



## Department of Energy

Washington, DC 20585

December 20, 2012

Dr. Dan Arvizu, President  
Alliance for Sustainable Energy, LLC  
National Renewable Energy Laboratory  
15013 Denver West Parkway  
Golden, Colorado 80401

WEL-2012-05

Dear Dr. Arvizu:

The Office of Health, Safety and Security's Office of Enforcement and Oversight evaluated an electrical shock near miss incident that occurred on February 27, 2012, at the National Renewable Energy Laboratory (NREL). The Alliance for Sustainable Energy, LLC (Alliance) manages and operates NREL under a contract with the Department of Energy (DOE) and is subject to the provisions of DOE's Worker Safety and Health Program rule (10 C.F.R. Part 851). The event revealed weaknesses in Alliance's electrical hazard identification and control processes that implement relevant Part 851 requirements and protect NREL workers from unmitigated hazardous energy.

This event occurred when a researcher in Lab 105 of the NREL Outdoor Test Facility performed a zero energy check on capacitors contained in a SPI-SUN Simulator 4600SLP. The simulator, used by Alliance personnel for testing photovoltaic modules, incorporates high voltage capacitors that can store 2,250 volts of direct current (VDC) electrical energy. After discharging the capacitors in accordance with the manufacturer's manual and applying proper lockout/tagout (LO/TO) procedures to the power breaker that fed the equipment, the researcher then performed his zero energy verification. Believing that the capacitors had been discharged, the researcher used a voltage probe rated at 1,000 VDC to assess the capacitors' output voltage. The probe registered 400 volts when the researcher performed the zero energy verification across the relay used to discharge the capacitors, indicating that the relay had failed. The researcher performing this check did not wear personal protective equipment (PPE) appropriate for performing work on or close to exposed and potentially energized parts of electrical systems at greater than 50 volts to ground. As a result, Alliance did not ensure that this researcher was provided with safe work conditions to perform this task and was therefore exposed to energized electrical energy sufficient to cause serious injury or electrocution.

The Office of Enforcement and Oversight commends the NREL first line supervisor for proactively investigating the event after determining that an equipment repair was performed during his one-week absence from the site. The supervisor's initiative allowed Alliance to examine elements of Alliance's



electrical safety and hazardous energy LO/TO programs that were not implemented consistent with the Laboratory's expectations and applicable regulatory requirements. Alliance performed a regulatory screening of this event on May 24, 2012, and determined that it met the criteria for reporting to the DOE Noncompliance Tracking System (NTS). On June 25, 2012, Alliance reported the worker safety and health (WSH) noncompliances associated with this event in NTS report NTS--GO-ASE-NREL-2012-0004.

The electrical shock near miss event revealed several potential violations of Part 851 requirements and the invoked standards, including 29 C.F.R. Part 1910, *Occupational Safety and Health Standards*, and National Fire Protection Association (NFPA) standard 70E, *Standard for Electrical Safety in the Workplace* (2004). The regulatory noncompliances were related to Alliance process deficiencies in the areas of electrical safety, hazard identification and assessment, hazard prevention and control, and worker training. Specific examples include:

- Alliance's site policies and procedures did not appropriately address methods for discharging or removing electrical energy that may be stored in capacitors. NFPA 70E requires LO/TO procedures to include requirements for releasing stored energy that might endanger personnel. Specifically, capacitors must be discharged, and high capacitance elements must be short-circuited and grounded before the equipment is touched or worked on.
- Alliance did not adequately identify and assess the electrical safety hazards associated with working and maintaining the SPI-SUN Simulator 4600SLP to ensure that precautionary measures were appropriately incorporated into work control documents as required by electrical safety and LO/TO procedures invoked by the Part 851 WSH program.
- Alliance did not develop an equipment-specific safe operating procedure to address site-specific electrical safety requirements that were not specified in the equipment's manufacturer's manual. The SPI-SUN Simulator 4600SLP manufacturer's manual did not address requirements and safe work practices described in NREL procedure 6-4.15, *Electrical Safety* (effective date April 5, 2010), which is a non-equipment-specific guidance procedure, including NREL requirements related to proper selection and use of PPE; instituting the two-worker rule; job-specific training; provisions for approach boundaries to live parts; equipment-specific LO/TO procedure; and installation of safety signs and barricades. Additionally, NREL procedure 2-1.1, *Integrated Safety Management System* (dated August 11, 2011) states that "Individual organizations and workers [must] maintain task-specific procedures, such as safe operating procedures (SOPs), desk procedures, or equipment manuals to keep their activities in compliance with the policies and Laboratory-level procedures."

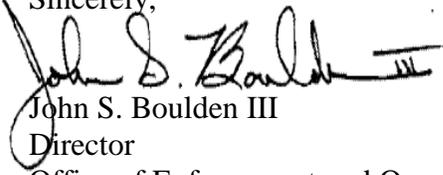
- Alliance did not perform zero energy verification with a voltage detector that was appropriately rated or had the voltage range for testing the potential energy of the capacitors. The researcher used a Fluke model 87 multimeter with a maximum input limit of 1,000 volts to perform zero voltage verification on high voltage capacitors with a potential to store 2,250 VDC. A notice in the Fluke multimeter manual warns users not to apply more than 1,000 volts between any terminal and earth ground to avoid electrical shock.
- Alliance did not provide the researcher with the appropriate training to perform the assigned tasks, in accordance with the training requirements described in procedure 6-4.15. The researcher's Required Training Plan indicated that he did not complete qualified electrical worker training that is required for workers having at least a moderate electrical exposure level. The electrical exposure level for this researcher would have been classified by NREL policy as high because the potential electrical hazard was 480 volts or higher. Workers in this category must be trained in hazard recognition precautionary measures such as LO/TO, the selection and use of PPE, and emergency response procedures.

The Office of Enforcement and Oversight acknowledges that Alliance is implementing a corrective action plan to address this and related electrical safety issues. In its efforts to address this matter, Alliance should ensure that its extent-of-condition review for this event assesses: (1) employee training for all workers and subcontractors who perform moderate or high hazard work with energized electrical systems and equipment; (2) the adequacy of procedures for all instrumentation equipped with high voltage capacitors; and (3) Alliance's capabilities for performing oversight and control of maintenance activities on laboratory equipment. Alliance's corrective actions, as identified in the NTS report, focus on event-specific causes without examining the potential for programmatic weaknesses in electrical hazard identification, abatement, and training. A thorough extent-of-condition review would promote effective improvements to mitigate programmatic weaknesses across all Alliance organizations.

The Office of Enforcement and Oversight is issuing this enforcement letter to Alliance to provide our feedback on the regulatory issues associated with this event and communicate other areas that Alliance could consider to prevent a more safety significant occurrence. The facts and circumstances surrounding this event, coupled with information from other recent NREL occurrence reports, suggest potential weaknesses in Alliance's ability to analyze hazards for work evolutions. In the absence of effective analysis, these weaknesses may adversely impact the selection and use of appropriate engineering controls, administrative controls, and PPE. The Office of Enforcement and Oversight and the DOE Golden Field Office will continue to closely monitor Alliance's effectiveness in preventing worker exposures to hazards and successfully implementing Part 851 requirements.

No response to this letter is required. If you have any questions, please contact me at (301) 903-2178, or your staff may contact Mr. Kevin Dressman, Director, Office of Worker Safety and Health Enforcement, at (301) 903-0100.

Sincerely,

A handwritten signature in black ink, appearing to read "John S. Boulden III". The signature is written in a cursive style with a horizontal line at the end.

John S. Boulden III

Director

Office of Enforcement and Oversight  
Office of Health, Safety and Security

cc: Maureen Jordan, NREL  
Carol Battershell, GFO