



Department of Energy
Washington, DC 20585

November 27, 2013

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

WEL-2013-04

Dear Dr. Arvizu:

The Office of Health, Safety and Security's Office of Enforcement and Oversight evaluated a drum rupture and flash event that occurred on February 8, 2013, at the National Renewable Energy Laboratory (NREL) Thermochemical User Facility (TCUF). 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 Office of Enforcement and Oversight is issuing this enforcement letter to Alliance in response to this safety significant event, and to share observations about NREL's processes for identifying, controlling, and responding to chemical hazards consistent with Part 851 requirements.

The drum explosion event occurred while aqueous condensate from a biomass gasification system was collecting in a 55 gallon high density polyethylene drum. The system, identified as the Thermochemical Process Development Unit (TCPDU), converts biomass materials into liquid and gaseous products using pyrolysis or gasification. The TCPDU was equipped with process engineering controls and Alliance had instituted administrative controls for operation, startup, shutdown, standby, maintenance, and cleanup. Two employees were overseeing the operation of the TCPDU when the condensate collection drum flashed and burst. One employee was located in the control room, while the second employee was working in the vicinity of process equipment performing a routine addition of dodecane. The heat of the explosion singed hair on the second employee's head, but the blast from the drum could have resulted in more serious injuries to workers in the area.

Alliance conducted a thorough and appropriately self-critical evaluation of the causal factors and related program deficiencies associated with this event. The independent incident investigation team concluded that the drum contained a flammable atmosphere containing syngas and/or acetone, which reacted with oxygen and was ignited from static electricity or a corona discharge in the condensate drum headspace. On June 24, 2013, Alliance reported the worker



safety and health (WSH) noncompliances associated with this event into DOE's Noncompliance Tracking System (NTS) report NTS--GO-ASE-NREL-2013-0008.

The Office of Enforcement and Oversight evaluated documentation related to the event, which included the NTS and occurrence reports, NREL's incident investigation report, and the NREL worker safety and health program and implementation procedures. Based on our evaluation, the drum explosion 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*. The regulatory deficiencies were related to hazard identification and assessment, hazard prevention and control, and worker training. Specific examples include:

1. On March 16, 2012, NREL's National Bioenergy Center was involved in an experimental bench-top flash ignition event with a 5 gallon container that was collecting aqueous effluent from the 4 inch Fluidized Bed Reactor (FBR). The event-specific corrective actions and lessons learned from the FBR event related to backflow prevention of flammable syngas into a condensate collection container did not result in appropriate modifications to the TCPDU or changes to operational procedures, which might have prevented the explosion on February 8, 2013.
2. Alliance did not appropriately assess and document the existing and potential chemical, physical, and safety hazards associated with the biomass gasification process at the TCPDU to reflect current equipment configurations and work practices of employees.
 - a. The hazard analysis that existed on February 8, 2013, for TCPDU did not accurately reflect a hazard profile that addressed the potential for the backflow of flammable syngas and/or the presence of significant quantities of flammable liquids in the condensate collection drum that could be affected by an ignition source to cause an explosion.
 - b. Support staff managing and performing process equipment modifications did not have sufficient knowledge of the hazards associated with the process to recognize that incorrect equipment installations would result in flammable syngas entering the process effluent condensate waste collection container.
 - c. The evaluation of electrostatic charge accumulation from the flow of flammable and combustible liquid/gases through the TCPDU into the condensate collection container was not considered by Alliance to be a significant hazard requiring additional mitigation.

- d. Alliance did not assess the potential hazards to operations personnel collecting condensate using partially filled drums containing unknown materials or consider the potential degradation of the high density polyethylene drum due to a lack of chemical resistance to condensate waste streams collecting at non-ambient temperatures.
 - e. The TCPDU standard operating procedure did not identify carbon monoxide alarms from personal and fixed monitors as a precursor to a process condition representing an explosive condition within the condensate collection drum.
 - f. Alliance does not track or document personal monitoring results obtained for operators who don carbon monoxide monitors that do not have data logging capabilities.
 - g. Alliance did not assess or document the exposures to all chemical and physical hazards encountered during the explosion by the employee in the vicinity of the ruptured drum.
3. The engineering and administrative controls for the biomass gasification process were not used or did not effectively function to prevent the conditions that led to the drum explosion.
- a. Multiple engineering controls integrated into the TCPDU process by Alliance did not mitigate a hazardous condition in the headspace of the condensate collection drum. The nitrogen purge line installed on the TCPDU condensate collection drum was not designed to provide a sufficient flowrate to inert the headspace, the exhaust line leading from the condensate collection drum was incorrectly connected to a pipe leading to the blower cart, and a one-way check valve controlling the backflow of syngas from the blower cart into the collection drum did not perform as intended.
 - b. The standard operating procedure addressing hazards and controls for TCPDU operations was expired, which should have resulted in suspension of work activities.
 - c. The management process to ensure that safety reviews were performed after design changes had occurred for the TCPDU was not fully implemented. Design changes made to process equipment did not result in a reanalysis of the hazard profile or visual verification of equipment installation as required by NREL procedures.
 - d. The sequence of events corresponding to the alarming of carbon monoxide fixed monitors indicate that this administrative control was not able to effectively modify the activities of the operators when unexpected process conditions occurred.

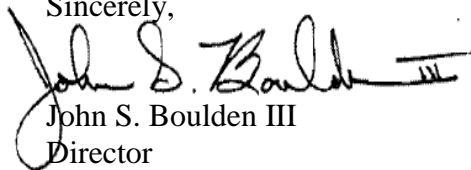
4. Alliance did not provide adequate training to workers regarding the hazards of this operation.
 - a. The operators involved in the event did not have sufficient practical training on field level emergency response to successfully implement the requirements of the TCPDU emergency procedure.
 - b. TCPDU operators were not trained to recognize that carbon monoxide alarms from personal and fixed monitors could indicate an explosive condition in the vicinity of the condensate waste collection container.

Alliance has used this event, and other recent events over the past year, as opportunities to achieve notable progress in identifying and implementing work control program enhancements, and to objectively assess needed improvements to implementation of NREL's worker safety and health program. Previously, Alliance has been challenged in its ability to consistently assess and control workplace hazards. When events have occurred, NREL's analysis often focused on event-specific factors, and often lacked a thorough extent-of-condition review that considered ancillary management processes, an examination of all potential regulatory noncompliances and potential programmatic weaknesses, and a verification of the effectiveness of corrective actions. The Office of Enforcement and Oversight recognizes that Alliance is instituting significant improvements to its electrical safety program and the laboratory work control process. In addition, Alliance regularly communicates with the Office of Enforcement and Oversight on these efforts to convey senior management commitment to sustainable improvements to NREL's worker safety and health program and effective implementation of Part 851 requirements.

The Office of Enforcement and Oversight is issuing this enforcement letter to Alliance to ensure management awareness of the regulatory issues associated with this event and to provide positive feedback on the measures that Alliance has taken to prevent recurrence. At this time, DOE is electing to exercise discretion and not pursue enforcement action against Alliance in this matter due to: (1) the independent incident investigation; (2) ongoing efforts by Alliance to critically examine work control processes and environment, safety and health training programs; and (3) evidence of self-identification of repetitive and programmatic weaknesses within NREL's worker safety and health program. The Office of Enforcement and Oversight and the DOE Golden Field Office will continue to closely monitor Alliance's effectiveness in providing a safe and healthful workplace 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 prominent initial "J".

John S. Boulden III
Director

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

cc: Maureen Jordan, NREL
Doug Kaemps, GFO