Center for Electric Power Safety Policies

- Purpose

  This document defines the responsibilities of personnel regarding safety within the electrical research labs of the Center for Electric Power. This policy applies to all personnel (faculty, staff, students and visitors).

- Personnel Behavior

1. Continuing access rights to labs is only granted to personnel who are trained in and adhere to all safety policies. Personnel without access rights to the lab, must be escorted the entire time they are in the lab, by the person allowing them in.

2. Follow all Center for Electric Power policies and any manufacturer's user and safety guides when using any tools and equipment.

3. At least two persons with lab access privileges must be present in the lab when a power source actively supplying in excess of 50 volts is being used. Both persons in the lab are required to be familiar with the equipment in use, its operation and methods of emergency shutdown.

4. In general, touching or modifying the test set-up of live circuits in excess of 50V is prohibited. This includes changing test connections while a circuit is powered.

5. Safety glasses, goggles or a safety shield must be used performing tests or cutting wire.

6. Do not wear jewelry or conductive apparel that could come in contact with energized parts.

7. Clothing such as cotton, Nomex, or equivalent fabrics are required while clothing such as polyester, nylon, rayon, acetate, or blends of these materials is prohibited when working around circuits where an Arc Flash hazard exists.

8. Do not wear gloves, ties, or loose-fitting clothing or jewelry when working on or around machinery with moving parts. Persons with long hair must wear hair up or tied back to prevent hair from catching on moving parts.

9. Open toe shoes may not be worn in the lab due to the risk of molten solder splashing on personnel's feet.

10. Use a fan to pull the fumes away from the soldering station to avoid inhaling fumes.

11. Eating and drinking in the electronics labs is prohibited.

12. Report <u>all</u> physical injuries to the lab manager immediately. Failure to report injuries within a timely fashion may prohibit your ability to make and receive Workers Compensation Insurance through the University.

13. Everyone in the lab is responsible for taking an active role in promoting safe work practices in the lab. As such, it is your responsibility to inform persons that perform unsafe actions in the lab of proper methods, procedures, practices, etc.

14. Report promptly to lab management and your advisor any unsafe condition or practice that you observe.

15. Make suggestions to improve safety in the laboratories to lab supervisors, the lab manager or your advisor.

16. Keep aisles clear of boxes, test equipment, etc.

17. Keep work areas clean. Clean up your workplace by removing trash, empty boxes, etc.

18. Return tools to their proper place immediately after using. Keeping tools at your bench while not actively using them is prohibited.

- Equipment Usage

1. Understand the grounding of equipment and circuits. All test equipment in the test set-up must have safety grounds. No floating of grounds to isolate noise issues is allowed. Troubleshooting of circuits that float with respect to earth ground must be done with a differential scope probe.

2. Modification, in any manner, of tools and test equipment is strictly prohibited. This includes cutting power cords found in the lab.

3. If possible, maintain a shield between solid state power devices and personnel when running tests.

4. Before use, visually inspect equipment and cords for defects including; damaged insulation, missing hardware, loose covers and screws.

5. Check the AC power disconnect boxes, isolation transformers, and power cables for proper mechanical and electrical operation before use. Do not use defective equipment or cords.

   Do not place cords across sharp objects that may damage the insulation. Always use insulated cables and insulate any exposed part of the conductor with electrical tape.

   Check connections in the test set-up and tighten loose connections before energizing the equipment.

6. Remain clear of unit when energizing or re-energizing electronic equipment that operate above the 50-volt minimum level. Only qualified personnel are allowed near live equipment.

7. Make sure energy storage components (e.g. capacitors) are discharged after energizing and make sure to de-energize the equipment after test.

Power down must be conducted before disconnecting or connecting probes or leads of instruments when working with energized electronic systems in a "live" test mode and the voltage exceeds the 50 volt level.

8. Lock out/tag out shall be used for high power equipment.

- Emergency

1. Know the location of all emergency exits. Never block aisle ways or exit paths with equipment or boxes. Know the location of the room electric power “shutdown” buttons, which de-energize all power in the lab when pressed. Know the location of emergency stop buttons, fire extinguishers, fire alarm switches, first aid boxes and AED units.

2. Resuscitation training is recommended for all personnel who work with energized electronic systems that exceed the 50-volt limit. In an emergency (fire, severe injury, or trauma), make sure all personnel are clear of the area where there is immediate danger and call the 911 operator immediately.

3. Electric shock treatment-

   Separate the person from current's source by turning off power. If the power cannot be turned off, stand on something dry and non-conductive, such as wooden board and try to separate the person from source using non-conductive object such as wooden or plastic broom handle, chair, or rubber doormat.

   Do CPR if necessary: check responsiveness, do chest compressions, and use an AED as soon as one is available.

   Check for other injuries: bleeding, fracture or burns.

   Wait for 911 to arrive.

   Follow up.

- Testing Rule

1. Understand the hazard of the circuit. How much total energy is available under fault conditions? These stored when the circuit is energized.

2. Understand the insulation requirement for high voltage. Make sure the required insulation distance is evaluated and calculated, if necessary to prevent arcing. Pay particular attention to corona effects with conductors. Some related standards for reference are UL60950-1 and IEC61800-5-1. Insufficient insulation distance can cause arc and flash.

3. Understand the copper area requirement for high current. Make sure the required copper area (including PCB traces, bus bars, and connection wire) is calculated for all current conductors. A

good reference for wire, cable, bus bar and insulation requirements is the National Electrical Code (NEC). Insufficient conducting area and too many conducting wires tied together can cause overheating, fire and insulation damage leading to electrical shorts.

4. Prepare a test procedure before testing and follow the procedure when testing.

- Definitions

1. Circuit - The complete path of an electric current including the source of electric energy.
2. Conductive - To have the quality to transmit heat, light, sound, or electricity.
3. Energized – Indicates the state of a circuit so as to permit operation. Power has been applied to the system.
4. Equipment - A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like, used as part of or in connection with an electrical installation.
5. Ground - A conducting connection, whether intentional or accidental, between an electrical circuit and the earth or to some conducting body that serves in place of the earth.
6. Insulated - A conductor encased within material of composition or thickness that is recognized by national standards as electrical insulation.
7. "Live" - In electronics, it means connected to electric power, in an operating state, or functioning.
8. Safety Glasses - An impact resistant set of lenses that are fitted in to frames which are used to protect the eyes.
9. Soldering - A metallic alloy, usually tin, lead, or silver, that when melted is used to join two different surfaces together in a firm union.
10. Volt - The potential developed across a resistance of one ohm when one ampere of current is flowing through it. Can be alternating or direct.
11. Voltage - An electric potential or potential difference expressed in volts.