Routine Electronic and Electrical Work, Testing, and Troubleshooting

High Energy Physics Division

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Approved: 11/9/04
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Approved: 11/10/04
Electrical Safety Committee

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The High Energy Physics Division operates by ANL guidelines, and places great emphasis upon establishing and maintaining safe working environments for the activities associated with its program of research. The Division holds electrical safety to be a line responsibility stemming from the Division Director to all individual employees, and expects its members to be knowledgeable of safe practices and to employ them on day-to-day basis.

Point of Contact
If you have questions on the content of this section please contact L. Reed, ES&H coordinator, at 2-4478.
Policy
Any equipment design/construction within the ANL High Energy Physics Division areas shall be designed in a manner such that all necessary measures are taken to protect the health and safety of employees and members of the public, and to minimize accidental damage to property.
Work with exposed voltages, as defined "Working Hot" below, should be avoided whenever possible. If a piece of equipment must be open, every effort must be made to install insulating barriers around the exposed voltages.
Approval

In the interim, each instance of "Working Hot" as defined below, must be approved by Leon Reed, who has been delegated this responsibility by the High Energy Physics Division Director, 70E trained, and approved by the ***Electrical Safety Committee*** (ESC) Chairman.
The approval will specify a hazard classification and time period for the job/task after which a new approval must be obtained.
If Leon Reed is not available, the Division Director may designate an alternate if approved by the ESC Chairman.

Safety Criteria for Equipment

- Design for safety. Consider safety to be an integral part of the design process.

- Wherever possible, work should be removed from the "working hot" category by installing a positive barrier that will prevent personnel or conductive material from contacting electrical current-carrying parts.

- Document your work. An up-to-date set of documentation adequate for operation, maintenance, testing, and safety should be available to anyone working on potentially hazardous equipment.
- Have designs reviewed. Systems and modifications to systems performing a function or controlling a potentially hazardous operation should be reviewed and approved at the level of project electrical engineer or above.
- Maintain for safety. Good maintenance is essential to safe operations.

Work Conditions

The primary ANL HEPD reference; Electrical Safety for Working On or Near Live Parts is the NFPA 70E 2004 edition, "Standard for Electrical Safety in the Workplace". Minimum safe work requirements in this section are based on 29 CFR 1910.333, "Selection and Use of Work Practices"; and DOE Order 5480.19, "Conduct of Operations."

Work Practices

Working hot - performing work on an electrically charged circuit or in close proximity to an exposed electrical circuit where the possibility exists to come in contact with a live circuit of 50 volts or greater.

- As provided for in Section 9.1, ES&H manual, routine electronic and electrical work of a developmental or testing nature may not require a Hot work Permit. In these cases, rules of electrical safety are required and they should address personnel safety and protective equipment to be used.

- Tests should be made when the electrical equipment is de-energized, or at most, energized with reduced hazard.

- Every effort must be made to de-energize a circuit before any work is started; all stored or mechanical energy that might endanger personnel is required to be released or restrained.

- Always use safety glasses as the minimum eye protection when fabricating or maintaining electrical equipment.

- Employees authorized to work on live (a piece of equipment or a device that contains any

exposed conductors with a voltage greater than 50 V either DC or RMS AC) systems must be familiar with the appropriate protective requirements. In addition, the following practices and safeguards must be implemented to protect the employee from injury.

- Personnel should inspect electrical equipment for defective parts, faulty insulation, improper grounding, loose connections, and unguarded live parts and should take remedial action before working on or near live (electrical potential of 50 V or greater to ground) parts.

- Perform Shock Hazard Analysis as per the NFPA 70E, 2004 edition, table 130.2 (c) "Approach Boundaries to Live Parts for Shock Protection", 70E, page 25 to determine the proper shock hazard PPE required.

- Personnel shall (1) assess the "hazard/risk category classification", 70E pages 29-31, (2) determine personnel protective equipment (PPE) as prescribed in table 130.7 (c) (10) "Protective Clothing & PPE Matrix", 70E page 33 and table 130.7 (c) (11) 70E page 34 " Protective Clothing Characteristics" which is design [approved, certified] for the system voltages.

- Do not bypass interlocks or other safety devices that protect persons against electrical shock.

- As much as possible, insulator barriers should prevent anyone from falling or leaning into live parts and should also contain any live part or prevent any live part such as a wire and cable from falling onto people or grounded metal.

- Stored energy devices (e.g. capacitors, batteries) must be discharged either through motor windings or through other effective means.

- High-capacitance elements are required to be short-circuited or grounded to offer errant electricity a path of low resistance; thus the user is protected by virtue of his higher resistance. Check circuit with appropriate instrumentation (e.g., voltmeter).

Grounding Practices

- Electric field strengths can produce a wide range of safety hazards such as startle reactions associated with spark discharges and contact currents from ungrounded conductors within the field. In addition, safety hazards associated with electro-explosive devices may exist when a high-intensity electric field is present. Care must be taken to eliminate ungrounded objects, to ground such objects, or to use insulated gloves when ungrounded objects must be handled

Working Alone

- It is the policy of the Laboratory and the High Energy Physics Division that employees working alone at ANL should not be subject to increased risk as a consequence. In some situations, it may be desirable or necessary to permit staff to work alone. This Working Alone Policy, implemented by the HEP Division, intended to supplement the ANL Working Alone Policy described in the ESH Manual, Chapter 1-6.

- Measures to ensure the safety of those working alone may include regular contacts with the supervisor or other responsible person.

- ANL has a telephone answering service available to call employees at a phone near the area where they plan to work alone. This service activated by calling the Telephone Answering Service at (630) 252-1991. The telephone answering service will provide a telephone call to you at your designated phone at time intervals designated by you. If you do not respond to their call, they will notify the ANL Security Department for an emergency response.
- Before leaving the work alone work area, you must cancel the telephone safety check.
- Working alone on electrical systems capable of producing paralyzing shock, without proper guarding or when high-energy and detonatable materials are present is not permitted and requires a safety watch.

Lockout/Tagout

Three forms of hazardous electrical energy control permitted.

- Individual employee control; the individual control shall be permitted when equipment with expose conductors and circuit parts is de-energized for minor maintenance, servicing, adjusting, cleaning, inspection, operating conditions, and the like. The work permitted without the placement of lockout /tagout devices on the disconnecting means provided the disconnecting means is adjacent to the conductor, circuit parts and equipment on which the work is performed, the disconnecting means is clearly visible to the individual qualified employee involved in the work, and the work does not extend beyond one shift.

- Simple Lockout/Tagout; involves a qualified person (s) de-energizing one set of conductors or circuit part source for the sole purpose of performing work on or near electrical equipment. Simple lockout/tagout plans shall not be required to be written for each application. Each worker shall be responsible for his or her own lockout/tagout.

- Complex Lockout/tagout; Shall be permitted where one or more of the following exist:

    1. Multiple energy sources
    2. Multiple crews
    3. Multiple crafts
    4. Multiple locations
    5. Multiple employers
    6. Different disconnecting means
    7. Particular sequences
    8. A job or task that continues for more than one work period.

  A person shall be in charge of a complex lockout/tagout procedure. Such person shall be a qualified individual who is specifically appointed with overall responsibility to ensure that all energy sources are under lockout/tagout and to account for persons working on the task. The complex lockout/tagout procedure shall identify the person in charge. The person in charge shall be accountable for the safe execution of the complex lockout/tagout. All complex

lockout/tagout procedures shall require a written plan of execution.

- The LOTO program as prescribed by NFPA 70E 120.2 is intended to protect personnel from injury during servicing or maintenance of machines and equipment.

- Only qualified personnel (one who is familiar with the construction and operation of the equipment and the hazards involved) are allowed to lock or implement a tagout procedure

- All persons who could be exposed shall be trained to understand the established procedure to control the energy and their responsibilities in executing the procedure.

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