

B O N N E V I L L E
P O W E R A D M I N I S T R A T I O N



Level I Accident Investigation
Report
March 1, 2010
Fatal Bobcat/Backhoe Accident
At the White Bluffs Substation

**Report Date:
March 31, 2010**

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DISCLAIMER

This report is an independent product of the Level I Accident Investigation Board appointed by Steve J. Goins, Chief Safety Officer, Bonneville Power Administration. The Board was appointed to perform a Level I Accident Investigation and to prepare an investigation report in accordance with *Bonneville Power Administration Manual*, Chapter 181, *Accident Investigation and Reporting*.

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.

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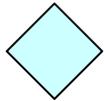
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Legend

BCFMI	BPA Electrical Utility Carpenter Foreman I
BCOPS	BPA Chief Substation Operator
BFTE	BPA Full Time Equivalent
BOPS	BPA Substation Operator
CC-1	Contract Carpenter
CFTE	Contract Full Time Equivalent
CHEO	Contract Heavy Equipment Operator
CL-1	Contract Laborer
COO	Chief Operating Officer
TFHE	BPA Organization Code

Legend for Events and Causal Factors Analysis (Appendix A)

Times in Events and Causal Factors Analysis are approximations.



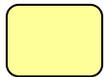
Accident



General Basic Event – The primary building block for analytic trees. Event resulting from the combination of more basic events.



Causal Factors – Represents the direct, root, and contributing causes.



Conditioning Event – Applies conditions or constraints to the events.



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Acronyms

AIB	Accident Investigation Board
ALS	Advanced Life Support
APM	BPA Accident Prevention Manual
BICS™	Bobcat Interlock Control System
BPA	Bonneville Power Administration
CFR	Code of Federal Regulations
ECF	Events and Causal Factors
J-1	Job Briefing including Hazard Analysis as referenced in BPA APM
NIOSH	National Institute for Occupational Safety and Health (NIOSH)
OSHA	U.S. Department of Labor, Occupational Safety and Health Administration
ROPS	Bobcat Roll Over Protection Structure

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SCOPE OF INVESTIGATION

On March 2, 2010 at the request of the Bonneville Power Administration (BPA) Chief Safety Officer, a Level I Accident Investigation was convened to investigate an accident in which a supplemental labor contractor was fatally injured in a Bobcat/backhoe accident at the White Bluffs Substation near Richland, Washington on March 1, 2010.

The scope of the investigation included a review of employee statements, interviews, work procedures, management systems, and other elements factoring into the incident. The purpose of the investigation was to determine the cause of the accident and probe for deficiencies, if any, in the following areas:

- Safety violations (*BPA Accident Prevention Manual* and the *BPA Work Standard*)
- Employee experience
- Contractor experience
- Work practices (BPA procedures)
- Management responsibilities
- Employee responsibilities

The investigation was conducted using the following methodology:

- Data collection activities relevant to the accident such as conducting interviews and reviewing employee statements
- Visit to accident site
- Consultation with Bobcat manufacturer's Product Safety Manager
- Review and inspection of the equipment
- Review of equipment operations and maintenance manuals
- Develop recommendations for corrective actions to prevent recurrence

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EXECUTIVE SUMMARY

On March 1, 2010, at approximately 0850, a Christenson Electric, Inc. (Christenson) employee was fatally injured at the Bonneville Power Administration's (BPA) White Bluffs Substation near Richland, Washington while loading a Bobcat equipped with a backhoe attachment onto a trailer for transport to another work site.

At approximately 0700, a mixed carpenter crew of two BPA and four Christenson personnel were preparing to load their equipment and tools to move to a different job location. The Christenson Heavy Equipment Operator (CHEO) reported to the job site and the BPA Carpenter Foreman I (BCFMI) at approximately 0750 (1 hour ordered travel) and as a result, missed the crew's J-1 job briefing. Upon arrival, the CHEO received a verbal briefing from the BCFMI and proceeded with assigned tasks. At approximately 0830 the CHEO and the Christenson Laborer (CL-1) prepared to load a BPA-owned Bobcat equipped with the backhoe attachment onto its transport trailer. While the CL-1 hooked the pickup to the trailer, the CHEO drove the Bobcat to retrieve the backhoe attachment from where it had been stored near the fence. As the CHEO approached the trailer ramps, the backhoe attachment came into contact with the trailer preventing the machine from being loaded. The CHEO reversed motion and backed up approximately one foot and stopped. The CHEO exited the machine twice attempting to connect and reconnect the hydraulic hoses for the backhoe attachment and re-entered the machine. The CHEO may have intended to use the hydraulics on the backhoe attachment in an effort to facilitate the loading of the Bobcat and backhoe attachment onto the trailer.

After re-entering the machine, the CHEO bypassed the Bobcat Interlock Control System (BICST[™]) and depressed the left foot hydraulic pedal which resulted in the Bobcat lift arms being raised, pinning the CHEO between the backhoe attachment seat and the Roll Over Protection Structure (ROPS) of the Bobcat. The CHEO received fatal injuries and was pronounced dead at Kadlec Medical Center in Richland Washington at 1005.

FINDINGS AND RECOMMENDATIONS

Findings and Recommendations are found in Table 3-1: Findings and Recommendations of this report as determined by the Accident Investigation Board (AIB). The findings are those the AIB considered significant and are based on facts and pertinent analytical results. Recommendations are managerial controls and safety measures concluded by the AIB to be necessary to prevent or minimize the probability or severity of a recurrence of this type of accident. Recommendations are derived from the findings and causal factors and are intended to assist BPA management in developing corrective actions.

A direct cause is the immediate event or condition that caused the accident. The AIB concluded that the direct cause of this accident was that the CHEO activated the hydraulic controls while standing in the pinch point. The Board determined the root cause of the accident was that the CHEO bypassed the Bobcat safety features. The AIB also identified contributing causes which are events or conditions that collectively with the other causes,

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increase the likelihood of the accident, but individually did not cause the accident. The AIB concluded that a contributing cause of this accident was that the CHEO did not receive a sufficient J-1 (pre-job briefing that included work planning, job hazards analysis, and controls). An interview with the BCFMI and a review of the written J-1 the day of the accident indicate that the briefing the CHEO received, an hour after the crew's job briefing, was verbal and only included assignment of job tasks associated with moving tools and equipment to a new job site.

The AIB determined that a second contributing cause was that the J-1 briefing for the entire crew was insufficient on the day of the accident. A review of the written J-1 from the day of the accident indicated that the work to be performed at the work site was unchanged from previous days' J-1's which included setting forms and pouring concrete and in fact did not reflect the actual work that was planned for that day (loading materials, tools, equipment to mobilize to next job site).

Although this accident involved a supplemental labor contractor, the AIB also could not determine if BPA personnel have been trained on all aspects of the Bobcat and attachments. The AIB concluded that employee training and equipment issues be addressed before the moratorium is lifted on the use of backhoe attachments. Equipment issues would include completion of safety inspections, addressing recall compliances and correcting identified deficiencies.

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1. INTRODUCTION

1.1. ACCIDENT OVERVIEW

On March 1, 2010, at approximately 0850, a Christenson Electric, Inc (Christenson) employee was fatally injured at the Bonneville Power Administration's (BPA) White Bluffs Substation near Richland, Washington while loading a BPA-owned Bobcat equipped with a backhoe attachment onto a trailer for transport to another work site. The accident occurred as the Contract Heavy Equipment Operator, now referred to as CHEO, moved into a position between the Bobcat Roll Over Protection Structure (ROPS) cage and the backhoe attachment; lowered the seat bar, bypassing the BICS™; and engaged the hydraulic systems which caused the Bobcat lift arms to raise the backhoe attachment, pinning the CHEO between the backhoe attachment seat and the Bobcat ROPS.

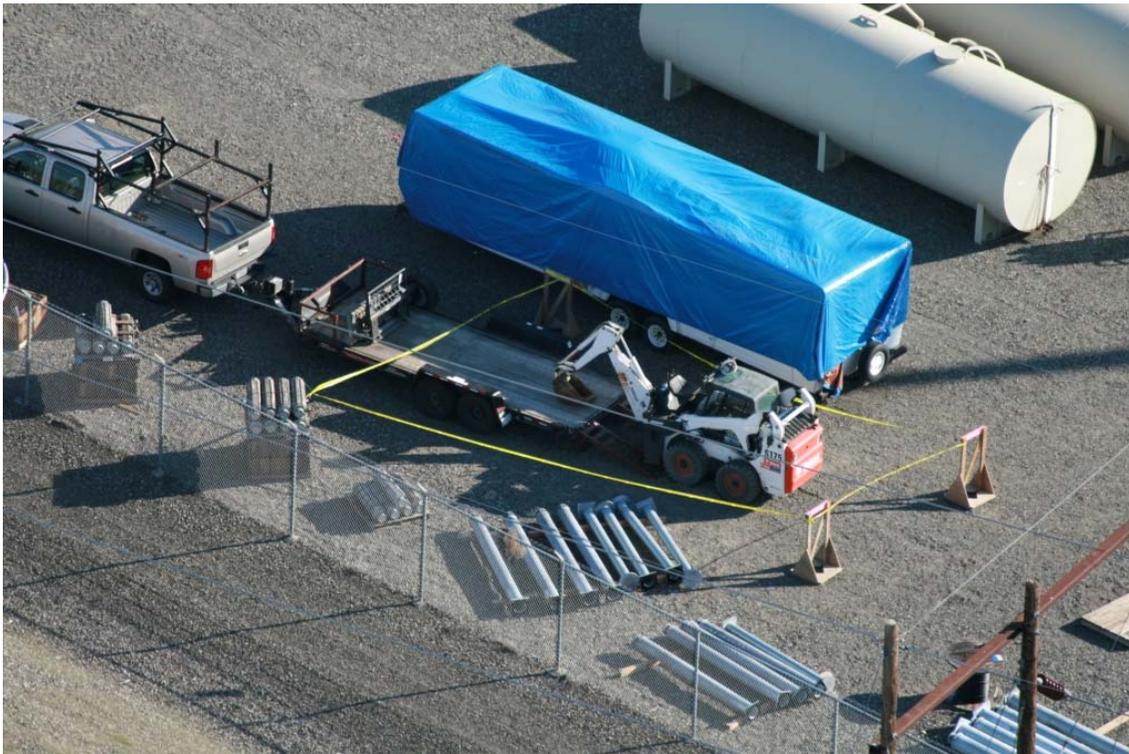


Figure 1-1: Aerial View of Accident Scene

1.2. ACCIDENT INVESTIGATION BOARD APPOINTMENT

On March 2, 2010, Steve J. Goins, Chief Safety Officer, appointed a Level I Accident Investigation Board (AIB) to investigate the Bobcat accident fatality in accordance with Delegation Order No. 0204-161, signed by the Secretary of Energy on October 7, 1996, and with BPA Manual Chapter 181, *Accident Investigation and Reporting*.

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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 1-2: Accident Investigation Terminology

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2. FACTS AND ANALYSIS

2.1. ACCIDENT DESCRIPTION AND CHRONOLOGY OF EVENTS

Table 2-1: Chronology of the Accident

(Times are approximations)

03/01/10 0704	BPA Carpenter Foreman I (BCFMI) and crew arrived at the White Bluffs Substation (job site)
0730	Crew held daily job briefing. The CHEO was not present
0750	The CHEO arrived at White Bluffs
0750	The BCFMI gave the CHEO a verbal briefing on job assignments
0830 - 0845	The Contract Laborer (CL-1) and the CHEO began working together to load Bobcat and backhoe attachment onto trailer
0830 - 0845	CHEO had difficulty loading Bobcat/backhoe attachment. The CL-1 saw the CHEO start to climb out of Bobcat seat
0845 - 0856	Accident Activation of hydraulic controls resulting in the CHEO being pinned between backhoe attachment and the ROPS.
0856	The BCFMI called 911
0907	Richland paramedic crews arrived
0919	Richland paramedics cleared the scene
0933	Richland paramedics arrived at Kadlec Medical Center
1005	CHEO officially pronounced dead
1040	BPA Chief Substation Operator (BCOPS) secured the scene and established access control of the accident scene
03/02/10	Chief Safety Officer issued memo convening AIB
03/02/10	Safety Office issued Safety Alert "Contractor Fatality" and includes moratorium on use of Bobcat with backhoe attachment

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2.1.1. Equipment Description

The Bobcat S175 Skid-steer loader is a small rigid-frame, rubber-tired machine weighing 6,220 lbs, and 68'' wide. It is a diesel-powered machine with lift arms used to attach a wide variety of tools or attachments. The Bobcat, a four-wheel drive machine, has the left-side drive wheels independent of the right-side drive wheels. By having the drive wheels independent of each other, wheel speed and rotational direction of the wheels determine the direction of the loader. Forward, reverse, travel speed and steering are controlled by two hand levers. Two foot pedals control the hydraulics that raise and lower the lift arms and the dump and rollback of the bucket. Bobcats are capable of zero-radius, "pirouette" turning, which makes them extremely maneuverable and valuable for applications that require a compact, agile loader. The lift arms on these machines are alongside the driver seat outside the cab with the pivot points behind the driver. Bobcats have fully-enclosed cabs and other features to protect the operator.



Figure 2-1: Bobcat S175

The Bobcat S175 is equipped with a safety interlock system, the Bobcat Interlock Control System (BICS™). To activate the hydraulic lift/tilt functions, the BICS™ requires the seat bar to be in the lowered position, the engine running, and the “press to operate loader” button pushed. See Appendix D: Bobcat Interlock Control System.

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A Bobcat backhoe attachment is a piece of excavating equipment consisting of a digging bucket on the end of a two-part articulated arm. It mounts on the front of the Bobcat using the “Bob-Tach” system. The boom is closest to the Bobcat and the section that carries the bucket is known as the arm. The seat and controls for the functions of the backhoe attachment are independent of the Bobcat. See Figure 2-2 for backhoe nomenclature.

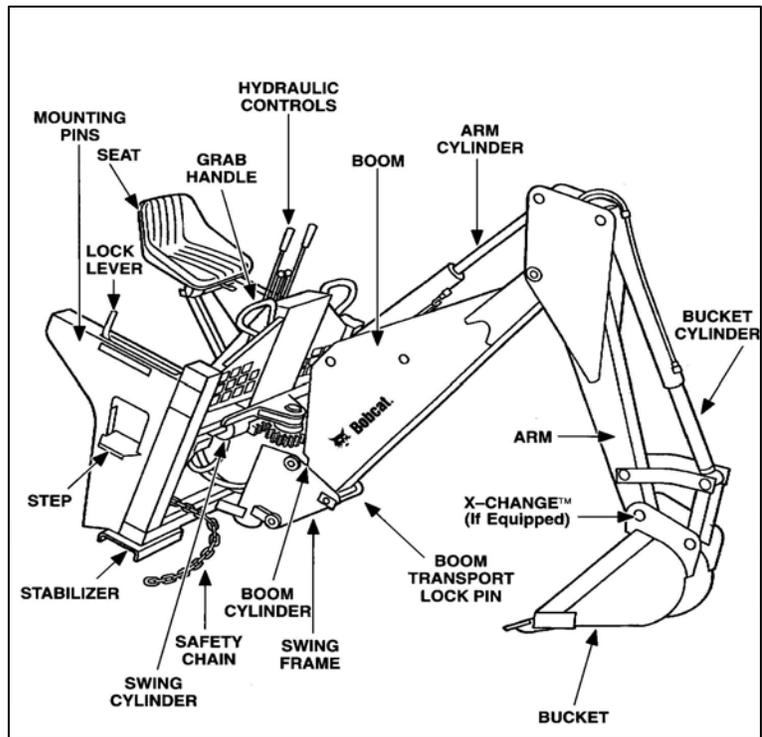


Figure 2-2: Backhoe Attachment

The AIB requested a Bobcat factory representative to conduct an operational and functional inspection of the Bobcat and backhoe attachment. Bobcat sent a Senior Product Design and Safety Engineer to perform the requested inspection. The Bobcat representative subsequently submitted a written report to the AIB. Based upon this report, the AIB concluded that the Bobcat and backhoe attachment involved in this accident were in good working order and were not a contributing cause to this accident.

2.1.2. Presumed Accident Scenario

Based on the data and facts collected through this investigation, the AIB reasoned that the most likely sequence for this accident is described below.

On the morning of March 1, 2010, the mixed carpenter crew of BPA and Christenson personnel were preparing to load their equipment and tools to move to a different job location. When the crew reported to the White Bluffs Substation at 0704, the mixed crew consisted of two BPA and four Christenson employees, but CHEO had not yet arrived at the site. At 0730 the BPA Electrical Utility Carpenter Forman I (BCFMI) gave a job briefing (J-1) to the crew present at the substation, however the CHEO who was in ordered travel status at the time of the J-1, was not present during the briefing.

At 0750, the CHEO arrived at the White Bluffs Substation and received a verbal briefing from the BCFMI about the tasks involved in the work scheduled for that day. With direction and help from other members of the crew, the CHEO used a four-wheeled material handler forklift to load tools and equipment into multiple vehicles. At approximately 0830 the CHEO and one of the Contract Laborers (CL-1) prepared to load a BPA-owned Bobcat

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equipped with the backhoe attachment onto its transport trailer. While the CL-1 hooked the pickup to the trailer, the CHEO drove the Bobcat to retrieve the backhoe attachment from where it had been stored near the fence. The CHEO hooked up the backhoe attachment using the “Bob-Tach” system. At this time the CHEO did not hook up the hydraulic hoses for the backhoe attachment. The CL-1 took a position on the left side of the trailer in full view of the CHEO. The CHEO proceeded to drive the Bobcat with the backhoe attachment from the fence location to the trailer loading ramps, a distance of approximately 90 feet. As the CHEO approached the trailer ramps, the backhoe attachment came into contact with the trailer, preventing the machine from being loaded. The CHEO reversed motion and backed up approximately one foot and stopped. The CHEO exited the machine and connected the hydraulic hoses for the backhoe and re-entered the machine. The CHEO exited the machine a second time to check the hydraulic connections because the hydraulic hose connectors design is such that in order for the connection to be made successfully no pressure can be within the hydraulic system. The CHEO may have intended to use the hydraulics on the backhoe attachment to facilitate loading the Bobcat and backhoe attachment onto the trailer.

The CHEO again re-entered the machine, and either remained standing, put the seat bar down and activated the BICS™ system or, put the seat bar down, sat on the bar and activated the BICS™. The CHEO reached for the backhoe seat to either pull from a seated position or, hold on to the backhoe seat for support. In either case, the CHEO depressed the left foot hydraulic pedal which resulted in the Bobcat lift arms being raised, pinning the CHEO between the backhoe attachment seat and the ROPS of the Bobcat. The CL1 turned off the Bobcat and summoned the crew for assistance.

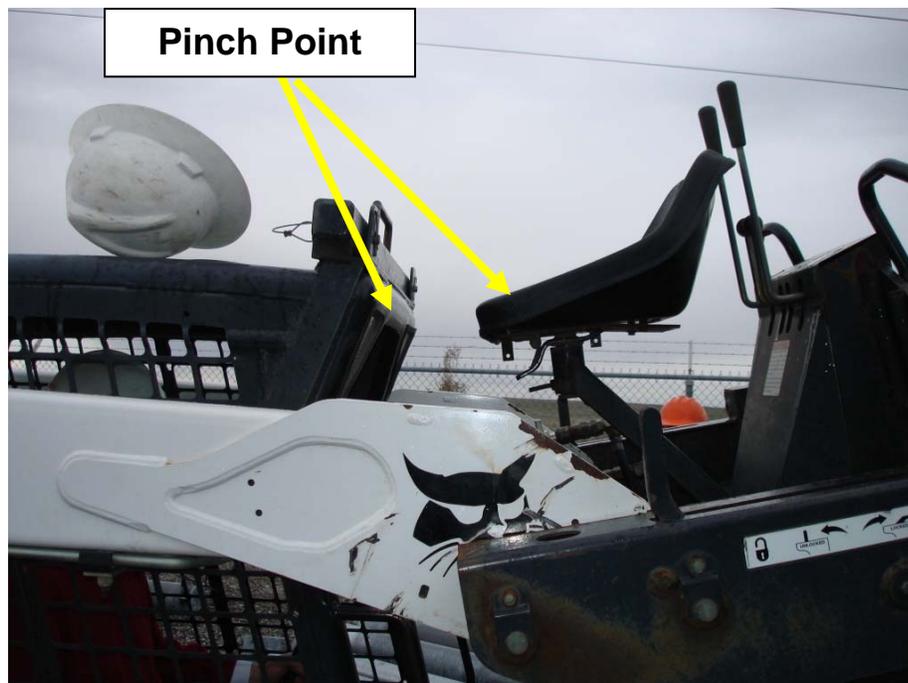


Figure 2-3: Pinch Point Between Bobcat and Backhoe Attachment

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2.1.3. Emergency Response and Investigative Readiness

2.1.3.1. *Emergency Response*

On March 1, 2010 at 0856, the BCFMI, used a Government-issued cell phone to call 911 for emergency services. The CL-1 was dispatched to the nearby Hammer Facility to escort the emergency vehicles upon their arrival. Richland Fire Department was dispatched to the accident scene. Advanced Life Support Unit (ALS) MD73 arrived at White Bluffs Substation at 0907.

When the ALS medical personnel arrived at the accident scene, they found the CHEO was conscious and complaining of chest pains. Medical personnel assessed the injuries and at 0919 transported the CHEO to Kadlec Medical Center. The ALS unit arrived at the Medical Center at 0933. The CHEO was pronounced dead at 1005.

2.1.3.2. *Investigative Readiness*

The City of Richland Police Department arrived at the scene at 0907 shortly after the ALS unit. The police took photographs of the accident scene and took witness statements from CL-1. All work at the substation had stopped and police were told by the BCFMI that work would not resume until BPA safety personnel investigated the accident.

Soon after the accident the BCFMI called and notified BPA line management of the accident. BPA line management directed the BCFMI to photograph the accident scene and to have all members of the carpenter crew write statements. The BCFMI notified the CHEO's spouse of the accident and that the CHEO was in route to the hospital.

BPA line management officials called Christenson management, the CHEO's employer, BPA upper management, and the BPA Safety Office to report the accident. A BPA Safety and Occupational Health Manager was dispatched to the substation.

BPA's electrician crew members returned to work at their work locations within the substation. The BPA Chief Substation Operator (BCOPS) and the BPA Substation Operator (BOPS) arrived at White Bluffs Substation at 0920 and took control of entry procedures, accumulation of facts for the substation logbook, and accident scene management. The BCOPS ordered all workers at the substation to stop work and stand-down. The BOPS notified the BPA Munro Dispatch Office of the accident.

BPA's Safety and Occupational Health Manager arrived at White Bluffs Substation at 1225 to assure accident scene preservation and to take photographs of the accident scene. BPA management officials arrived at 1303. Christenson management arrived between 1630 and 1700.

A Level I AIB was convened on March 2, 2010. The AIB arrived at White Bluffs Substation on the morning of March 2, 2010 to assume control of the accident scene and began data collection activities.

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The AIB concluded accident scene management was not timely, coordinated, or appropriately delegated:

- Notification of family occurred outside the chain of command
- All personnel at the substation had not been directed to write statements
- Employees were allowed to return to normal work duties within the substation
- Access to accident scene was not immediately limited
- The Dispatch Office was not contacted in a timely manner

FINDING: Immediately after the accident, the scene was not secured and not appropriately transitioned to the AIB.

RECOMMENDATION: BPA management shall develop policy and procedure to ensure transition of an emergency event location to an AIB.

FINDING: Control and leadership immediately after the accident was lacking.

RECOMMENDATION: BPA management shall develop protocol for employees on immediate accident and after-accident response, i.e., notification of BPA management, gathering statements, standing down employees, scene preservation, and emergency contacts.

2.1.4. Medical Analysis

The AIB requested but was not provided with medical records or clinical diagnoses to substantiate that there were, in fact, no fitness for duty issues and/or concerns relative to the CHEO's state of health that may have had a contributing factor in this accident. The AIB did receive a copy of the Benton County Coroner's Office report which stated the cause of death as a "crushing injury in the workplace" but the results of toxicology samples were not anticipated to be received prior to publication of this report. The State of Washington's Department of Labor and Industries determined that there was no need to conduct an autopsy and communicated this decision to the Coroner's Office. The AIB concluded that the toxicology results need to be reviewed upon receipt.

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2.2. HAZARDS, CONTROLS, AND MANAGEMENT SYSTEMS

2.2.1. Management Systems

2.2.1.1. Contract Requirements

The BPA uses a master contract to hire supplemental labor employees to fill gaps in workload peaks and valleys. Employees under this contract work in conjunction with BPA employees in a mixed crew environment. Overall supervision of the contract employees is under the direction and control of their contract supervisors but BPA employees give job directions on individual tasks.

The CHEO began work as a supplemental labor equipment operator in September 2007. The CHEO worked from September 2007 through November 2007 and was released at that time. The CHEO restarted with BPA on June 29, 2009. A new supplemental labor contract was put in place effective September 13, 2009. This chronological timeline reveals that the CHEO started under the supplemental labor contract that expired on August 31, 2009 and continued employment under the new supplemental labor contract until the day of the accident.

The AIB reviewed the current and past supplemental labor contract requirements. Both contracts' requirements cover BPA policies, fitness for duty, energized electrical facility access, safety and health standards, environmental and hazardous materials standards, and individual craft knowledge, skills, and abilities. The current contract requires that the contractor, at its expense, be responsible for:

- ensuring that its employees are kept current on the latest technologies, skills, and techniques for which they are providing services;
- providing on-going training to reinforce and expand the professional and technical skills, knowledge, and abilities of its employees;
- providing all training to meet pre-requisite skills for replacement personnel at its expense; and
- providing an Employee Training Record (Appendix B of Master Contract 00044235) for each worker.

The Employee Training Record must be signed by the contractor, the contract employee, and the BPA representative requesting the contract employee. This written documentation must indicate the employees' formal training in the subjects covered on the Employee Training Record.

The AIB requested the written training records from Christenson Operating Engineers Local 701, and BPA for the CHEO, however none were provided. The AIB found that the current

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contract lacks a mechanism to ensure that vendors are meeting the terms of the contract to verify training and certification of supplemental labor employees supplied to BPA.

In review of the craft specific requirements in Required Tools, Equipment, Training, and Certifications section of Appendix A of the contract, the AIB found inconsistencies between Appendix A and Appendix B - *Employee Training Record*. The *Employee Training Record* should list all specified equipment required for each labor classification listed in Required Tools, Equipment, Training, and Certifications for check-off and verification of employee training and certifications.

FINDING: Supplemental Labor contract lacks a mechanism to ensure the vendor is meeting the terms of the contract to verify training and certification of supplemental labor employees.

RECOMMENDATION: BPA shall enforce the supplemental labor contract to ensure the verification process of the contract provisions will be met.

2.2.1.2. Accident Prevention Manual

The BPA *Accident Prevention Manual* (APM) contains the mandatory minimum requirements for dealing with the principle hazards inherent in daily work activities. Under the terms of supplemental labor contract with BPA, contract personnel are required to become familiar with and to follow the safety practices of the BPA APM. In the course of the investigation the AIB found two areas of the APM that were relevant to the accident. These areas are in Rule R-5, *Responsibilities* and Rule J-1, *Job Briefing*.

Rule R-5 Responsibilities

In part, Rule R-5 states:

- “Supervisors shall ensure that employees fully understand how to perform their work with safety to themselves and others. They shall impart to each employee the understanding that willful violations of established safety practices and rules will not be tolerated.”
- “All employees must follow the rules applicable to the job being performed and report all unsafe tools, unsafe equipment, and hazardous conditions or procedures which come to their attention.”

The intent of this rule is for all employees to follow all safety guidelines associated with any given task or operation of equipment, which includes, but is not limited to, applicable APM rules, work standards, operational manuals, OSHA regulations, and equipment warning labels. The AIB concluded that the CHEO failed to follow the manufacturer’s recommended safety practices for the safe operation of the Bobcat with the backhoe attachment.

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The AIB concluded that there was a lack of responsibility toward safety by a failure to adhere to Rule R-5 Responsibilities.

FINDING: The CHEO bypassed Bobcat safety systems.

RECOMMENDATION: BPA management Chief Operating Officer (COO) shall require all BPA employees who operate mobile fleet equipment receive proper training in the safe use of this equipment. BPA management shall require that all contracts for operating mobile equipment include a requirement that contractor certify that their employees who will operate mobile fleet equipment under this contract have received proper training in the safe use of this equipment.

FINDING: The CHEO failed to follow instructions in operation and maintenance manual.

RECOMMENDATION: Site management shall require all BPA and contract personnel to follow operation and maintenance manuals of mobile fleet equipment.

Rule J-1 Job Briefing

Rule J-1 covers job briefings and states that “the person-in-charge of the job shall conduct job briefings with all workers assigned to the job. Job briefings shall be held at the work site with additional briefings conducted when work situations change that may pose different or additional hazards to workers”. All job briefings must cover at least the following subjects:

- Hazards associated with the job
- Work procedures
- Special precautions
- Energy source controls
- Personal protective equipment
- Clearances, Work Permits, Hold Orders”

Through the documented job briefing forms, employee statements, and employee interviews, the AIB concluded that the crew did hold daily job briefings and did document those briefings. The AIB was provided 35 daily job briefing forms covering the work at White Bluffs Substation beginning in December 2009. The AIB concluded that the J-1s did not reflect the different work scenarios of the 35 days and as a result, the hazards, the work conditions, and the tasks were not updated for the actual work being performed on the day of the accident.

On the day of the accident, the CHEO arrived at the jobsite after the job briefing had been completed and signed by the crew. The BCFM1 stated in an interview that he had given the CHEO a verbal job briefing when he arrived at the site but the CHEO did not sign the J-I form.

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The AIB concluded that insufficient J-1's were conducted.

FINDING: The CHEO did not receive an adequate job briefing.

RECOMMENDATION: BPA management shall ensure that all members of a crew assigned to perform the work receive an adequate job briefing.

FINDING: Job briefing was inadequate for work tasks being performed.

RECOMMENDATION: TFHE management to conduct additional job briefing training of involved crew.

2.2.1.3. Safety Statistics

Between 1980 and 1992, the National Institute for Occupational Safety and Health (NIOSH) National Traumatic Occupational Fatalities Surveillance System used death certificates to identify 54 work related deaths involving skid-steer loaders in which 25 of them, or 46 percent, were the result of the worker being pinned between the bucket and the equipment frame or pinned between the lift arms and frame. During this same time frame, an additional work-related 65 fatalities were attributed to being pinned in the same fashion but the specific loader types were not identified. As a result, it is unknown if these 65 work-related fatalities involved skid steer loaders or some other type of loader. Therefore the safety statistical results of these unknown loader fatalities are not used in this statistical analysis. Moreover, even the statistical results involving skid-steer loaders may be understated because they only include results from industrial accidents that are required to be reported and do not include skid-steer loader accidents as a result of general public use.

During the time period 1992 to 1997, the NIOSH Fatality Assessment and Control Evaluation Program identified 37 work-related fatalities involving skid-steer loaders. Of the 37 fatalities, 29 of them, or 78 percent, were the result of workers being pinned as described above.

In a shorter time frame of 1992 to 1994, there were 20 work-related fatalities involving skid-steer loaders according to the Census of Fatal Occupational Injuries of the Bureau of Labor Statistics. Of these 20 fatalities, 14 of them, or 70 percent, involved pinning the worker between the loader bucket and the frame or between the lift arms and the frame.

Between 1997 and 2007, the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Integrated Management Information System revealed that 100 accidents were recorded specifically involving skid-steer loaders. Moreover, the deliberate bypass of safety features such as seatbelts and safety control interlock systems was the direct

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cause of 20 percent of these accidents with all but one resulting in a fatality. This last data point for which statistics are available is important as OSHA states that the manufacturers' engineered safety interlock controls are, in fact, intentionally being circumvented by the worker. It should also be noted that modifications or additions to the equipment that affect the safe operations of equipment require the manufacturers' written approval per OSHA 29 CFR 1926.602(c)(ii).

The fatality rate of skid-steer loaders does not appear to be decreasing despite the equipment manufacturers' installation of interlock safety features in the 1980's, which were anticipated to reduce the number of fatal accidents. The Bobcat's BICS™ was introduced in 1995. Nevertheless, workers continue to circumvent the manufacturers' safety interlock systems. Moreover, there are no federal or state prescriptive training requirements, nor are there any special licenses required to operate a skid-steer loader.

During a re-enactment of a potential accident scenario, using another BPA-owned Bobcat with backhoe attachment, an unexpected event occurred as the result of modifications to the backhoe attachment seat. While attempting to turn off the machine, the back of the modified seat came in contact with the control levers causing the inadvertent movement of the backhoe boom and bucket. Upon further inspection of this machine, the AIB discovered:

- modifications to the backhoe attachment that included cutting of step areas and hydraulic hose locations; and
- manufacturer recall repairs had not been addressed.

The AIB recommends resolving these equipment safety issues before the moratorium is lifted on the use of backhoe attachments. Resolution of the equipment safety issues includes completion of safety inspections, addressing recall compliances and correcting identified deficiencies.

FINDING: The AIB discovered hazardous modifications and the absence of safety recall repairs on the BPA-owned Bobcat used in the re-enactment.

RECOMMENDATION: BPA management shall order inspections of all mobile fleet equipment for safety compromising modifications and safety recall compliance.

RECOMMENDATION: BPA management shall revise and enforce the current policy that requires approval for any modifications of mobile fleet equipment in accordance with OSHA 29 CFR 1926.602(c)(ii), and implement a process for tracking all equipment recalls for timely completion.

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2.2.2. Personnel Training

Although this accident involved a supplemental labor contractor, the AIB also could not determine if BPA personnel have been trained on all aspects of the Bobcat and attachments. The AIB concluded that employee training be addressed before the moratorium is lifted on the use of backhoe attachments.

2.2.2.1. Department of Labor – OSHA Required Training

OSHA does not have training requirements specifically for skid-steer (Bobcat) loaders.

2.2.2.2. Bobcat Manufacturer Training - Operator Training for Backhoe Attachment

Bobcat offers operator training courses for their equipment.

The AIB requested copies of training records for the CHEO from unions, BPA, and Christenson but none were provided.

FINDING: The AIB was not provided training records to base any conclusions on the CHEO's qualifications.

RECOMMENDATION: BPA Safety Office shall assess the training records when received to ascertain that the appropriate training was received by the CHEO.

FINDING: BPA and contract personnel have not been adequately trained on the safe operation of skid-steer loaders and attachments.

RECOMMENDATION: BPA management shall develop and implement skid-steer training requirements for all personnel, BFTE and CFTE, utilizing this equipment.

2.3. ANALYSIS

2.3.1. Events and Causal Factors

The AIB developed a basic chronology of events and subsequently employed the accident investigation core analytical techniques to identify the causal factors for this accident. Causal factors are events or conditions that produced or contributed to the occurrence of the accident and consist of direct, root and contributing causes. When the causal factors are integrated with the chronology, this product is called the Events and Causal Factors Chart.

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Causal factors consist of direct, root and contributing causes. A direct cause is the immediate event or condition that caused the accident. The AIB concluded that the direct cause of this accident was the CHEO activated the hydraulic controls while standing in the pinch point.

The root causes of the accident are the fundamental causes that, if corrected, would prevent recurrence of this and similar accidents. The AIB concluded that the root cause of this accident was that the CHEO bypassed the Bobcat safety features. The AIB also identified contributing causes that are events or conditions that, collectively with the other causes, increase the likelihood of the accident, but individually did not cause the accident. The AIB concluded that a contributing cause of this accident was the CHEO did not receive a sufficient J-1 (pre-job briefing that included work planning, job hazards analysis, and controls). Interview with the BCFMI and a review of the written J-1 the day of the accident indicate that the briefing the CHEO received, an hour after the crew's job briefing, was verbal and only included assignment of job tasks associated with moving tools and equipment to a new job site.

The AIB determined that a second contributing cause was that the J-1 briefing for the entire crew was insufficient on the day of the accident. A review of the written J-1 from the day of the accident indicated that the work to be performed at the work site was unchanged from previous days' J-1's which included setting forms and pouring concrete and in fact did not reflect the actual work that was planned for that day (loading materials, tools, equipment to mobilize to next job site). The AIB's events and causal factors chart is contained in this report as Appendix A.

2.3.2. Barrier Analysis

Another analytical technique the AIB used was Barrier Analysis. This analysis identifies management (administrative) and physical barriers/systems to isolate and avoid the work place hazards. In this particular accident scenario, the worker was the CHEO and the hazard was the unintended backhoe attachment movement. The AIB identified nine (9) barriers for this work activity and they were: J-1 job briefing; *Bobcat Operator's Handbook*; *Bobcat Operation and Maintenance Manual for the Backhoe Attachment Model 709*; warning signs on the Bobcat; CHEO training; Bobcat Interlock Control System (BICS™); the Bobcat seat bar; familiarity with backhoe attachment; and seat break-away. The result of the AIB Barrier Analysis is included in this report as Appendix B.

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2.3.3. Change Analysis

The third core analytical technique used in the development of causal factors was Change Analysis. The AIB used the Change Analysis technique to examine the changes between what is normal or expected (accident-free activity) and what actually occurred before the accident (whether planned or unplanned). The AIB identified four (4) changes for this work activity and they were: the CHEO was standing in pinch point; the CHEO, in a standing position, bypassed the BICS™ by lowering the seat bar; the CHEO was inexperienced on the Bobcat with a backhoe attachment; and the CHEO bypassed safety features. The results of the change analysis were also used by the AIB in the development of the causal

factors for this accident and included in this report as Appendix C.

Table 2-2: Causal Factors

Direct Cause
CHEO activated hydraulic controls
Root Cause
CHEO bypassed the safety features
Contributing Causes
CHEO did not receive a sufficient J-1
Insufficient J-1 for the day's work

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3. FINDINGS AND RECOMMENDATIONS

Table 3-1: Findings and Recommendations

Findings	Recommendations
CHEO bypassed Bobcat safety systems.	BPA management Chief Operating Officer (COO) shall require all BPA employees who operate mobile fleet equipment receive proper training in the safe use of this equipment. BPA management shall require that all contracts for operating mobile equipment include a requirement that contractor certify that their employees who will operate mobile fleet equipment under this contract have received proper training in the safe use of this equipment.
CHEO failed to follow instructions in operation and maintenance manual.	Site management shall require all BPA and contract personnel to follow operation and maintenance manuals of mobile fleet equipment.
CHEO did not receive an adequate job briefing.	BPA management shall ensure that all members of a crew assigned to perform the work receive an adequate job briefing.
J-1 was inadequate for work tasks being performed.	TFHE management shall conduct additional job briefing training of involved crew.
Immediately after the accident, the scene was not secured and not appropriately transitioned to the AIB. Control and leadership immediately after the accident was lacking.	BPA management shall develop policy and procedure to ensure transition of an emergency event location to an AIB. BPA management shall develop protocol for employees on immediate accident and after-accident response, i.e., notification of BPA management, gathering statements, standing down employees, scene preservation, and emergency contacts.
Supplemental labor contract does not list all required specific equipment training referenced in <i>Appendix A – Required Tools, Equipment, Training, and Certification</i> in <i>Appendix B – Contract Employee Training Record</i> .	Supplemental Labor contract shall include all equipment referenced in Appendix A of the contract in Appendix B.

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Findings	Recommendations
Supplemental Labor contract lacks a mechanism to ensure the vendor is meeting the terms of the contract to verify training and certification of supplemental labor employees.	BPA shall enforce the supplemental labor contract to ensure the verification process of the contract provisions is being met.
The AIB was not provided training records to base any conclusions on the CHEO's qualifications.	BPA Safety Office shall assess the training records when received to ascertain that the appropriate training was received by the CHEO.
BPA and contract personnel have not been adequately trained on the safe operation of skid-steer loaders and attachments.	BPA management shall develop and implement skid-steer training requirements for all personnel, BFTE and CFTE, utilizing this equipment.
The AIB discovered hazardous modifications and the absence of safety recall repairs on the BPA-owned Bobcat used in the re-enactment.	<p>BPA management shall order inspections of all mobile fleet equipment for safety compromising modifications and safety recall compliance.</p> <p>BPA management shall revise and enforce the current policy that requires approval for any modifications of mobile fleet equipment in accordance with OSHA 29 CFR 1926.602(c)(ii), and implement a process for tracking all equipment recalls for timely completion.</p>

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Board Authority
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4. BOARD AUTHORITY LETTER

DOE F 1325.9a Electronic Form Approved by GILR - 09/28/2001 (8-99)

United States Government

Department of Energy
Bonneville Power Administration

memorandum

DATE: March 2, 2010

**REPLY TO
ATTN OF:** NF/WHSE-E

SUBJECT: Level I Accident Investigation Board

TO: Kim Leathley, Executive Vice President, Internal Business Services – N-4

This memorandum is to confirm the appointment of the individuals listed below to Bonneville Power Administration's Level I Accident Investigation Board. The purpose of the Board is to investigate a contractor fatality that occurred on March 1, 2010.

Gregory L. Olesen	Manager, District Operations and Maintenance, Transmission Field Services. Board Chairperson.
Cynthia D. Franke	Manager, Construction & Maintenance Internal Operations, Transmission Field Services. Board Member
Rodney D. Leetch	Manager, Equipment Pool Services, Transmission Field Services. Board Member
James C. Cramer	Safety & Occupational Health Manager, Internal Business Services. Board Member

The incident shall be thoroughly investigated and a report prepared in a manner consistent with BPA's Manual Chapter 181. During the investigation, the team shall review the incident site, equipment, work procedures, management systems, and other elements that are possible factors in the incident. Bonneville's final report shall include the facts, analysis of facts and conclusions with findings and recommendations. The report shall be forwarded by memorandum to the Chief Safety Officer within 30 calendar days.

Steve J. Goins
Chief Safety Officer

cc:
A. Decker – K-7
B. Silverstein – T/Ditt2
R. Furrer – TF – Ditt2
D. Hunter – 1FB-DOB1
J. White – TF/CSB-1
G. Rehbein – TFH/CSB-1
B. Folden – TFHE/CSB-1
D. Pelton – TFHS/CSB-1
R. Byrd – NSSP
T. Race – NF/Sickler
Official File – NF

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5. BOARD MEMBERS' SIGNATURES

Gregory L. Olesen Manager, District Operations and Maintenance, Transmission Field Services
AIB Chairperson.

Signature:  Date: 3/31/10

Cynthia D. Franke Manager, Construction & Maintenance Internal Operations, Transmission Field Services
AIB Member

Signature:  Date: 3/31/10

Rodney D. Leetch Manager, Equipment Pool Services, Transmission Field Services
AIB Member

Signature:  Date: 3/31/10

James C. Cramer Safety & Occupational Health Manager, Internal Business Services
AIB Member

Signature:  Date: 3/31/10

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6. BOARD MEMBERS

Board Members

Chairperson	Greg Olesen, Manager, District Operations and Maintenance, Transmission Field Services
Member	Cynthia D. Franke, Manager, Construction & Maintenance Internal Operations, Transmission Field Services
Member	James C. Cramer, Safety & Occupational Health Manager, Internal Business Services
Member	Rodney D. Leetch, Manager, Equipment Pool Services, Transmission Field Services

Advisor/Team Coordinator

Advisor	Dennis Vernon, MAS Consultants
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Administrative Coordinator

Consultant	Susan Keffer, Project Enhancement Corporation
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Appendix A: Events and Causal Factors
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Appendix A: Events and Causal Factors

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 A-1: Events and Causal Factors Analysis on pages A-1 through A-4.

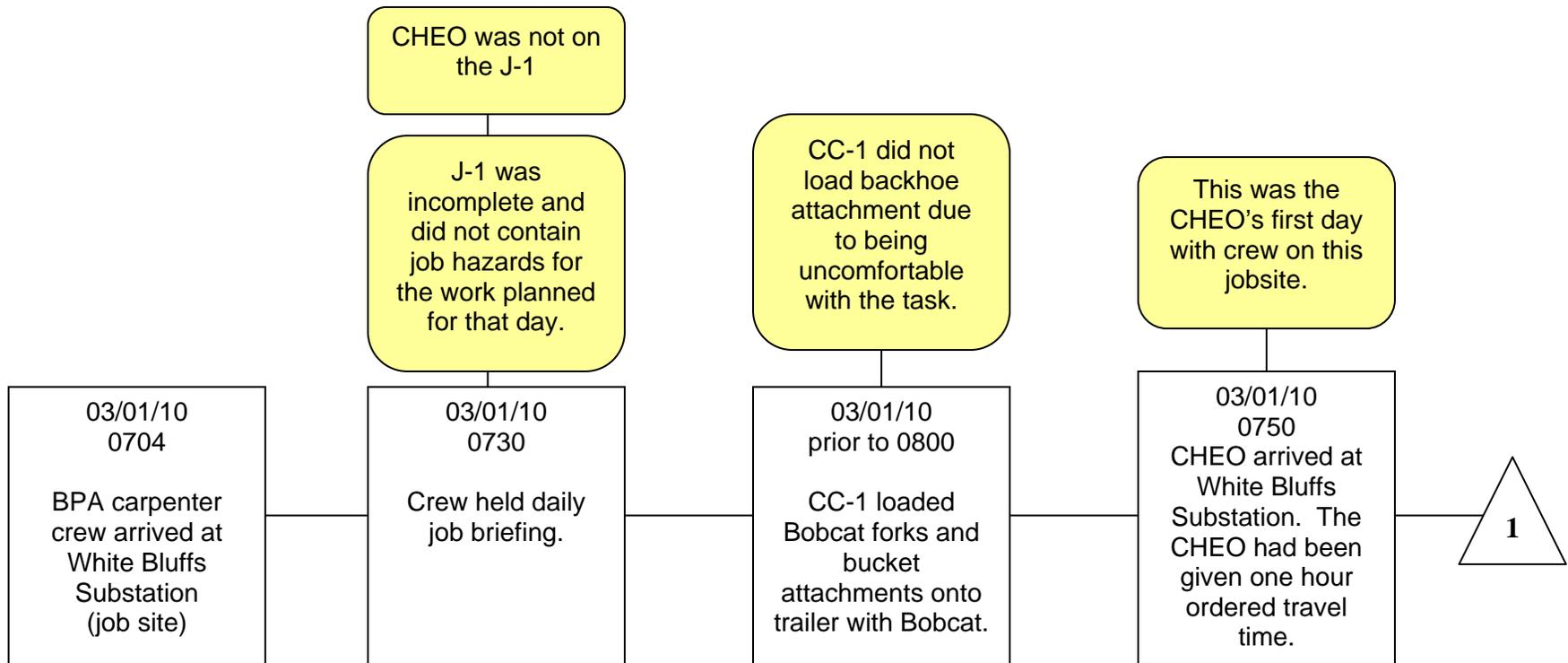
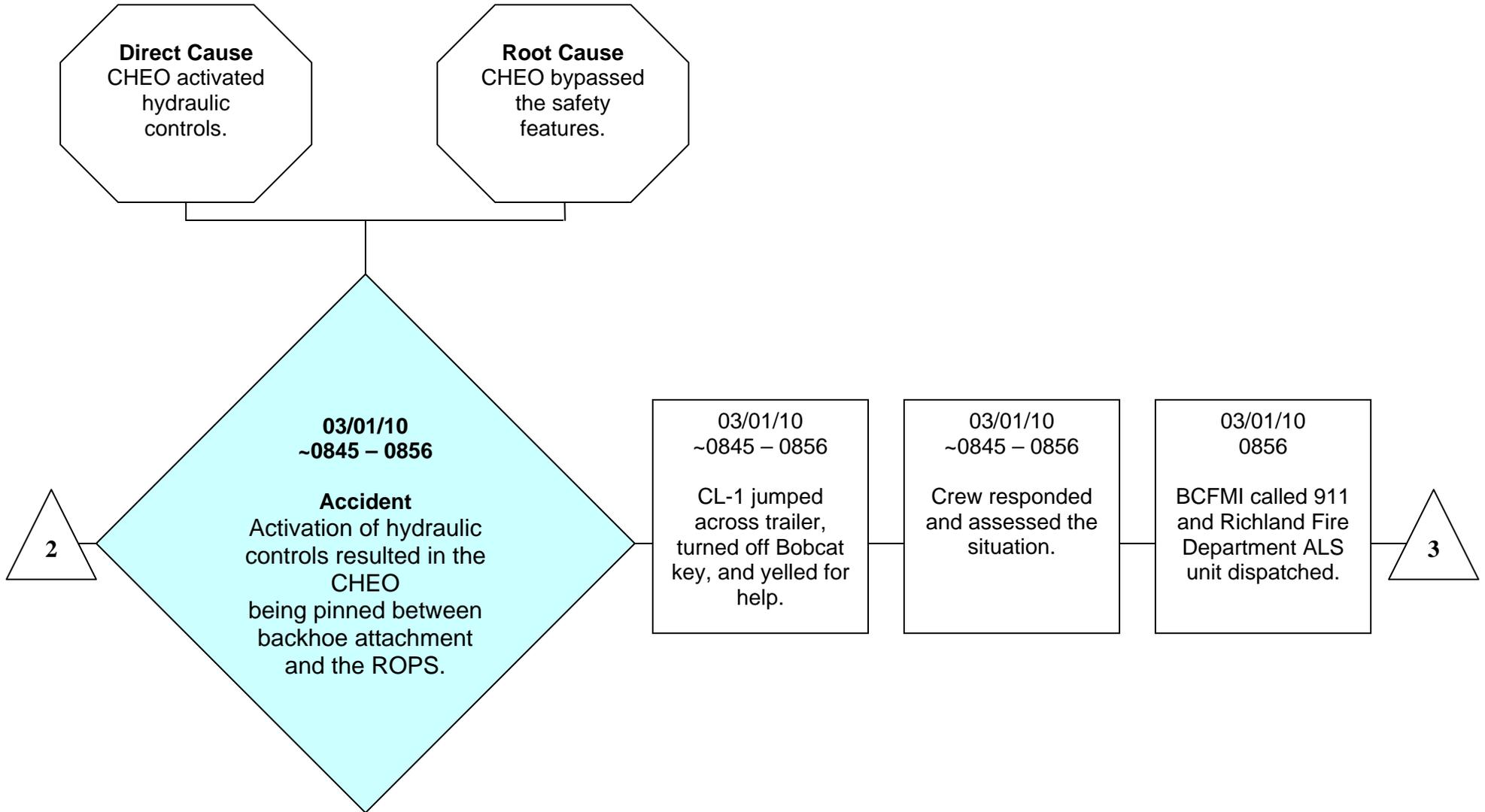
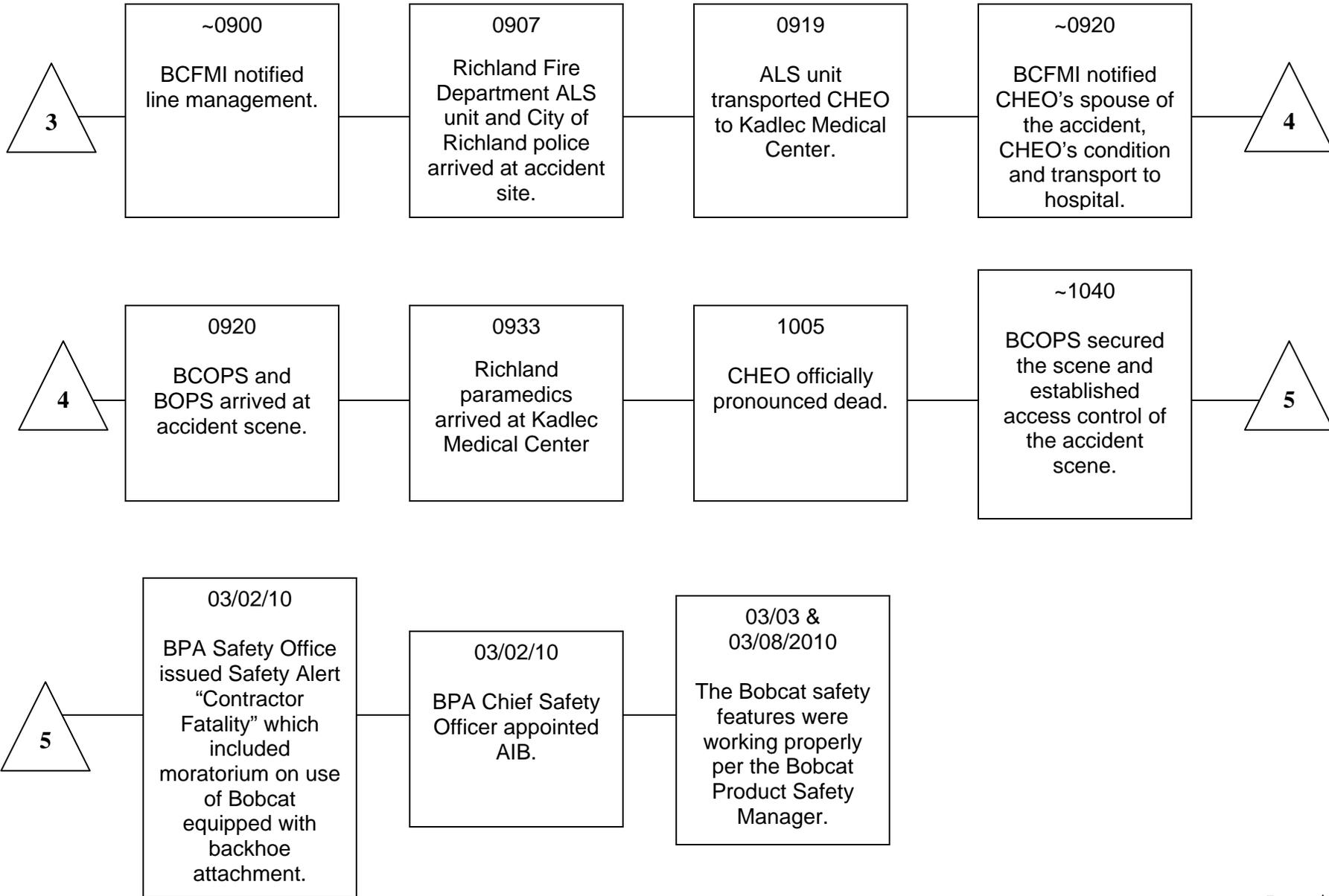


Figure A-1: Events and Causal Factors Analysis

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Appendix A: Events and Causal Factors Analysis



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Appendix A: Events and Causal Factors



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Appendix B: Barrier Analysis

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: Unintended backhoe attachment movement		Target: CHEO	
What were the barriers?	How did barrier perform?	Why did the barrier fail?	How did barrier affect the accident?
J-1 job briefing	Did not serve intended purpose to identify hazards	Lack of job briefing	Hazard wasn't identified
<i>Bobcat Operator's Handbook</i>	Unknown	Unknown	N/A
<i>Bobcat Operation and Maintenance Manual for the Backhoe Attachment Model 709</i>	Unknown	Not available in Bobcat	Improper procedures in attaching and detaching backhoe attachment
Warning signs on bobcat	Unknown	Were not heeded	If all warning signs were heeded, hazards would have been avoided
CHEO training	Unknown	No evidence of CHEO training	If trained, proper procedures may have been followed
Bobcat BICS™	As designed	Features were bypassed	Allowed movement of the backhoe attachment
Seat Bar	As designed	Features were bypassed	Allowed movement of the backhoe attachment

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Appendix A: Events and Causal Factors

Hazard: Unintended backhoe attachment movement		Target: CHEO	
What were the barriers?	How did barrier perform?	Why did the barrier fail?	How did barrier affect the accident?
Familiarity with backhoe attachment	Unknown	Unknown	If trained, proper procedures may have been followed
Seat break-away	Barrier did not exist	Barrier did not exist	Could have resulted in less serious injuries/fatality

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Appendix C: Change Analysis

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	New CHEO; experience was unknown to the crew	Operator experienced on Bobcat with backhoe attachment	Equipment familiarity	Unsafe operation
	CHEO standing in pinch point	Operator sitting in seat	Position of CHEO	CHEO positioned in pinch point
	CHEO in a standing position defeats the BICS™ system by lowering seat bar	Seat bar in up position locking out lift arm operations	Position of seat bar	Movement of backhoe attachment/bobcat lift arms
When	Preparing to load Bobcat/backhoe attachment	N/A	N/A	N/A
Where	North fence line of White Bluffs Substation	N/A	N/A	N/A
Who	CHEO inexperienced on Bobcat with backhoe attachment	Operator experienced on Bobcat with backhoe attachment	Equipment familiarity	Unsafe operation
How	CHEO bypassed safety features	Operator follows all safety features	CHEO put himself in unsafe position	Movement of backhoe attachment/bobcat lift arms

Appendix D: Bobcat Interlock Control System

Safe Operation is the Operator's Responsibility

- Carefully follow the operating and maintenance instructions.
- Machine signs (decals) instruct on the safe operation and care of your Bobcat loader or attachment. The signs and their locations are shown in the Operation & Maintenance Manual.
- An Operator's Handbook is fastened to the operator cab of the loader. Its brief instructions are convenient to the operator.

Before you leave the operator's seat:

- Lower the lift arms, put the attachment flat on the ground.
- Stop the engine.
- Engage the parking brake.
- Raise seat bar.
- (Foot Pedal Controls) Move pedals until both lock.

The seat bar system must deactivate the lift and tilt control functions when the seat bar is up.

The seat bar system must deactivate these functions when the seat bar is up. Service the system if controls do not deactivate.

Seat Bar Restraint System

The seat bar restraint system has a pivoting seat bar with arm rests. The operator controls the use of the seat bar. The seat bar in the down position helps to keep the operator in the seat. Models with foot pedals have hydraulic valve spool interlocks for the lift and tilt functions. The spool interlocks require the operator to lower the seat bar in order to operate the foot pedal controls. When the seat bar is down, the PRESS TO OPERATE LOADER Button is activated and the engine is running, the lift, tilt and traction drive functions can be operated. When the seat bar is up, the lift and tilt control pedals are locked when returned to the NEUTRAL position.

When the seat bar is down, the PRESS TO OPERATE LOADER button is activated and the engine is running, the lift, tilt and traction drive functions can be operated.

When the seat bar is up, the handles and pedals are locked when returned to the NEUTRAL position.

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Appendix D: Bobcat Interlock Control System

1. **PRESS TO OPERATE LOADER** Press to activate BICS™ System when the Seat Bar is down and operator is seated in operating position.
2. **SEAT BAR** The light comes *ON* when the seat bar is down.
3. **LIFT & TILT VALVE** The light comes *ON* when the seat bar is down and the PRESS TO OPERATE Button is pressed. The lift and tilt functions can be operated when the light is *ON*.
4. **TRACTION** The light comes *ON* when the seat bar is down, engine is running, and parking brake is released. The loader can be moved forward or backward when the light is *ON*.
5. **TRACTION LOCK OVERRIDE** (Function Only When Seat Bar Is Raised and The Engine Is Running) Press to unlock the brakes. Allows you to use the steering levers to move the loader forward or backward when using the backhoe attachment or for loader service. Press a second time to lock the brakes.
6. **ALARM** The ALARM beeps when there is an Error, Warning, or Shutdown condition.



Figure D-1: Bobcat Interlock Control System (BICS™)