CHAPTER 3 GENERAL REQUIREMENTS

3.1 SAFETY ANALYSIS AND SAFETY REVIEWS/INSPECTIONS

3.1.1. Modifications to existing and new projects may be required to have either a Safety Analysis Report (SAR) or Safety Assessment Document (SAD) depending on the safety analysis reviews performed on the activities per PPPL Procedure ESH-014, "National Environmental Policy Act (NEPA) Review System," and the requirements of ES&HD 5008, Chapter 11, Section 1, "Operations Hazards Criteria."

3.1.2. The documentation and installation of all new and retrofit electrical work shall be subject to a safety review performed by an ES&H Division Electrical Safety representative, Quality Control, and AC Power Representatives prior to energizing equipment. This is to verify compliance with the procedures, codes and standards that were in effect on the date that such work was approved by a final design review (FDR) or Project Configuration Controls action. If it is determined that the installation involves a hazard to life, equipment, or environment, then the current standards and codes shall be used to mitigate the hazard.

3.2 CODES AND STANDARDS

3.2.1. Electrical work shall comply with the latest revisions to the following codes and standards:

A. National Electrical Code (NEC) - National Fire Protection Association (NFPA) No. 70
B. National Electrical Safety Code (NESC) - ANSI C2
C. Occupational Safety and Health Act (OSHA)
-Title 29 CFR 1910 Subpart S - Electrical
-Title 29 CFR 1926 Subpart K, Subpart V - Electrical
D. Relevant DOE Orders - See Chapter 16, Paragraph M
E. Relevant PPPL documents - See Chapter 16, Paragraph N
F. NFPA 70E- Standard for Electrical Safety Requirements for Employee Workplaces

3.2.2. When conflicts arise between the mandatory requirements of the referenced codes and standards, the requirements that provide the greater personnel safety shall govern. The NESC "Administrative Authority" shall be the Head of Electrical Safety in the PPPL ES&H Division. The NEC " Authority Having Jurisdiction" is the Industrial Safety and Fire Protection Specialist, Office of the Director, Environment, Safety, and Health Division, the Department of Energy-CH or equivalent.

3.2.3. Standards and prescriptive or performance specifications that are recommended by the Department of Energy and directly impact the safety practices and procedures of this Section 2.0, Electrical Safety are included in Chapter 16, "REFERENCES."

3.2.4. When no clearly applicable code or standard provides adequate guidance or when questions regarding workmanship, judgment, or conflicting criteria arise, personnel safety (not equipment protection or utilization) shall be the primary consideration.

3.2.5. Electrical installations at PPPL are not included under the jurisdiction of the New Jersey Electrical Subcode, Title 5:Chapter 23-3.16 of the N. J. Administrative Code.

3.2.6. SARs and SADs should use NEC and OSHA voltage levels where assessing a degree of hazard, (e.g. 480 V rather than 460 V. Where electrical systems or apparatus are identified or specified, use the voltage levels described in industry consensus standard ANSI C84.1 (e.g. 480 V switchgear and 460 V motors). Local lighting switches, receptacles, and plugs used on 15-20 amp branch circuits are rated at 125 or 250 volts.

3.3 Safe Work Practices

3.3.1 Training

The minimum electrical training requirements for working on different voltage classes are shown in Table 3.3 below. All personnel shall have the proper training to work on electrical circuits. Additional training may be required by personnel in order to become a "Qualified Person" to perform the tasks they are assigned.

TABLE 3.3 PPPL SAFETY TRAINING REQUIREMENTS FOR ELECTRICAL WORK

Working on **50 volts and below** circuits *DE-ENERGIZED OR ENERGIZED*	(Class A)	No training beyond (GET) General Employee Training
Working on **240 vac or 250 vdc** and below *POSITIVELY DE-ENERGIZED ONLY See note below*	(Class B)	Basic Electrical Safety training Renewed every 3 years
Working on **240 vac or 250 vdc** and below *ENERGIZED See note below*	(Class C)	Electrical Utilization Training Renewed every 3 years
Working on or managing **480 / 277 vac or 251 vdc** and higher *See note below*	(Class D	Electrical Utilization Training Renewed every 3 years
Working on or managing **600 vac** and above *See note below*	(Class E)	Electrical Utilization Training and Line Crew Training Renewed every 3 years

See paragraph 3.3.2 for the criteria for positively de-energizing circuits and safing circuits.
Note: Troubleshooting and testing may be performed on energized 120/208 volt circuits by qualified persons trained for the tasks they are to perform. Such persons shall also be familiar with the proper use of precautionary techniques, personal protective equipment, including arc flash, and insulating and shielding materials, tools and test equipment. Electrical Utilization Training is required for those personnel that perform troubleshooting on various types and different voltage and current levels of electrical equipment using approved procedures.

3.3.2 Working De-energized

PPPL policy, NFPA 70E, and OSHA 29CFR 1910.333(a)(1) requires " Live parts to which an employee may be exposed shall be de-energized (Electrically Safe Work Condition) before the employee works on or near them, unless the employer can demonstrate that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Live parts that operate at less than 50 volts to ground need not be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs."

A. **Electrically Safe Work Condition** shall be achieved when allconditions below are met:

1. After properly interrupting the load current, open the disconnecting device(s) for each source.
2. Determine all possible sources of electrical supply to specific equipment has been disconnected from all sources of energy operated over 50 volts. Check applicable up-to-date drawings, diagrams, identification tags, perform a hazard analysis and have approved work procedures.
3. Where possible, visually verify that all blades of the disconnecting devices are fully open or that draw-out type circuit breakers are withdrawn to the fully disconnected position.
4. After disconnecting means has been visually checked, lockout and safety tagout devices shall be installed in accordance with documented and approved PPPL procedure ESH-016 to prevent a change of state.
5. Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are de-energized. Test each phase conductor or circuit part both phase – to – phase and phase – to - ground while wearing the required personal protective equipment (PPE). Before and after each test, determine that the voltage detector is operating satisfactorily.
6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault current.
7. Circuits 480/277 V ac, 251-600 V dc shall be shorted and grounded with an approved safety ground when a job hazard analysis determines grounds are needed for personnel safety.
8. Circuits greater than 600 volts shall have at least one visible break not susceptible to arc-over. See Chapter 4, paragraphs 4.1 through 4.3 & 4.18.
9 Equipment parts, circuits and energy sources which have not been positively de-energized in accordance with steps 1 thru 8 above shall be considered energized.

B. **Requirements for Working De-energized:**

1. A Qualified person may work alone on de-energized circuits rated below 250 volts.

2. A Safety Watch and a Qualified Person (see definitions in chapter 2) are required to positively de-energize circuits 251 - 600 volts. Thereafter, one Qualified Person may work alone (See paragraph 3.3.2 F).

3. Over 600 volts the same requirements as para. 3.3.2 (A) above. If the JHA (Job Hazard Analysis) indicates that other hazards exist in the work area, then two Qualified Persons are required and one of them will perform the Safety Watch duties.

C. Equipment parts, circuits and energy sources which have not been positively de-energized in accordance with 3.3.2 (A) above shall be considered energized, operational and live.
D. See paragraphs 3.3.3 thru 3.3.6 for special requirements, hazard analysis, procedures and approval criteria for working energized.

3.3.3. Working Energized

When positive de-energization is not feasible because it would introduce additional or increased hazards or is infeasible due to equipment design or operational limitations, the circuit may be worked energized, in accordance with the following requirements.

A. When Energized Work is Permissible

1 Examples of increased or additional hazards include interruption of life support equipment, deactivation of emergency alarm systems, shutdown of hazardous location ventilation equipment, or removal of illumination for an area, such as in an operating room.

2. Examples of work that may be performed on or near energized circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (e.g., startup or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous industrial process as in a chemical plant that would otherwise need to be completely shutdown in order to work on one circuit or piece of equipment.

3. **For voltages of less than 50volts**, the decision to de-energize must include consideration of the capacity of the source and any over-current protection between the energy source and the worker. Equipment that operates at less than 50 volts is generally regarded as non-hazardous, it is considered hazardous when high currents are envolved eg…3ka at 25V, 200A at 40V, etc. Though there is low probability of electric shock at voltages less than 50 V, there is a hazard due to arcing and heat in case of an accidental fault (see NFPA 70E 130.3(A) for calculations). Protective covers or barriers shall be placed over terminals and other live parts to protect personnel. If it is essential to work on or near energized low voltage circuits for other than troubleshooting and testing observe the safety rules required for working on or near energized systems as specified in “Procedural Requirements to Work Energized” shown below.

B. Procedural Requirements to Work Energized.

If live parts are not placed in an electrically safe work condition, work to be performed shall be considered energized electrical work and shall be performed only upon obtaining an approved “Energized Electrical Work Permit”(see ESHD 5008, Section 2, Chapter 17, Attachment J for a blank copy of the permit. Approval of an “Energized Electrical Work Permit” for working energized will only be given in rare instances and only with approval by the cognizant Division Head(s), Head of Power Systems, Electrical Safety Engineer and the Head of Engineering and Technical Infrastructure. Testing, troubleshooting, and voltage measuring does not require an “Energized Electrical Work Permit”.

Elements of the Energized Electrical Work Permit shall include the following items:

1. Requestor shall describe the circuit, equipment and levels of voltage and current to be worked on, their location, and a description of the work to be done.
2. Requestor shall provide justification why work must be performed energized.
3. The electrically qualified persons doing the work shall have:
   a. A detailed job work procedure including the safe work practices to be completed
   b. Results of the Shock Hazard Analysis and determination of the shock protection boundaries
   c. Determine the results of the Flash Hazard Analysis and determination of the Flash protection boundaries (see NFPA70E, Section 130.3A).
   d. Determined the necessary personal protective equipment (PPE) to safely perform the assigned task and shall obtain same.
   e. Employed means to restrict access of unqualified persons from the work area. Designate a qualified "safety watch" who is knowledgeable to assist in the safe performance of the work with communication and safety equipment necessary to fulfill their responsibility.
   f. Complete a job hazard analysis (JHA), and review the JHA with all job participants in a job briefing;
   g. Obtained necessary approvals to perform the energized electrical work.

Approved procedures including a hazard / risk analysis of work to be performed prior to the start of work. The work site area shall be examined and work activities shall be reviewed for hazards by cognizant personnel. As a minimum, the following core functions must be performed for all work:

1. Scope of work defined
2. Hazards analyzed
3. Hazard controls developed and implemented including required PPE, and shock protection boundaries established
4. Perform all work within controls using "Qualified Personnel"
5. Provide feedback for continuous improvement.

Exemptions to Work Permit. Work performed on, or near, live parts by qualified persons related to the tasks such as testing, troubleshooting, voltage measuring, etc. shall be permitted to be performed without an energized electrical work permit. Personnel must have approved work procedures, including appropriate safe work practices and personal protective equipment as specified in the job hazard analysis and in accordance with NFPA 70E article 130.7 have been implemented.

Troubleshooting shall only be performed on 125vdc circuits where the available short circuit current is less than 5kA, and 120/208vac power and lighting and control circuits where the available short circuit current is less than 10kA as specified in PPPL Engineering Standard, ES-ELEC-005.

Test instruments and equipment shall only be used by qualified persons performing testing work on or near live parts operating at 50 volts or more.

Only persons fully trained and knowledgeable of the equipment shall perform Trouble-shooting on circuits above 480volts and only when it is not possible to trouble-shoot the equipment in a de-energized state.

Insulated tools shall be used for making calibration adjustments when there is a chance of the tool falling and causing an electrical fault.

No repairs, removals, or replacement of electrical equipment shall be allowed when Trouble-shooting on energized circuits.

C. Shock Protection Boundaries

Limited, Restricted, and Prohibited approach zone boundary distances to live parts for shock protection specify precautionary techniques and Personnel Protective Equipment and shall be observed as specified in NFPA 70E, Tables 130.2(C), 130.7(c)(9)(a) through 130.7(c) (11).
See Chapter 4, paragraph 4.10.1 for guarding of live parts and Electrical Engineering Standards of Safe Work Practices (ES-ELEC-005) for further guidance.

1. A "Limited approach boundary" is defined as a shock protection boundary to be crossed by only qualified persons (at a distance from a live part) which is not to be crossed by unqualified persons unless escorted by a qualified person.

2 A "Restricted approach boundary" is defined as a shock protection boundary to be crossed by only qualified persons (at a distance from a live part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed.

3. A "Prohibited approach boundary" is defined as a shock protection boundary to _be crossed by only qualified persons (at a distance from a live part) which, when crossed by a body part or object, requires the same protection as if direct contact is made with a live part.

D. Arc Flash Protection Boundary

An electric arc can cause serious injury or fatality at distances of several feet from the arc. Whenever energized bus is exposed, workers inside the arc flash zone must wear Flame Resistant (FR) rated clothing and other flash protection as specified in NFPA 70E, Tables 130.7(c)(9)(a), 130.7(c)(10), 130.7(c)11). The arc flash distance shall be calculated as specified in NFPA 70E, Section 130.3(A).

E. Mitigation of Electrical Hazards

Placing a circuit in an electrically safe work condition is a hazardous activity and is considered working on an energized circuit until verified de-energized. Two qualified workers are required to place a circuit in an electrically safe work condition. See paragraph 3.3.2 for how to establish a safe work condition.

Typical Examples of how hazards are mitigated when working energized:

1. Meter-mans gloves insulated tools, safety glasses, face shield and FR clothing shall be used when working on or about energized circuits; until all the circuits have been de-energized.

2. Making voltage measurements or trouble shooting shall require a hazard analysis, and approved procedures with supervisory approval since this process is required to positively de-energize systems and equipment.

3. When working in Electrical equipment below 600 volts with a short circuit rating of less than 10KA the equipment may be worked on with the incoming line side of the equipment energized providing: The JHA establishes the short circuit rating is below 10KA

a. The main breaker or disconnect has been opened, and LO/TO has been applied.
b. The energized line side terminals shall have a protective shield (1000 volt shielding) placed over them to prevent inadvertent contact.
c. The load side tested with verified test equipment for de-energization.
d. Hard hat, Safety glasses, FR shirt, long pants, or coveralls, V rated tools and V rated gloves shall be worn if inadvertent contact with live parts is possible; if not, leather protective gloves may be worn.

For additional requirements for guarding of live parts above 50 volts see chapter 4, paragraph 4.10.1 and consult the Electrical Engineering Standards of Safe Work Practices (ES-ELEC-005, Latest Revision) for further guidance.

F. Area hazard designations

In addition to the above requirements these additional precautions shall be adhered to when working on or near energized systems.

ISOLATION OF HAZARDS, Section 2, Chapter 4, specifies the additional precautions that shall be taken when working in the following energized area safety classifications:

1. Paragraph 4.12.1, "General Access Area"
2. Paragraph 4.12.2, "Limited Access Areas "
3. Paragraph 4.12.3, "Interlocked Access Areas"
4. Paragraphs 4.13 , "Temporary Hazardous operations in General Access areas"
5. Paragraphs 4.14, "Temporary Hazardous operations in other than General Access areas" shall be adhered to.

Capacitors and Capacitor Banks, Section 2, Chapter 6, specify the minimum design, operating, accessing, steps to de-energize, testing and inspection criteria.

In all cases to work energized a Hazardous analysis must be performed, Procedure approval obtained and correct Personal Protective Equipment (PPE) and FR clothing shall be worn and employed by all personnel when in the shock protection approach boundaries and /or arc flash boundary. In all cases a "Safety Watch" shall be present when working energized until the area is de-energized and declared a safe area.

G. Hi pot and Megger Testing

Prior to conducting test the following safety prerequisites shall be performed:

1. Hazardous analysis performed and procedure written.
2. There shall be restrictive access to the areas the test is being performed in.
3. Qualified individuals shall be familiar with electrical safety and the potential hazards when conducting the test.
4. Warning signs and announcements indicating that testing may be taking place.
5. While test is in progress, the red rotating lights shall be on.
6. Suitable barriers shall be in place to prevent unauthorized personnel from entering the area.
7. While test is in progress there shall be a qualified Safety Watch to monitor the test operator.
8. Test operator shall stand on an approved/tested electrical safety mat during the test.
9. Personnel protective equipment shall be used (Class 2 gloves and safety glasses).
10. Personnel shall not attempt to touch the test set until it is positively de-energized and the circuit being tested has had a resistive discharge stick, then a ground stick attached to it.
11. The ground lead of all test sets are to be securely connected to building ground for all tests.

3.3.4 Working in Confined Spaces

Confined spaces, as used in this Electrical Safety, Section 2.0 are those areas that lack sufficient work room and shock reaction space. They exist around electrical equipment whenever adequate NEC access clearances have not been provided. In confined spaces the following additional precautions shall be taken when working hot. See N.E.C. art. 110.26 & 110.30 for working clearance requirements.

1. On 120/208 Volt systems, cover any exposed live parts and grounded surfaces adjacent to the intended work area that may be contacted by dropped, insulated hand tools or an unprotected part of a worker reacting to a shock. Protective barriers, shielding insulated blankets (currently tested), clean G-11, and fire retardant wood panels are approved covering materials.

2. When working in confined spaces within massive grounds, such as, tanks, vacuum vessels, etc. the precautions for massive grounds shall also apply (see chapter 4, para. 4.16)

3.3.5. Working on (CRT) Cathode-Ray-Tube Equipment

Troubleshooting and testing and making measurements are the only time employees shall work on energized CRT equipment. When possible the CRT equipment shall be de-energized prior to the test leads being connected and then the CRT energized.

No repairs, removals, additions, or modifications are to be made on energized electrical equipment.

Employees working on energized cathode-ray-tube (CRT) equipment shall observe the following requirements before removing energy barriers:

A. If performing the work in general-access areas, use the procedures of paragraph 4.13, in Chapter 4.

B. If performing the work in electronic-repair shops, all work on CRT equipment with power supplies that exceed either 240 V ac or 250 Vdc, and 10 J shall comply with the following criteria:

1. Safety signs shall be posted at the shop area boundary stating:

WARNING
High Voltage May Be Present
Authorized Personnel Only

2. Only Qualified Persons shall be allowed to enter the shop area boundary.

3. While Class E (over 600v) power supplies are energized, a safety sign stating:

DANGER
High Voltage
Qualified Persons Only

shall be displayed at the shop area boundary, and a safety watch shall be available within this area when probing inside of the energized equipment.

Qualified workers may omit the use of hard-hats when engaged in activities involving high voltage components with special safety concerns, such as the anode circuits in CRTs. Class 00 high voltage gloves and safety glasses are to be worn.

3.3.6 Portable Measuring & Test Equipment

Portable electrical and electronic measuring and testing equipment represent three potential sources of electrical hazards such as defects or failures in the equipment, misapplication in an electric circuit, and unintentional contact between the user and a live part. Use the following criteria to reduce such risk:

A. Quality equipment is manufactured and tested using the following standards:

1. ANSI C39.5 - “Safety Requirements for Electrical and Electronic Measuring and Controlling Instrumentation”

2. UL Standard 1244 - “Electrical and Electronic Measuring and Testing Equipment” and tested and approved for UL3111.

3. IEC 61010-1

4. All inputs protected to IEC 1010-1 Category III, 1000 volt rating and tested for a minimum transient voltage of 8 kv.

5. Internal fusing capable of interrupting short circuit current from an infinite source (no internal impedance)

B. Portable electrical and electronic measuring and testing equipment shall only be used by qualified persons and in circuits where the operating voltage and fault currents are known not to exceed the equipment range. Measuring and test equipment used on high energy systems shall have the following additional requirements:

1. Fused current inputs (high energy fuses)
2. Overload protection on the ohms function
3. Test leads with shrouded connectors and finger guards
4. Recessed input jacks
5. Meets the latest safety standards (Category III-600V or 1000V) and are independently certified.

Failure of an instrument may result in a dangerous, possibly lethal arc flash.

Associated probes that show no physical defects may be considered insulated tools.

C. Portable test instruments and equipment together with all associated test leads, power cords, insulated probes, and connectors shall be visually inspected by the user for external defects or damage before they are used on any shift. If there are any defects or evidence of damage that might expose an employee to injury, the defective or damaged item shall be tagged with a "WARNING" tag. It shall not be used until any required repairs and tests have been made.

D. Always consider the safety symbols and read safety information both on the equipment and in the manufacturer's instruction manual if available.

E. Glove protectors may be omitted from Class 0 glove sets under limited use conditions, i.e.,where small equipment and parts manipulation require exceptional finger dexterity. Rubber insulating gloves that have been used without protectors shall not be used with protectors until the rubber gloves have been returned to Electrical Safety and given an inspection and electrical test.

F. Eye protection (safety glasses or goggles) shall be worn when performing testing.

3.3.7 Cutting and Drilling-PPE Requirements

The minimum requirements for cutting and drilling of penetrations **3** inches deep or deeper are specified in procedure ENG-028. This procedure specifies the minimum personnel protective equipment and measures that must be adhered to prior to cutting or drilling. The following electrical safety requirements pertain:

A. The cutting equipment & vacuum must be grounded and plugged into a "Ground Fault Interrupter" adapter or circuit, and the mechanic must wear as a minimum Class "O" electrical insulating gloves provided by ES&H. These above requirements apply to vacuum cleaning equipment also. A separate equipment ground (#2 awg minimum) wire must be run from each piece of equipment in use to building steel.

B. All persons in the area must not make any other body contact with the cutting machine unless additional insulating measures are taken.

C. An assistant operating a vacuum machine to remove water from the floor, which is potentially in electrical contact with a ground fault (severed conductor), must wear rated gloves as a minimum, and a rated apron if the device is a metallic conductor.

3.3.7.1 Cutting of Conduits
The cutting of new conduits will normally be performed on the floor. All measurements and fit-ups shall be done prior to conduits being installed overhead where possible. Any existing/installed conduit cuts not being made on the floor and being cut in place will require that the conduit being cut be marked and that a second person verifies that the right conduit has been identified for cutting. Safety glasses with shields shall be required at all times when working and cutting materials overhead. The proper PPE shall be identified in the JHA (Job Hazard Analysis) prior to start of work

3.3.7.2 The requirements of ENG-028 R6 apply for the boring, drilling or cutting of penetrations in sheet rock walls that exceed a depth of 1-1/2 inches, unless it is known that no nonmetallic cables or conduit/piping is concealed behind the sheet rock wall. The recommended minimum cutting or drilling depth tool settings should not be beyond the drywall thickness and should not exceed a maximum 1-1/2 inches.
The N.E.C. art. 300.4 requires all nonmetallic sheath cable to be installed a minimum of 1-1/4 inches from the edge of framing members, therefore sheet rock shall not be cut or drilled to a depth greater that 1-1/2 inches until ascertaining there are no cables or conduit present. N.E.C. Table 300.5 also specifies the minimum cover requirements for 0 to 600 volts direct burial and concrete encased conduits and cables.

3.3.8 Electrical Inspection of Rental Equipment

Rental Equipment may not meet its design specifications when received because of prior_renter misuse or inadequate maintenance by the owner. All rental equipment shall be_thoroughly visually inspected and test operated to ensure personnel safety and functionality before being used on site. This shall be informal and of the standard pre-operations type inspection which is good work practice.

A. Electrical wiring shall be checked for damage and short circuits.

B. Receptacles and plugs checked for damage and proper wiring configuration.

C. All GFCI's receptacles shall be tested prior to use.

3.3.9 Temporary Wiring - General

3.3.7.1 Temporary wiring is permitted during periods of construction, configuration changes, maintenance, repair, emergencies, demolition of equipment or structures, or similar activities.

3.3.7.2 Temporary wiring shall be installed with the same level of safety and quality as required for permanent electrical wiring.

3.3.7.3 Temporary wiring shall be removed immediately upon completion of construction or purpose for which the wiring was installed.

3.3.7.4 Temporary wiring shall be approved or identified as suitable for installation and installed in accordance with the rules specified in the current edition of the NEC, article 590 (Temporary Installations) and OSHA, 29CFR 1910 and 1926.

3.3.7.5 Temporary wiring shall be protected from accidental damage.

3.3.7.6 Temporary wiring shall not be used as a substitute for permanent wiring.

3.3.10 Extension Cords

3.3.10.1 Use only one extension cord for lamps, appliances, or other equipment in conjunction with the equipments power supply cord. The use of multiple extension cords (daisy chaining) is prohibited.

3.3.10.2 Only high-visibility orange or yellow extension cords shall be used.

3.3.10.3 All extension cords shall be listed or labeled by a NRTL (Nationally Recognized Testing Laboratory)

3.3.10.4 All multi-conductor flexible cords and cables shall be of the type identified in N.E.C. Table 400.4 for hard usage or extra-hard usage.

3.3.10.5 Inspect extension cords for damage prior to placing them in service and daily during use.

3.3.10.6 Extension cords cable or jacket shall not be repaired or taped. The plug and receptacle ends may be replaced with UL approved parts provided the repaired cord is tested and found to be the equivalent of the factory assembled and approved cord. PPPL recommends the full replacement of all damaged extension cords.

3.3.10.7 Use of GFCI receptacles or portable GFCI receptacles (available in the stock room) are required to be used at the supply end of all extension cords used with electrical equipment and hand tools, including double insulated tools since the condition of these tools or the extension cords being used may be questionable due to previous hard usage.

3.3.10.8 Extension cords shall be properly supported per NEC article 590.4(J); and are not suitable for installation in cable trays.

3.3.10.9 Extension cords shall not be run through holes in walls, ceilings, floor doorways, windows, or other pinch points unless protection is provided to avoid damage from sharp corners and projections. Cords may not be concealed behind walls, ceilings, or floors.

3.3.10.10 Extension cords shall not be plugged into multi-outlet power strips since extension cords are not to be spliced or daisy chained.

3.3.10.11 Extension cords shall not be used when the cord insulation is damaged, cracked, or spliced; or when the ground pin is missing from the male end of the cord.

3.3.11 Multiple Outlet Boxes / Power Strips

3.3.11.1 Each multiple outlet power strip shall be plugged into a wall receptacle. Use of one multi-outlet strip to provide power to one or more multi-outlet power strips is not permitted.

3.3.11.2 Multi-outlet power strips shall not be plugged into extension cords.

3.3.11.3 Multi-outlet power strips shall not be used to provide power to space heaters, hot plates, coffee pots, or any other power loads above 750 watts.

3.3.11.4 Multi-outlet power strips are permitted to be used for typical lower power consumption office equipment and for surge protection for computers and their associated equipment.

3.3.11.5 Multi-outlet power strips may not be used outdoors.

3.3.12 Ground Fault Circuit Interrupters (GFCI's) for Personnel

3.3.12.1 GFCI's shall be required for all temporary wiring used to supply temporary power to equipment used by personnel during construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities.

3.3.12.2 All 125 volt, single phase, 15-,20-,and 30 ampere receptacle outlets that are not part of the permanent wiring of the building or structure and that are in use by personnel shall have GFCI protection for personnel.

3.3.12.3 If a receptacle is installed or exists as part of the permanent wiring of the building or structure and is used for temporary electric power, GFCI protection for personnel shall be provided.

3.3.12.4 GFCI's may be installed as either circuit breakers or receptacles. In either case, the GFCI's may be wired to protect multiple receptacles. Individual GFCI portable plug-in adapters are available in the PPPL stock room.

3.3.12.5 PPPL requires GFCI protection for the following other conditions:

1. Any 120v convenience outlet located within 6 feet of a sink.
2. Any 120v convenience outlet located outdoors.
3. Any 120v convenience outlet located within 6 feet of a massive ground. A massive ground is a large area of metal, wet earth, or other highly conductive surface).
4. Any resistance heating equipment not having a metal covering, such as heating tapes.
5. GFCI's are required in all bathrooms, garages, crawl spaces at or below grade, and unfinished basements

3..3.12.6 GFCI's must be tested prior to use as a standard good work practice