U.S. Department of Energy
National Nuclear Security Administration
and
Office of Health, Safety and Security

Type A Accident Investigation Report

June 26, 2009 Vehicle Fatality Accident at Lawrence Livermore National Laboratory

October 2009

Disclaimer

This report is an independent product of the Type A Accident Investigation Board appointed by Thomas P. D'Agostino, Administrator, National Nuclear Security Administration, U.S. Department of Energy and Glenn S. Podonsky, Chief Health, Safety and Security Officer, Office of Health, Safety and Security. The Board was appointed to perform a Type A Accident Investigation and to prepare an investigation report in accordance with DOE Order 225.1A, *Accident Investigations.*

The discussion of the facts as determined by the Board and the views expressed in the report do not assume, and are not intended to establish, the existence of any duty at law on the part of the U.S. Government, its employees or agents, contractors, their employees or agents, or subcontractors at any tier, or any other party.

This report neither determines nor implies liability.

Department of Energy
Washington, DC 20585

October 1, 2009

Release Authorization

On July 8, 2009, a Type A Accident Investigation Board was appointed to investigate the June 26, 2009, vehicle fatality accident that occurred at the Lawrence Livermore National Laboratory parking lot of Building 242. The Board's responsibilities have been completed with respect to this investigation. The analyses and the identification of the contributing causes, the root cause and the Judgments of Need resulting from this investigation were performed in accordance with DOE Order 225.1A, *Accident Investigations.*

The report of the Accident Investigation Board has been accepted and the authorization to release this report for general distribution has been granted.

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Legend

LE1	Lawrence Livermore National Security, LLC Employee (Driver)
LE2	Previous Driver of V1
LF	Fleet Maintenance Employee
P1	Security Police Officer
RE	Reconstruction Engineer
S1	LE1's Supervisor
V1	2008 Chevrolet Silverado 1500 Extended Cab Truck, Government Vehicle
V2	Chevrolet Impala, Government Vehicle
V3	2002 Toyota Celica, Privately Owned
V4	2005 Nissan Altima, Privately Owned
V5	Honda CBR600 Motorcycle, Privately Owned
E20	Fire Engine 20
M20	Medic 20 Ambulance

Acronyms

ACFD	Alameda County Fire Department
ACRECC	Alameda County Regional Emergency Communications Center
CAIRS	Computerized Accident Incident Recording System
CHP	California Highway Patrol
DART	Days Away/Restricted or job transfer
DOE	United States Department of Energy
DOT	United States Department of Transportation
DOE O	DOE Order
DOE M	DOE Manual
HSS	Office of Health, Safety and Security
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
JON	Judgment of Need
LLNL	Lawrence Livermore National Laboratory
LLNS	Lawrence Livermore National Security, LLC
LPFD	Livermore/Pleasanton Fire Department
LSO	Livermore Site Office
NHTSA	National Highway Traffic Safety Administration
NNSA	National Nuclear Security Administration
ORPS	Occurrence Reporting and Processing System
SPO	Security Police Officer
TRC	Total Recordable Cases
WAL A	Work Authorization Level

Executive Summary

On June 26, 2009, a Lawrence Livermore National Security (LLNS) employee was in the process of transporting six boxes containing personal property to his new office in preparation for a routine transfer to another position within the Lawrence Livermore National Laboratory. The employee checked out a government-owned, full-size pickup truck to facilitate his relocation. While attempting to back the vehicle from its parking space, the driver did not have his seat-belt secured; had his door open; and, was in a reclining position (most likely in an attempt to locate and disengage the parking brake set by the previous driver). Witnesses saw the truck backing up at a rapid rate of speed (which was evident by skid marks), driver side door open and no visible driver. After the truck collided with unoccupied vehicles in the parking lot, the driver was ejected and received fatal injuries. Emergency medical response was believed to be both appropriate and timely.

In the past, the Department has decided whether or not to investigate vehicle accidents even when involving a government-owned vehicle and/or resulting in a fatality based on the specific circumstances surrounding the event. As an example, these decisions could be based upon the fact that a Type A accident investigation would not reveal lessons learned that could be applied to prevent the recurrence of a similar type of an accident. With the frequency of fatal vehicle related accidents noticeably increasing on DOE (now 4 within the last 15 months), senior level Department management concern also has grown. Consequently, as a result of this fatal accident, the Office of Health, Safety and Security and the National Nuclear Security Administration elected to appoint a Type A accident investigation board to ascertain the causal factors of this fatality and, moreover, identify what actions are needed to prevent recurrence. Since the causal factors that resulted in this fatality could happen at any DOE site, it is incumbent upon all DOE Programs and site managers to review prevailing practices at their site for possible enhancements.

Everyone has an inherent responsibility for their own safety and, therefore, need to familiarize themselves with a new vehicle's safety features prior to use. Site managers should ensure that driver safety and/or education programs include consideration for personnel with limited operating experience with large vehicles with significant blind spots such as full size pick-up trucks. This report highlights the need for DOE sites to review the utilization and deployment of their fleet vehicles with due consideration that perhaps greater care should be given to assigning pick-up trucks with extended cargo bays.

Conclusions and Judgments of Need

Table ES-1 summarizes the conclusions and Judgments of Need (JON) determined by the Board. The conclusions are those the Board considered significant and are based on facts and pertinent analytical results. Judgments of Need are managerial controls and safety measures believed by the Board to be necessary to prevent or minimize the probability or severity of a recurrence of this type of accident. Judgments of Need are derived from the conclusions and causal

factors and are intended to assist managers in developing corrective actions. The Board determined that the root cause of the accident was that the vehicle safety features were not used by the LLNS employee. Although not a factor in the accident, the accident scene was not preserved nor transitioned from an emergency response to an accident scene; this hampered the Board's efficiency. Thus the Board identified this issue as a conclusion with associated Judgments of Need.

Table ES-1: Conclusions and Judgments of Needs

Conclusion	Judgment of Need
Vehicle safety features were not used by the Driver.	**JON:1** - LLNS needs to improve the safe driving behavior of the site workforce.
The Board concluded that LLNS management did not foresee the potential consequence of an inexperienced driver operating such a vehicle and therefore did not evaluate if the possession of a valid driver's license was a sufficient demonstration of experience to safety operate the vehicle. The Driver was unfamiliar with operation of the vehicle.	**JON:2** - LLNS needs to improve the selection process for general-use fleet vehicles. **JON:3** - LLNS needs to familiarize the workforce with vehicle safety features of the fleet.
Vehicle safety should be recognized as a job hazard and the leading cause of fatalities within the Department. This should be addressed as a corporate problem to reduce the frequency and severity of vehicle accidents.	**JON:4** - HSS, in conjunction with DOE program offices, needs to heighten awareness of vehicle safety to reduce fatal vehicle accidents in the Department.
The overall emergency response actions and subsequent medical care provided to the Driver was appropriate and timely.	None.
The accident scene was not preserved and not appropriately transitioned to the accident investigation readiness team.	**JON:5** - LLNS needs to develop and implement procedures to ensure effective accident scene management **JON:6** - LSO needs to revise existing procedures and practices to ensure the transition of an emergency event location to an accident investigation readiness team.
LLNL fleet management conducted a timely and comprehensive inspection of the accident vehicle.	None.
The Board was not provided with any medical information to base any conclusions on the Driver's medical state, Fitness for Duty or, cause of death.	**JON:7** – LSO needs to assess the final reports from the California Highway Patrol and the LLNS Incident Analysis Team when each report is received and notify HSS and NNSA if there are any additional actions that should be addressed.

1.0 Introduction

1.1. Background

A serious motor vehicle accident occurred at approximately 10:30 A.M., June 26, 2009 in the Building 242 parking lot at the Lawrence Livermore National Laboratory (LLNL). While backing up a government-owned pickup truck, a Lawrence Livermore National Security, LLC (LLNS) employee (LE1) was ejected from the vehicle and sustained severe head trauma. He subsequently succumbed to his injuries. LLNS was notified of his death on June 30.

On July 8, 2009, Thomas D'Agostino, Administrator, National Nuclear Security Administration (NNSA) and Glenn Podonsky, Chief Health, Safety and Security Officer, Office of Health, Safety and Security (HSS) appointed a Type A Accident Investigation Board (referred to as "the Board") to investigate the accident in accordance with DOE Order 225.1A, *Accident Investigations* (see Appendix A).

1.2. Facility Description

Founded in 1952, LLNL is a premier research and development institution for science and technology applied to national security. LLNL's primary mission is to ensure that the nation's nuclear weapons remain safe, secure, and reliable. LLNL's special capabilities are also applied to the prevention of the spread and use of weapons of mass destruction and to strengthen homeland security. With broadly based capabilities and leadership in mission-focused areas of science and technology, LLNL meets other national needs with major advances in research programs in energy and environment; bioscience and biotechnology; and basic science and applied technology.

LLNS has operated LLNL for the NNSA since October 1, 2007. LLNS is comprised of Bechtel National, Inc., the University of California, Babcock and Wilcox, Inc., Washington Division of URS Corporation, and Battelle. The contract between NNSA and LLNS is managed by the NNSA's Livermore Site Office (LSO). The LSO provides day to day oversight of LLNL for the NNSA.

1.2.1. On-Site Emergency Support

On October 1, 2007, LLNS contracted with the Alameda County Fire Department (ACFD) to provide emergency services to LLNL. The ACFD is a full-service fire department providing all risk response to the largest fire service response area in the county covering more than 490 square miles of urban, suburban, and rural areas. With the addition of LLNL, the department is comprised of 26 fire companies and 21 fire stations that serve the unincorporated areas of Alameda County, the City of San Leandro, the City of Dublin and LLNL. The decision to outsource these emergency response services was based upon the results of a Cost/Benefit Analysis that concluded LLNS can achieve savings of up to 3.6 million dollars during the proposed two year period of performance. Working through Alameda County, the LLNS would continue to manage the Alameda County Regional Communication Center and provide mutual aid to surrounding communities.

1.3. Scope, Conduct, and Methodology

The Board began its investigation on July 13, 2009, completed its on-site activities with a factual accuracy review on July 22, 2009, and submitted its final report for acceptance to the appointing officials on July 31, 2009 in accordance with their appointment memorandum (Appendix A).

The Board determined the events, conditions and causal factors of the vehicle fatality accident that occurred at LLNL on June 26, 2009. As directed in the appointment memorandum, the Board evaluated the adequacy and implementation of the following topical areas:

- Vehicle operations requirements and training;
- Roadway, parking area and traffic designs;
- Emergency response;
- Cooperative agreement and memoranda of understanding with off-site emergency response agencies; and
- Similarity or common factors with other recent DOE-complex vehicle-related accidents.

Vehicle operations requirements and training are discussed in Section 2.2 - Motor Vehicle Safety Program. Roadway, parking area and traffic designs were not reviewed because the Board determined they had no effect on this accident. Adequacy of emergency response is discussed in Section 3.2 - Emergency Response Analysis. Cooperative agreement and memoranda of understanding with off-site emergency response agencies is discussed in Sections 3.1 - LLNL Emergency Providers and 3.2 - Emergency Response Analysis. Similarity or common factors with other recent DOE-complex vehicle-related accidents are discussed in Section 2.4 - Statistical Analysis.

In accordance with the appointment memorandum, the Board requested copies of the LLNS Incident Analysis Report and the California Highway Patrol (CHP) report; however, neither report was available as a final product during the Board's investigation. In place of the final reports, the Board relied on an interview with the CHP; a draft report from the LLNS Incident Analysis Team; and presentations and discussions with the LLNS Team. No medical information was provided to the Board as requested. The next of kin declined to provide access to accident medical records. It is expected that the autopsy report will be a part of the CHP report when issued. Due to current fiscal issues in the state of California, it is expected the CHP report will be significantly delayed. It is anticipated that LSO will assess the CHP and LLNS Incident Analysis Team reports and notify HSS and NNSA if any further action is required.

The Board used event and causal factor charting, barrier analysis, and change analysis to analyze the facts and identify the cause(s) of the accident. The Board's investigation resulted in conclusions being drawn and JONs developed for corrective action.

Accident Investigation Terminology

A **causal factor** is an event or condition in the accident sequence that contributes to the unwanted result. There are three types of causal factors: direct cause(s), which is the immediate event(s) or condition(s) that caused the accident; root causes(s), which is the causal factor that, if corrected, would prevent recurrence of the accident; and the contributing causal factors, which are the causal factors that collectively with the other causes increase the likelihood of an accident, but which did not cause the accident.

Event and causal factors analysis includes charting, which depicts the logical sequence of events and conditions (causal factors that allowed the accident to occur), and the use of deductive reasoning to determine the events or conditions that contributed to the accident.

Barrier analysis reviews the hazards, the targets (people or objects) of the hazards, and the controls or barriers that management systems put in place to separate the hazards from the targets. Barriers may be physical or administrative.

Change analysis is a systematic approach that examines planned or unplanned changes in a system that caused the undesirable results related to the accident.

Figure 1-1: Accident Investigation Terminology

2.0 Facts and Analysis

2.1. Accident Description and Chronology

2.1.1. Accident Background

A serious motor vehicle accident occurred at approximately 10:30 A.M., June 26, 2009 in the Building 242 parking lot at LLNL. While backing up a government-owned pickup truck, a LLNS employee (LE1) was ejected from the vehicle and sustained severe head trauma. He subsequently succumbed to his injuries. The LLNS was notified of his death on June 30.

2.1.2. Accident Description

On June 26, 2009, LE1 was packing up his office in Trailer 3726 and moving to his new office in Building 235. LE1's supervisor (S1) signed out a government-owned 2008 Chevrolet Silverado 1500 extended cab truck (V1) for LE1 to move boxes between the offices. V1 was located in the parking lot north and adjacent to Building 242 [see Figure 2-1: Accident Site]. V1 was parked in a space next to the sidewalk directly adjacent to Building 242 and was facing Building 242 (parked facing forward in the space) [see Figure 2-3: Accident Reconstruction]. A government-owned white Chevrolet

Figure 2-2: View of Tire Friction Marks

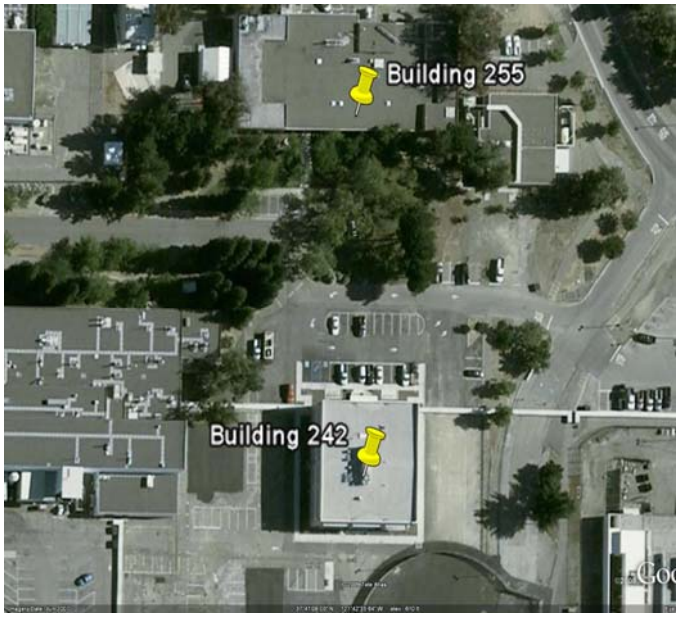


Figure 2-1: Accident Site

Impala (V2) was parked next to and east of V1 (on the driver's side of V1) [see Figure 2-4: Chevrolet Impala (V2) with Damage to Front Passenger Door]. A line of parking spaces were to the north of and parallel to the V1 parking space. On the west end of this parallel line of parking spaces was a privately-owned Toyota Celica (V3) [see Figure 2-5: 2002 Toyota Celica (V3) with Damage to Front End] and a privately-owned Honda CBR600 motorcycle (V5) [see Figure 2-6: Honda CBR600 Motorcycle (V5)] was parked on the end of the row adjacent to and west of V3. At approximately 10:31 A.M., LE1 loaded a hand truck from Building 235 into the bed of

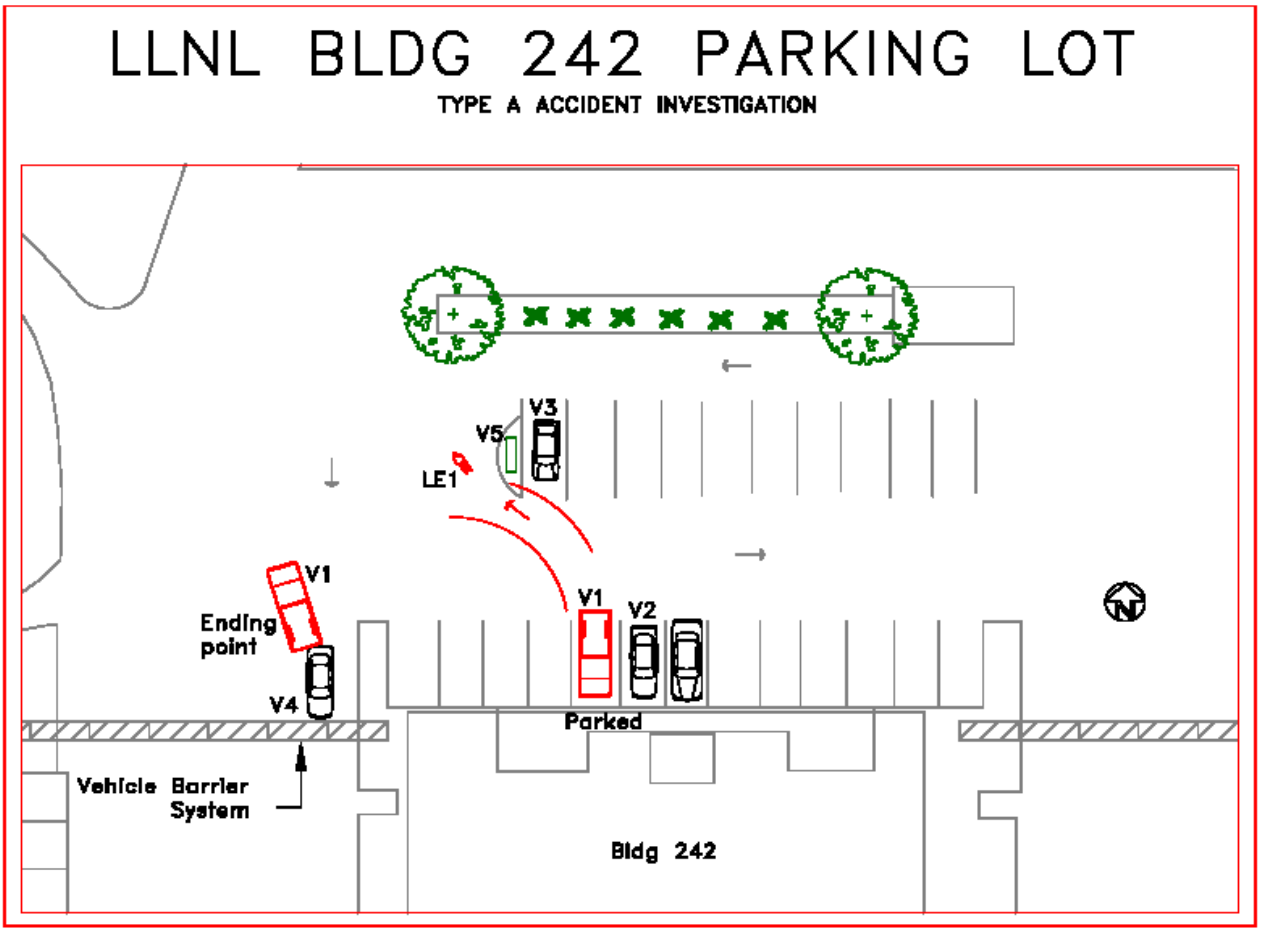


Figure 2-3: Accident Reconstruction

V1 and got into V1. V1 backed out of the parking space reaching a speed of approximately 20 mph and moved in a semicircular path to the west [see Figure 2-2: View of Tire Friction Marks]. The open driver-side door of V1 caught on the door handle of the front passenger-side door of V2 and dented that door of V2. After backing normally for a few feet, the truck rapidly accelerated while turning. After V1 left its parking space, the open driver-side door of V1 impacted with the front, driver's side of the V3. This impact shattered door window of V1, pushed the door beyond its opening limit, and ejected LE1 from the cab of V1. V3 had damage on its front driver-side and along the front bumper. V5 was knocked over by LE1 as he passed over it on his way to the pavement. V1 stopped when the rear bumper of V1 impacted with the rear bumper of a privately-owned 2005 Nissan Altima (V4) that was parked parallel to where V1 was parked and several spaces west of the V1 parking space [see Figure 2-7: 2005 Nissan Altima (V4)]. V4 was crushed between a concrete barrier and V1 and was totaled by the impact [see Figure 2-8: 2008 Chevrolet Silverado 1500 Extended Cab Truck (V1) after Impact with V4, Driver Door Over-Extended]. A LLNS Security Police Officer (SPO) turned off the engine of V1, placed the transmission in Park, and put the ignition key on the seat. The driver's side safety belt in V1 was not engaged.

LE1 was observed lying next to and west of V5 which was lying on its side. At approximately 10:36 A.M., 911 calls resulted in a fire engine (E20) and an ambulance (M20) being dispatched to the accident scene. At approximately 10:39 A.M., both E20 and M20 arrive at the accident scene. Paramedics attended to LE1. The paramedics found LE1 lying on his back. LE1 had a significant head injury and a large pool of blood under his head. LE1 was not responsive, was breathing, had a pulse, his eyes were dilated, and he had severe head trauma. The paramedics attempted to secure an airway in LE1 but could not due to a gag reflex. The paramedics cut off LE1's clothes. There were abrasions on LE1's back and chest.

Figure 2-4: Chevrolet Impala (V2) with Damage to Front Passenger Door

At approximately 10:41 A.M., an emergency helicopter was requested by E20. At approximately 10:55 A.M., M20 arrived at the helicopter landing zone with LE1. The helicopter landing zone was located in the buffer zone (open field) of the LLNL site, east of Vasco Road and adjacent to the site's West Gate entrance. At approximately 11:10 A.M., the helicopter arrived at the landing zone and lifted off with LE1 to Eden Medical Center at approximately 11:28 A.M.

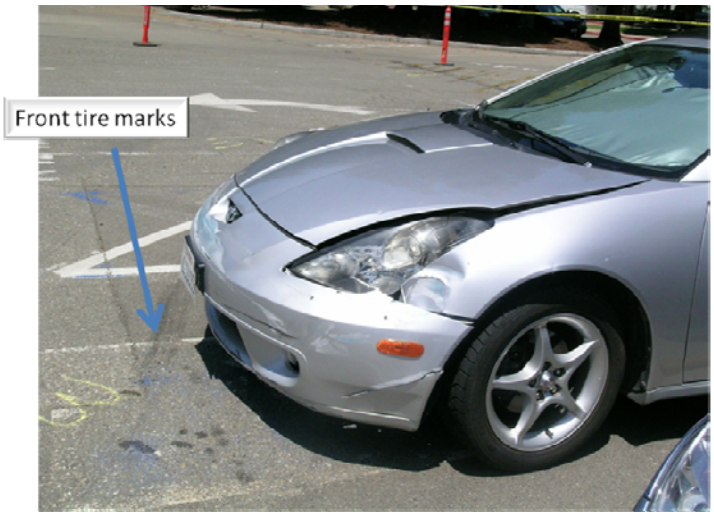


Figure 2-5: 2002 Toyota Celica (V3) with Damage to Front End

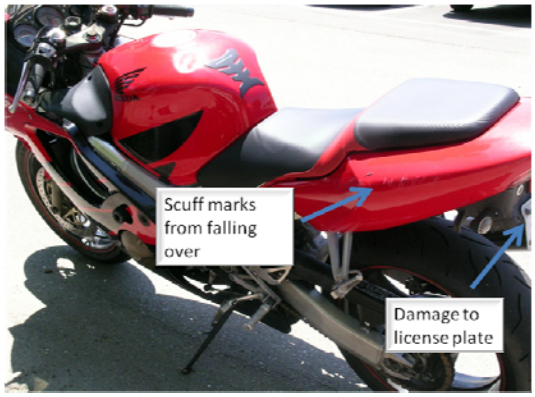


Figure 2-6: Honda CBR600 Motorcycle (V5)

Figure 2-7: 2005 Nissan Altima (V4)

Figure 2-8: 2008 Chevrolet Silverado 1500 Extended Cab Truck (V1) After Impact with V4, Driver Door Over-Extended

2.1.3. Chronology of the Event

Table 2-1: Summary Event Chart and Accident Chronology

Date	Time	Event
7/2008		LLNL leased V1
8/8/2008		V1 ignition interlock repaired at Moore GMC
8/19/2008		V1 in-service at LLNL
1/13/2009		V1 driver-side mirror repaired by LLNL Fleet
6/25/2009	11:10 A.M.	LE2 left truck with parking brake engaged.
6/25/2009	~1:00 P.M.	LE1 and S1 meet in Building 235 (discussing LE1's move)
6/26/2009 Day of Accident	Before 10:00 A.M.	LE1 packed office in T3726
	~10:00 A.M.	LE1 in the office of S1
	10:27 A.M.	LE1 entered B235 limited area (location of his office)
	~ 10:30 A.M.	Discussion between LE1 and S1 LE1 checked TESA lock on his office in B235 LE1 and S1 walked to the B235 lobby LE1 selected a hand-truck S1 signed out V1 for LE1

Date	Time	Event
	10:31 – 10:35 A.M. Accident Time Sequence	V2 is observed shaking in its parking space Sounds of revving engine in B242 parking lot. Sounds of squealing wheels in B242 parking lot V1 accelerated backwards out of parking stall in front of B242 V1 impacted V3 Driver-side door of V1 opened beyond opening limit Driver-side door glass of V1 shattered LE1 was ejected from the cab of V1 V5 was knocked over LE1 landed on the parking lot pavement V1 continued semi-circular arc path V1 impacted V4 and came to a stop LE1 is seen lying on the parking lot pavement 911 calls are made for a medical emergency
	10:36 A.M.	E20 and M20 were dispatched to the accident scene SPO personnel arrived at the accident scene. P1 turned off the V1 engine, removed the ignition key, placed the key on the seat in V1, and did not touch the seat belt
	10:39 A.M.	E20 and M20 arrived at the accident scene
	10:41 A.M.	E20 requested an emergency helicopter
	10:55 A.M.	M20 arrived at the helicopter landing zone with LE1
	10:55 A.M.	CHP was notified by LLNL
	11:09 A.M.	CHP arrived at the West Gate entrance of LLNL
	11:10 A.M.	Helicopter arrived at the landing zone
	11:28 A.M.	Helicopter left the landing zone with LE1 to Eden Medical Center
	~4:30 P.M.	CHP impounded V1
6/26/2009 – 7/1/2009		V1 inspected by CHP; V1 functioned normally
7/1/2009		V1 released by CHP back to LLNL
7/3/2009		V1 inspected by LF and RE; V1 mechanically functioning normally

2.2. Motor Vehicle Safety Program

A review of current regulations and directives for applicability to the event determined that 10 CFR Part 851, *Worker Safety and Health Program*, was applicable. Part 851 has several requirements pertaining to the management of a general motor vehicle safety program:

- 851.24: (a) Contractors must have a structured approach to their worker safety and health program that at a minimum, include provisions for the following applicable functional areas in their worker safety and health program:…motor vehicle safety. (b) In implementing the structured approach required by paragraph (a) of this section, contractors must comply with the applicable standards and provisions in Appendix A of this part, entitled *Worker Safety and Health Functional Areas.*
- Appendix A, Section 9, *Motor Vehicle Safety*: (a) Contractors must implement a motor vehicle safety program to protect the safety and health of all drivers and passengers in Government-owned or leased motor vehicles and powered industrial equipment (i.e., fork trucks, tractors, platform lift trucks, and other similar specialized equipment powered by an electric motor or an internal combustion engine). (b) The contractor must tailor the motor vehicle safety program to the individual DOE site or facility, based on an analysis of the needs of that particular site or facility. (c) The motor vehicle safety program must address, as applicable to the contractor's operations: (1) Minimum licensing requirements (including appropriate testing and medical qualification) for personnel operating motor vehicles and powered industrial equipment; (2) Requirements for the use of seat belts and provision of other safety devices; (3) Training for specialty vehicle operators; (4) Requirements for motor vehicle maintenance and inspection; (5) Uniform traffic and pedestrian control devices and road signs; (6) On-site speed limits and other traffic rules; (7) Awareness campaigns and incentive programs to encourage safe driving; and (8) Enforcement provisions.

LLNS has to address Part 851 compliance, its *Worker Safety and Health Program*, (WSHP) dated September 2007. Supplementing this is a lower tier document UCRL-AM-133867, *Environment, Safety and Health Manual*; (ESH Manual) dated December 10, 2007. Both versions were in effect on June 26, 2009. Appendix F9, *Motor Vehicle Safety*, of the WSHP, succinctly describes the provisions in place for complying with this functional area. For general motor vehicle safety, Section F9.1, *Licensing Requirements*, states that possession of a state driver's license is the fundamental qualification for operating a government-owned vehicle on the LLNL site. Further, in contrast to the licensing, training, monitoring, and health requirements for the operation of industrial-type vehicles, cranes, and lifts, the WSHP specifies no additional training or instruction for the safe operation of a general purpose, government-owned vehicle. LLNS does provide some vehicle safety information on the site's Lessons Learned intranet web site, and reinforces, as described in Section F9.7, *Awareness Campaigns and Incentive Programs*, vehicle safety performance by "…the strong enforcement of the LLNL

Motor Vehicle Safety Program through administrative punishment and adverse performance evaluations…."

The ESH Manual, in Document 21.3, *Vehicle Operations and Traffic*, provides more detailed requirements. Section 3.0, *Controls for Safely Operating Vehicles and Bicycles*, states that drivers "…are responsible for visually inspecting a vehicle before operation to ensure that it is safe." However, no information is provided to the driver for determining whether a vehicle is safe to operate; only suggestions are provided. Finally, Section 3.12, *Training*, requires no specific training or instruction for competently operating every general-purpose, government-owned vehicle available at LLNL, yet Section 5.0, *Responsibilities*, states that "[d]rivers are responsible for operating motor vehicles in a safe manner."

In spite of general motor vehicle safety being incumbent on all on-site licensed drivers, accidents of varying degree occur. Lessons Learned Bulletin LL-2009-LLNL-04, LLNL-MI-413418, *Before Backing Up, Take Time to Look Around Your Vehicle*, dated May 28, 2009, provides chronic evidence of the unsafe operation of general-purpose LLNL motor vehicles. The bulletin states that, on average, a minor vehicular accident on site occurs once every 23 days, and that in the past 14 months, there were 114 vehicle accidents that cost approximately $40,000 in repairs to government vehicles. The bulletin reminds the reader that "[l]icensed drivers are trained to safely back up vehicles; we perform this operation routinely (usually the first thing we do in our car)." The Board noted that this accident rate had not resulted in any additional action by LLNS.

On June 26, 2009, LE1 decided to use a general purpose Laboratory vehicle--a full-sized, extended cab, pickup truck--to move boxed personal belongings from one office to another. LE1 had a current California driver's license. LE1's supervisor had signed LE1's name on the LLNL Truck Register sheet indicating that LE1 was using that vehicle. Further, there was no fleet management evidence that LE1 had operated this government-owned vehicle before. Thus, the LLNS motor vehicle safety program did not protect the safety and health of all drivers using government-owned motor vehicles in that nothing was in place to either determine if LE1 could competently operate a vehicle of this type or aid LE1 to do so.

The Board concluded that LLNS management did not foresee the potential consequence of an inexperienced driver operating such a vehicle and therefore did not evaluate if the possession of a valid driver's license was a sufficient demonstration of experience to safely operate the vehicle. [See **JON:2** and **JON:3**]

2.3. Integrated Safety Management

LLNL's ES&H Manual Document 2.2, *LLNL Institution-wide Work Control Process*, classifies activities commonly performed by the public in areas where the hazards are those commonly encountered by the public, such as driving automobiles in a parking lot, as Work Authorization Level A (WAL A). WAL A activities can be self-authorized with knowledge of the supervisor, do not require any activity specific documentation, does not require discussion of the activity with the supervisor, and shall be performed with generally accepted practices and applicable public regulation and LLNL requirements. Document 2.2 goes on to state "It is important for all workers to consider the aspects of work planning identified in this Document, particularly as they apply to the five ISM functions when performing these tasks, because even WAL A activities may result in serious injuries, accidents, or environmental impact if done improperly or inappropriately."

An Integrated Safety Management System (ISMS) Phase I Verification of the LLNS ISMS was conducted in May 2009. It concluded that Phase I objectives had been met and the LLNS ISMS Description should be approved after the resolution of two weaknesses. The resolution of the weaknesses would not change how this work would be managed under the LLNS ISMS. Although the principles of ISM apply to all activities, the Board did not conclude that the principles of ISM play a significant role in this accident beyond operating vehicles safely.

LLNS has accepted the risk of driving non-commercial, non-industrial vehicles with minimal safety management controls.

2.4. Statistical Analysis

Backup collisions are one of the most common types of non-traffic auto collisions, are responsible for the deaths of 221 people in the U.S. in 2007 and caused approximately 14,000 injuries. Between 1992 and 2009, there have been 604 vehicle-related accidents reported in the Department's Occurrence Reporting and Processing System (ORPS) resulting in 119 injuries and 16 deaths. In total, there have been 47 fatal accidents within DOE in this time period. Moreover, statistics reflect an upward trend of vehicle-related fatalities since 1992 and the Department is currently on track to surpass the previous high of 3 fatalities in 2000. In contrast, the U.S. Department of Transportation (DOT) statistics show a downward trend with the reported number of traffic fatalities for 2008 hit the lowest level since 1991. The DOT numbers of fatalities in the first 3 months of 2009 continue to decrease. The fatality rate, which account for variables like fewer miles traveled, also, reached the lowest level recorded. The 2008 highway death count was 37,261, a drop of 9.7 percent from 2007 while the 2008 fatality rate was 1.27, about 7 percent below the rate of 1.36 for 2007.

In an endeavor to gain an appreciation for the frequency of occurrences involving backing accidents, the DOT recognizes the difficulty of attaining quantitative statics. Specifically, such accident types often occur in driveways, parking lots or non-highway situations, which do not have the same law enforcement reporting requirements as accidents on public roads. The U.S. National Highway Traffic Safety

Administration (NHTSA) found that backup collisions often occur in residential driveways and parking lots and involve sport utility vehicles or small trucks. The NHTSA within the DOT has developed a statistical methodology of estimating the total number of backing accidents which showed that approximately 60 percent of these accidents resulted in a fatality. Normalizing the data is not only a challenge for DOT but also for DOE as well, since vehicle accidents are no longer reported to ORPS unless an injury occurs.

The Board concluded that vehicle safety should be recognized as a job hazard and the leading cause of fatalities within the Department. This should be addressed as a corporate problem to reduce the frequency and severity of vehicle accidents. **[**See **JON:4]**

2.5. Accident Analysis

2.5.1. Presumed Accident Scenario

In the absence of medical reports, the CHP report, and a final LLNS Incident Analysis Report, the Board developed the most likely sequence for this accident based upon the available evidence to describe and explain the dynamics of the specific sequence.

During mid-morning on June 26, 2009, LE1 was preparing to move six boxes of office materials from one office to another. After entering, starting and putting the truck in reverse gear, the individual either realizes that the truck's emergency brake was on, has difficulty locating the brake release [see Figure 2-9: Location of Parking Brake on 2008 Chevrolet Silverado (V1)], and opens the driver door to aid in looking for the release or, due to the blind spots associated with a full-sized pickup truck, opens the driver's door to peer backwards to assist in backing the truck up. The opened truck door then contacts the front passenger door of an adjacent, parked vehicle (V2) and dents the vehicle's door. The contact of the

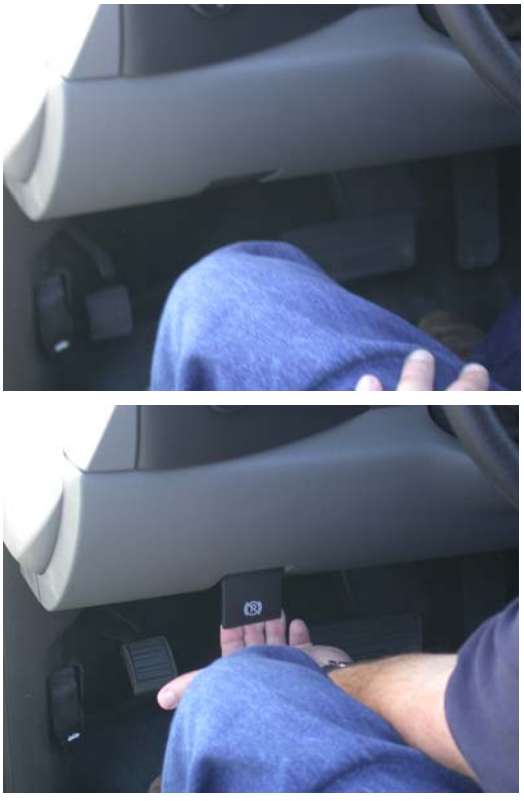


Figure 2-9: Location of Parking Brake on 2008 Chevrolet Silverado (V1)

two vehicle doors likely startled the individual who then attempts to stop the truck.

LE1 then either quickly put his foot on the brake pedal such that his foot slipped off and instead fully depressed the gas pedal or he missed the brake pedal altogether and instead fully depressed the gas pedal. This would help to explain the period of truck backward movement prior to the time tire friction marks started. The truck subsequently rapidly accelerated backwards across the parking lot in a counterclockwise arc and struck the left front corner of another parked vehicle (V3). This vehicle contact quickly moved the open truck door beyond its normal limit and resulted in the individual being ejected from the truck and onto the parking lot pavement a number of feet to the left of the V3. The individual grazed a parked motorcycle (V5) adjacent to the passenger side of V3 before landing on the pavement.

The truck then decelerated but continued in its counterclockwise arc until it struck a third parked vehicle (V4), where the truck then stopped moving.

2.5.2. Barrier Analysis

After a basic chronology of events was developed, the Board performed a Barrier Analysis of the accident. To start the Barrier Analysis, the Board chose a target (the person or item to be protected) and the hazard (what the person or item is to be protected from). The Board chose as the target LE1 while driving V1 and the hazard as LE1 being ejected from V1. There were 5 barriers identified and analyzed by the Board: 1) Familiarity with the operation of V1, 2) Seat belts in V1, 3) LLNS Vehicle Safety Program, 4) Cab doors on V1, and 5) Safety alarms in cab of V1. Safety alarms in the vehicle included audible alarms to indicate a door being ajar or a seat belt being disengaged when the key is in the ignition. The analysis indicated that all the barriers played a role in directly exposing the target to the hazard in this accident. The Barrier Analysis is presented in Appendix B.

2.5.3. Change Analysis

To further support the development of causal factors, the Board performed a Change Analysis of the accident. The Board examined the planned and unplanned changes that caused the undesired results or outcomes related to the event. The changes that related to this accident were: 1) the seat belt was not worn by LE1, 2) V1 was in gear when the parking brake was released, 3) V1 safety alarms were not heeded by LE1, 4) physical contact between V1 and V2, 5) the use of V1 by LE1, 6) LE1's unfamiliarity with the parking brake release location, 7) the driver-side door of V1 was open presenting an ejection hazard to the driver, and 8) the driver-side door was open when V1 was in gear. The Change Analysis is presented in Appendix C.

2.5.4. Event and Causal Factors Chart

After performing the barrier and change analyses, the Board assigned results from each analysis to events on the chronology of events. This involved assigning the analyses results as conditions that were related or caused the events on the chronology. Assigning these conditions with events resulted in the events and causal factors (ECF) chart as seen in Appendix D. Once conditions were assigned, the Board examined the chart to determine which events were significant (meaning which events played a role in causing the accident). The Board then assessed the significant

events (and the conditions of each) to determine the causal factors of the accident. The causal factors that resulted were: 1) LLNS had available large pickup trucks for general-use, 2) the parking brake was set by the previous driver of V1, 3) LE1 moved his own boxes from his office, 4) LE1 was provided with a large pickup truck to move 6 boxes, 5) the driver-side door of V1 was open when V1 was in gear, 6) the V1 parking brake was released when the vehicle was in gear, 7) the alarms in the cab of V1 were not heeded by LE1, 8) the brake release was difficult to from the driver's seat of V1, 9) the seat belt was not worn by LE1, and 10) the excessive speed of the truck.

2.5.5. Causal Factors

After developing the list of causal factors, the Board determined the direct, root, and contributing causes of the accident. The direct cause is the last action to occur before the injury or fatality. The Board determined that the direct cause of the accident was the ejection of LE1 from V1. From the list of causal factors, Board determined that the further causes of the accident were: 1) the vehicle safety features were not used and 2) unfamiliarity with operation of the vehicle. A root cause is one or more causes that if any alone were mitigated would prevent the accident. The Board determined that the root cause of the accident was that the vehicle safety features were not used. Contributing causes are those that have to occur with other causes for an accident to occur. The Board determined that the contributing cause was unfamiliarity with the operation of the vehicle.

The Board concluded that vehicle safety features were not used by LLNS employee. **[S**ee **JON:1]**

The Board concluded that LE1 was unfamiliar with operation of the vehicle. **[**See **JON:2** and **JON:3]**

3.0 Emergency Response

3.1. LLNL Emergency Providers

The onsite Fire Department is administratively a part of the LLNL Emergency Management Department and is operated and staffed by the Alameda County Fire Department (ACFD) under contract (Subcontract #B526570) to LLNS. Under this contractual agreement, the Fire Department is responsible for providing full-time fire suppression and rescue services, pre-incident planning, assigned fire prevention activities, emergency medical services, hazardous material emergency response (including chemical, biological and radiological incidents), personnel training/drills, and maintenance and testing of equipment.

The Fire Department's primary jurisdictional response areas include the Livermore site (Site 200); the Experimental Test Site (Site 300), located approximately 15 miles southeast of Site 200; and Sandia National Laboratory – Livermore, having a contiguous border to the south of Site 200. Two full-time stations are staffed at LLNL, with eight firefighters at Site 200 (Station #20) and four at Site 300 (Station #21). A Battalion Chief is on duty for all LLNL emergencies. Fire Department personnel are trained and certified as Emergency Medical Technician-I by Alameda County and the State of California. Additionally, some fire personnel are State of California licensed and Alameda County certified paramedics.

The Fire Department also operates the Alameda County Regional Emergency Communications Center (ACRECC). Located at LLNL, the ACRECC handles dispatching for nearly 60,000 fire and medical emergency assistance calls each year from residents of the county and several cities within the county. A total of 41 fire stations are dispatched by ACRECC. The center also coordinates mutual aid requests. Services provided by ACRECC include:

- Full emergency fire and emergency medical dispatch services;
- Fire and rescue mutual aid resource coordination;
- Emergency medical dispatch pre-arrival instructions for member agencies and the fire departments; and
- Hospital coordination for multi-casualty-incidents and hospital diversions within the County of Alameda.

For medical services at the Livermore site, patients are evaluated and transported to the appropriate receiving facility in accordance with Alameda County Emergency Medical Services policies and procedures. In general, basic life-support patients are transported to the onsite Health Services Department during normal working hours. Advanced life-support patients, as well as patients needing emergency medical assistance outside of normal working hours, are transported to the appropriate offsite receiving facility. ValleyCare Medical Center in Pleasanton is the primary destination. Patients who meet Alameda County critical trauma criteria are transported to Eden Medical Center in Castro Valley (designated trauma center for southern Alameda County). During normal working hours, the Health Services Department provides treatment for ill and

injured employees on a walk-in basis in addition to scheduled services.

The onsite Health Services Department, an Accreditation Association for Ambulatory Health Care accredited organization, is managed by a physician and includes physicians, nurse practitioners, registered nurses, clinical psychologists, physical therapists, x-ray technician, medical assistants and administrative personnel. Physician specialty training includes occupational medicine, emergency medicine, internal medicine, and preventive medicine. Nurse practitioners and nurses specialty training includes occupational health, adult health and emergency medicine. All professional staff members who work in the treatment area have received basic life support training. Physicians and nurse practitioners maintain advanced cardiac life support training. All licensed professional staff maintains current state licenses.

3.2. Emergency Response Analysis

On June 26, 2009 at approximately 10:36 A.M., the onsite Fire Department responded to several 911 calls regarding a vehicular accident in the parking lot north of Building 242. Two fire department vehicles were dispatched to the accident scene – Fire Engine 20 (E20) and a medical truck, Medic 20 (M20). Each fire department vehicle was manned by a four-person crew, meeting the minimum staffing requirements for each fire apparatus. The crew comprising E20 consisted of a driver, firefighter, and two paramedics. The crew for M20 included a driver, two firefighters, and a paramedic. Drivers are firefighters, with all firefighters having Emergency Medical Technician (EMT) certification. At approximately 10:39 A.M., E20 and M20 arrived at the accident scene. The Board confirmed that the response time of approximately 3 ½ minutes from the initial emergency call was acceptable and within the response time metric of 4 minutes of dispatch 90% of the time per the LLNS/ACFD contract. The fire department paramedics appropriately prioritized and tended to LE1's life-safety vitals. At approximately 10:41 A.M., E20 requested emergency helicopter support to transport the patient to Eden Medical Center of Castro Valley, the designated trauma center for southern Alameda County. This decision increased Advanced Life Support capability due to the benefit of two trauma nurses accompanying the emergency helicopter and most likely shortened the overall arrival time at the medical center. The Fire Department Battalion Chief requested mutual aid from the Livermore/Pleasanton Fire Department (LPFD) at approximately 10:43 A.M. to manage the helicopter landing zone in the buffer zone (open field) of the LLNL site, east of Vasco Road and adjacent to the site's West Gate entrance. Establishment of the safe helicopter landing zone was accomplished according to Fire Department policy.

At approximately 10:50 A.M., LPFD Fire Engine 96 arrived at LLNL site to manage the helicopter landing zone. At approximately 10:55 A.M., M20 arrived at the helicopter landing zone with LE1. Total elapsed time from E20/M20 arrival on-scene to completion of LE1 transport to the landing zone was approximately 16 minutes. At approximately 11:10 A.M., the helicopter (CalStar) arrived and lifted off approximately 18 minutes later to Eden Medical Center. Total elapsed from E20/M20 arrival on-scene to transport of the LE1 to Eden Medical Center was approximately 50 minutes, which the Board considers to be a highly responsive demonstration of life-safety performance.

The Board concluded that the overall emergency response actions and subsequent medical care provided to LE1 was appropriate and timely.

3.3. Accident Response and Investigative Readiness

Upon his arrival at the scene at approximately 11:09 A.M., the CHP officer conducted a functional check of the vehicle controls and did not note any deficiencies. The officer then released custody of the vehicle and the accident scene to LLNS. LLNS did not secure the accident scene after CHP released its control; the accident vehicle was relocated to the LLNL fleet headquarters facility.

Photographs were taken of the accident scene by various LLNS personnel and subsequently provided to the Board without an accompanying chain of custody. As a result, the Board was unable to establish or identify the pedigree of the pictures. Photographs did not contain complete identification data (i.e., time, date, photographer's name).

When the CHP was informed that the LLNS employee prognosis was "brain dead" [1], the CHP returned to LLNL with a contractor tow truck and, in conformance with CHP standard operating procedures for fatal vehicle accidents, took possession of the accident vehicle for a full evaluation by certified CHP vehicle inspectors. When the CHP returned the accident vehicle to LLNS fleet management, LLNS commenced a timely vehicle inspection. The Board was provided with the LLNS comprehensive vehicle inspection report denoting that there were no defects noted in the operational components and features of the accident vehicle. This accident vehicle inspection and evaluation report assisted the Board in concluding that the vehicle was not a contributing factor to the accident.

LLNS employed the services of a professional accident recreation services (Collision Reconstruction Engineers, Inc.) which provided a detailed and comprehensive evaluation of the accident dynamics. This draft assessment included taking all of the necessary measurements of the available physical evidence and identifying the trajectory path of the accident vehicle.

The Board interviewed the investigating officer of the CHP for this accident (along with his supervisor) who advised that their report will not be completed for some time. Moreover, the CHP could not project an estimated date of report completion due to the uncertainty of the California economic crises which also impacts the delivery of an autopsy report that is routinely incorporated in the CHP report. An autopsy report would have provided the Board with clinical diagnosis, identified contributory conditions or an unrecognized cause.

The Board was not provided any medical evidence such as any paramedic report, a

[1] Brain death is a legal definition that refers to the irreversible end of all brain activity (including involuntary activity necessary to sustain life) due to total necrosis of the cerebral neurons following loss of blood flow and oxygenation. It should not be confused with a persistent vegetative state.

hospital trauma room report or a death certificate. On July 24, 2009, LLNS informed the Board that the family of LE1 declined to release to the Board, any medical records related to the accident.

The Livermore Site Office (LSO) Accident Investigation Program is documented in a Standard Operating Procedure (LSO-SOP-AMTS-031) and contains provisions for either LSO or LLNL to implement for accident scene management but does not address interface and coordination with emergency response components. LLNS did not produce an implementation document for the Contractor Requirements Document to DOE Order 225.1A, *Accident Investigations*, or a comparable procedure which addresses the LLNS's readiness and capability to support Type A and Type B accident investigation boards.

The LSO procedure assigns LSO the responsibility to ensure accident scene management until the Board assumes control. Documentation reviewed by the Board did not reflect that the configuration of the accident scene was timely preserved; evidence control, accountability and chain of custody were either not accomplished or not timely; and, initial witness statements immediately following the accident were not taken. Conversely, personnel were interviewed by LLNS' Incident Analysis Team days later; interviewer's notes were transcribed and subsequently ingrained into Team's meeting minutes presented to the Board in a binder which did not facilitate reference or retrieval. The LLNS Incident Analysis Team provided the Board with a draft report on July 21, 2009.

A composite record specifying the origin of the evidence, custodianship, and dates of transfer was not established by LLNS. In addition, the LE1's personal effects were not inventoried but may have provided insight into his medical condition at the time of the accident – a missed opportunity. The same with a closed circuit television located in close proximity of the parking lot where the accident occurred which may have recorded the entire vehicle accident sequence prior to being automatically erased and reused – another missed opportunity for data collection.

With the possible exception of the medical evidence, the Board recognizes that although the procedural deficiencies indicated above did not affect the ultimate outcome of the Board's investigation however, it did impact the Board's efficiency. The LLNS inspection of the vehicle resulted in providing the necessary documentation that there were no defects with the operational controls or components. However, LLNS has not generated formal procedures that govern accident scene management, site readiness actions or evidence collection, preservation and chain of custody, nor did they demonstrate the ability to provide accident investigative readiness capabilities to support a Type A accident investigation. LLNS needs to ensure the necessary procedures are in place that serve as the framework and work structure to transition an accident site. The LSO responsibility for ensuring accident scene management until the Board assumes control was not accomplished. There needs to be a program in place for emergency personnel to interface and transfer custody/control of physical evidence to the accident investigation site readiness team.

The accident scene was not preserved nor transitioned from an emergency response to an accident scene. **[**See **JON:5** and **JON:6]**

LLNL fleet management conducted a timely and comprehensive inspection of the accident vehicle.

The Board was not provided any medical information to base any conclusions on the Driver's medical state, Fitness for Duty or, cause of death. [See **JON:7**]

4.0 Conclusions and Judgments of Need

JONs are the managerial controls and safety measures determined by the Board to be necessary to prevent or minimize the probability or severity of a recurrence. These JONs are linked directly to the casual factors which are derived from the facts and analysis. They form the basis for corrective action plans which must be developed by line management. The Board also identified a JON for its conclusion regarding the preservation of the accident scene. The Board's conclusions and JONs are listed below in Table 4-1.

The root cause of this accident was that the vehicle safety features were not used by the LLNS employee. A contributing cause was the employee's unfamiliarity with the operation of the vehicle. The three JONs identified by the Board for these causes were assigned to LLNS.

The Board concluded that vehicle safety should be recognized as a job hazard and is the leading cause of fatalities within the Department. This conclusion led the Board to identify a JON assigned to HSS, in conjunction with DOE program offices, regarding the need to heighten awareness of vehicle safety. The Board also concluded that the accident scene was not preserved and assigned JONs to LLNS and LSO regarding this issue.

It is anticipated that LSO will review the CHP and LLNS Incident Analysis reports when finalized and inform HSS and NNSA if any additional actions are required.

Table 4-1: Conclusions and Judgments of Need

Conclusion	Judgment of Need
Vehicle safety features were not used by LLNS employee.	**JON:1** - LLNS needs to improve the safe driving behavior of the site workforce.
The Board concluded that LLNS management did not foresee the potential consequence of an inexperienced driver operating such a vehicle and therefore did not evaluate if the possession of a valid driver's license was a sufficient demonstration of experience to safety operate the vehicle. LE1 was unfamiliar with operation of the vehicle.	**JON:2** - LLNS needs to improve the selection process for general-use fleet vehicles. **JON:3** - LLNS needs to familiarize the workforce with vehicle safety features of the fleet.

Conclusion	Judgment of Need
Vehicle safety should be recognized as a job hazard and the leading cause of fatalities within the Department. This should be addressed as a corporate problem to reduce the frequency and severity of vehicle accidents.	**JON:4** - HSS, in conjunction with DOE program offices, needs to heighten awareness of vehicle safety to reduce fatal vehicle accidents in the Department.
The overall emergency response actions and subsequent medical care provided to the LE1 was appropriate and timely.	None.
The accident scene was not preserved and not appropriately transitioned to the accident investigation readiness team.	**JON:5** - LLNS needs to develop and implement procedures to ensure effective accident scene management. **JON:6** - LSO needs to revise existing procedures and practices to ensure the transition of an emergency event location to an accident investigation readiness team.
LLNL fleet management conducted a timely and comprehensive inspection of the accident vehicle.	None.
The Board was not provided with any medical information to base any conclusions on the Driver's medical state, Fitness for Duty or, cause of death.	**JON:7** – LSO needs to assess the final reports from the California Highway Patrol and the LLNS Incident Analysis Team when each report is received and notify HSS and NNSA if there are any additional actions that should be addressed.

5.0 Board Signatures

Donald C. Brunell
DOE Accident Investigation Board Chairperson
U.S. Department of Energy
Sandia Site Office

John E. Franchere, CSP
DOE Accident Investigator and Board Member
U.S. Department of Energy
Sandia Site Office

Steven G. Zobel, CHP
DOE Accident Investigation Board Member
U.S. Department of Energy
Office of Health, Safety and Security, HS-30

Roy Kearns
DOE Accident Investigation Board Member
U.S. Department of Energy
Livermore Site Office

6.0 Board Members, Advisors, Consultants

Board Members

Chairperson	Donald C. Brunell, Chair, SSO
Member	John E. Franchere, CSP, Investigator/Board Member, SSO
Member	Steven G. Zobel, CHP Board Member, HS-31
Member	Roy Kearns, Board Member, LSO

Advisor/Team Coordinator

Advisor	Dennis Vernon, MAS Consultants
Technical Writer	Ralph Kopenhaver, CE2 Corporation

Administrative Assistant

Consultant	Susan Keffer, Project Enhancement Corporation

Appendix A: Appointment of Type A Accident Investigation Board

Department of Energy
Washington, DC 20585

July 8, 2009

MEMORANDUM FOR: DONALD C. BRUNELL
SENIOR TECHNICAL SAFETY ADVISOR
SANDIA SITE OFFICE

FROM: THOMAS P. D'AGOSTINO
ADMINISTRATOR
NATIONAL NUCLEAR SECURITY
ADMINISTRATION

GLENN S. PODONSKY
CHIEF HEALTH, SAFETY AND SECURITY OFFICER
OFFICE OF HEALTH, SAFETY AND SECURITY

SUBJECT: Type A Accident Investigation of the June 26, 2009, Vehicle Fatality Accident at Lawrence Livermore National Laboratory

You are hereby appointed Chairperson of a Type A Accident Investigation Board to determine the events, conditions and causal factors of the vehicle fatality accident that occurred at the Lawrence Livermore National Laboratory (LLNL) on June 26, 2009. This event involved a laboratory employee operating a government vehicle in a parking lot near Building 242. This event is also being investigated by the California Highway Patrol as a traffic accident and an Incident Analysis is being performed by the laboratory. In order to minimize duplication, you should use the results from those investigations to adjust your approach to the Type A investigation. The scope of your investigation will include an evaluation of the adequacy and implementation of the following areas:

1) Vehicle operations requirements and training
2) Roadway, parking area and traffic design
3) Emergency response
4) Cooperative agreements and memoranda of understanding with offsite emergency response agencies
5) Similarity or common factors with other recent DOE-complex vehicle-related accidents

As you deem necessary, other advisors and support personnel may be added to the Board to ensure a high quality report is generated in a timely manner. It is anticipated

that Livermore Site Office will designate a representative to observe this investigation and, as appropriate, provide assistance to the Board during their data collection activities.

You will provide periodic reports on the status and progress of this investigation. Discussions of the investigation and copies of the daft report will be strictly controlled until release of the final release is authorized. The final investigation report should be provided for acceptance by July 31, 2009.

cc: Kimberly Davis, SSO
Garrett Harencak, NA-1 0
Gerald Talbot, NA-17
George Miller, LLNL
Charles Lewis, HS-30
Dave Pegram, HS-30
William Roege, HS-30
Alice Williams, LSO
Frank Russo, NA 3.6
Tom Williams, NA 3.6

Appendix B: Barrier Analysis

Barrier analysis is based on the premise that hazards are associated with all tasks. A barrier is any means used to control, prevent, or impede a hazard from reaching a target, thereby reducing the severity of the resultant accident or adverse consequence. A hazard is the potential for an unwanted condition to result in an accident or other adverse consequence. A target is a person or object that a hazard may damage, injure, or fatally harm. Barrier analysis determines how a hazard overcomes the barriers, comes into contact with a target (e.g., from the barriers or controls not being in place, not being used properly, or failing), and leads to an accident or adverse consequence. The results of the barrier analysis are used to support the development of causal factors.

Table B-1: Barrier Analysis

Hazard: Being ejected from vehicle		**Target: Driver**	
What were the barriers?	**How did each barrier perform?**	**Why did the barrier fail?**	**How did the barrier affect the accident?**
Familiarity with the operations of the truck	N/A	It was not required for the operator of the truck to become familiar with operating it before driving it. The only required vehicular training for operating this government vehicle was training for obtaining a valid state driver's license.	Opportunity for the employee to operate the vehicle incorrectly
Seat belts in the truck	The LLNL Vehicle Safety Program Plan states that seat belts will be worn when operating a vehicle. The seat belt was not used.	For unknown reason, driver's seat belt was not in use.	Driver not protected from ejection hazard.
LLNL Vehicle Safety Program	N/A	Expected LE1 to solely and independently be able to safely operate V1.	The program allowed an individual to drive an unfamiliar vehicle as an acceptable risk.
Doors of truck cab	No requirement to keep door(s) closed when vehicle is in gear or moving.	The driver's door was open.	Driver not protected from an ejection hazard.

Hazard: Being ejected from vehicle		Target: Driver	
What were the barriers?	**How did each barrier perform?**	**Why did the barrier fail?**	**How did the barrier affect the accident?**
Truck safety alarms	Truck safety alarms were ignored.	Alarms were ignored.	Driver not protected from an ejection hazard.

Appendix C: Change Analysis

Change is anything that disturbs the "balance" of a system from operating as planned. Change is often the source of deviations in system operations. Change can be planned, anticipated, and desired, or it can be unintentional and unwanted. Change analysis examines the planned or unplanned disturbances or deviations that caused the undesired results or outcomes related to the accident. This process analyzes the difference between what is normal (or "ideal") and what actually occurred. The results of the change analysis are used to support the development of causal factors.

Table C-1: Change Analysis

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
WHAT Conditions, driver's activities, equipment	Seat belt not used Door open Ignored audible alarm	Seat belt worn Door closed Heeded audible alarm		Ejected from vehicle
WHEN Occurred, identified, facility status, schedule	N/A	N/A	N/A	N/A
WHERE Physical location, environmental conditions	Next to Impala	Next to open space More space between vehicles	Physical contact between the truck and Impala.	Truck door caught on Impala
WHO Staff involved, training qualifications, supervision	Moved his boxes Driver unfamiliar with vehicle	Custodians move boxes Familiarize self with vehicle	Use of truck Unfamiliar with brake release location	Unfamiliar with truck Distracted while looking for brake release
HOW Control chain, hazard analysis, monitoring	Operated truck controls out of sequence	Operates controls in sequence	Truck in gear when brake released Door open when truck in gear	Unexpected movement of truck

Appendix D: Events and Causal Factor Analysis

An events and causal factors analysis was performed in accordance with the DOE Workbook *Conducting Accident Investigations*. The events and causal factors analysis requires deductive reasoning to determine those events and/or conditions that contributed to the accident. Causal factors are the events or conditions that produced or contributed to the accident, and they consist of direct, contributing, and root causes. The direct cause is the immediate event(s) or condition(s) that caused the accident. The contributing causes are the events or conditions that, collectively with the other causes, increased the likelihood of the accident, but which did not solely cause the accident. Root causes are the events or conditions that, if corrected, would prevent recurrence of this and similar accidents. The causal factors are identified in Figure D-1: Events and Causal Factors Analysis on pages D-1 through D-3.

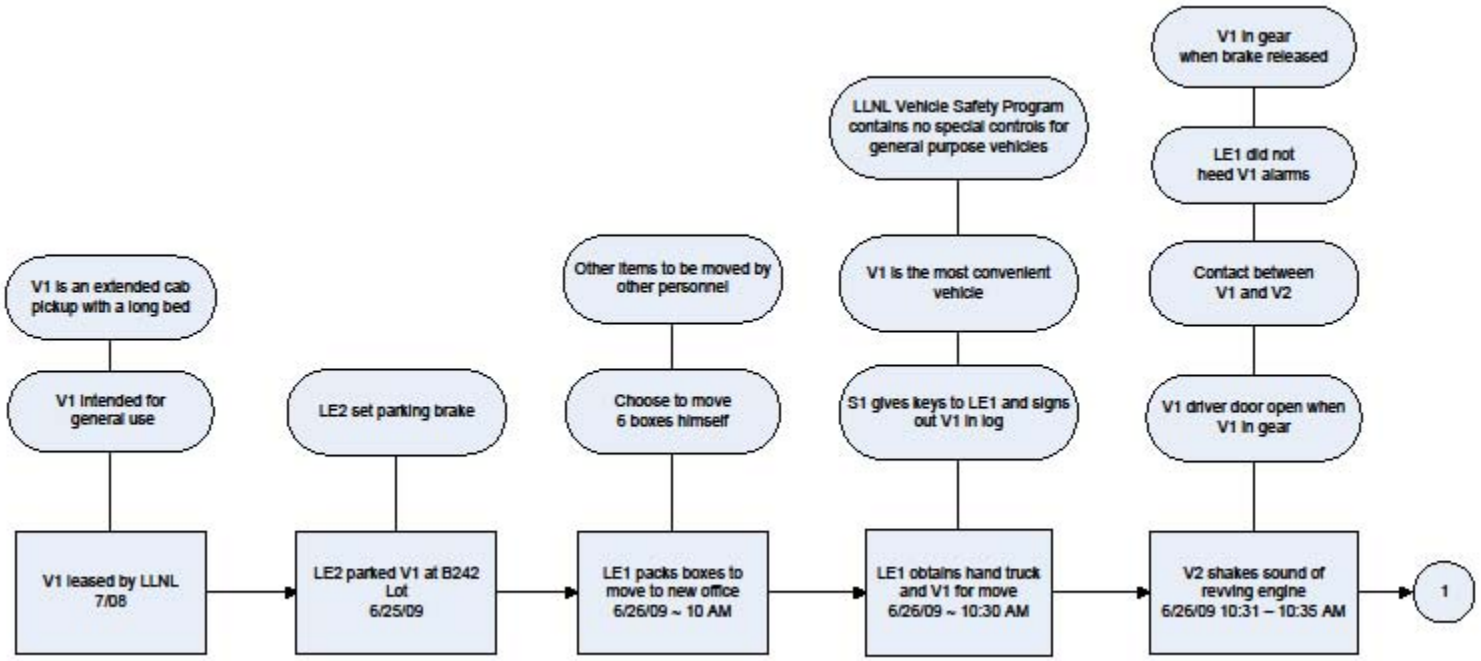
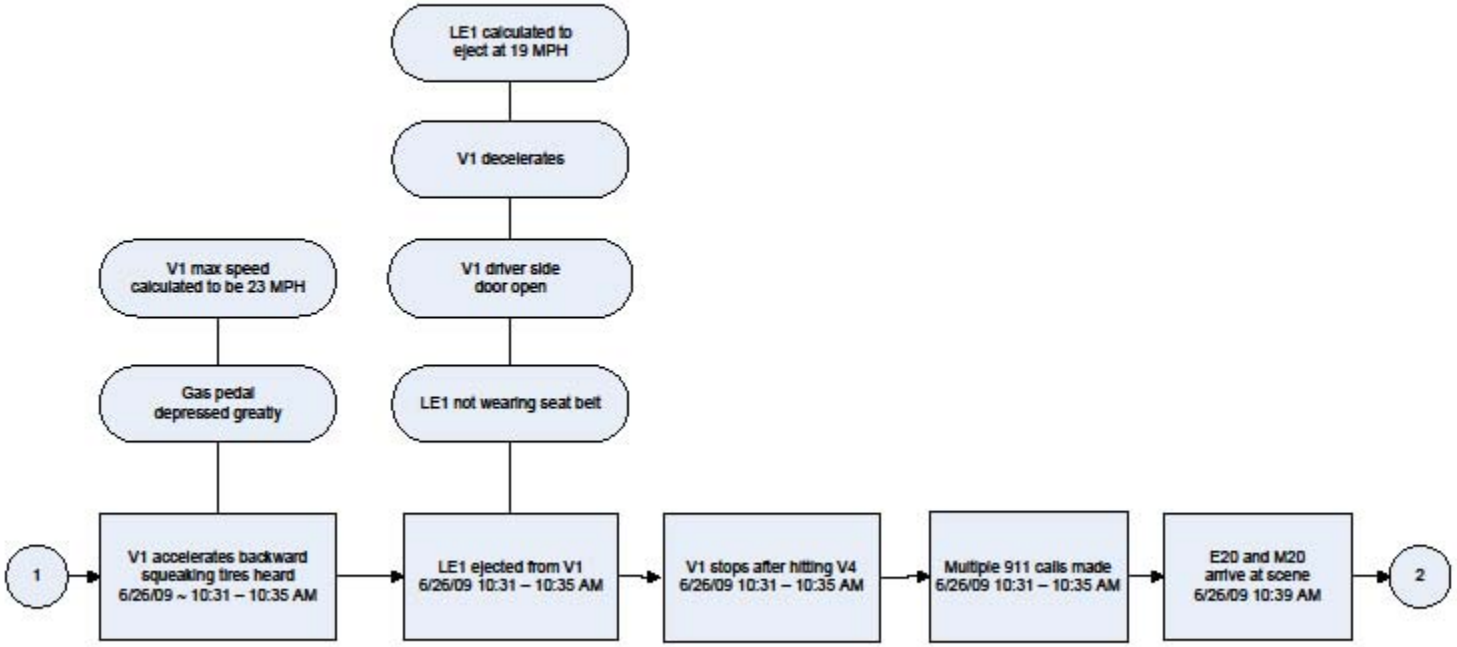
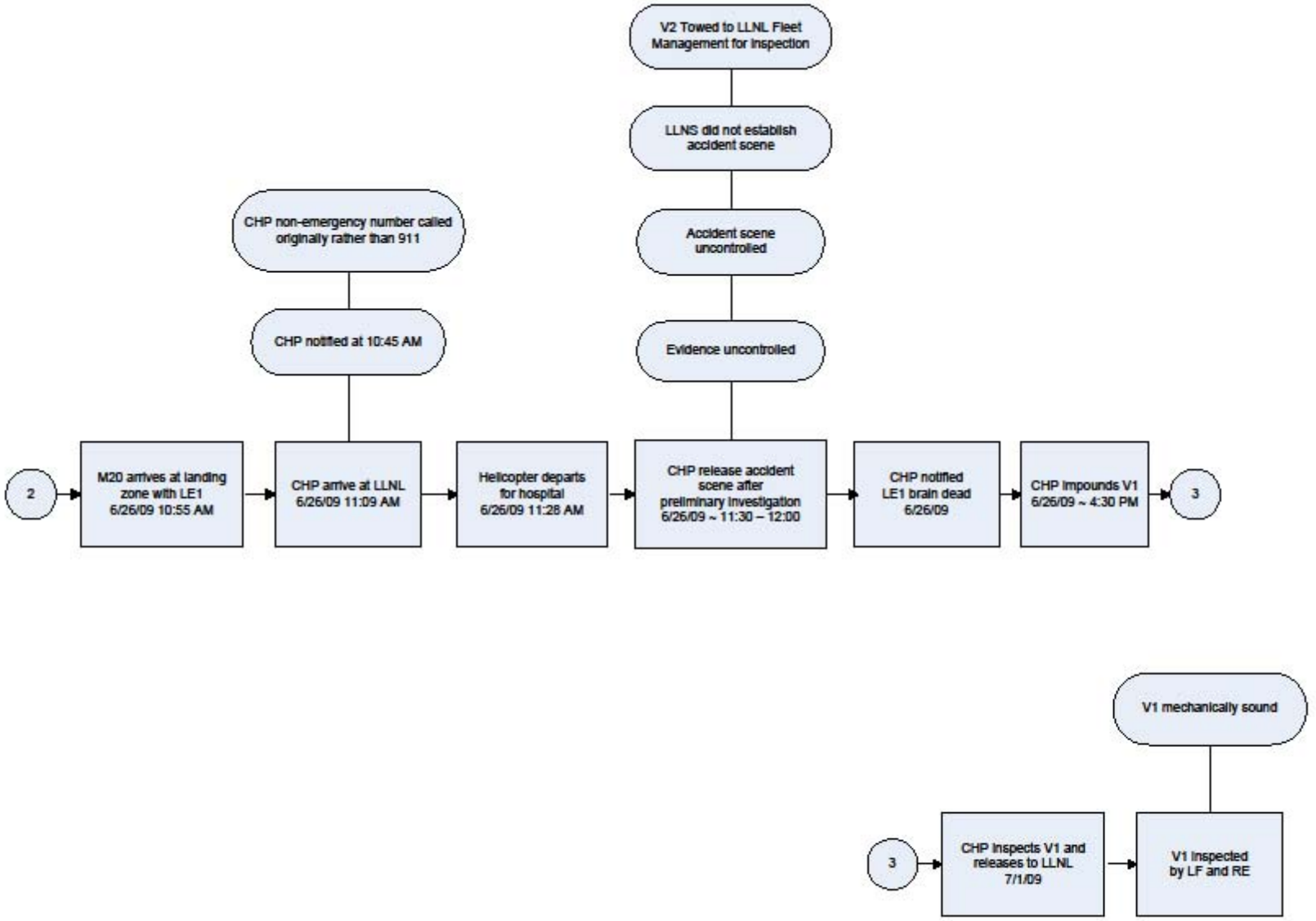


Figure D-1: Events and Causal Factors Analysis


LE1 calculated to eject at 19 MPH
V1 decelerates
V1 max speed calculated to be 23 MPH
V1 driver side door open
Gas pedal depressed greatly
LE1 not wearing seat belt
1
V1 accelerates backward squealing tires heard 6/26/09 ~ 10:31 – 10:35 AM
LE1 ejected from V1 6/26/09 10:31 – 10:35 AM
V1 stops after hitting V4 6/26/09 10:31 – 10:35 AM
Multiple 911 calls made 6/26/09 10:31 – 10:35 AM
E20 and M20 arrive at scene 6/26/09 10:39 AM
2


V2 Towed to LLNL Fleet Management for Inspection
LLNS did not establish accident scene
Accident scene uncontrolled
Evidence uncontrolled
CHP non-emergency number called originally rather than 911
CHP notified at 10:45 AM
2
M20 arrives at landing zone with LE1 6/26/09 10:55 AM
CHP arrive at LLNL 6/26/09 11:09 AM
Helicopter departs for hospital 6/26/09 11:28 AM
CHP release accident scene after preliminary investigation 6/26/09 ~ 11:30 – 12:00
CHP notified LE1 brain dead 6/26/09
CHP impounds V1 6/26/09 ~ 4:30 PM
3
V1 mechanically sound
3
CHP inspects V1 and releases to LLNL 7/1/09
V1 inspected by LF and RE

National Nuclear Security Administration
Immediate Office of the Administrator

U.S. Department of Energy
Office of Health, Safety and Security