National High Magnetic Field Laboratory Safety Program

TITLE: Electrical Work Program	**SUBJECT:** Electrical Work Methods Assurance
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Additional Approval Signatures on Revision and Approval Page	**APPROVAL:** NHMFL Deputy Lab Director 

Overall Mission and Overview:

The National High Magnetic Field Laboratory (NHMFL) Environmental, Health, and Safety (EHS) program's mission is to:

Provide support and guidance to all NHMFL departments with the implementation, maintenance and review of a comprehensive environmental, health, and safety program. The primary goal of the MagLab's EHS program is to control, reduce or eliminate work-related injuries, illnesses and loss of NHMFL resources.

The NHMFL is charged by the National Science Foundation (NSF) to safely:

- Promote magnet-related research to serve an interdisciplinary scientific user community.
- Provide unique high-magnetic-field facilities through a competitive and transparent proposal review process.
- Advance magnet and magnet-related technology.
- Partner with universities, other national laboratories and industry to enhance national competitiveness in magnet and related technologies.
- Serve the NSF as a prominent example of its successful stewardship of large research facilities.
- Support science and technology education in the United States.
- Increase diversity in the science, technology, engineering, and mathematics workforce
- Promote collaboration among our three partner institutions: Florida State University (FSU), the University of Florida (UF) and Los Alamos National Laboratory (LANL).

ELECTRICAL WORK PROGRAM INDEX:

1.0 PURPOSE:

This program and attached appendices establish reasonable and adequate methods to assure minimum practical protection from electrical shock, arc, and blast hazards for all employees and contractors who are required to perform work in the vicinity of exposed energized circuits. This procedure is written in accordance with the NFPA 70E.

2.0 SCOPE:

This program applies to all personnel at the NHMFL, including employees and contractors working on electrical equipment or systems that are under the control of the NHMFL.
This program identifies the specific requirements for the protection of personnel working on facility machinery, equipment, and systems from the hazards due to the unexpected or accidental release of stored or potential energy. All personnel who may be exposed to the hazards of electricity are required to be familiar with this procedure. However, knowledge in the specifics of this procedure does not make a person qualified to work in proximity to energized or potentially energized exposed electrical parts. Work practices shall be established at each work area and for each job task, which include specific electrical safety concerns/activities.

3.0 POLICY:

It is the policy of the NHMFL that all live parts operating at 50 volts or above to which an employee may be exposed shall be place in an electrically safe work condition before work is done on or near them (Refer to SP-1 Safety Clearance Procedure), except under the following circumstances:

- When de-energizing would introduce additional or increased threats to human life or health.
- When de-energization is not feasible due to the nature of the work to be performed (such as troubleshooting, calibration or testing) or the type of equipment being worked on.

All energized electrical work that is not classified as calibrating, troubleshooting, or testing requires an Energized Electrical Work Permit (see Error! Reference source not found.) that must be signed by the safety office, head of facilities and the Director of the lab or their designee.

4.0 DEFINITIONS AND ACRONYMS:

Arc Flash - A dangerous condition associated with the possible release of energy caused by an electric arc. This hazard may exist when electrical conductors are exposed or when enclosed and a person interacts with the equipment in such a way that could cause an arc.

Arc Flash Hazard Analysis - A study investigating a worker's potential exposure to arc flash energy, conducted for the purpose of injury prevention and the determination of safe work practices, arc flash boundary, and the appropriate levels of personal protective equipment (PPE). The NHMFL has performed an Arc Flash Hazard Analysis up to all electrical panels.

Boundary, Arc Flash - The distance beyond which the energy from an arc flash will be ≤ 1.2 cal/cm^2 or has the potential for a second degree burn or less.

4.0 DEFINITIONS AND ACRONYMS (CONT.)

Boundary Limited Approach - The distance at which a shock hazard exists, which a barrier must be set up, and which only qualified personnel are allowed to cross.

Boundary, Prohibited Approach - The distance at which a shock hazard exists, which the qualified employee's head and torso must not pass.

Boundary, Restricted Approach - The distance at which a shock hazard exists, which the qualified employee's hands and arms and tools must be insulated against the nominal voltage of the system. The qualified employee assumes that any item which passes this boundary will come in contact with the energized conductor.

Arc Flash Suit - A complete arc-rated clothing and equipment system that covers the entire body, except for the hands and feet.

Arc Rating - The value attributed to materials that describe their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm^2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of break open threshold (EBT) (should a material system exhibit a break open response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value.

Electrical Hazard - A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

Energized - Electrically connected to, or is, a source of voltage.

Enclosure - The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage.

Qualified Person - One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.

Electrically Safe Work Condition - A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with SP-1, and tested to ensure the absence of voltage.

Working on energized electrical conductors or circuit parts - Intentionally encountering energized electrical conductors or circuit parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment a person is wearing. There are two categories of "working on": Diagnostic testing is taking readings or measurements of electrical equipment with approved test equipment that does not require making any physical change to the equipment; repair is any physical alteration of electrical equipment such as making or tightening connections, removing, or replacing components, etc.

5.0 TRAINING

5.1 Employees that will perform energized electrical work must be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury. This training shall include:

5.2 Electrical Worker Qualified Person 0 (QP-0):

a. Completion of Electrical Safety Online Training
b. Completion of Shop and Tool Online Training
c. Completion of Safety Clearance Procedure SP-1 Online Training
d. Completion of Controlled Access Procedure SP-18 Online Training
e. Completion of CPR and AED Training
f. Completion of Electrical Procedure SP-70 Online Training
g. Completion of Electrical QP-0 Qualification Card NHMFL Qualification Card QC-2.1.

5.3 Electrical Worker Qualified Person 2 (QP-2):
Completion of QP-0 training plus:

a. Completion of Electrical QP-2 Qualification Card NHMFL Qualification Card QC-2.2.

5.4 Electrical Worker Qualified Person 4 (QP-4):
Completion of QP-2 training plus:

a. Completion of Electrical Worker QP-4 Qualification Card NHMFL Qualification Card-2.3.

5.5 Electrical Worker Qualified Person 4 Magnet Power Supply and Transformer Technician (QP-4MSPTT):
Completion of QP-2 training plus:

a. Completion of Electrical Worker QP-4MPSTT Qualification Card NHMFL Qualification Card -2.4

5.6 Schedules shall be established to provide retraining of personnel to stay current on any work techniques and procedural changes. Retraining cycles shall not exceed 1 year.

5.7 Training shall be documented for each employee trained. The documentation shall be made when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment. The documentation shall contain the content of training, each employee's name,

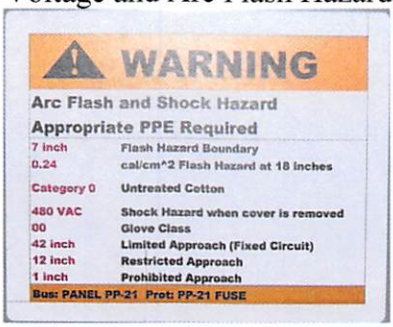
and dates of training. Records of employee training shall be retained by the NHMFL Safety Department.

6.0 PERFORMING ENERGIZED ELECTRICAL WORK:

6.1 The decision to perform energized work shall be made by the NHMFL Director or designee on a case-by-case basis where it has been determined that it is infeasible (not inconvenient) or could produce a greater hazard to de-energize the equipment.

6.2 TROUBLESHOOTING/TESTING/REPAIR/INSTALLATION PROCESS

1. Determine Nominal Voltage and Arc Flash Hazard of the Electrical System



2. Determine Limited Approach Boundary, Prohibited Approach Boundary, Restricted Approach Boundary

Nominal Voltage	Limited Approach Boundary	Restricted Approach Boundary	Prohibited Approach Boundary
50V - 240 V	3 ft 6 in (1m)	1" (25 mm)	1" (25 mm)
240V – 800V	3 ft 6 in (1m)	1 ft (0.3 m)	1" (25 mm)
800V-5 kV	5 ft (1.5m)	1ft 5 in (0.5m)	4" (0.1 m)
5kV-15kV	5 ft (1.5m)	2ft 2 in (0.7m)	7" (0.2 m)

3. Determine Personal Qualification Level and Required PPE for Hazard Risk Category (HRC).

NOMINAL SYSTEM VOLTAGE	ARC FLASH HAZARD CATEGORY	REQUIRED QUALIFICATION LEVEL	PPE	MIN ISM RISK CAT
50-120	None	QP0	PERFORM ISM	LOW
>120-300	0	QP2	HRC0	*LOW MED
>300-750	0	QP2	HRC0	LOW MED
	1	QP2	HRC2	LOW MED
	2	QP2	HRC2	LOW MED
	3	QP4&QP4-MPSTT	HRC4	MED
	4	QP4&QP4-MPSTT	HRC4	MED
751-15kV	4	QP4&QP4-MPSTT	HRC4	MED

*Can be reduced to Low if working on a single-phase circuit <= 220.

See **Appendix 2** for Arc Flash Protective Clothing required for each Hazard Risk Category.

4. Determine if an Energized Work Permit is Required
   a. Troubleshooting or testing at a HRC 2 or less does not require an energized work permit.
   b. Troubleshooting or testing at a HRC 4 does require an Energized Work Permit.
   c. Repair or installation does require an Energized Work Permit.

5. Perform ISM Hazard Analysis and Mitigation as follows:
   a. Prior to performing any energized electrical work task, an ISM hazard analysis must be conducted.
   b. See **Appendix 4** for guidance on ISM risk for many common electrical tasks at the NHMFL.

6. Obtain ISM or Energized Work Permit Approvals. See **Appendix 1** for Energized Work Permit.

7. Establish Barricades as required by section 9.0

8. Complete mitigation required by ISM process

9. Don PPE

10. Perform Work

6.3 Additional job briefings shall be held if changes that might affect the safety of employees occur during the work.

6.4 A standing energized work permit may be issued for energized work that may need to be performed on a regular basis by qualified employees. Standing energized work permits must be renewed annually.

7.0 OPERATING ELECTRICAL EQUIPMENT:

7.1 An arc flash hazard may exist when a person interacts with enclosed electrical equipment in such a way that could cause an arc. The ability of an arc to turn into an explosive arc flash is dependent on the impedance of the electrical system to that point, the voltage and the time before the protective device opens. In general, single circuits are safer than electrical panels which are safer than, main bussing and switch gear.

7.2 See **Appendix 4** for guidance on ISM risk for many common electrical tasks at the NHMFL.

7.3 Examples of operations with a low-medium or higher ISM risk category that may cause an arc flash include:

- 7.3.1 Opening or closing large manual disconnects > 200 amps (45T Power Supply, RS Compressors)
- 7.3.2 Manually opening circuits on large motors while running
- 7.3.3 Starting large motors by manually closing the disconnect
- 7.3.4 Opening or closing circuits on equipment with faulty protection breakers
- 7.3.5 Reclosing circuits after repeated trips
- 7.3.6 Racking in or out switch gear breakers
- 7.3.7 Manually closing or opening 800 amp or greater switchgear breakers.
- 7.3.8 Opening or closing bus disconnect switches on the 480V distribution bus

7.4 Examples of operations that can be mitigated to a low ISM risk category with Level 0 PPE include:

7.4.1 Switching an on/off control switch in a motor control center, or for a high-powered fixed piece of equipment.
7.4.2 Plugging in equipment <600V

7.5 Examples of operations with a low ISM risk category that are in hazard category 0 include:

7.5.1 Switching on or off a single branch circuit breaker in an electrical panel <=480V
7.5.2 Opening a disconnect on a piece of equipment such as a vacuum pump or milling machine where the motor is turned off.
7.5.3 Switching an on/off control switch for a fixed piece of equipment fed by a single branch circuit.
7.5.4 Plugging in equipment <240V
7.5.5 Turning on normal office or laboratory lights

8.0 BARRICADES:

8.1 Conductors that are exposed, and not in an electrically safe work condition shall be barricaded to prevent inadvertent touch or approach within an area where the Arc Flash energy is > 1.2 cal/cm. Barricades are not required for 120V systems fed by a single circuit < 20 A.

8.2 Barricade Requirements for energized conductors:
8.2.1 The barricade shall be set up at or beyond the Arc Flash Boundary or the Limited Approach Boundary, whichever is greater. The minimum distance is 42" (1m) away from the exposed conductor.
8.2.2 The barricade shall be easily recognizable and continuous so that the safe boundary is clearly defined.

8.3 Only qualified employees wearing the appropriate PPE shall be permitted inside of the barricade.

8.4 While the conductor is exposed, the area must be occupied by a qualified person.

8.5 The NHMFL combines the Arc Flash and Shock Boundaries (Limited Approach, Prohibited Approach, and Restricted Approach) as defined in NFPA70E to simplify.

9.0 ELECTRICAL WORK TOOLS

9.1 All tools shall be maintained in good working condition. Only tools specifically designed for the task at hand shall be used.

9.2 When working in proximity to energized or potentially energized conductors and exposed electrical parts, workers shall use insulated tools and equipment if the tools and equipment have the potential to contact such conductors or exposed electrical parts. Tools used as insulated must be rated for the intended task and must be visually inspected for damage before use.

9.3 Portable ladders shall have nonconductive side rails.

9.4 Extension cords, power strips and temporary wiring used in maintenance and other non-office related activities shall be equipped with UL approved GFCI protection.

10.0 EQUIPMENT IDENTIFICATION REQUIRMENTS

10.1 Equipment shall have labels or information placards placed in easily accessible locations. Information required shall include such items as manufacturer's name, voltage, current, wattage or other ratings as required.

10.2 All disconnecting devices shall be legibly marked as to their purpose.

10.3 Entrances to locations where there are exposed energized electrical parts shall be marked with danger signs indicating the electrical contact hazard and the voltage level. The signs shall also indicate entry is restricted to qualified persons.

10.4 Where possible, entrances to such locations shall be locked or otherwise made inaccessible to unqualified personnel.

11.0 BATTERIES AND BATTERY BANKS

11.1 Rechargeable large capacity storage batteries used as a source of electrical energy and the areas, in which they are housed, require focused practices to minimize risk to personnel while servicing and/or inspecting. The following procedures shall be observed.

11.2 Only insulated hand tools shall be used when working on or near exposed battery terminals when there is a risk due to grounding.

11.3 Checking and filling/draining of battery electrolyte shall only be performed by personnel properly protected by eye protection (goggles or face shields), long sleeves and rubber gloves.

11.4 Exhaust systems shall be properly maintained and operable to minimize the risk of hazardous and toxic fume accumulation.

11.5 Facilities for quick drenching of the eyes and body with fresh water shall be immediately available when there is a potential for battery electrolyte exposure.

12.0 PREVENTIVE MAINTENANCE

The following sections identify minimum preventive maintenance requirements.

12.1 All grounding and bonding systems shall be maintained and tested.

12.2 Workings spaces around, and escape routes from, electrical equipment shall be kept clear and unobstructed.

12.3 Warning signs shall be generously distributed, securely attached and maintained in legible condition.

12.4 All protective covers, doors and other enclosing systems shall be properly in place to ensure that no unprotected openings exist.

12.5 Attachment plugs, receptacles, cover plates and connectors shall be maintained in good working condition.

12.6 Substation, switchgear, and other electrical equipment enclosures shall be kept free of vegetation, miscellaneous material, and spare parts.

12.7 Up-dated facility one-line drawings of the switch gear, electrical riser diagrams up to the panel level, and electrical floor plan drawings of panels and switch gear shall be updated every three years.

12.8 The ARC Flash study shall be updated every three years or as necessary.

12.9 Switchgear and Main Transformer shall be visually inspected annually by qualified employees to determine general condition of all equipment including the integrity of grounding systems.

12.10 Switchgear Breakers in US1, US2, US3, US4 and GS gear will be exercised on an annual basis and removed for inspection and testing every three years.

13.0 CONTRACTORS PERFORMING ENERGIZED ELECTRICAL WORK

13.1 Contractors must provide a list of electrical workers and their qualifications to the NHMFL before performing energized electrical work. A documented meeting shall take place between the NHMFL and the contractor.

13.2 The NHMFL shall inform contract employers of the following:

13.2.1 Information about the scope of work the contractor needs.

13.2.3 Known hazards that are covered by their scope of work.

13.3 The NHMFL shall report observed contract employer-related violations to the contractor.

13.4 The contractor shall ensure that each of his or her employees is instructed in the hazards associated with the scope of work.

13.5 The contractor shall ensure that each of his or her employees follows the work practices required by this procedure and the scope of work.

14.0 AUDITING:

14.1 The electrical safety program shall undergo a documented audit every 3 years by the NHMFL Safety Department to verify the principles and procedures of the electrical safety program are following this procedure.

14.2 Field work shall undergo a documented audit to verify the requirements contained in the procedures of the electrical safety program are being followed. When the auditing determines that the principles and procedures of the electrical safety program are not being followed, the appropriate revisions to the training program or revisions to the procedures shall be made.

14.3 The frequency of field work audits shall not exceed 1 year.

14.4 The frequency of PPE inspections shall not exceed 6 months.

APPENDIX 1: NHMFL ENERGIZED WORK PERMIT

NHMFL Energized Work Permit			
Building:	Room/Area:		Equipment:
Job Supervisor:		Date Start/Time:	Expiration Date/Time:
Description of work to be done:			
Description of Circuit/Equipment:			
Justification for why equipment cannot be de-energized:			
Results of Shock Hazard Analysis (NFPA-70E 2004 130.2)			
Maximum Voltage:	Glove Voltage Rating: (Inspect gloves before use, check certification date)		
Limited Approach Boundary: (in.)	Restricted Approach Boundary: (in.)	Prohibited Approach Boundary: (in.)	
Results of Arc Flash Hazard Analysis (NFPA-70E 2004 130.3)			
Hazard Risk Category:	Flash Protection Boundary: (in.)		
☐ All-Natural Fiber Outerwear			
☐ Fire Retardant Clothing	ATPV Rating: Cal/cm^2		
☐ Required Additional PPE:			
Safety Checklist (Verify that proper controls are in place):			
☐ Workers must be trained, qualified, and have full knowledge of equipment.			
☐ Safety watch is required. This person must be trained, qualified, be able to cut off all power sources, and have immediate access to a telephone or radio to call 911 in case of emergency.			
☐ Insulated tools and equipment required.			
☐ Remove all jewelry and metal apparel.			
☐ Use barricades and warning signs.			
☐ Documented job briefing (ISM) including discussion of any job-specific hazards.			
☐ See attachment for added information, special requirements, procedures, or written work plans.			
APPROVALS			
Safety Department Representative:			Date:
Head of Facilities or Designee:			Date:
Lab Director or Designee:			Date:
AUTHORIZED WORKERS that understand and agree to the above:			
Printed or typed name(s):	Signature(s)		Date(s)

Note:
When a Safety Watch is required, the Safety Watch must be a QUALIFIED PERSON who is responsible for monitoring the qualified person(s) doing the work. A Safety Watch must:

- Be a QUALIFIED PERSON
- Have no other duties that preclude continually observing, coaching, and monitoring for potential hazards and mistakes
- Have a thorough knowledge of the specific working procedures to be followed and the work to be done
- Be close enough to the work in progress to safely monitor the progress and methods of the QUALIFIED PERSON doing the work: The Safety Watch must use clothing and PPE appropriate to the hazard and the distance from the work in progress. In no case should the Safety Watch be more than 50 feet from the qualified person (s) performing the work.
- Ensure only QUALIFIED PERSONS are allowed to enter the LIMITED APPROACH BOUNDARY

APPENDIX 2: ARC FLASH PROTECTIVE CLOTHING

Hazard/Risk Category	Protective Clothing and PPE
0	**Protective Clothing, Non-melting, or Untreated Natural Fiber (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a Fabric Weight of at Least 4.5 oz/yd^2** Shirt (long sleeve) Pant (long) **Protective Equipment** Safety glasses or safety goggles (SR) Hearing Protection (ear canal inserts) Heavy duty leather gloves (AN) (See Note 1.)
2	**Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm^2 (See Note 3.)** Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated flash suit hood or arc rated face shield (See Note 2) and arc-rated balaclava Arc-rated jacket, parka, rainwear, or hardhat liner (AN) **Protective Equipment** Hard hat Safety Glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves with rubber insulated inserts (See Note 1.) Leather work shoes
4	**Arc-Rated Clothing Selected So That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm^2 (See Note 3.)** Arc-rated long sleeve shirt (AR) & Arc-rated pants (AR) or Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves with rubber insulated inserts (See Note 1.) Arc-rated jacket parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses (SR) Hearing Protection (ear canal inserts) Leather work shoes
Legend/Notes	**AN: as needed (optional). AR: as required. SR: selection required** **Notes:** 1. If rubber insulating gloves with leather protectors are required by Table 130.7(C) (9) of NFPA 70E, additional leather or arc related gloves are not required. The combination of rubber insulting gloves with leather protectors satisfies the arc flash protection requirement. 2. Face shields are to have wrap-around guarding to protect not only the face but the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn. 3. Arc rating is defined in Article 100 and can be either the arc thermal performance value (ATPV) or energy of break open threshold (E_{bt}). ATPV is defined in ASTM F 1959, *Standard Test Method for Determining the Arc Thermal Performance Value of Materials for Clothing*, as the incident energy on a material, or a multilayer system of materials, that results in a 50 percent probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll curve, in cal/cm^2. E_{bt} is defined in ASTM F 1959 as the incident energy on a material or material system that results in a 50 percent probability of break open. Arc rating is reported as either ATPV or EBT, whichever is the lower value.

APPENDIX 2: ARC FLASH PROTECTIVE CLOTHING-CONTINUED

- **General requirements and PPE maintenance**

  - Equipment shall be appropriate for the specific parts of the body to be protected and for the work to be performed.
  - Protective equipment shall be maintained in a safe and reliable condition and shall be periodically inspected and/or tested as required. At a minimum, all PPE shall be inspected by the user before each usage.
  - Damaged, or equipment failing to pass test requirement, shall be properly disposed of and replaced
  - When performing work on exposed electrical equipment, clothing with exposed zippers, metal buttons, metal fasteners, or loose or flapping parts must not be worn.
  - Conductive articles of jewelry, such as watch bands, bracelets, rings, necklaces, and oversized belt buckles shall not be worn when there is a danger of encountering energized parts.

- **Specific equipment care and maintenance**

  - Hard hats shall be kept clean and in good condition and shall not be altered or defaced in any manner.
  - If the eye or face protective devices exhibit broken parts, heat distortion, or excessive scratches on the lens they shall not be used.
  - Arc Rated clothing shall be worn where there is a danger of an electrical explosion or severe arcing.
  - All clothing shall be examined by the qualified person for rips, tears, and/or flaws in the material or workmanship prior to each use. If they are damaged in any way, they shall not be used.
  - Everyone assigned protective equipment shall be responsible for the care and storage of the issued equipment.
  - All new protective rubber equipment shall be certified by the supplier as having been tested by a certified testing laboratory, prior to being issued for use.
  - Rubber protective equipment shall be tested according to ASTM and OSHA 1910.137 at intervals not to exceed those listed below.

Rubber Gloves	6 months
Rubber Blankets	12 months
Rubber Sleeves	12 months
All other rubber goods	As required by inspection

- **Rubber insulated protective equipment**

    - Rubber insulated protective equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damaged.
    - Insulating equipment with any of the following defects shall not be used:
    - A hole, tears, puncture, or cut.
    - Ozone cutting or ozone checking (the cutting action produced by ozone on rubber under mechanical stress into a series of interlacing cracks).
    - An embedded foreign object.
    - Any of the following texture changes: swelling, softening, hardening, or becoming sticky or inelastic.
    - Any other defect that damages the insulating properties.

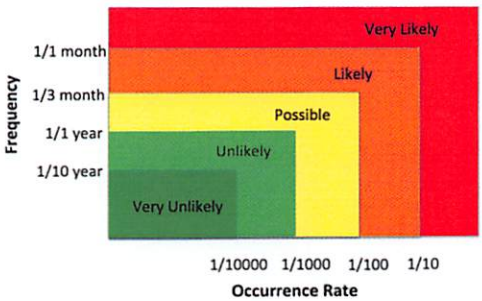
- **Gloves**
    - Gloves in service shall be kept in canvas glove bags, cuff down. Gloves shall not be folded, creased, or rolled while in storage. Gloves shall be protected from heat, ozone, or prolonged exposure to the direct rays of the sun, and from contact with sharp articles or materials likely to damage gloves or causes deterioration of the rubber. Clean only with lukewarm water and mild soap detergent. Do not use solvents, oils, or grease on rubber gloves. Do not powder gloves with baby powder or other dusts which contain softening agents. Use only manufacturer recommended powers and dusts.

APPENDIX 3: INTEGRATED SAFETY MANAGEMENT:

All electrical work tasks must be evaluated using the integrated safety management to determine how the work should proceed. Electrical determined to fall in the Low-Medium or above requires a second worker to be present. Specific requirements are defined below:

1. Define the Scope
2. Analyze the hazards
3. Develop and implement hazard controls
4. Perform work within the controls
5. Feedback and improvements

		Consequences				
		A	B	C	D	E
	Likelihood	Negligible	Minor	Moderate	Significant	Severe
E	Very Likely	Low Med	Medium	Med Hi	High	High
D	Likely	Low	Low Med	Medium	Med Hi	High
C	Possible	Low	Low Med	Medium	Med Hi	Med Hi
B	Unlikely	Low	Low Med	Low Med	Medium	Med Hi
A	Very Unlikely	Low	Low	Low Med	Medium	Medium



Definitions:

Consequences, in a worst-case scenario if something goes wrong:

A. Negligible: minor injury resulting in basic first aid treatment that can be provided on site.
B. Minor: minor injury resulting in advanced first aid treatment administered by a physician.
C. Moderate: injuries that require treatment above first aid but do not require hospitalization.
D. Significant: Severe injuries and hospitalization.
E. Severe: Death or permanent disability.

Likelihood, whichever is the greater risk (see graphic):

A. Very Unlikely: less than once in a ten thousand times (<0.01%) and less frequently than once per 10 years.
B. Unlikely: less than once in a thousand times (<0.1% of the time) and less frequently than once per year.
C. Possible: less than once in a hundred times (<1% of the time) and less frequently than once per 3 months.
D. Likely: less than once in ten times (<10% of the time) and less than once per month.

E. Very likely: more than once in ten times and more frequently than once per month.

Residual risk categories after all controls are in place define how the work will proceed:

A. Low: proceed using ISM
B. Low Medium: proceed with caution using ISM. A second worker is in the vicinity.
C. Medium: Seek guidance from safety department before proceeding. Two authorized workers must be in place before work can proceed. Limited number of authorized workers as maintained by the safety department.
D. Medium High. Seek guidance from safety department before proceeding. Two authorized workers must be in place before work can proceed. Limited number of authorized workers as maintained by the safety department. Work can only proceed if authorized by the Director or his designee.
E. High: Work will not be performed.

ENERGIZED WORK ISM GUIDANCE:

a. None of the AC electrical systems at the NHMFL <=240V have a Arc Flash energy higher than a Hazard Risk Category 0 (1.2 cal/cm at 18")
b. The primary hazard of exposed conductors <= 120V AC is shock. These circuits have been shown empirically in IEEE 1584 to have minimal potential to create an Arc Flash. Although an arc can form at 120V, the 60Hz sinusoidal wave form crosses through zero 120 times each second. Both the current and voltage decay to the point where the arc will extinguish within 0.5 cycles or 0.008 second. This prevents the arc from developing enough energy to turn into expanding, burning plasma.
c. If uncertain about the nominal voltage or arc flash hazard, contact the NHMFL Facilities Department.
d. Electrical equipment and feeders shall be considered energized until they are locked, tagged, and verified in accordance with Safety Clearance Procedure – SP-1.
e. Verification of de-energized condition shall be made by a qualified person before any work is performed on or near exposed electrical parts.
f. A qualified person shall verify that no energized condition exists because of inadvertently induced voltage and/or back feed.
g. Test equipment shall be checked for proper operation immediately before and immediately after this test following manufacturer's recommendations.

ISM HAZARDS TO CONSIDER

a. Shock from inadvertent touch. If any part of your body or tool will get closer than the restricted approach boundary to an energized conductor, it should be protected and insulated as if contact will be made.
b. The position of hands and other body parts in relation to the exposed conductor.
c. Slipping, falling, or reaching which may result in an uncontrolled movement into a

d. conductor.
e. Working on ladders or other unstable work positions.
f. Exposure to other workers or visitors.
g. Stored energy in capacitors.
h. Reenergization or changes in energy levels due to controls activation, capacitors, magnet quenches, other employees.
i. Condition of electrical insulation of testing equipment.
j. Jewelry or other conductive materials.
k. Wet conditions or sweating skin.
l. Loose connections or conductors which may come loose.
m. Conductive objects such as tubing, tape measures, glasses, tools which may come in contract with exposed conductors or can fall causing a short circuit.
n. Poor lighting making it difficult to see energized components.
o. Not enough information about the circuit, possible voltages or hazards associated with the circuit.

MITIGATING STEPS:

a. GFCI outlets or GFCI extension cords.
b. Use of clip-on leads for digital multi meters.
c. Make sure that any work that does not require energized circuits is completed separate from testing.
d. Making test equipment connections with equipment that is deenergized and then energizing with conductors enclosed.
e. Review of task by second person
f. Use of insulated gloves
g. Safety Glasses.
h. Waiting for scheduled downtime.
i. Check connections with power off.
j. Designing equipment with enclosed test points.
k. Designing equipment with enclosed electrical components for non-electrical work.
l. Good lighting.
m. Proper ladders or platforms to ensure comfortable, stable body positions.

APPENDIX 4: ISM GUIDELINES FOR COMMON ELECTRICAL TROUBLESHOOTING, TESTING, REPAIR, MAINTENANCE AND OPERATION

Task	ISM LIKELIHOOD OF GENERATING AN ARC FLASH	ISM CONSEQUENCE BEFORE CONTROLS	ISM RISK CATEGORY AFTER CONTROLS	PPE	MITIGATION/CONTROLS	QP LEVEL	LIMITED APPROACH BOUNDARY	RESTRICTED APPROACH BOUNDARY	PROHIBITED APPROACH BOUNDARY
Use of DMM to 50V - 120V	Very Unlikely	Minor	Low	Safety Glasses	Assumes all body parts are 1" or > from exposed conductors (insulated tool)	0	Qualified person present	contact	contact
Use of DMM to 120V < 240V on <=20 A circuit	Very Unlikely	Minor	Low	Level 0	Assumes all body parts are 1" or > from exposed conductors (insulated tool)	0	Qualified person present	contact	contact
Use of DMM to 120V < 240V on => 20 A circuit	Unlikely	Minor	Low Med	Level 0	2 Man Rule, Meter not in hand, one hand at back	2	3'6"	1'	1"
Use of DMM to 480V	Unlikely	Moderate	Low Med	Level 2 unless labeled for less	2 Man Rule, Meter not in hand, one hand at back	2	3'6"	1'	1"
Use of DMM up to 700V	Unlikely	Significant	Low Med	Level 4	2 Man Rule, Meter not in hand, one hand at back	4	3'6"	1'	1"
Use of test equipment > 700 V	Unlikely	Significant	Low Med	Level 4	2 Man Rule, Hot Stick	4	3'6"/5'	2'2"	7"
Switching Breakers in Enclosed Panel <= 480V	Very Unlikely	Negligible	Low	None	None	None	None	None	None
Operating HOA Control Switches in an MCC	Unlikely	Negligible	Low	Level 0	Stand to Side	0	None	None	None
Operating HOA Control Switches in a MCC after a trip	Unlikely	Negligible	Low	Level 0	Stand to Side	0	None	None	None
Operating HOA Control Switches in a MCC after a repeated trip	Unlikely	Negligible	Low Med	Level 0	2 Man Rule	2	None	None	None
Operating Disconnect in a MCC under load	Unlikely	Moderate	Low Med	Level 2	2 Man Rule, Stand to Side	2	None	None	None

Task	ISM LIKELIHOOD OF GENERATING AN ARC FLASH	ISM CONSEQUENCE BEFORE CONTROLS	ISM RISK CATEGORY AFTER CONTROLS	PPE	MITIGATION/CONTROLS	QP LEVEL	LIMITED APPROACH BOUNDARY	RESTRICTED APPROACH BOUNDARY	PROHIBITED APPROACH BOUNDARY
Operating single circuit disconnect <=480V and <200amps	Very Unlikely	Negligible	Low	Level 0	Stand to Side	0	None	None	None
Operating hybrid disconnect - PS off	Very Unlikely	Moderate	Low Med	Level 2	2 Man Rule, Stand to Side	2	None	None	None
Operating Bus Plugs	Very Unlikely	Moderate	Low Med	Level 2	2 Man Rule, Use Insulated Pole	2	None	None	None
Operating > 200A Disconnect	Very Unlikely	Moderate	Low Med	Level 2	2 Man Rule, Stand to Side	2	None	None	None
Resetting 480V Breaker in WTP, LR280, PURIFIER Panel	Unlikely	Moderate	Low Med	Level 2	2 Man Rule,	2	3'6"	1'	1"
Plugging in PLC cable in LR280, PURIFIER Panel	Unlikely	Moderate	Low Med	Level 2	2 Man Rule	2	3'6"	1'	1"
Plugging in PLC cable in WTCP	Unlikely	Negligible	Low	Level 0		0	3'6"	contact	contact
Replacing fuses in energized cabinet < 600V	Likely	Severe	Medium High		Energized Work Permit	4	3'6"	1'	1"
Removing or Replacing fuse in MCC bucket w same box disconnect locked out (all disc locked out)	Unlikely	Moderate	Low Med	Level 2	2 Man Rule, LO/TO	2	3'6"	1'	1"
Opening door visual inspect on HRC 3 480V gear - no switching	Very Unlikely	Severe	Low Med	Level 2	2 Man Rule,	2	3'6"	1'	1"
Opening door visual inspect on HRC 3 480V gear – switching	Unlikely	Severe	Low Med	Level 4	2 Man Rule	2	3'6"	1'	1"
Racking HRC 3 breakers using remote racking tool - outside Arc Flash Boundary	Unlikely	Negligible	Low	Safety Glasses, Hearing Protection	2 Man Rule	0	3'6"	1'	1"
Operating HRC 3 breakers using remote trip/charge - outside Arc Flash Boundary	Unlikely	Negligible	Low	Safety Glasses, Hearing Protection	2 Man Rule	0	3'6"	1'	1"

Racking HRC 3 Breaker using Remote tool, breaker hangs up	Possible	Significant	Medium High		Energized Work Permit		3'6"	1'	1"
Task	ISM LIKELIHOOD OF GENERATING AN ARC FLASH	ISM CONSEQUENCE BEFORE CONTROLS	ISM RISK CATEGORY AFTER CONTROLS	PPE	MITIGATION/CONTROLS	QP LEVEL	LIMITED APPROACH BOUNDARY	RESTRICTED APPROACH BOUNDARY	PROHIBITED APPROACH BOUNDARY
Opening door on 12.4 KV branch breakers visual inspection - no switching	Very Unlikely	Significant	Low	Level 0		0	5'	2'2"	7"
Opening door on 12.4 KV main breakers visual inspection - no switching	Very Unlikely	Severe	Low Med	Level 2	2 Man Rule	2	5'	2'2"	7"
Pulling wire into an energized panel <600 V	Possible	Significant	Medium High		Energized Work Permit	4	3'6"	1'	1"
Drilling Holes in an energized panel <600 V	Possible	Significant	Medium High		Energized Work Permit	4	3'6"	1'	1"
Pulling wire in a conduit w energized conductors <600 V	Unlikely	Moderate	Medium High		Energized Work Permit	4	3'6"	1'	1"
Running wire in a cable tray with energized conductors	Unlikely	Negligible	Low	Safety glasses and gloves		0	None	None	None
Plugging in a cord up to 220V	Very Unlikely	Negligible	Low	none		None	None	None	None
Plugging in a cord 220 - 480V	Unlikely	Negligible	Low	Level 0		0	None	None	None
Tightening screws in DCS cabinet	Unlikely	Negligible	Low	Safety Glasses	Assumes all body parts are 1" or > from exposed conductors (insulated tool)	0	Qualified person present	contact	contact
Tightening screws in an energized 120V control panel	Unlikely	Negligible	Low	Safety Glasses	Assumes all body parts are 1" or > from exposed conductors (insulated tool)	2	Qualified person present	contact	contact

Task	ISM LIKELIHOOD OF GENERATING AN ARC FLASH	ISM CONSEQUENCE BEFORE CONTROLS	ISM RISK CATEGORY AFTER CONTROLS	PPE	MITIGATION/CONTROLS	QP LEVEL	LIMITED APPROACH BOUNDARY	RESTRICTED APPROACH BOUNDARY	PROHIBITED APPROACH BOUNDARY
Tightening screws that are energized 240V Panel	Possible	Moderate	Med Hi		Energized Work Permit	4	3'6"	1'	1"
Tightening screws that are energized 480V Panel	Possible	Significant	High		Energized Work Permit	4	3'6"	1'	1"
Inserting a Bus Plug on energized 480V Bus	Possible	Significant	High		Energized Work Permit	4	3'6"	1'	1"
Visual work inside Limited Approach HC0	Very Unlikely	Negligible	Low	None		0	3'6"	1'	1"
Visual work inside Limited Approach HC1	Very Unlikely	Negligible	Low	Level 0		0	3'6"	1'	1"
Visual work inside Limited Approach HC2	Very Unlikely	Negligible	Low	Level 0		0	3'6"	1'	1"
Cell 13 Load Resistor PS Testing	Unlikely	Negligible	Low	Safety Glasses	Cell Walk Down, Fence in Place, Cell Door shut				
Cell 13 Transformer Testing	Note: Since the set up for this cell is highly variable, an ISM should be done based on the situation				Energized Work Permit				
Cell 16 Operation	Note: Since the set up for this cell is highly variable, an ISM should be done based on the situation				Energized Work Permit				

APPENDIX 5: QUALIFYING AUTHORITIES LIST

Qualifying Authority	Job Title	Hazard Category/ Risk Electrical Worker **0**	Hazard Category/ Risk Electrical Worker **2**	Hazard Category/ Risk Electrical Worker **4**	Hazard/Risk Category DC Magnet Power Supplies and Transformer **4**
Marshall Wood	Electrical Supervisor	X	X	X	
Andy Powell	Electronics Engineer	X	X		X
Bryon Dalton	Head of Magnet Operations	X			
John Kynoch	Department Head and Mechanical Engineer	X			

APPENDIX 6: NHMFL ELECTRICAL WORKER QUALIFICATION STANDARD

1.0 PURPOSE

1.1 This qualification standard is to be utilized by NHMFL employees qualifying as electrical workers in the NHMFL Facilities Department, Control Room, Electronics Shop, and other NHMFL personnel tasked with doing electrical work.

1.2 This standard defines the minimum requirements for personnel to become qualified as a Qualified Electrical Workers.

2.0 SCOPE

2.1 The guidelines contained herein apply to all NHMFL personnel qualifying as Electrical Workers.

2.2 This standard is to be used in conjunction with all applicable Safety Procedures and Electrical Safety Practical Skills documents.

2.3 Completion of this qualification standard is not the termination of the educational process for an individual. However, it serves as the baseline foundation for further study and qualification.

3.0 QUALIFICATION ORGANIZATION

3.1 COORDINATION AND ADMINISTER ELECTRICAL SUPERVISOR AND SAFETY DEPARTMENT

3.1.1 Coordinate and administer the qualification program. The ELECTRICAL SUPERVISOR AND SAFETY DEPARTMENT are the responsible parties.

3.1.2 Assign qualification cards to trainees and assign completion dates for qualification.

3.1.3 Designate personnel as qualifying authorities, and ensure those personnel so designated have the requisite knowledge and experience to adequately ascertain, or check-out, the level of knowledge of Control Room Operator and Plant Operator trainees.

3.1.4 Establish realistic qualification goals for everyone.

3.2 QUALIFYING AUTHORITY

3.2.1 Personnel designated by the Assistant Director of Environmental, Health, Safety, and Security, Head of Facilities, and the Electrical Supervisor to sign-off on individual qualification line items on the trainee's qualification card. The qualifying authority must have received Electrical Qualifiers Certification Training from an external certifying corporation selected by the safety department. A list of those individuals designated as Qualifying Authorities and the systems that are authorized to sign for are found in **Appendix 5** of this standard.

3.2.2 The qualifying authority will examine and ensure an individual has the required understanding of the area for which the qualifying authority has been designated.

3.2.3 Qualifying Authorities are to verify the training and component knowledge of trainees, utilizing this standard as a guide for minimum knowledge requirements. If the trainee meets at least the minimum knowledge requirements set herein, then the qualifying authority may sign-off in the appropriate section of the trainee's qualification card.

3.2.4 If the trainee meets the requirements, the qualifying authority may assign research to that trainee. When the trainee has researched the requested information and has shown a competent level of knowledge to the qualifying authority, the qualifying authority may sign-off for that item.

3.3 QUALIFYING ELECTRICAL WORKER

3.3.1 The trainee shall comply with departmental procedures and Safety Procedures.

3.3.2 The qualifying worker shall use this standard to determine the minimum knowledge requirements and time frame for Electrical Worker qualifications.

3.3.3. A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

3.3.4 The qualifying worker, or trainee, once he/she feels they have reached a competent level of knowledge, is to go to a qualifying authority for an area "check-out".

3.3.5 The trainee shall perform practical factors on equipment, tools, and personnel protective equipment (PPE) identified within this qualification standard. A practical factor is a qualification task in which the trainee performs an operation on a piece of equipment, test equipment or PPE under the direct supervision of a qualified worker or designated qualifying authority. The number of practical factors required depends on the level of difficulty of operation and is specified in this standard.

3.3.6 A check-out is a verbal or written process where a qualifying authority examines (or checks-out) the trainee's level of knowledge on a certain system, procedures, test equipment and Personal Protective Equipment (PPE). A practical factor is method of examination where the trainee physically demonstrates a specific task to the qualifying authority. The trainee may be required to answer questions about the specific task being tested on. The list of practical factors is listed in section. If the trainee meets at least the minimum level of knowledge based on the requirements within this qualification standard, the qualifying authority may then sign-off for that item.

4.0 POSITIONS TO BE QUALIFIED

4.1 Qualified Electrical Worker 0 (QP-0) - Electrical Workers expected to work on electrical systems $\leq$ 220 volts and are trained in use of a Level 0 PPE and test equipment.

4.2 Qualified Electrical Worker 2 (QP-2) Electrical Workers expected to work on electrical systems up to 480 volts and energies up to 8 cal/cm^2 or less and are trained in use of a Level 2 PPE and test equipment.

4.3 Qualified Electrical Worker 4 (QP-4) – Electrical Workers expected to work on electrical systems 480 volts and above and energies up to 40 cal/cm^2 and are trained in use of a Level 4 PPE and test equipment.

4.4 Qualified DC Magnet Power Supply and Transformer Technician 4 (QP-4MPSTT) – DC Magnet Power Supply and Transformer Technician expected to work on DC Magnet Power Supplies and Transformers at energies up to 40 cal/cm^2 and are trained in use of a Level 4 PPE and test equipment.

5.0 QUALIFICATION CARD VERIFICATION AND APPROVAL

5.1 Qualification cards have been developed for the positions of QP0, QP2, QP4, and QP4-MPSTT. This standard identifies the minimum requirements for qualifying as QP0, QP2, QP4, and QP4-MPSTT. The qualification cards are used to document the status of training and verify approval of qualification. Additional qualifications may be needed to work on specific electrical equipment.

5.2 KNOWLEDGE REQUIREMENTS - ELECTRCIAL WORKER - QP-0

5.2.1 This section details the minimum knowledge requirements for the below listed systems and components, and the required practical factors that the trainee shall attain for each hazard risk category.

5.2.2 To become qualified, the Electrical Workers Qualification Card must first be completed.

5.2.3 The Electrical Worker trainee shall have knowledge and understanding of:

5.2.3.1 Integrated Safety Management
5.2.3.2 Multi Meter
5.2.3.3 Hazard risk category 0 - Personal Protective Equipment (PPE)

5.2.4 Approach Distances and Boundaries

5.2.4.1 Distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment
5.2.4.2 Determine nominal voltage of exposed energized electrical conductors and circuit parts.
5.2.4.3 Best Electrical Safety Work Practices

5.3 KNOWLEDGE REQUIREMENTS - ELECTRICIAL WORKER - QP-2

5.3.1 This section details the minimum knowledge requirements for the below listed systems and components, and the required practical factors that the trainee shall attain for each hazard risk category.

5.3.2 In order to become qualified, the Electrical Workers Qualification Card QP-0 must first be completed.

5.3.3 The Electrical Worker trainee shall have knowledge and understanding of:

5.3.3.1 Integrated Safety Management
5.3.3.2 Multi Meter
5.3.3.3 Hazard risk category 0 and 2 - Personal Protective Equipment (PPE)
5.3.3.4 Approach Distances and Boundaries
5.3.3.5 Distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment
5.3.3.6 Determine nominal voltage of exposed energized electrical conductors and circuit parts
5.3.3.7 Best Electrical Safety Work Practices
5.3.3.8 Knowledge for Practical Factors the trainee shall be able to operate electrical test equipment correctly and safely (e.g., voltmeter, amp meter) and components using applicable procedures

5.4 Electrical Worker Safety Training Requirements:

5.4.1 The Electrical Worker QP-2 shall be trained and certified in:

5.4.1.1 Online Safety Clearance Procedure, SP-1
5.4.1.2 Online Electrical Safety
5.4.1.3 Online Electrical Work Procedure SP-70
5.4.1.4 Online Shop and Tool Safety
5.4.1.5 Online Controlled Access Procedure, SP-18
5.4.1.6 Adult CPR and AED Training

5.5 KNOWLEDGE REQUIREMENTS - ELECTRICAL WORKER - QP-4

5.5.1 This section details the minimum knowledge requirements for the below listed systems and components, and the required practical factors that the trainee shall attain for each hazard risk category.

5.5.2 In order to become qualified, the Electrical Workers Qualification Card QP-2 must first be completed.

5.5.3 The Electrical Worker trainee shall have knowledge and understanding of:

- 5.5.3.1 Integrated Safety Meter
- 5.5.3.2 Multi Meter
- 5.5.3.3 Hot stick with high voltage probe
- 5.5.3.4 Hazard risk category 0, 2, and 4 - Personal Protective Equipment (PPE)
- 5.5.3.5 Approach Distances and Boundaries
- 5.5.3.6 Distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment
- 5.5.3.7 Determine nominal voltage of exposed energized electrical conductors and circuit parts
- 5.5.3.8 Best Electrical Safety Work Practices
- 5.5.3.9 Knowledge for Practical Factors the trainee shall be able to operate electrical test equipment correctly and safely (e.g., voltmeter, amp meter) and components using applicable procedures

5.6 Electrical Worker Safety Training Requirements:

5.6.1 The Electrical Worker QP-4 shall be trained and certified in:

- 5.6.1.1 Online Safety Clearance Procedure, SP-1
- 5.6.1.2 Online Electrical Safety
- 5.6.1.3 Online Electrical Work Procedure SP-70
- 5.6.1.4 Online Shop and Tool Safety
- 5.6.1.5 Online Controlled Access Procedure, SP-18
- 5.6.1.6 Adult CPR and AED Training

6.1 QP-0 Knowledge Requirements

6.1.1 Integrated Safety Management:

- 6.1.1.1 Define Scope of Work
- 6.1.1.2 How to Identify Hazards
- 6.1.1.3 Development Hazard Controls
- 6.1.1.4 Work within Hazard Controls
- 6.1.1.5 Feedback and Improvement

6.1.2 Multi-Meter

6.1.2.1 Use
6.1.2.2 Meter functions
6.1.2.3 How to configure it
6.1.2.4 How to properly hold it
6.1.2.5 When to inspect
6.1.2.6 What to inspect

6.1.3 Personal Protective Equipment (PPE)

6.1.3.1 < 208 Volts
6.1.3.2 When to inspect
6.1.3.3 When to don it
6.1.3.4 How to wear

6.1.4 Approach Distances and Boundaries:

6.1.4.1 Arc Flash Identification Label
6.1.4.2 Safe Distances - What do they mean?
6.1.4.3 How to establish and setup a boundary
6.1.4.4 Define: limited, prohibited, and restricted boundaries
6.1.4.5 PPE required within in the boundaries

6.1.5 How to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment:

6.1.5.1 Understanding flow path of electricity
6.1.5.2 Electrical and wiring diagram
6.1.5.3 Test equipment needed
6.1.5.4 Procedural steps to follow

6.1.6 Determine nominal voltage of exposed energized electrical conductors and circuit parts:

6.1.6.1 How to read a basic transformer diagram
6.1.6.2 How to setup a multi-meter
6.1.6.3 Understanding of equipment labeling

6.1.7 Best Electrical Safety Work Practices:

6.1.7.1 Keep all un-insulated body parts beyond the restricted approach boundary.
6.1.7.2 Be mindful of any exposed electrical conductors inside the workspace.
6.1.7.3 Keep the floor free of any liquids.
6.1.7.4 Use only insulated ladders.
6.1.7.5 Keep all non-essential personnel beyond the limited approach boundary.

6.1.7.6 Bleed down capacitors where possible.
6.1.7.7 Utilize Lockout/Tagout.
6.1.7.9 Inspect electrical meters, probes, and other test equipment prior to use.
6.1.7.10 Remove jewelry or other conductive materials.
6.1.7.11 Position the body as far practical from any energized conductors and breakers.
6.1.7.12 Avoid (where possible) holding a multi-meter when performing a voltage test.
6.1.7.11 Be mindful of and when possible, remove conductive objects such as tubing, tape measures, glasses, tools which may come in contact with exposed conductors or can fall causing a short circuit.
6.1.7.12 Know the nominal voltage of system or component being worked on.
6.1.7.13 Wear the correct level of Personal Protective Equipment (PPE) for the job being performed.
6.1.7.14 Ensure adequate lighting is available.
6.1.7.15 Read and follow appropriate safety procedures.
6.1.7.16 Keep workspace clean and free of debris.
6.1.7.17 Clean-up workspace after job is complete.
6.1.7.18 Use the correct tool for the job.
6.1.7.19 Have the requisite number of personnel on hand for the task.

6.2 QP-2 Knowledge Requirements

6.2.1 Integrated Safety Management:

6.2.1.1 Define Scope of Work
6.2.2.2 How to Identify Hazards
6.2.3.3 Development Hazard Controls
6.2.4.4 Work within Hazard Controls
6.2.5.5 Feedback and Improvement

6.2.2 Multi-Meter:

6.2.2.1 Use
6.2.2.2 Meter functions
6.2.2.3 How to configure it
6.2.2.3 How to properly hold it
6.2.2.4 When to inspect
6.2.2.5 What to inspect

6.2.3 Personal Protective Equipment:

6.2.3.1 Up to 480 Volts
6.2.3.2 When to inspect
6.2.3.3 When to don it
6.2.3.4 How to wear

6.2.4 Approach Distances and Boundaries:

6.2.4.1 Arc Flash Identification Label
6.2.4.2 Safe Distances - What do they mean?
6.2.4.3 How to establish and setup a boundary
6.2.4.4 Define: limited, prohibited, and restricted boundaries
6.2.4.5 PPE required within in the boundaries

6.2.5 How to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment:

6.2.5.1 Understanding flow path of electricity
6.2.5.2 Electrical and wire diagram
6.2.5.3 Test equipment needed
6.2.5.4 Procedural steps to follow

6.2.6 Determine nominal voltage of exposed energized electrical conductors and circuit parts:

6.2.6.1 How to read a basic transformer diagram
6.2.6.2 How to setup a meter
6.2.6.3 Understanding of equipment labeling

6.2.7 Best Electrical Safety Work Practices:

6.2.7.1 Keep all un-insulated body parts beyond the restricted approach boundary.
6.2.7.2 Be mindful of any exposed electrical conductors inside the workspace.
6.2.7.3 Keep the floor free of any liquids.
6.2.7.4 Use only insulated ladders.
6.2.7.5 Keep all non-essential personnel beyond the limited approach boundary.
6.2.7.6 Bleed down capacitors where possible.
6.2.7.7 Utilize Lockout/Tagout when possible.
6.2.7.8 Inspect electrical meters, probes, and other test equipment prior to use.
6.2.7.9 Remove jewelry or other conductive materials.
6.2.7.10 Position the body as far practical from any energized conductors and breakers.
6.2.7.11 Avoid (where possible) holding a multi-meter when performing a voltage test.
6.2.7.12 Be mindful of and when possible, remove conductive objects such as tubing, tape measures, glasses, tools which may encounter exposed conductors or can fall causing a short circuit.
6.2.7.13 Know the nominal voltage of system or component being worked on.
6.2.7.14 Wear the correct level of Personal Protective Equipment (PPE) for the job being performed.
6.2.7.15 Ensure adequate lighting is available.
6.2.7.16 Read and follow appropriate safety procedures.
6.2.7.17 Keep workspace clean and free of debris.

6.2.7.18 Clean-up workspace after job is complete.
6.2.7.19 Use the correct tool for the job.
6.2.7.20 Have the requisite number of personnel on hand for the task.

6.3 QP-4 Knowledge Requirements

6.3.1 Integrated Safety Management:

6.3.1.1 Define Scope of Work
6.3.1.2 How to Identify Hazards
6.3.1.3 Development Hazard Controls
6.3.1.4 Work within Hazard Controls
6.3.1.5 Feedback and Improvement

6.3.2 Multi-Meter

6.3.2.1 Use
6.3.2.2 Meter functions
6.3.2.3 How to configure it
6.3.2.4 How to properly hold it
6.3.2.5 When to inspect
6.3.2.6 What to inspect

6.3.3 Hot Stick with High Voltage Probe

6.3.3.1 Use
6.3.3.2 Meter functions
6.3.3.3 How to configure it
6.3.3.4 How to properly hold it
6.3.3.5 When to inspect
6.3.3.6 What to inspect
6.3.3.7 PPE required to don

6.3.4 Personal Protective Equipment

6.3.4.1 Up to 12,500 Volts
6.3.4.2 Components of PPE
6.3.4.3 When to inspect
6.3.5.4 When to don it
6.3.5.5 How to wear

6.3.5 Approach Distances and Boundaries:

6.3.5.1 Arc Flash Identification Label
6.3.5.2 Safe Distances - What do they mean?
6.3.5.3 How to establish and setup a boundary

6.3.5.4 Define: limited, prohibited, and restricted boundaries
6.3.5.5 PPE required within in the boundaries

6.3.6 How to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment:

6.3.6.1 Understanding flow path of electricity
6.3.6.2 Electrical and wire diagram
6.3.6.3 Test equipment needed
6.3.6.4 Procedural steps to follow

6.3.7 Define hazards in the DC Power Supplies and Transformer (Only for QP4-MPSTT)

6.3.7.1 Understanding flow path of electricity
6.3.7.2 Identify sections in the power supplies and transformer
6.3.7.3 Understanding of stored energy in capacitor banks
6.3.7.4 Understanding the back feed of de-energized power supplies
6.3.7.5 Understanding of the Emergency Power Off (EPO) buttons
6.3.7.6 Understanding of all power sources associated with power supplies
6.3.7.7 Understanding of tap changers
6.3.7.8 Understanding the sequence of powering down power supplies

6.3.8 Best Electrical Safety Work Practices:

6.3.8.1 Keep all un-insulated body parts beyond the restricted approach boundary.
6.3.8.2 Be mindful of any exposed electrical conductors inside the workspace.
6.3.8.3 Keep the floor free of any liquids.
6.3.8.4 Use only insulated ladders.
6.3.8.5 Keep all non-essential personnel beyond the limited approach boundary.
6.3.8.6 Bleed down capacitors where possible.
6.3.8.7 Utilize Lockout/Tagout when possible.
6.3.8.8 Inspect electrical meters, probes, and other test equipment prior to use.
6.3.8.9 Remove jewelry or other conductive materials.
6.3.8.10 Position the body as far practical from any energized conductors and breakers.
6.3.8.11 Avoid (where possible) holding a multi-meter when performing a voltage test.
6.3.8.12 Be mindful of and when possible, remove conductive objects such as tubing, tape measures, glasses, tools which may encounter exposed conductors or can fall causing a short circuit.
6.3.8.13 Know the nominal voltage of system or component being worked on.
6.3.8.14 Wear the correct level of Personal Protective Equipment (PPE) for the job being performed.
6.3.8.15 Ensure adequate lighting is available.
6.3.8.16 Read and follow appropriate safety procedures.
6.3.8.17 Keep workspace clean and free of debris.
6.3.8.18 Clean-up workspace after job is complete.
6.3.8.19 Use the correct tool for the job.

6.3.8.20 Have the requisite number of personnel on hand for the task.

7.0 ELECTRICAL WORKER PRACTICAL FACTORS

7.1 Electrical Worker QP-0 Practical Factors

Practical Factor	Required Number of Practical Factors
7.1.2 Don Level 0 PPE per SP-70 Energized Work Procedure, **Appendix 4**.	2
7.1.3 Use a Multi-Meter on a 120V outlet: 7.1.3.1 Inspect meter and leads 7.1.3.2 Ensure leads are in proper location 7.1.3.3 Turn to proper setting 7.1.3.4 Don proper PPE 7.1.3.5 Verify voltage at 120 outlet that is known to be energized 7.1.3.6 Check voltage at test outlet 7.1.3.7 Re-verify voltage at the first outlet 7.1.3.8 Secure meter	2

7.2 Electrical Worker QP-2 Practical Factors

Practical Factor	Required Number of Practical Factors
7.2.1 Use the ISM process (form may be used) for checking fuses in a hazard risk category 2 panel.	2
7.2.2 Inspect and Don Level 2 PPE per SP-70 Energized Work Procedure, **Appendix 4**.	2
7.2.3 Perform a Lockout/Tagout on a HRC 2 Device	2
7.2.4 Operate a breaker in/on a Hazard Risk Category 2 Panel: 7.2.4.1 Determine number of personnel required 7.2.4.2 Setup a Limited Approach Boundary 7.2.4.3 Recite the Restricted Approach Boundary 7.2.4.4 Recite the Prohibited Approach Boundary 7.2.4.5 Inspect and Don Appropriate Level PPE 7.2.4.6 Operate breaker using best electrical safety practices 7.2.4.7 Breakdown Boundary 7.2.4.8 Secure PPE	2
7.2.5 Check Voltage in a Hazard Risk Category 2 Panel: 7.2.5.1 Determine number of personnel required	2

7.2.5.2 Setup a Limited Approach Boundary
7.2.5.3 Recite the Restricted Approach Boundary
7.2.5.4 Recite the Prohibited Approach Boundary
7.2.5.5 Inspect and Don Appropriate Level PPE
7.2.5.6 Check voltage using proper meter and hand positioning
7.2.5.7 Breakdown Boundary
7.2.5.8 Secure PPE

7.2.6 Check Fuses in a Hazard Risk Category 2 Panel: 2

7.2.7 Operate a breaker in/on a Hazard Risk Category 2 Panel: 2

7.2.7.1 Determine number of personnel required
7.2.7.2 Setup a Limited Approach Boundary
7.2.7.3 Recite the Restricted Approach Boundary
7.2.7.4 Recite the Prohibited Approach Boundary
7.2.7.5 Inspect and Don Appropriate Level PPE
7.2.7.6 Check fuses using proper meter and hand positioning
7.2.7.7 Breakdown Boundary
7.2.7.8 Secure PPE

7.2.8 Operate an HRC-2 Disconnect: 2
7.2.8.1 Determine number of personnel required
7.2.8.2 Inspect and don appropriate PPE
7.2.8.3 Demonstrate proper body positioning
7.2.8.4 Operate disconnect
7.2.8.5 Secure PPE

7.3 Electrical Worker QP-4 Practical Factors (Not Including QP-4MPSTT)

Practical Factor	Required Number of Practical Factors
7.3.1 Use the ISM process (form may be used) for racking out HRC 4 breakers.	2
7.3.2 Rack out and Lock out Power Supply Breakers:	2
7.3.3 Inspect and Don Level 4 PPE per SP-70 Energized Work Procedure, **Appendix 4**	2
7.3.4 Use a hot stick with high voltage probe on a power supply transformer to verify absence of power:	2

7.3.4.1 Inspect high voltage probe and hot stick
7.3.4.2 Gather number of personnel required
7.3.4.3 Inspect and don appropriate PPE
7.3.4.4 Use hot stick and high voltage probe to verify absence of voltage

7.3.4.5 Secure PPE
7.3.4.6 Secure hot stick and high voltage probe

7.3.5 Operate a breaker in/on a Hazard Risk Category 4 Panel: 2
7.3.5.1 Determine number of personnel required
7.3.5.2 Setup a Limited Approach Boundary
7.3.5.3 Recite the Restricted Approach Boundary
7.3.5.4 Recite the Prohibited Approach Boundary
7.3.5.5 Inspect and Don Appropriate Level PPE
7.3.5.6 Breakdown Boundary
7.3.5.7 Secure PPE

7.3.6 Rack out a 480 Volt breaker in/on a Hazard Risk Category 4 Panel: 2
7.3.6.1 Determine number of personnel required
7.3.6.2 Setup a Limited Approach Boundary
7.3.6.3 Recite the Restricted Approach Boundary
7.3.6.4 Recite the Prohibited Approach Boundary
7.3.6.5 Inspect and Don Appropriate Level PPE
7.3.6.6 Breakdown Boundary
7.3.6.7 Secure PPE

7.4 Power Supply and Transformer Technician QP-4MPSTT Practical Factors

Practical Factor	Required Number of Practical Factors
7.4.1 Inspect and Don Level 4 PPE per SP-70 Energized Work Procedure, **Appendix 4**.	2
7.4.2 Use a hot stick with high voltage probe on a power supply transformer to verify absence of power:	2

7.4.2.1 Inspect high voltage probe and hot stick
7.4.2.2 Gather number of personnel required
7.4.2.3 Inspect and don appropriate PPE
7.4.2.4 Use hot stick and high voltage probe to verify absence of voltage
7.2.4.5 Secure PPE
7.4.2.6 Secure hot stick and high voltage probe.

8.0 QUALIFICATION CARD VERIFICATION AND APPROVAL

8.1 Qualification Cards (QC) have been developed for the following qualifications:

QC 2.1 - Electrical Worker QP-0
QC 2.2 - Electrical Worker QP-2
QC 2.3 - Electrical Worker QP-4
QC 2.4 - DC Magnet Power Supply and Transformer Technician QP4-MPSTT

8.2 After completing each qualification card, the trainee shall go to the qualifying authority for a final walkthrough and checkout to verify the trainee is ready to perform their specified duties. Upon completion of this final checkout and walkthrough, the completed qualification cards will be forwarded to their immediate supervisor for review and final authorization.

NATIONAL HIGH MAGNETIC FIELD LABORATORY

NHMFL

FLORIDA STATE UNIVERSITY

ELECTRICAL WORKER QP-0 QUALIFICATION CARD – 2.1

NAME:_____

DATE QUALIFICATION CARD ASSIGNED:_____

QUALIFICATION COMPLETION DATE:_____

I. TRAINING REQUIREMENTS:

REQUIRED TRAINING	Q.A. SIGNATURE	DATE
A. SAFETY CLEARANCE PROCEDURE, SP-1 (Online)		
B. ELECTRICAL WORK PROCEDURE SP-70 (Online)		
C. ELECTRICAL SAFETY (Online)		
D. SHOP AND TOOL SAFETY (Online)		
E. CONTROLLED ACCESS PROCEDURE (Online)		
F. CPR and AED		
BLOCK SIGNATURE	NHMFL Safety	

II. QP-0 CHECK OUTS:

ITEM	Q.A. SIGNATURE	DATE
A. INTEGRATED SAFETY MANAGEMENT		
B. MULTI-METER		
C. PERSONAL PROTECTIVE EQUIPMENT		
D. APPROACH DISTANCES AND BOUNDARIES		
E. HOW TO DISTINGUISH EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS FROM OTHER PARTS OF ELECTRICAL EQUIPMENT		
F. DETERMINE NOMINAL VOLTAGE OF EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS		
G. BEST ELECTRICAL SAFETY WORK PRACTICES		
BLOCK SIGNATURE	Qualifying Authority	

III. ELECTRICAL WORKER QP-0 PRACTICAL FACTORS:

PRACTICAL FACTOR	Q.A. SIGNATURE	DATE
A1. DON LEVEL 0 PPE	_____	_____
A2. DON LEVEL 0 PPE	_____	_____
B1. USE A MULTI-METER ON A 120 VOLT OUTLET	_____	_____
B2. USE A MULTI-METER ON A 120 VOLT OUTLET	_____	_____
BLOCK SIGNATURE	_____ Qualifying Authority	_____

IV. FINAL CHECK-OUT AND WALKTHROUGH:

1. FINAL CHECK-OUT	_____ Qualifying Authority	_____
2. FINAL WALKTHROUGH	_____ Qualifying Authority	_____

QUALIFIED AS ELECTRICAL WORKER QP-0

IMMEDIATE SUPERVISOR:_____ DATE:_____

NATIONAL HIGH MAGNETIC FIELD LABORATORY

NHMFL

FLORIDA STATE UNIVERSITY

ELECTRICAL WORKER QP-2 QUALIFICATION CARD – 2.2

NAME:_____

DATE QUALIFICATION CARD ASSIGNED:_____

QUALIFICATION COMPLETION DATE:_____

I. QUALIFICATION REQUIREMENTS:

REQUIRED QUALIFICATION	Q.A. SIGNATURE	DATE
A. ELECTRICAL WORKER QP-0 QUALIFIED	_____ Qualifying Authority	_____

II. QP-2 CHECKOUTS:

SYSTEM	Q.A. SIGNATURE	DATE
A. INTEGRATED SAFETY MANAGEMENT	_____	_____
B. MULTI-METER	_____	_____
C. PERSONAL PROTECTIVE EQUIPMENT	_____	_____
D. APPROACH DISTANCES AND BOUNDARIES	_____	_____
E. HOW TO DISTINGUISH EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS FROM OTHER PARTS OF ELECTRICAL EQUIPMENT	_____	_____
F. DETERMINE NOMINAL VOLTAGE OF EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS	_____	_____
G. BEST ELECTRICAL SAFETY WORK PRACTICES	_____	_____
BLOCK SIGNATURE	_____ Qualifying Authority	_____

III. ELECTRICAL WORKER QP-2 PRACTICAL FACTORS:

PRACTICAL FACTOR	Q.A. SIGNATURE	DATE
A1. USE THE ISM PROCESSS (FORM MAY BE USED) FOR CHECKING FUSES IN A HAZARD RISK CATEGORY 2 PANEL.		
A2. USE THE ISM PROCESSS (FORM MAY BE USED) FOR CHECKING FUSES IN A HAZARD RISK CATEGORY 2 PANEL.		
B1. INSPECT & DON LEVEL 2 PPE		
B2. INSPECT & DON LEVEL 2 PPE		
C1. PERFORM A LOCKOUT/TAGOUT ON A HRC 2 DEVICE.		
C2. PERFORM A LOCKOUT/TAGOUT ON A HRC 2 DEVICE.		
D1. OPERATE A BREAKER IN/ON A HAZARD RISK CATEGORY 2 PANEL		
D2. OPERATE A BREAKER IN/ON A HAZARD RISK CATEGORY 2 PANEL		
E1. CHECK VOLTAGE IN A HAZARD RISK CATEGORY 2 PANEL		
E2. CHECK VOLTAGE IN A HAZARD RISK CATEGORY 2 PANEL		
F1. CHECK FUSES IN A HAZARD RISK CATEGORY 2 PANEL		
F2. CHECK FUSES IN A HAZARD RISK CATEGORY 2 PANEL		
G1. OPERATE A BREAKER IN/ON A HAZARD RISK CATEGORY 2 PANEL		
G2. OPERATE A BREAKER IN/ON A HAZARD RISK CATEGORY 2 PANEL		

H1. OPERATE A HRC-2 DISCONNECT _____ _____

H2. OPERATE A HRC-2 DISCONNECT _____ _____

BLOCK SIGNATURE _____ _____
Qualifying Authority

IV. FINAL CHECK-OUT AND WALKTHROUGH:

1. FINAL CHECK-OUT _____ _____
Qualifying Authority

2. FINAL WALKTHROUGH _____ _____
Qualifying Authority

QUALIFIED AS ELECTRICAL WORKER QP-2

BLOCK SIGNATURE _____ _____
Immediate Supervisor

NATIONAL HIGH MAGNETIC FIELD LABORATORY

NHMFL

FLORIDA STATE UNIVERSITY

ELECTRICAL WORKER QP-4 QUALIFICATION CARD – 2.3

NAME: _____

DATE QUALIFICATION CARD ASSIGNED: _____

QUALIFICATION COMPLETION DATE: _____

Operated by Florida State University, University of Florida, and Los Alamos National Laboratory
Supported by the U.S. National Science Foundation and the State of Florida

I. QUALIFICATION REQUIREMENTS:

REQUIRED QUALIFICATION	Q.A. SIGNATURE	DATE
A. ELECTRICAL WORKER QP-2 QUALIFIED	_____ Qualifying Authority	_____

II. QP-4 CHECKOUTS:

SYSTEM	Q.A. SIGNATURE	DATE
A. INTEGRATED SAFETY MANAGEMENT	_____	_____
B. MULTI-METER	_____	_____
C. HOT STICK WITH HIGH VOLTAGE PROBE	_____	_____
D. PERSONAL PROTECTIVE EQUIPMENT	_____	_____
E. APPROACH DISTANCES AND BOUNDARIES	_____	_____
F. HOW TO DISTINGUISH EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS FROM OTHER PARTS OF ELECTRICAL EQUIPMENT	_____	_____
G. DETERMINE NOMINAL VOLTAGE OF EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS	_____	_____
H. BEST ELECTRICAL SAFETY WORK PRACTICES	_____	_____
BLOCK SIGNATURE	_____ Qualifying Authority	_____

III. ELECTRICAL WORKER QP-4 PRACTICAL FACTORS:

PRACTICAL FACTOR	Q.A. SIGNATURE	DATE
A1. USE THE ISM PROCESSS (FORM MAY BE USED) FOR RACKING OUT HRC 4 BREAKERS.	_____	_____
A2. USE THE ISM PROCESS (FORM MAY BE USED) FOR RACKING OUT HRC 4 BREAKERS		
B1. RACKOUT AND LOCKOUT POWER SUPPLY BREAKERS	_____	_____
B2. RACKOUT AND LOCKOUT POWER SUPPLY BREAKERS	_____	_____
B1. INSPECT AND DON LEVEL 4 PPE	_____	_____
B2. INSPECT AND DON LEVEL 4 PPE	_____	_____
C1. USE A HOT STICK WITH A HIGH VOLTAGE PROBE ON A POWER SUPPLY TRANSFORMERTO VERIFY THE ABSENCE OF POWER	_____	_____
C2. USE A HOT STICK WITH A HIGH VOLTAGE PROBE ON A POWER SUPPLY TRANSFORMERTO VERIFY THE ABSENCE OF POWER	_____	_____
D1. OPERATE A BREAKER IN/ON A HAZARD RISK CATEGORY 4 PANEL	_____	_____
D2. OPERATE A BREAKER IN/ON A HAZARD RISK CATEGORY 4 PANEL	_____	_____
E1. RACK OUT A 480 VOLT BREAKER IN/ON A HAZARD RISK CATEGORY 4 PANEL	_____	_____
E2. RACK OUT A 480 VOLT BREAKER IN/ON A HAZARD RISK CATEGORY 4 PANEL	_____	_____
BLOCK SIGNATURE	_____ Qualifying Authority	_____

IV. FINAL CHECK-OUT AND WALKTHROUGH:

1. FINAL CHECK-OUT _____ _____
Qualifying Authority

2. FINAL WALKTHROUGH _____ _____
Qualifying Authority

QUALIFIED AS ELECTRICAL WORKER QP-4

IMMEDIATE SUPERVISOR:_____ DATE:_____

NATIONAL HIGH MAGNETIC FIELD LABORATORY

NHMFL

FLORIDA STATE UNIVERSITY

DC MAGNET POWER SUPPLY AND TRANSFORMER TECHNICIAN QP-4MPSTT QUALIFICATION CARD – 2.4

NAME:_____

DATE QUALIFICATION CARD ASSIGNED:_____

QUALIFICATION COMPLETION DATE:_____

Operated by Florida State University, University of Florida, and Los Alamos National Laboratory
Supported by the U.S. National Science Foundation and the State of Florida

I. QUALIFICATION REQUIREMENTS:

REQUIRED QUALIFICATION	Q.A. SIGNATURE	DATE
A. ELECTRICAL WORKER QP-2 QUALIFIED	_____ Qualifying Authority	_____

II. QP-4MPSTT CHECKOUTS:

SYSTEM	Q.A. SIGNATURE	DATE
A. INTEGRATED SAFETY MANAGEMENT	_____	_____
B. MULTI-METER	_____	_____
C. HOT STICK WITH HIGH VOLTAGE PROBE	_____	_____
D. PERSONAL PROTECTIVE EQUIPMENT	_____	_____
E. APPROACH DISTANCES AND BOUNDARIES	_____	_____
F. HOW TO DISTINGUISH EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS FROM OTHER PARTS OF ELECTRICAL EQUIPMENT	_____	_____
F. UNDERSTANDING FLOW PATH OF ELECTRICITY	_____	_____
G. IDENTIFY SECTIONS IN THE POWER SUPPLIES AND TRANSFORMER	_____	_____
H. UNDERSTANDING OF STORED ENERGY IN CAPACITOR BANKS	_____	_____
J. UNDERSTANDING THE BACK FEED OF DE-ENERGIZED POWER	_____	_____

K. UNDERSTANDING OF THE EMERGENCY POWER OFF (EPO) BUTTONS _____ _____

L. UNDERSTANDING OF ALL POWER SOURCES ASSOCIATED WITH POWER SUPPLIES _____ _____

M. UNDERSTANDING OF TAP CHANGERS _____ _____

N. UNDERSTANDING THE SEQUENCE OF POWERING DOWN POWER SUPPLIES _____ _____

O. DETERMINE NOMINAL VOLTAGE OF EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS _____ _____

P. BEST ELECTRICAL SAFETY WORK PRACTICES _____ _____

BLOCK SIGNATURE _____ _____

Qualifying Authority

III. DC MAGNET POWER SUPPLY AND TRANFORMER TECHNICIAN FACTORS:

PRACTICAL FACTOR	Q.A. SIGNATURE	DATE
A1. INSPECT AND DON LEVEL 4 PPE	_____	_____
A2. INSPECT AND DON LEVEL 4 PPE	_____	_____
B1. USE A HOT STICK WITH A HIGH VOLTAGE PROBE ON A POWER SUPPLY TRANSFORMERTO VERIFY THE ABSENCE OF POWER	_____	_____
B2. USE A HOT STICK WITH A HIGH VOLTAGE PROBE ON A POWER SUPPLY TRANSFORMERTO VERIFY THE ABSENCE OF POWER	_____	_____
C1. DETERMINE NOMINAL VOLTAGE OF EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS	_____	_____
C2. DETERMINE NOMINAL VOLTAGE OF EXPOSED ENERGIZED ELECTRICAL CONDUCTORS AND CIRCUIT PARTS	_____	_____
BLOCK SIGNATURE	_____ Qualifying Authority	_____

IV. FINAL CHECK-OUT AND WALKTHROUGH:

1. FINAL CHECK-OUT	_____ Qualifying Authority	_____
2. FINAL WALKTHROUGH	_____ Qualifying Authority	_____

QUALIFIED AS ELECTRICAL WORKER QP-4MPSTT

IMMEDIATE SUPERVISOR:_____ DATE:_____

REVISIONS, REVIEWS AND APPROVALS

Revisions and Reviews

Date	Revision #	Section	Description
10/13/2013	001	All	Review and Signatures
10/22/2019	002	Front Page	Updated names and titles
2/22/2022	003	All	Updated program format

Approvals

Title	Reviewer	Signature
Director: Environmental Health & Safety	Jeffrey Braunwart