Operating Experience Summary

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Office of Health, Safety and Security
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Type A Accident Investigation—Vehicle Fatality

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On June 26, 2009, a Lawrence Livermore National Security (LLNS) employee, who was transporting boxes of personal property from one Lawrence Livermore National Laboratory building to another in a government-owned pickup truck, sustained a severe head injury when he was ejected from the vehicle. He was transported by helicopter to a local medical facility, where he later died. (ORPS Report NA--LSO-LLNL-LLNL-2009-0028)

The driver (LE1) was attempting to back the truck out of a parking space and did not have his seatbelt secured. Witnesses saw the vehicle back up at a high rate of speed (as evidenced by skid marks) with the driver's side door open and no driver visible. As the truck moved backward, it hit several adjacent, unoccupied parked vehicles (Figure 1-1). Because the employee was not wearing a seatbelt, the impact with other vehicles caused him to be ejected through the open driver's side door and he struck the pavement, resulting in the fatal head injury.

The results of the Type A Accident Investigation into the fatality are discussed below, and the Accident Board's report can be accessed at http://www.hss.energy.gov/csa/csp/aip/accidents/typea/LLNL_TypeA_Report.pdf.

Because several reports (e.g., medical records, police report) related to this accident were unavailable for review, the Board developed a "most likely" accident sequence based on available evidence. The Board surmised that after the LLNS employee entered the truck (V1), he started it and put it in reverse gear, but then realized that the emergency brake was on. They

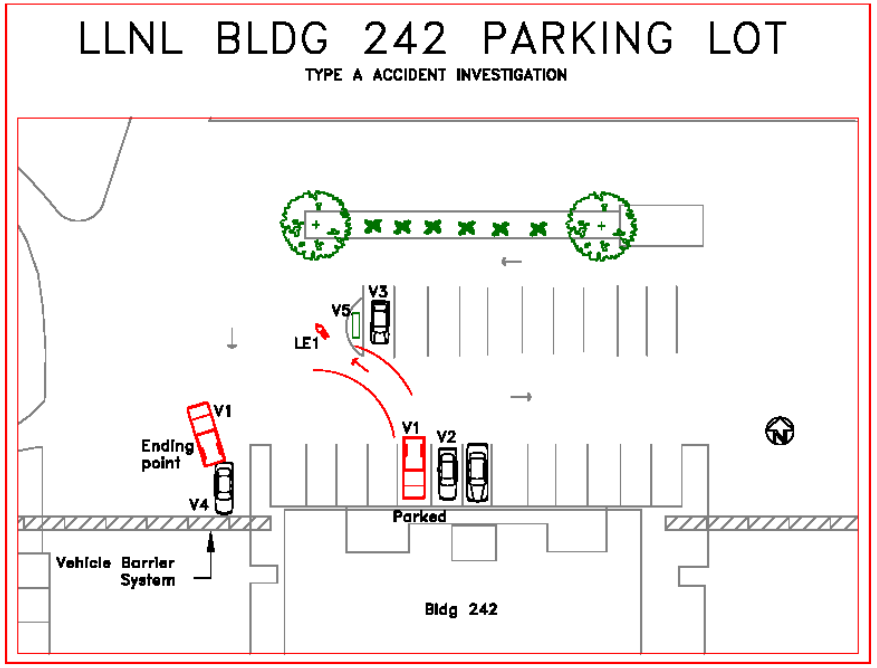

Figure 1-1. Diagram of accident scene

concluded the employee either opened the driver's side door because he was having difficulty locating the emergency brake release or, because there was a "blind spot" associated with the full-size pickup truck, he opened the door to look behind him when backing up.

As he backed up with the truck door open, the door hit the front passenger side of an adjacent, parked vehicle (V2), which may have startled the LLNS employee, causing him to try to stop the truck. The Board believes that he either inadvertently depressed the gas pedal, rather than the brake pedal, or his foot slipped off the brake pedal and onto the gas pedal, resulting in the truck rapidly accelerating backwards.

As shown in Figure 1-1, the truck continued moving backwards in a counterclockwise arc and struck the left front corner of another parked vehicle (V3), which resulted in the truck door opening beyond its normal limit (Figure 1-2) and the LLNS employee being ejected. As he was flung to the pavement, the ejected employee hit a parked motorcycle (V5) and knocked it over. The truck then decelerated, but continued moving in the counterclockwise arc until it struck a third parked vehicle (V4) and stopped.

Figure 1-2. Hyperextended door of truck post-accident

The Board found no evidence that the LLNS employee had operated the pickup truck previously. Based on their review, the Board determined that LLNS had no requirements in place either to determine that the employee could competently operate the pickup truck or to help him do so. They concluded that LLNS management did not foresee the potential consequences of a driver inexperienced in operating a vehicle like the pickup truck.

The LLNS Environment, Safety and Health Manual states that drivers are responsible for visually inspecting a vehicle before operation to ensure that it is safe. However, the manual provides no information to assist the driver in determining whether a vehicle is safe to operate, particularly a vehicle that is larger than the privately owned vehicles most employees drive on a daily basis.

In addition, LLNS motor vehicle safety requirements do not include a requirement for any additional training or instruction in the safe operation of a general purpose, government-owned vehicle. The only qualification for operating such a vehicle onsite is the possession of a state driver's license; however, LLNS did not evaluate whether the possession of a valid driver's license was sufficient to demonstrate the necessary experience to safely operate all site vehicles.

The Board determined that the direct cause of the accident was the driver's ejection from the pickup truck. They also determined that the LLNS employee did not use the vehicle safety features (e.g., the seatbelt) and that this was the root cause of the accident. A contributing cause was that the employee was unfamiliar with the operation of the vehicle and probably did not know where the emergency brake was located. Figure 1-3a shows the location of the emergency brake release; Figure 1-3b shows the release with the handle extended.

Figure 1-3a. Location of emergency brake release

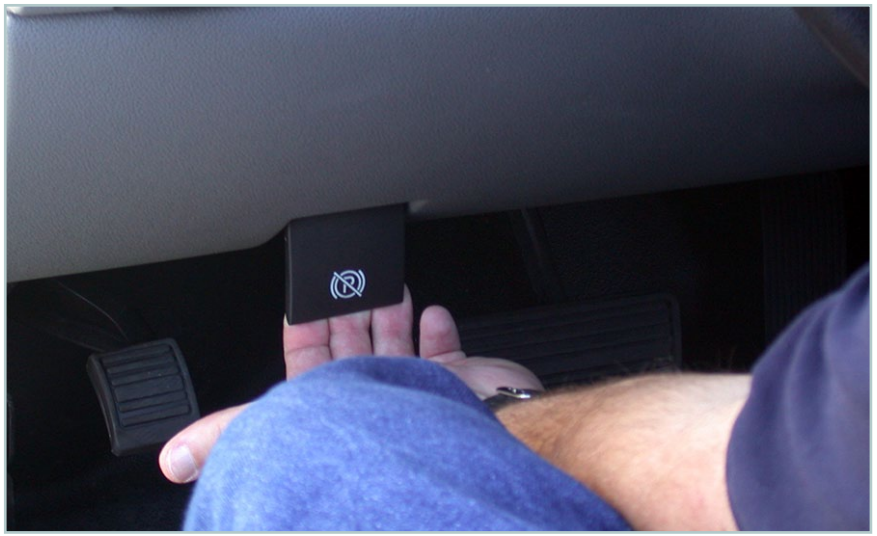

Figure 1-3b. Emergency brake release extended

The Board's Judgments of Need (JON) included the following.

- LLNS needs to improve the safe driving behavior of the site workforce.
- LLNS needs to familiarize the workforce with vehicle safety features of the fleet.

The frequency of fatal vehicle-related accidents is increasing across the Complex (4 fatalities within the last 15 months). OE Summary 2009-04 discussed seven DOE work-related vehicle fatalities reported to the ORPS database, two of which occurred in 2008. Because vehicle accidents are the leading cause of fatalities within the Department, the Board identified the following JON.

- The Office of Health, Safety and Security, in conjunction with DOE program offices, needs to heighten awareness of vehicle safety issues to reduce the number of fatal vehicle accidents in the Department.

This fatality illustrates the importance of becoming familiar with the location of all vehicle safety controls (e.g., emergency brake) before attempting to operate a vehicle, especially if it is a type of vehicle that you have never driven. More importantly, this fatality demonstrates that we cannot rely upon standardization across the automotive industry to know where all of the vehicle safety control levers are located and the necessity of always using a seatbelt even if driving only a short distance.

KEYWORDS: Type A, fatality, vehicle, pickup truck, seatbelt, ejected, emergency brake

ISM CORE FUNCTIONS: Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls, Provide Feedback and Improvement

Chemical Safety Board Releases Report on Imperial Sugar Dust Explosion 2

The Chemical Safety Board (CSB) recently released their investigation report on the February 7, 2008, dust explosion at the Imperial Sugar facility in Port Wentworth, Georgia, which resulted in 14 worker fatalities. Eight workers died at the scene; 6 others succumbed to their injuries at an Augusta, Georgia, burn center, and an additional 36 workers were treated for serious burns and injuries. The explosions and subsequent fires destroyed sugar packing buildings, a palletizer room, and silos and severely damaged other areas of the facility. Figure 2-1 shows the destruction following the explosion. The CSB report can be accessed at http://www.chemsafety.gov/UserFiles/file/Imperial%20Sugar%20Report%20Final%20updated.pdf; a video is available at http://www.csb.gov/videoroom/detail.aspx?VID=33.

The CSB determined that the first dust explosion occurred in an enclosed steel belt conveyor located below the sugar silos. Secondary dust explosions propagated throughout several buildings, and sudden, violent fireballs erupted in surrounding areas. The fire sprinkler system failed because the explosions ruptured the water pipes.

The CSB also determined that when the granulated sugar belt conveyors were enclosed the hazards associated with combustible dust generation and accumulation inside the new enclosure were not evaluated and a dust removal system was not installed to ensure that the sugar dust did not reach the minimum explosible concentration inside the enclosure. Because the large open work areas were not equipped with airborne dust removal equipment, sugar dust accumulated on overhead conduit, piping, ceiling

Figure 2-1. Elevator building, silos, and packing facility following explosion and fire

beams, lights, and equipment. Although much of the granulated and powdered sugar processing equipment was connected to a dust collection system, the system was inadequately maintained and did not effectively remove dust from the equipment.

Housekeeping was also inadequate. Workers reported that sugar spillage and dust generation were constant problems. Horizontal and elevated surfaces where dust accumulated were cleaned infrequently, so accumulations reached dangerous levels.

The CSB concluded that the Port Wentworth Imperial Sugar facility incident was a combination of a primary and multiple secondary dust explosions. Secondary dust explosions would have been highly unlikely had routine maintenance and timely housekeeping activities been performed to remove accumulations from elevated horizontal surfaces and spilled granulated and powdered sugar on the floors.

Similar Events

Events involving dust explosions have also occurred within DOE. Although on a smaller scale, a dust and combustible debris explosion and fire occurred at the Kansas City Plant in 2007, and an operator's hair was singed when accumulated dust and debris ignited into a 3-foot fireball during a grinding operation. Investigators determined that the root cause of the event was that fire hazards and controls were not identified or addressed in the instructions for the grinding operation. They also determined that the exhaust system was ineffective in removing dust that accumulated when operating the grinder. (ORPS Report NA--KCSO-AS-KCP-2007-0012; final report issued January 14, 2008)

A similar event also occurred in 1991 at Idaho National Laboratory, when a coal dust fire and explosion at a coal-fired steam generating facility resulted in structural and equipment damage. An operator transferring coal into a day bunker did not close a slide gate barrier between the explosive air-coal dust mixture in the bunker and the boiler fire box. (ORPS Report DP-ID--WINC-ICPP-1991-0015)

Combustible dust is defined in National Fire Protection Association (NFPA) 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*. The Standard also provides guidance on the control of dusts to prevent explosions. The textbox below shows some of the recommendations in the Standard.

OE Summary 2007-07 discusses a 2007 OSHA instruction on combustible dust, as well as several events that resulted from combustible dust. A revision to the 2007 version of the OSHA instruction, *Combustible Dust National Emphasis Program*, was issued in March 2008. The revised instruction includes policies and procedures for inspecting workplaces that create or handle combustible dusts and can be accessed at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=3830. Additionally, paragraph 29 CFR 1910.22, *Walking-Working Surfaces,* requires employers to keep work places and other areas clean, which includes the removal of dust accumulations (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9714).

NFPA Guidance on Control of Combustible Dust

- Minimize the escape of dust from process equipment or ventilation systems.
- Use dust collection systems and filters.
- Use surfaces that minimize dust accumulation and facilitate cleaning.
- Provide access to all hidden areas to permit inspection.
- Inspect for dust residues in open and hidden areas at regular intervals.
- Clean dust residues at regular intervals.
- Develop and implement a hazardous dust inspection, testing, housekeeping, and control program.

This event demonstrates the dangers of combustible dust and the hazards posed when dust or combustible particles accumulate on surfaces, inside equipment, or in the air. Housekeeping is an effective method of identifying and removing potential hazards, and it is important to ensure that appropriate housekeeping polices are in place and adhered to. Proper maintenance of dust collection systems is also essential to ensure that all dust removal equipment is performing effectively so that dust accumulations do not reach the minimum explosible concentration.

KEYWORDS: Industry, combustible dust, injuries, fire, explosion, equipment design, maintenance, housekeeping

ISM CORE FUNCTIONS: Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls

The Office of Health, Safety and Security (HSS), Office of Analysis publishes the *Operating Experience Summary* to promote safety throughout the Department of Energy (DOE) complex by encouraging the exchange of lessons-learned information among DOE facilities.

To issue the Summary in a timely manner, HSS relies on preliminary information such as daily operations reports, notification reports, and conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the Summary, please bring this to the attention of Mr. Jeffrey Robertson, (301) 903-8008, or e-mail address Jeffrey.Robertson@hq.doe.gov, so we may issue a correction. If you have difficulty accessing the Summary on the Web (http://www.hss.energy.gov/csa/analysis/oesummary/index.html), please contact the Information Center, (800) 473-4375, for assistance. We would like to hear from you regarding how we can make our products better and more useful. Please forward any comments to Mr. Robertson at the e-mail address above.

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Commonly Used Acronyms and Initialisms

Agencies/Organizations	
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
CPSC	Consumer Product Safety Commission
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
INPO	Institute for Nuclear Power Operations
NIOSH	National Institute for Occupational Safety and Health
NNSA	National Nuclear Security Administration
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration

Units of Measure	
AC	alternating current
DC	direct current
mg	milligram (1/1000th of a gram)
kg	kilogram (1000 grams)
psi (a)(d)(g)	pounds per square inch (absolute) (differential) (gauge)
RAD	Radiation Absorbed Dose
REM	Roentgen Equivalent Man
TWA	Time Weighted Average
v/kv	volt/kilovolt

Job Titles/Positions	
RCT	Radiological Control Technician

Authorization Basis/Documents	
JHA	Job Hazards Analysis
JSA	Job Safety Analysis
NOV	Notice of Violation
SAR	Safety Analysis Report
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question

Regulations/Acts	
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DD&D	Decontamination, Decommissioning, and Dismantlement
RCRA	Resource Conservation and Recovery Act
TSCA	Toxic Substances Control Act

Miscellaneous	
ALARA	As low as reasonably achievable
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
ISM	Integrated Safety Management
MSDS	Material Safety Data Sheet
ORPS	Occurrence Reporting and Processing System
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
SME	Subject Matter Expert