1. REQUIREMENTS

1.1 Electrical Safety Training

1.1.1 Affected personnel working at INL facilities and areas shall be trained in accordance with:

A. National Electrical Code (NEC), NFPA 70.

B. Standard for Electrical Safety in the Workplace, NFPA 70E, 2009 Edition

C. National Electrical Code, ANSI C2

1.2 Identifying and Complying with Electrical Safety Requirements

1.2.1 Job hazards associated with electrical work shall be evaluated, mitigated, and communicated per RD-2000, Work Coordination and Hazard Control.

1.2.2 The flow chart in NFPA 70E, Annex F, and the electrical job safety analysis (JSA) (example, Appendix A) shall be used to determine required hazards control.

1.2.3 Live parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee works on or near them, unless work on energized components can be justified according to NFPA 70E, 130.1 “Justification for Work”.

1.2.4 Except as described in 1.3, below, electrical safety practices shall comply with the requirements in this document and with all applicable requirements of NFPA 70E.

1.3 Exceptions to NFPA 70E Electrical Safety Requirements

1.3.1 29 CFR 1910.269, Electrical Power Generation, Transmission, and Distribution, shall apply to work on generation, transmission, or distribution systems.

1.3.2 LWP-9400, Lockouts and Tagouts, shall be used rather than NFPA 70E, Annex G, Sample Lockout/Tagout procedure. A hard copy of this procedure is available from Construction Management personnel.

1.3.3 The definition for near in this procedure shall be used, rather than that found in the NFPA 70E definitions (see subsection 1.6 of this procedure for instructions for working near overhead electrical lines).

1.3.4 Ground fault circuit interrupter (GFCI) protection (which may include portable GFCI units or cord sets incorporating listed ground-fault circuit-interrupter protection) shall be used as follows.

1.3.4.1 GFCI protection shall be used for all temporary wiring applications that supply power to equipment used by personnel for service and construction, remodeling, maintenance, repair, or demolition of buildings, structures, or equipment.

NOTE: *Temporary wiring shall have documented testing by an Idaho State Licensed Electrician performed prior to use. This documentation shall include the State Licenses number of the electrician performing the test.*

1.3.4.2 GFCI protection shall be used for all 125-volt, single-phase, 15- 20 and 30-ampere receptacle outlets used for temporary electric power, or as an extension to the power supply cord.

Exception: *Receptacles on a 2-wire, single-phase portable or vehicle-mounted generator rated not more than 5kw, where the circuit conductors of the generator are insulated from the generator frame and all other grounded surfaces, do not require GFCI protection.*

1.3.5 RF Electricians: Refer to Article 340 of NFPA 70E 2005 Edition for work involving radio frequency (RF) equipment.

1.4 Assured Equipment Grounding Conductor Program for Cord and Plug Connected Equipment

NOTE: *The following applies to all cord and plug connected equipment, powered by circuits other than 125 volt, 15, 20, and 30 amp circuits utilizing a GFCI, that is used by personnel for service and construction, remodeling, maintenance, repair, or demolition of buildings, structures or similar activities. This shall include, but not be limited to, such equipment as Bang Boards (temporary power panels) which are powered by a Separately Derived System (transformer). The Bang Board shall be grounded, on the secondary side of the transformer, per National Electric Code (NEC) Article 250.*

1.4.1 Develop and maintain an Assured Equipment Grounding Conductor Program (AEGCP) that complies with the current edition of the National Electric Code.

1.4.2 Ensure that the AEGCP requires that the following tests be performed and recorded.

1.4.2.1 All equipment-grounding conductors shall be tested for continuity, this should also include a continuity check between the grounding prong of the cord plug and the case of the equipment. Values shall be 10 ohms or less.

1.4.2.2 Each receptacle and attachment plug shall be checked for correct attachment of the equipment-grounding conductor to the correct terminal.

1.4.2.3 All current carrying conductors shall be checked for the correct polarity.

1.4.2.4 All current carrying conductors shall be checked for continuity between them and the grounding conductor and the case equipment. Values shall be infinity.

1.4.3 Ensure that the AEGCP requires that the tests mentioned above are performed at the following intervals:

1.4.3.1 Before the electrical equipment is used on a subcontractor's site.

1.4.3.2 When there is evidence of electrical equipment damage.

1.4.3.3 Before electrical equipment is returned to service following repairs.

1.4.3.4 At least every three months for equipment used for temporary purposes.

1.4.4 When equipment is covered by the AEGCP, ensure that a written procedure is continuously enforced at the site by one or more designated persons, who are trained to the requirements of this procedure, to ensure that equipment grounding conductors for all cord sets, receptacles that are not a part of the permanent wiring of the building or structure, and equipment connected by cord and plug are installed and maintained in accordance with the applicable requirements of the current issue of NEPA-70.

1.5 Personal Protective Equipment (PPE)

1.5.1 Only PPE that meets the applicable requirements for electrical work shall be used.

1.5.2 The following kinds of PPE shall be tested by a certified testing laboratory per the following schedule:

Item	Frequency
Rubber gloves (in use)	6 Months
Rubber gloves (in storage)	12 Months
Rubber sleeves	12 Months
Rubber blankets	12 Months

1.5.3 Rubber gloves shall be selected based on the maximum use voltage (phase-to-phase or phase-to-ground) in accordance with the following table:

Class	Voltage	Label
Class 00	500 V	Red or Yellow
Class 0	1,000 V	Red
Class 1	7.5 kV	White
Class 2	17 kV	Yellow
Class 3	26.5 kV	Green
Class 4	36 kV	Orange

1.5.4 Class O or class OO gloves without leather protectors shall be used ONLY for making fine adjustments, taking measurements, or performing other similar intricate work.

1.6 Working Near Overhead Electrical Lines

1.6.1 Before work is performed near overhead electrical lines, the Contractor POC shall be notified and the following approvals and clearances shall be obtained.

1.6.1.1 When lines must be de-energized, the Contractor POC shall be notified 72 hours in advance.

1.6.1.2 Before performing work where personnel or equipment can make contact with distribution system equipment while working within 50 feet of overhead power lines, a high-voltage work permit and/or high-voltage work clearance shall be obtained.

1.6.1.3 Before work is performed within 13 feet of energized distribution or transmission lines, a high-voltage work clearance shall be obtained to have the power de-energized.

1.6.1.4 Except in emergencies, all outages on INL power lines shall be coordinated by the area outage coordinator.

1.6.1.5 For overhead lines not belonging to Power Management, the approach distances found in NFPA 70E, Annex C, shall be used.

1.7 Work on or Near Live Parts/Energized Components

1.7.1 In addition to electrical safety requirements imposed in the subcontract documents, requirements of NFPA 70E, Article 130, “Justification for Work” shall be applied to electrical work, (electrical hazard analysis, shock hazards analysis, flash hazard analysis, etc.).

1.7.2 If work will involve or will be performed around exposed, energized components, the Contractor POC shall be contacted to determine safe approach distances and boundaries (including flash protection boundary, limited approach boundary, restricted approach boundary, and prohibited approach boundary, as appropriate).

1.7.3 Appropriate boundaries as identified in NFPA 70E shall be installed and maintained around exposed, energized components.

1.7.4 Only those persons who have specialized training appropriate to the hazards involved shall be allowed to cross boundaries around exposed, energized components.

1.7.5 The work control document shall specify PPE that is appropriate for such work and is rated for the voltage and energy level involved.

1.8 Emergency Situations

1.8.1 All personnel shall respond immediately to emergency situations by contacting the INL power dispatcher by phone (526-2300) or by contacting the WCC at 526-1515 or by radio, channel WCC/TRF.

NOTE: *Examples of an emergency situation are power lines on the ground, power poles on fire, damage to a power pole causing power lines to fall, vehicles or equipment coming into contact with lines, and danger to people and/or property.*

1.8.2 If a line has fallen on an occupied vehicle, occupants shall stay in the vehicle until help arrives from Power Management, UNLESS it is

necessary to leave the vehicle to obtain assistance or because of other hazards such as fire.

1.8.3 When a line is on the ground, on a vehicle, or touching a piece of machinery such as a crane, the following precautions shall be taken:

1.8.3.1 Do not approach a downed line.

1.8.3.2 If it is necessary to leave a vehicle or the area of a downed line, take the following protective actions.

1.8.3.2.1 Do not touch the vehicle and the earth at the same time.

1.8.3.2.2 Avoid step potentials in the earth that result when energized lines come in contact with the earth by either:

A. hopping away from the vehicle and the lines with both feet together

<u>OR</u>

B. taking small shuffling steps.

1.8.3.2.3 Never, under any circumstance, touch the vehicle involved while standing on the ground.

2. DEFINITIONS

For definitions of terms used throughout the INL Subcontractor Requirements Manual, refer to LST-359.

3. REFERENCES

3.1 Source Documents

NFPA 70 National Electrical Code

NFPA 70E, 2009 Edition, Standard for Electrical Safety Requirements for Employee Workplaces.

29 CFR 1926 Subpart K - Electrical

3.2 Related Requirements

The following documents may also contain requirements that apply to this activity:

RD-2012, Lockouts and Tagouts
RD-2000, Work Coordination and Hazard Control

4. APPENDICES

Appendix A, Electrical Job Safety Analysis

Appendix A

Job Safety Analysis (Example)

JSA #:_____

Activity Being Analyzed:		**JSA Developed by:**	
Facility or Project and Location:	**Date of Analysis:** **Update Review Requirements:**	**S&H Representative Approval/Date:**	**Facility or Project Manager Approval /Date:**
Brief Description of the Job and Expected Results:			
Required Job Training:		**Required Personal Protective Equipment:**	

Job Steps	Hazards	Hazard Elimination
1. Work area is prepared.	1.A Disabling necessary services or exposure hazardous processes.	1.A.1 Drawings and prints are reviewed to identify multiple power sources and critical operations or safety systems affected. 1.A.2 All required forms are processed for outages, lockouts and tagouts, fire systems emergency alarms, hazardous chemicals, etc. Work is coordinated with facility or area management.
	1.B Lack of training or experience.	1.B.1 All personnel are trained and qualified, and follow procedures. 1.B.2 Workers who are not familiar with area or system(s) are briefed by line management. 1.B.3 A pre-job briefing is conducted per NFPA Annex I, I.1 and LWP-9201.
2. General requirements common to energized and deenergized work.	2.A Using portable power	2.A.1 All electrical portable power tools, operating at 110 volts or more are protected by a GFCI.
	2.B Shock (conductive materials).	2.B.1 All conductive materials (such as jewelry and key chains) are removed from the body. 2.B.2 Electrically safe hard hats are worn whenever there is a danger of head injury from electrical shock or burns due to contact with exposed energized parts.
	2.C Flash burns.	2.C.1 Full cover fire retardant clothing and face shield are worn when there is a possibility of exposure to an electrical arc flash while working inside the flash protection boundary.
	2.D Lack of work coordination.	2.D.1 Before performing ANY work, facility management is contacted and facility management authorization is received.
3. Diagnostic, troubleshooting, and calibration activities.	3.A Shock (conductive materials).	3.A.1 Diagnostic, troubleshooting, and calibration activities may be performed with approved test instruments and equipment on exposed energized electrical conductors and circuit parts by qualified personnel without the use of lockout and tagout ONLY after all other possibilities have been eliminated.

DEENERGIZING SYSTEMS

4. Verifying system is deenergized.	4.A Electrocution prior to deenergization. Class / Voltage 00 — 500 V 0 — 1,000 V 1 — 7.5 kV 2 — 17 kV 3 — 26.5 kV 4 — 36 kV	4.A.1 **Backup and the *100% rule* are required for electrical systems over 300 volts**. For electrical systems 300 volts or less, the need for backup is determined by the qualified person performing the job. Back up must have the same level of safety training and PPE as the worker performing the work. Backup has no other duties, other than protecting the person performing the work from the hazards associated with electrical shock. 4.A.2 The system is deenergized, locked, and tagged out. 4.A.3 The system is tried to verify that the power has been interrupted. 4.A.4 In addition to the hazard elimination performed in **2, 3, and 4**, verification is made that the system is deenergized using instruments approved for the purpose and the following PPE: ∃ **less than 300 volts line to line:** minimum requirement is to conduct a hazards evaluation and use electrically insulated tools, PPE, and shields or barriers, as appropriate. ∃ **300 volts to ground and less than 600 volts line to line:** minimum PPE: eye and face protection, gloves rated for the voltage, (see chart at left), and an electrically rated insulated mat when practical. ∃ **600 volts to ground and less than 13.8 KV line to line:** minimum PPE: eye and face protection, gloves rated for the voltage (see chart at left), an electrically insulated mat and sleeves, when practical. In addition to PPE, the system must be grounded with appropriate ground clusters whenever possible; if it isn=t grounded it isn=t dead, appropriate PPE must be used. 4.A.5 Other close proximity conductors are identified and either deenergized, locked and tagged, or insulation barriers are provided. It is ensured that all sources of power have been checked.

ENERGIZED SYSTEMS

5. Electrical work is performed on **energized systems** over 50 volts ONLY if management has demonstrated that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limits. Reference 29 CFR 1910.333(a)(1). **Approval for working on or near energized parts:** Signature of immediate supervisor or foreman. _____ Signature of person in charge of the facility. _____	5.A Injury and/or incapacitation Class / Voltage 00 — 500 V 0 — 1,000 V 1 — 7.5 kV 2 — 17 kV 3 — 26.5 kV 4 — 36 kV	5.A.1 **Backup and the *100% rule* are required for electrical systems over 300 volts**. For electrical systems 300 volts or less, the need for backup is determined by the qualified person performing the job. Backup must have the same safety training and PPE as the worker performing the work. Backup has no other duties, other than protecting the person performing the work from the hazards associated with electrical shock. 5.B.1 Voltages involved are identified, including close proximity circuits. Electrical work is performed using the personal protective equipment listed below: ∃ **less than 300 volts line to line:** minimum requirement is to conduct a hazards evaluation and use electric insulated tools, PPE, and shields or barriers, as appropriate. ∃ **300 volts to ground and less than 600 volts line to line**: minimum PPE: eye and face protection, gloves r the voltage, (see chart at left), and an electrically rated insulated mat when practical. ∃ **600 volts to ground and less than 13.8 kV line to line:** minimum PPE: eye and face protection, gloves rated for the voltage (see chart at left), an electrically insulated mat and sleeves, when practical. It is recommended that when working with voltages above 600 volts, two sources of protection are used (such as hot stick and gloves, hot stick and bucket truck, or blanket and gloves).

Additional Hazards Identified and Methods of Elimination		