input type="checkbox"/> NA: <input type="checkbox"/>	Effect of ground fault: <input type="checkbox"/>
Listed conductors, if applicable: <input type="checkbox"/> NA: <input type="checkbox"/>	Effect of short circuit: <input type="checkbox"/>
Other Internal Issues:	Effect of interlock failure: <input type="checkbox"/> NA: <input type="checkbox"/>
Neat workmanship: <input type="checkbox"/>	Effect of overload: <input type="checkbox"/>
Listed components used, if applicable: <input type="checkbox"/> NA: <input type="checkbox"/>	Effect of incorrect setting: <input type="checkbox"/> NA: <input type="checkbox"/>
Free of sharp edges: <input type="checkbox"/> NA: <input type="checkbox"/>	Maintenance:
Proper cooling: <input type="checkbox"/> NA: <input type="checkbox"/>	Any safety issues with access and maintenance: Yes <input type="checkbox"/> No <input type="checkbox"/>
Automatic discharge of high voltage capacitor: <input type="checkbox"/> NA: <input type="checkbox"/>	

EQUIPMENT INSPECTOR Tracking Number of Piece of Equipment Actually Evaluated (See attached for additional EQUIPMENT INSPECTOR Tracking numbers of identical equipment if individual numbers were assigned):

NOTE: APPROVED EQUIPMENT SHALL BE INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTIONS PROVIDED BY THE DESIGNER/BUILDER AND EQUIPMENT INSPECTOR.

Condition of Usage (Include all designer/builder instructions, drawings or information that is relevant to the safe installation and use of this equipment. Attach additional sheets as necessary.):

This equipment is APPROVED for installation or use. IF THIS EQUIPMENT IS MODIFIED, DAMAGED, OR UTILIZED FOR OTHER THAN THE INTENDED USE STATED ABOVE, THIS APPROVAL IS VOID, PENDING REFIELD EVALUATION.

DATE:	EQUIPMENT INSPECTOR Printed Name:	EQUIPMENT INSPECTOR Signature:

This equipment is REJECTED for use (See Comments Above).

Date:	EQUIPMENT INSPECTOR Printed Name:	EQUIPMENT INSPECTOR Signature:

This Page Intentionally Left Blank

Appendix B: Facility Electrical Equipment Approval Form

PART 1			
Group:	Responsible Person (optional):	Badge etc. # (optional):	
Equipment Name: <input type="checkbox"/> Multiple <input type="checkbox"/> Single			
Manufacturer:			
Model Number:			
Serial Number of Piece Equipment Actually Evaluated (See Attached for Additional Serial Numbers of identical equipment):			
Property Number of Piece of Equipment Actually Evaluated (See attached for additional Property Numbers of identical equipment):			
Location (optional)	TA:	Bldg:	Room:
Identify Equipment Status : <input type="checkbox"/> New <input type="checkbox"/> Modified <input type="checkbox"/> Not Previously Approved <input type="checkbox"/> In use			
Function:			
PART 2 (Refer to Appendix C)		APPROVE	REJECT
1. Suitability for installation and use in conformity with 29 CFR 1910 Subpart S and/or NEC.		<input type="checkbox"/>	<input type="checkbox"/>
2. Mechanical strength and durability, including for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided.		<input type="checkbox"/>	<input type="checkbox"/>
3. Wire bending and connection space.		<input type="checkbox"/>	<input type="checkbox"/>
4. Electrical insulation.		<input type="checkbox"/>	<input type="checkbox"/>
5. Heating effects under normal conditions of use and also under abnormal conditions likely to arise in service.		<input type="checkbox"/>	<input type="checkbox"/>
6. Arcing effects.		<input type="checkbox"/>	<input type="checkbox"/>
7. Classification by type, size, voltage, current capacity, and specific use.		<input type="checkbox"/>	<input type="checkbox"/>
8. Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment.		<input type="checkbox"/>	<input type="checkbox"/>
EQUIPMENT INSPECTOR Tracking Number of Piece of Equipment Actually Evaluated (See attached for additional EQUIPMENT INSPECTOR Tracking numbers of identical equipment if individual numbers were assigned):			
NOTE: APPROVED EQUIPMENT SHALL BE INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTIONS PROVIDED BY THE DESIGNER/BUILDER AND EQUIPMENT INSPECTOR.			
CONDITIONS OF USE: <input type="checkbox"/> Indoor Only <input type="checkbox"/> Damp/Wet Locations <input type="checkbox"/> Hazardous Classified Locations (Flammable/Explosive)			
COMMENTS (Include all designer/builder instructions, drawings or information that is relevant to the safe installation and use of this equipment. Attach additional sheets as necessary.):			

This equipment is APPROVED for installation or use at LANL. IF THIS EQUIPMENT IS MODIFIED, DAMAGED, OR UTILIZED FOR OTHER THAN THE INTENDED USE STATED ABOVE, THIS APPROVAL IS VOID, PENDING REFIELD EVALUATION.

DATE:	EQUIPMENT INSPECTOR Printed Name:	EQUIPMENT INSPECTOR Signature:

This equipment is REJECTED for use at LANL (See Comments Above.).

Date:	EQUIPMENT INSPECTOR Printed Name:	EQUIPMENT INSPECTOR Signature:

Appendix C: Instructions for Facility Electrical Equipment Approval Form

PART 1 – Equipment Identification

- Enter as much information as necessary to be able to track adequately.
- Equipment Status refers to equipment operation. If equipment is new or modified, it shall be examined and approved using Section 2 of this document checklist. If equipment has not been previously approved, the equipment shall be examined and approved before use.
- The function should be stated to give a short description of the use of the equipment.

PART 2 – Example Guidelines for Equipment Approval

I. Some potential considerations of suitability for installation and use are as follows:

- Operation, considering environmental conditions
- Temperature, humidity, air pressure, non-ionizing radiation (RF and EMI), ionizing radiation, outdoor/indoor, etc.
- Normal and abnormal use, considering duty cycle, average and peak power, etc.
- Properly sized and installed equipment grounding (chassis grounding)
- Equipment design that includes consideration of the available short circuit and ground fault current
- Properly sized and installed over-current protection (fuses or circuit breakers)
- Separation of high- and low-voltage components, especially where high voltage could escape along a hidden fault path

(See 2005 NEC 250.110 & 110.9.)

II. Mechanical strength and durability considerations include the following:

- Enclosure of parts to:
 - Prevent damage to internal components during use and transportation
 - Contain arcing, heating, and explosion
 - Prevent injury to personnel from hazardous energized parts
 - Prevent damage to internal components from environmental conditions
- Workmanship—unused openings effectively closed
- Integrity of electrical equipment and connections
- Any item that would adversely affect the safe operation or mechanical strength of the equipment, such as damaged, corroded, or overheated parts

(See 2005 NEC 110.12.)

III. Wire bending and connection space includes the consideration of assembly and potential repair based on the following:

- The protection of conductors and their insulation against damage by over-bending, over crowding, location near moving parts in equipment, and at termination points.

(See 2005 NEC 312.6 and Tables 312.6(a) & (b).)

IV. The integrity of insulation ensures that the system or component does the following:

- Prevents the escape/transfer of electrical energy to other conductors and to personnel;
- Is free from short circuits or potential short circuits;
- Uses listed conductors where possible; and

- Is free from grounds other than those required or permitted by Article 250 of the National Electrical Code.

(See 2005 NEC 110.7.)

V. Verify that conductors are installed and used in such a manner that normal listed or approved temperature ratings are not exceeded. If the condition of use in the R&D environment is substantially different from that anticipated in the product listing, have a subject matter expert determine that an appropriate level of safety is maintained. Also determine that exposed parts will not burn personnel or initiate fires.

(See 2005 NEC 310.10, including the Fine Print Note.)

VI. Appropriate requirements for arcing effects include the following:

- If the equipment's ordinary operation produces arcs, sparks, flames, or molten metal, verify that it is enclosed or separated and isolated from all combustible material.
- Verify that potential arc blast/electrical explosions are prevented from injuring personnel and damaging other equipment

(See 2005 NEC 110.18.)

VII. Require that a permanent label be attached to the equipment that includes the following:

- The manufacturer's (or local builder's) name or other descriptive marking by which the organization responsible for the equipment can be identified
- Other markings will include the equipment voltage, current, wattage, and any additional wording that the EQUIPMENT INSPECTOR deems necessary for the safe operation of the equipment (e.g., type, size, power, stored energy, secondary hazards, specific use, and specific users)

(See 2005 NEC 110.21.)

VIII. Other factors contributing to the practical safeguarding of personnel include the following:

- Reviewing non-electrical hazards by appropriate subject matter experts.
- Preventing electric shock, burn, or reflex hazards by eliminating personnel contact,
- Ensuring that live parts of equipment operating at 50 volts or more are protected against accidental contact by approved enclosures or by any of the following means:
 - By location in a box, enclosure, room, or vault that is accessible only to Equipment Inspectors
 - By suitable permanent, substantial partitions or screens arranged so that only Equipment Inspectors will have access to the space within reach of the live parts
 - By location on a suitable balcony, gallery, or platform elevated and arranged so as to exclude unEquipment Inspectors
 - By elevation of 8 ft or more above the floor or other working surface
- A procedure of safeing and energy removal, e.g., disconnection, LOTO, removal of stored energy, for both normal/emergency shutdown has been established
- Damage to eyes, skin or other equipment from UV and IR
- Personnel injury or equipment interference from RF fields
- Preventing personnel exposure to excessive noise
- Preventing personnel exposure to X-rays for equipment >15 kV operating, especially in a vacuum
- Standard designs, including fail-safe design:
 - Use listed or recognized components where possible

- Use accepted color coding of wires, especially grounded (white or gray) and grounding conductors (bare or green)
- Consider the loss of electrical power, pneumatic, etc.
- Consider the automatic removal of stored energy
- Consider the use of interlocks on enclosures and other systems

(See 2005 NEC 110.27 and 110.31.)

This Page Left Intentionally Blank

Appendix D: Reputable Manufacturer Unlisted Electrical Equipment Approval Form

PART 1			
Group:	Responsible Person (optional):	Badge etc. # (optional):	
Equipment Name: <input type="checkbox"/> Multiple <input type="checkbox"/> Single			
Manufacturer:			
Model Number:			
Serial Number of Piece Equipment Actually Evaluated (See Attached for Additional Serial Numbers of identical equipment):			
Property Number of Piece of Equipment Actually Evaluated (See attached for additional Property Numbers of identical equipment):			
Location (optional)	TA:	Bldg:	Room:
Identify Equipment Status : <input type="checkbox"/> New <input type="checkbox"/> Modified <input type="checkbox"/> Not Previously Approved <input type="checkbox"/> In Use			
Function:			
PART 2		APPROVE	REJECT
1. The case is grounded (Less than 1 ohm) through the power cord to the grounding pin on the plug.		<input type="checkbox"/>	<input type="checkbox"/>
2. The plug is polarized.		<input type="checkbox"/>	<input type="checkbox"/>
3. The equipment input voltage and frequency match those of the building's electrical system.		<input type="checkbox"/>	<input type="checkbox"/>
4. The equipment construction is suitable for the intended operating environment.		<input type="checkbox"/>	<input type="checkbox"/>
5. The equipment is in its original, unmodified and undamaged condition.		<input type="checkbox"/>	<input type="checkbox"/>
6. The equipment has externally accessible supplementary over current protection (e.g. fuses) that are properly sized. (Equipment not having this, needs evaluation to determine if the equipment is safe for use)		<input type="checkbox"/>	<input type="checkbox"/>
EQUIPMENT INSPECTOR Tracking Number of Piece of Equipment Actually Evaluated (See attached for additional EQUIPMENT INSPECTOR Tracking numbers of identical equipment if individual numbers were assigned):			
NOTE: APPROVED EQUIPMENT SHALL BE INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTIONS PROVIDED BY THE DESIGNER/BUILDER AND EQUIPMENT INSPECTOR.			
CONDITIONS OF USE: <input type="checkbox"/> Indoor Only <input type="checkbox"/> Damp/Wet Locations <input type="checkbox"/> Hazardous Classified Locations (Flammable/Explosive)			
COMMENTS (Include all designer/builder instructions, drawings or information that is relevant to the safe installation and use of this equipment. Attach additional sheets as necessary.):			

This equipment is APPROVED for installation or use. IF THIS EQUIPMENT IS MODIFIED, DAMAGED, OR UTILIZED FOR OTHER THAN THE INTENDED USE STATED ABOVE, THIS APPROVAL IS VOID, PENDING REFIELD EVALUATION.

DATE:	EQUIPMENT INSPECTOR Printed Name:	EQUIPMENT INSPECTOR Signature:

This equipment is REJECTED for use at (See Comments Above.).

Date:	EQUIPMENT INSPECTOR Printed Name:	EQUIPMENT INSPECTOR Signature:

Appendix E: Electrical Systems Approval Form

PART 1 – EQUIPMENT DATA:

Approval is for intended use within the approving organization only

Group(s):	Responsible Person(s):	Badge etc. Number(s):
System Name:		
Serial Number of system actually evaluated (see attached for additional serial numbers of Identical systems):		
System Description:		
Manufacturer:		# of pieces of equipment:
Date Built:		Date Last Modified:
Status (check one): <input type="checkbox"/> New <input type="checkbox"/> Modified <input type="checkbox"/> Not Previously Approved		
Equipment Location:	TA:	Building: Room:
Subsystems:		

PART 2 – HAZARD ASSESSMENT

Determine all electrical and non-electrical hazards that could injure an employee, including the operation and maintenance workers.

1	Electrical hazard classification	
2	Stored electrical energy in capacitors (E and V)	
3	Batteries, including UPSs	
4	Electromagnetic fields produced (dc to 300 GHz, pulsed)	
5	Infrared, optical, and UV	
6	X-rays	
7	Heat and sparks	
8	Acoustic energy	
9	Other (chemical, high pressure, cryogen, etc.)	

PART 3 – EVALUATION FOR OPERATION: Determine that electrical equipment is free from recognized hazards that are likely to cause death or serious physical harm to employees during system operation [29 CFR 1910.303 (b)].		Approve	Reject
1	Enclosure, isolation. No exposed hazardous energized conductors, no unused openings.	<input type="checkbox"/>	<input type="checkbox"/>
2	Grounding. All conductive enclosures exposed to personnel properly grounded.	<input type="checkbox"/>	<input type="checkbox"/>
3	Overcurrent protection. Provision for overload, ground fault, and short circuit protection.	<input type="checkbox"/>	<input type="checkbox"/>
4	Failure analysis. Adequate electrical and fire protection systems for failure modes.	<input type="checkbox"/>	<input type="checkbox"/>
5	Operation safety analysis and controls documented where? e.g., HCP	<input type="checkbox"/>	<input type="checkbox"/>
6	System is labeled as approved, how?	<input type="checkbox"/>	<input type="checkbox"/>
7	other, explain	<input type="checkbox"/>	<input type="checkbox"/>
PART 4 – EVALUATION FOR WORKING ON SYSTEM: Determine that engineering methods are implemented to safely enter into and work on the system.		Approve	Reject
1	Method(s) of energy isolation (e.g., plug control, LOTO, Kirk key).	<input type="checkbox"/>	<input type="checkbox"/>
2	Automatic methods of stored energy removal.	<input type="checkbox"/>	<input type="checkbox"/>
3	Proper design for the manual removal and/or verification of capacitively stored energy.	<input type="checkbox"/>	<input type="checkbox"/>
4	Documentation for entry and work on system where?	<input type="checkbox"/>	<input type="checkbox"/>
EQUIPMENT INSPECTOR Tracking Number:			

NOTE: SYSTEM SHALL BE INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTIONS PROVIDED BY THE DESIGNER/BUILDER, EQUIPMENT INSPECTOR or HCP.

Comments/conditions of use: (Include all designer/builder instructions, restrictions on use, drawings or information that is relevant to the safe installation and use of this equipment. Attach additional sheets as necessary.)

- This system and its associated electrical equipment is approved for installation and use at LANL. IF THIS SYSTEM IS MODIFIED, DAMAGED, OR REPAIRED IN A MANNER THAT AFFECTS SAFETY, THIS APPROVAL IS VOID, PENDING RE-FIELD EVALUATION BY AN EQUIPMENT INSPECTOR.
- This system is rejected for use at LANL (See comments Above)

Note: the following signatures indicate that these EQUIPMENT INSPECTORS have reviewed some or all parts of this system for safety. In some cases an EQUIPMENT INSPECTOR inspects only sections of the system for which their group is responsible. The Division EQUIPMENT INSPECTOR assures that all components have been reviewed by one or more group EQUIPMENT INSPECTORS.

Division	Date:	Division EQUIPMENT INSPECTOR	Division EQUIPMENT INSPECTOR Signature
Division	Date:	EQUIPMENT INSPECTOR Print	EQUIPMENT INSPECTOR Signature:
Division	Date:	EQUIPMENT INSPECTOR Print	EQUIPMENT INSPECTOR Signature:
Division	Date:	EQUIPMENT INSPECTOR Print	EQUIPMENT INSPECTOR Signature:
Division	Date:	EQUIPMENT INSPECTOR Print	EQUIPMENT INSPECTOR Signature:

PART 5 – SPECIFIC TESTS PERFORMED FOR APPROVAL				
List tests performed relevant to safety. This primarily applies to new systems.			Date	Who
1				
2				
3				
4				
5				
6				
7				
PART 6 – IMMEDIATE IMPROVEMENTS				
List required modifications (with a due date) and compensatory measures taken.			Date	Who
1				
2				
3				
4				
5				
6				
7				

Appendix F: EXAMPLE APPROVAL LABELS

ELECTRICAL SAFETY APPROVED	
File No.	_____
Division / Group	_____
ESO _____	Date _____
Approved for the intended use only within the approving organization. Refer to LIR402-600-01.	

Los Alamos National Laboratory (LANL) Label



**APPROVED
ELECTRICAL SAFETY**

Date _____ By _____

20051.

Sandia National Laboratory (SNL) Label



Argonne National Laboratory (ANL) Label