

# BLUE - Electrical Shock Event in an R&D Laboratory

**Lesson ID:** INL-BEA-LL-2006-031 (*Source: User Submitted*)

**Originator:** Idaho National Laboratory

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**Statement:** This event brought into light several key processes that must be functional to preclude similar events. They are: 1) a process to evaluate non-UL (or equivalent) listed equipment prior to use; 2) a process to evaluate equipment after repair or modification by qualified personnel; 3) when equipment is determined to be deficient a positive means of removing it from service must be invoked; 4) there must be a formal process established for troubleshooting of equipment; and 5) all employees should understand the correct response to take for GFCI trips.

**Discussion:** On April 3, 2006, an experimenter was in the process of putting a NO<sub>x</sub> analyzer in service in preparation to begin an experiment supporting the evaluation of an off-gas system's performance at Hanford. The experimenter was rearranging some equipment when both of his elbows came into contact with the body of the analyzer. He experienced what he thought was an electrical shock. The intensity of what he felt was very mild and the experimenter was not certain he had received a shock. Investigation subsequently determined a voltage splitter that the analyzer was plugged into was not grounded. The analyzer has to be grounded to prevent leakage voltage and current from being present on the body of the analyzer.

**Analysis:** The suspect voltage splitter had been rewired incorrectly, i.e., neutral wired to ground, sometime previous to this event (approximately 18 months) without a proper evaluation by qualified personnel subsequent to the modification. Another barrier to this event was the requirement to have all equipment that is not UL or equivalent listed evaluated prior using the equipment at the Idaho National Laboratory (INL). At the INL this program is titled the "Authority Having Jurisdiction" (AHJ) process. This requirement was not generally known outside of the safety professionals and was consequently overlooked. All staff associated with laboratories should be made aware of this requirement.

When testing the analyzer, it tripped GFCI circuits numerous times. During this time the experimenters appropriately contacted the equipment vendor, building manager, and electricians for trouble shooting. Several GFCI outlets were replaced and several new parts ordered for the analyzer, none of which seemed to help. This caused confusion with involved staff and posed questions of how to handle things after multiple GFCI trips from different units. This kind of confusion must be eliminated.

The only time the analyzer would operate was when it was plugged into the GFCI outlets on the voltage splitter. The lab worker questioned why the analyzer would trip other GFCIs but not the

ones on the voltage splitter. An electrician used a GFCI tester on the voltage splitter and based on the results of his tests, he determined that the GFCIs were wired incorrectly and would not function as GFCIs. The electrician's message was intended to mean don't use the voltage splitter, but the experimenters understood it to say it was still acceptable to use. All personnel must understand that when a piece of equipment is determined to be defective, positive means must be invoked to prevent its use.

When the shock occurred, the on-shift experimenter and a laboratory technician began troubleshooting the problem without benefit of an appropriate agreed to plan. To preclude injury to personnel this activity should have been covered by appropriate paperwork that was reviewed and approved by qualified staff.

- Actions:**
1. Programs such as the INL AHJ process must be in place and appropriately communicated to affected personnel. In regard to the AHJ program, the requirements of LRD-14401, INL Fire Protection Program, and LRD-14113, Electrical Safety, must be met.
  2. Alert staff to ensure that legacy equipment that is not UL or equivalent listed is evaluated to make sure it is safe and acceptable for operation with regards to applicable codes and standards. If listed equipment is not available, standard equipment constructed in accordance with a specification standard such as ANSI or NFPA should be used. If listed or standard equipment is not available, an engineering evaluation is required that is acceptable to the Authority Having Jurisdiction. This evaluation must meet the requirements of the National Electrical Code, Article 110.3, Examination, Identification, Installation and Use of Equipment.
  3. Ensure that equipment is checked by a qualified person after repairs or modifications to determine if the job was done correctly and the equipment still meets safety requirements.
  4. Ensure all personnel know that when equipment is found to be defective a positive means of removing it from service is used rather than simply verbally communicating to others that it is defective. Verbal communication does not always convey the intended message as occurred in this event. The affected equipment must be tagged (warning tag or equivalent) in accordance with company requirements.
  5. Make sure that all personnel understand the correct actions to take when it is necessary to troubleshoot equipment, i.e., follow established work control processes.
  6. All INL staff should be made aware of the correct actions to take when a GFCI circuit trips. If a GFCI trips while using electric equipment, it may be reset one time. If the GFCI trips a second time, the electrical equipment, extension cord and GFCI should be evaluated by a qualified electrical worker as a ground fault condition is suspected. Contact your responsible manager.

**Keywords:** electrical shock, GFCI, AUTHORITY HAVING JURISDICTION, troubleshooting

**Hazard(s):** Electrical / NEC

**ISM Code(s):** Analyze Hazards, Define Work, Perform Work

**Work Function(s):** Conduct of Operations - Configuration Management, Conduct of Operations - Procedure Adherence, Laboratory Experimentation, Maintenance - Electrical

**References:** Occurrence Report NE-ID-BEA-INLLABS-2006-0002, Personnel Shock at CFA-625 Laboratory 120

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