BONNEVILLE
POWER ADMINISTRATION

Level I Accident Investigation Report

Fatal Fall
Dworshak-Taft # 1 500 kV Line, September 20, 2012

Report Date:
November 30, 2012

DISCLAIMER

This report is an independent product of the Level I Accident Investigation Board appointed by Brad Bea, 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.

RELEASE AUTHORIZATION

On September 21, 2012, an Accident Investigation Board was appointed to investigate the Fall Fatality on the Dworshak-Taft # 1 500 kV line on September 20, 2012. The Board's responsibilities have been completed with respect to this investigation. The analysis and the identification of the causal factors and the Findings and Recommendations resulting from this investigation were performed in accordance with *Bonneville Power Administration Manual, Chapter 181, Accident Investigation and Reporting*.

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

Brad Bea
Chief Safety Officer, Bonneville Power Administration

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Acronyms

AED	automated external defibrillator
AHOL	ahead on line
APM	Accident Prevention Manual
BPA	Bonneville Power Administration
CPR	Cardiopulmonary Resuscitation
Dittmer	Dittmer Control Center
DOE	Department of Energy
ECF	Events and Causal Factors
LLSH	long line, short haul
MAD	Minimum Approach Distance
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
PPG	Portable Protective Grounds
TFS	Transmission Field Services
TLM	Transmission Line Maintenance

SCOPE OF INVESTIGATION

On September 21, 2012, 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 BPA lineman was fatally injured as the result of a fall from a tower on the Dworshak-Taft # 1 500 kV line.

The purpose of the investigation was to determine the cause of the accident and to develop recommendations for corrective actions to prevent recurrence.

The scope of the investigation included examination of the accident site, conducting interviews, review of employee statements, work procedures, management systems, and other elements factoring into the incident.

EXECUTIVE SUMMARY

Introduction

On the morning of September 20, 2012, a Bonneville Power Administration journeyman lineman fell to his death while a line crew was preparing to install a work platform in advance of replacing dead-end insulators on a steel tower. This work was being performed as part of scheduled transmission line maintenance.

On September 21, 2012, the Chief Safety Officer for Bonneville Power Administration appointed a Level 1 Accident Investigation Board to investigate the accident, in accordance with the requirements of Bonneville Power Administration Manual Chapter 181.

Accident Description

Early in the morning of September 20, 2012, work crews from Spokane, WA and Kalispell, MT assembled at the fly yard located near the Taft exit of Interstate 90 on the Idaho Montana border. A work clearance on the Dworshak-Taft #1 500kV line was obtained and a job briefing was conducted that included discussions of the work hazards and how the work was to be performed. A separate helicopter safety briefing was also conducted. At the conclusion of the job briefings, the combined crew of Spokane and Kalispell workers traveled the approximate five miles by road to tower 83/4.

The crew arrived at the tower and climbed to their work positions on the tower. The linemen had to first install portable protective grounds (PPGs). While the crew was getting ready in the tower, other crew members in the fly yard worked to assemble tools and materials; and assisted with the helicopter long line operations. The tower crew radioed they were ready for the PPGs which were delivered by the helicopter. The PPGs were installed by the crew and they called for the platform.

The helicopter flew the platform to the crew in the tower. While the pilot was maneuvering to get the platform to turn parallel to the line, LM-1 decided to change work locations to help guide in the platform. At approximately 1102, LM-1 unbelted, moved around (behind) LM-3 towards the center of the tower and appeared to lose his footing and fell.

Accident Response

At the tower location, LM-2, LM-4 and ALM-2 immediately climbed down the tower, went to LM-1 and began basic first aid. An automated external defibrillator (AED) was retrieved and applied to LM-1.

Immediately after the fall, National 911 Center was contacted via satellite phone. National 911 contacted Mineral County MT dispatch and pertinent information was passed along before the call was dropped. BPA Dittmer Control Center was contacted, who assisted with contacting medevac. Heavy smoke in the Missoula, MT area due to large forest fires, caused delays in

medevac response, and a ground response was dispatched from Superior, MT (approximately 43 miles away).

No stretcher or backboard was available, so the crew at the fly yard fashioned a backboard. The helicopter picked up the backboard and LM-5 (rescuer) and flew to LM-1's location. The pilot observed that CPR had begun and decided to transfer LM-5 and LM-1 on the backboard into the bed of a truck so CPR could continue.

ALM-1, LM-5, LM-3 and LM-6 continued CPR in the bed of the truck while LEO-1 drove approximately five miles down the hill to the I-90 Taft exit. When the truck reached the highway, the EMS vehicles had just arrived. LM-1 was moved from the bed of the truck and EMS personnel took over CPR and began advanced life support. EMS personnel consulted with medical control and LM-1 was pronounced dead at 1221.

Results of the Investigation (Findings and Recommendations)

The Board determined the facts of the accident and analyzed the facts to determine what happened, why it happened, and what needs to be done to prevent recurrence. The Board used Barrier Analysis, Change Analysis and Causal Factors Analysis to arrive at Findings and Recommendations, which if implemented should prevent a similar accident.

The Board concluded, based upon the available evidence, that the Direct Cause of the fall was LM-1's loss of contact with the tower while being unbelted and changing positions on the tower.

The Board determined the Root Cause of the fatal injury was not using the fall protection function (safety strap) incorporated into the safety harness to remain attached to the tower. However, it must be emphasized that changing locations unattached is a common practice and is in compliance with BPA's work rules and policies, and OSHA regulations.

Upon examination of all available facts and evidence, the Board was not able to determine other contributing factors, which would have increased the likelihood of the fall and fatal injury. The Board notes this is inherently dangerous work and BPA provides personal protective equipment, training and guidance to mitigate the dangers of this work. LM-1 was trained, qualified, and capable of performing this work.

Table ES-1: Findings and Recommendations

Findings	Recommendations
All crew members were following all applicable rules, standards, and policies concerning fall protection.	BPA shall review the current rules, standards, and policies to determine if the Agency should adopt a 100 percent fall protection requirement.
Based on the information provided to the Board, the Board determined there were no medical conditions that contributed to this accident.	None.
LM-1 had completed all required training and was a qualified climber in accordance with BPA requirements.	None.
The Board found that the job briefing met the intent of the APM Rule J-1 requirement, however was not recorded on the most current form that indicates that a rescue plan was discussed.	BPA management shall ensure all workers will utilize form 5480.25e (Job Briefing Information Sheet) or most current version of the Job Briefing Notebook (March, 2010). BPA management shall ensure the Job Briefings include a thorough discussion of a rescue plan.
The Board determined that CPR protocol and BPA's short-haul/rescue procedures were followed and that the decision to use the truck to transport LM-1 was appropriate.	None.
The Board determined the immediate response actions taken following the accident were appropriate. As required by BPA Accident Prevention Manual, the scene was preserved, photographed and the witness statements completed in a timely manner.	None.
The Board found that currently within the agency, there is no requirement to have a backboard as part of rescue equipment inventory. A backboard on site may have expedited the rescue efforts.	BPA shall evaluate the need for and provide backboards where necessary to assure crews are able to comply with the requirements for rescue equipment as stated in Section X.P-1 (2.a) of BPA's Work Standards, Section X, *Miscellaneous.*

Findings	Recommendations
The Step-and-Touch Kit was not utilized during this work.	BPA Management shall review APM Rule G-1 and TLM Standards and Guides Sections I.A.2 and I.A.3 with the Bell and Kalispell crews.
Proper voltage testing procedures were not used when verifying the line as de-energized.	BPA Management shall review APM Rule G-2 and BPA Work Standard VI.B with the Bell and Kalispell crews.
The insulated overhead ground wire was not grounded.	BPA management shall review APM Rule G-9 with the Bell and Kalispell crews.

1. INTRODUCTION

1.1. About Bonneville Power Administration

The Bonneville Power Administration (BPA) is a U.S. Federal agency based in the Pacific Northwest. BPA was created by an act of Congress in 1937 to market electric power from the Bonneville Dam located on the Columbia River and to construct facilities necessary to transmit that power. Congress has since designated Bonneville to be the marketing agent for power from all of the Federally-owned hydroelectric projects in the Pacific Northwest. Bonneville, whose headquarters are located in Portland, Oregon, is one of four regional Federal power marketing agencies within the U.S. Department of Energy (DOE).

The Bonneville Power Administration's mission as a public service organization is to create and deliver the best value for our customers and constituents as we act in concert with others to assure the Pacific Northwest:

- An adequate, efficient, economical and reliable power supply;
- A transmission system that is adequate to the task of integrating and transmitting power from Federal and non-Federal generating units, providing service to BPA's customers, providing interregional interconnections, and maintaining electrical reliability and stability; and
- Mitigation of the Federal Columbia River Power System's impacts on fish and wildlife.

1.2. Transmission Field Services

Transmission Field Services is responsible for managing field operations; and maintenance and construction of BPA's high-voltage electrical transmission system and providing safe, reliable, and cost-effective service to customers. These responsibilities include physical field operations, maintenance, and construction of BPA's electric and non-electric plant facilities in the BPA service area.

There are 13 District Offices within Transmission Field Services that are responsible for implementing field operations; and maintenance and construction activities. Resources are shared to achieve goals, and staff works with customer account teams. District Office responsibilities include coordinating work and resources between districts, operating and maintaining the BPA transmission system including the buildings, and grounds, mobile equipment and rights-of-ways.

District Offices contain one or more Transmission Line Maintenance (TLM) crews which have the responsibility to inspect, maintain and repair lines and rights-of-ways, and build assigned projects.

2. FACTS AND ANALYSIS

2.1. Description of Work Activity

On September 20, 2012, a combination of two work crews, the Bell crew (Spokane, WA) including LM-1, and the Kalispell crew (Kalispell, MT), were scheduled to begin the work of replacing aging dead-end insulators on the Dworshak-Taft # 1 500 kV transmission line at mile 83 structure 4 (83/4). (Figure 1) This line was de-energized and a work clearance was issued from Dittmer Control Center (Dittmer). The work plan was to use a BPA helicopter to fly dead-end platforms, tools, and materials to men working in the tower. Figure 2 shows similar work performed on a different type of tower.

The Bell and Kalispell crews work with helicopters on a regular basis and are trained and familiar with the hazards associated with them. The Kalispell crew had performed this type of work with a helicopter earlier in the year, and was working with the Bell crew to familiarize them with the procedure. Both the Bell and Kalispell crews have extensive experience using the crane instead of the helicopter but both methods use the same work procedures and have similar requirements. A discussion was held during the job briefing outlining the use of the helicopter for this work procedure.

Three crew members worked on Position 1 ahead on line (AHOL) and three crew members worked on Position 3 AHOL on the other side of the tower simultaneously. Another crew member was designated as the tower radio man. The radio man was to communicate with the helicopter pilot while the materials were delivered.

Seven crew members were in the tower: five linemen and two apprentices. Other crew members worked in the fly yard, approximately three miles away by air, hooking and unhooking material to the helicopter long line. The helicopter flew a work platform to the tower and the linemen were to attach the platform and hang it parallel to the dead-end insulators, one end connected to the tower and one end to the conductor in the horizontal position. Once the platform was secured, the linemen were to use the platform to stand on and relieve the tension on the insulators with chain hoists. The crew would remove the old insulators and the helicopter would fly them to the fly yard where the insulators were unhooked and new insulators were attached. The new insulators would be flown to the tower where the crew would install them. The design of this dead-end position had twin conductors and double strings of insulators.

This work was being performed in a remote mountainous location in Montana near the Idaho border. The right of way access road was a very rough and rutted road with several switchbacks and steep hillsides. Figure 1 shows an aerial view of the route from Exit 5 - Taft, off Interstate 90, approximately five miles to tower structure 83/4.

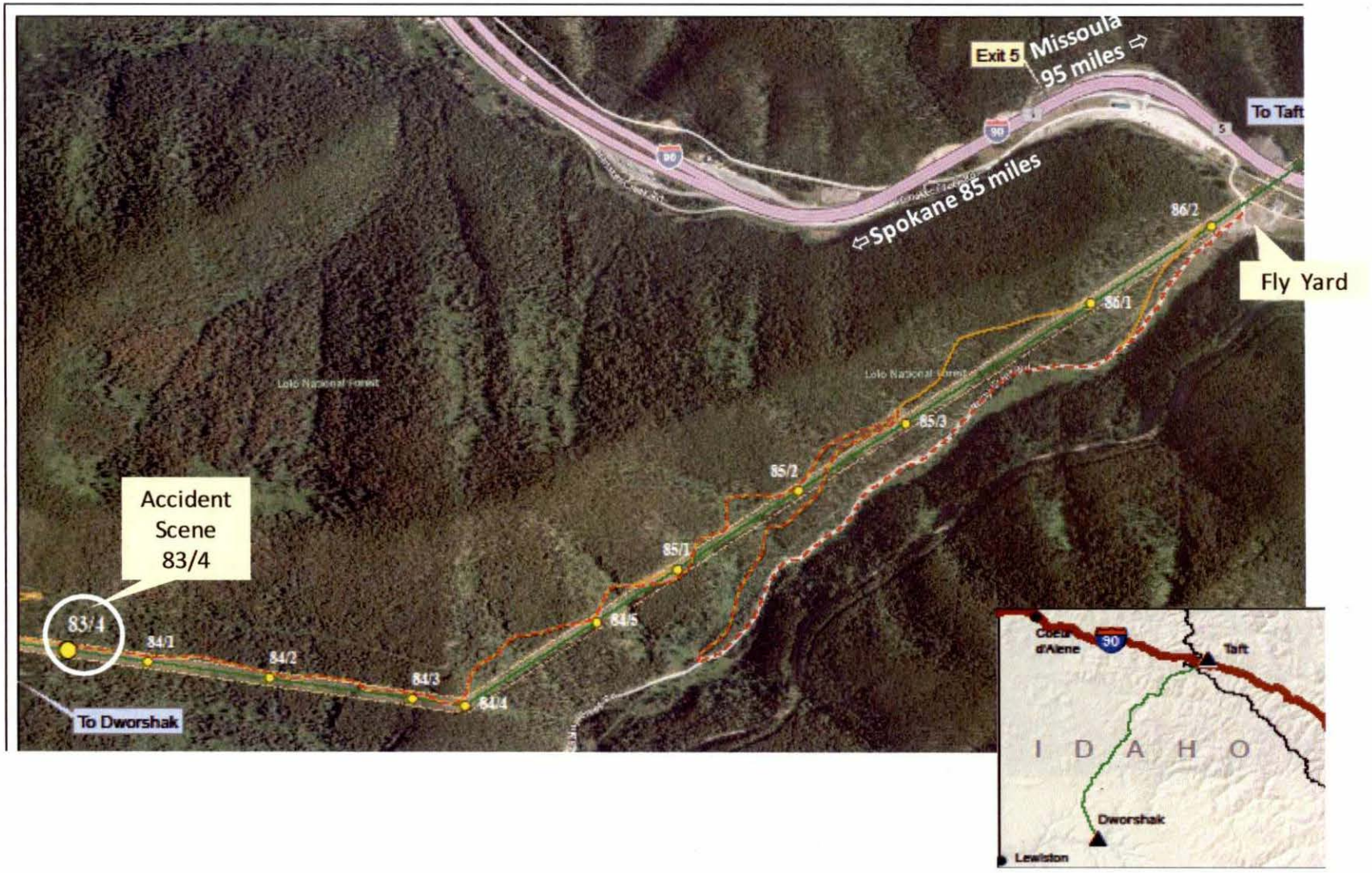

Figure 1: Aerial Map of the Access Road to Tower 83/4 from the Fly Yard

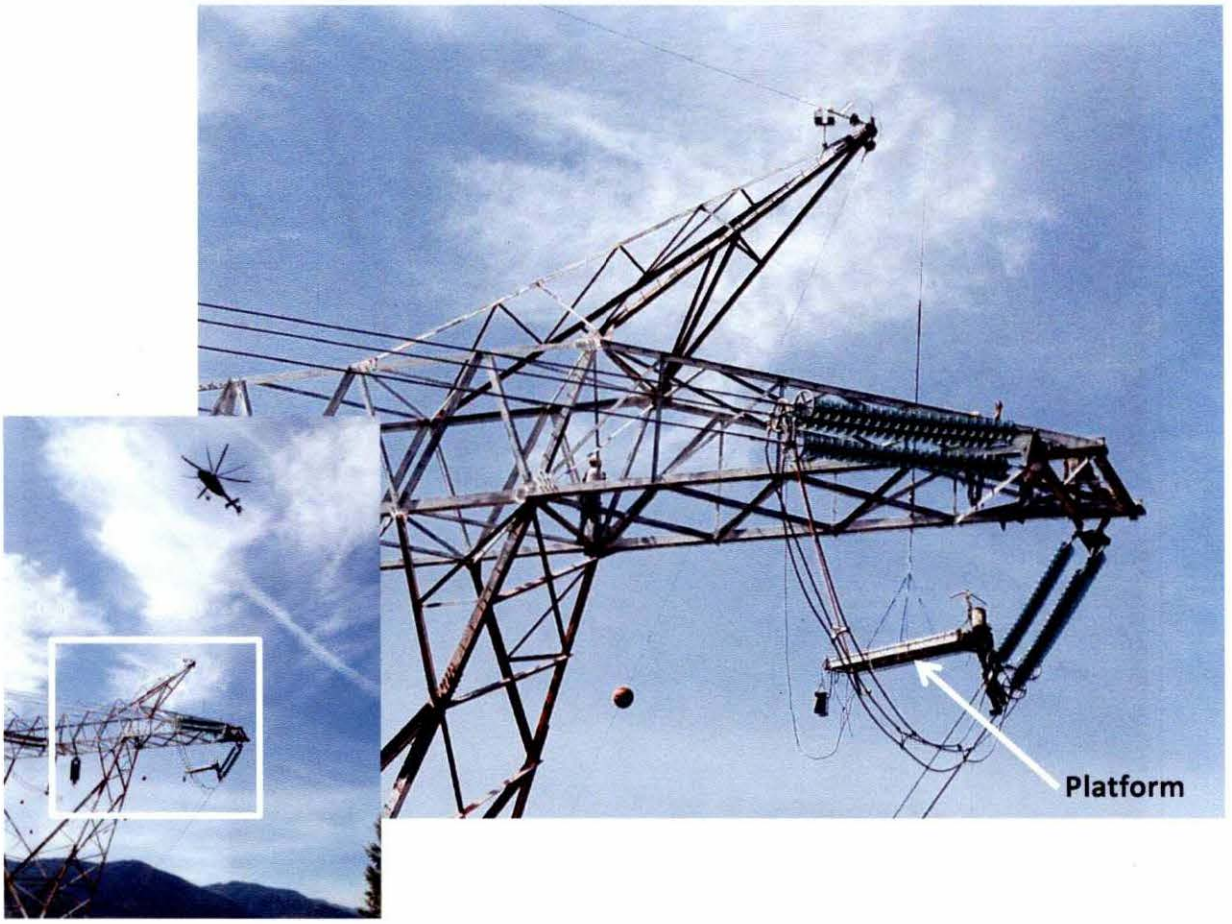

Figure 2: Similar Work Performed on a Different Type of Tower

2.2. Accident Scenario

The crew arrived at the fly yard at the Taft, MT, exit off Interstate 90 between 0730 and 0800[1] and started by assembling insulator strings and getting the rigging set up on the platforms. At 0816, TLFM-I received Work Clearance D-5516-W on the Dworshak-Taft # 1 500 kV line to change out insulators. Shortly after receiving the clearance, TLFM-I held a job briefing discussing the day's work and how it was to be performed, work assignments, and hazards to watch out for. When the job briefing was completed, the helicopter pilot discussed how the work was to be done utilizing the helicopter and the hazards associated with this job.

Once the job briefings were complete, TLFM-I, LM-1, LM-2, LM-3, LM-4, ALM-1, and ALM-2, got into their trucks and proceeded to tower 83/4. Once arriving at the tower, at approximately 1030, the crew put on fall protection equipment, climbed the tower and called the fly yard for the portable protective grounds (PPGs) and hot stick. The helicopter delivered the

[1] All times in this report have been adjusted to Pacific Daylight Time.

PPGs and hot stick and the PPGs were installed. Figure 3 identifies the locations of the crew on the tower.

The crew then repositioned, belted-in on the tower in anticipation of the platforms being flown in. LM-1, LM-2, and LM-3 were on the arm at Position 3 AHOL, approximately 83 feet above the ground, with TLFM-I on the wire. LM-2 was at the very outer edge with LM-1 to his left and LM-3 on LM-1's left. LM-3 was the radio man for the day's work. On Position 1 AHOL, ALM-1 was on the wire with LM-4 and ALM-2 in the tower.

At approximately 1055, the call was made to the fly yard to have the helicopter deliver the first platform to the crew on the tower. While waiting for the platform, LM-1 and LM-2 asked LM-4 to confirm how the platforms were to be connected to the tower. LM-4 unbelted and repositioned from Position 1 over to Position 3 to further discuss with LM-1 and LM-2 how the platform was to be attached to the tower. In doing this, LM-4 had to move around LM-3 twice, once going out to where LM-2 was and once more to return to Position 1. Shortly after LM-4 returned to his work location and belted in, the platform arrived.

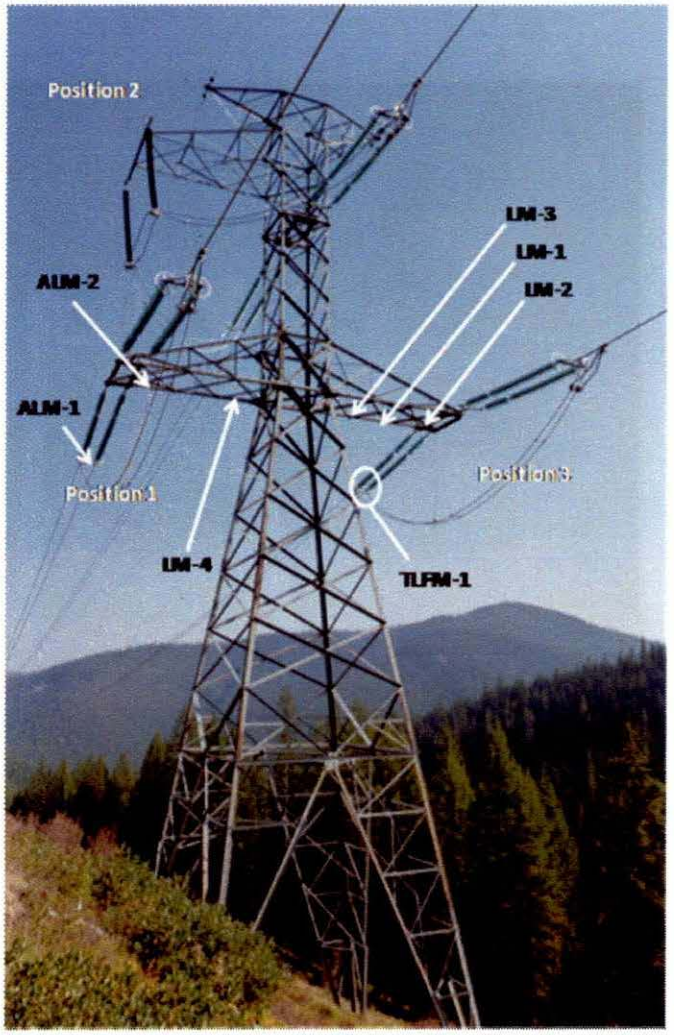

Figure 3: Location of Workers in Tower 83/4

When the platform was being lowered down to Position 3, it was parallel to the line. As the platform approached the tower, it rotated approximately 90 degrees. The platform was then somewhat perpendicular to the line with one end between the insulator string and the jumper.

The pilot was hovering and maneuvering to get the platform to turn parallel to the line. LM-1 decided to change work locations to help guide the platform. At approximately 1102, LM-1 unbelted, moved to his left around (behind) LM-3 towards the center of the tower and appeared to lose his footing and fell.

Immediately, LM-4 started descending the tower with LM-2 close behind. TLFM-I remained in the tower and radioed the fly yard that there had been an accident and that a lineman had fallen

from the tower. Immediately following, the pilot radioed to the fly yard and requested that life flight be contacted. ALM-2 and LM-3 started down the tower followed by ALM-1.

Figure 4: 83/4 Tower Arm

2.2.1. Accident Description and Chronology of Events

Table 1 provides a brief chronology of significant events leading up to the fall accident. The fully developed chronology is included as Appendix D.

Table 1: Chronology of the Accident

Time	Accident Event of September 20, 2012
~0600	Work crews gathered in the motel parking lot to begin the day's work.
0610	Work crew traveled to the "Osborne yard" (a staging area for materials)
~0730 - 0800	Work crews began arriving at fly yard.

Time	Accident Event of September 20, 2012
0816	TLFM-I picked up clearance from Dittmer Control Center.
~0816 to 0900	TLFM-I conducted job briefing for changing insulators.
~0816 to 0900	Pilot conducted aviation job briefing for the helicopter operations portion of the work to be accomplished.
~0900	The tower crew departed for structure 83/4.
~1030	Tower crew called for the PPGs and hot stick to be flown up.
1037 to 1048	Helicopter flew the PPGs and hot stick to tower crew.
~ 1050	Tower crew installed the PPGs.
~1100	Helicopter delivered the platform to tower crew.
~1100	Platform slowly rotated at right angle to insulators.
~1100	LM-1 unbelted to change position.
~1101	LM-1 went around (behind) LM-3.
~1102	LM-1 fell from the tower.

2.3. Emergency Response and Investigative Readiness

2.3.1. Emergency Response

Immediately after the fall, TLFM-I got on the radio and directed TLFM-III in the fly yard to call 911, stating someone had fallen out of the tower. The pilot also called TLFM-III and directed him to call for a medevac helicopter.

LM-1 was approximately 30 to 40 feet downhill from the tower, approximately 100 feet from the road. LM-2, LM-4 and ALM-2 climbed down the tower. LM-2 and LM-4 ran to LM-1 and got to him at approximately 1105. ALM-2 ran to get the automated external defibrillator (AED) from the truck up on the road. LM-2 and LM-4 began basic first aid. When ALM-2 arrived with the AED, the pads were applied according to the instructions and LM-1's vitals were monitored. After approximately 10 minutes, the AED advised to shock the patient and LM-2 initiated the shock. The AED then advised cardiopulmonary resuscitation (CPR) and LM-2 and LM-4 started CPR.

At the fly yard, TLFM-III used the satellite phone to call the National 911 Center at approximately 1110. Between approximately 1115 and 1118 the following communications were made:

- National 911 Center connected TLFM-III to Missoula, MT, 911 who gave TLFM-III the number for the Mineral County, MT 911 dispatcher.
- Then National 911 Center connected TLFM-III through to Mineral County 911.
- TLFM-III gave Mineral County a brief description of the emergency and location and then the call dropped.
- TLFM-III was not sure if Mineral County got the information, so TLFM-III called the BPA Dittmer Control Center (Dittmer) on the radio and informed them of the situation and location of the emergency, and asked the Dittmer dispatcher to call Mineral County 911 to request a medevac helicopter.

TLFM-I was notified by the Dittmer dispatcher via radio that Missoula Life Flight was not able to fly because of limited visibility (smoke) in their area. TLFM-I asked Dittmer to call Spokane, WA, MedStar. Mineral County 911got a ground response going at approximately 1132 and estimated it would be 20 to 40 minutes. An ambulance arrived at Exit 5 at approximately 1210. MedStar called Dittmer dispatch back at 1147 and notified them that the medevac helicopter had been dispatched from Spokane with an estimated arrival time of 1230. Prior to arrival at the location, the medevac helicopter was notified their services were not required and they returned to Spokane.

LM-5 volunteered to perform a long line, short haul (LLSH) rescue. Since there was no stretcher or backboard available, the crew in the fly yard fashioned a backboard using a fiberglass hook ladder and trailer side boards. The helicopter rigging was reconfigured for LLSH rescue and the helicopter pilot conducted a safety briefing outlining the rescue. The helicopter picked up LM-5 and the backboard and flew to LM-1's location at about 1133. The crew unhooked the backboard and LM-5, and secured LM-1 to the backboard.

The pilot observed that CPR had begun and proper protocol requires that CPR be continued uninterrupted. BPA's *Short Haul/Rescue Procedures and Policies and Helicopter Ambulance Services Procedures*, Section 11.d, *Operations* also specifically states that CPR will not be conducted during a short-haul/rescue. The pilot decided to transfer LM-1 and the backboard into the bed of a truck, located on the access road adjacent to Tower 83/4, so CPR could continue on the way to the fly yard. The helicopter did a trial run to verify there was adequate long line to safely land the backboard in the truck bed. The helicopter transported LM-1 and LM-5 to the back of the truck at approximately 1141 and then returned to the fly yard. During this time, TLFM-I provided clearances to the helicopter.

Between 1142 to 1200, ALM-1, LM-5, LM-3 and LM-6 continued CPR in the bed of the truck while LEO-1 drove the approximately five miles down the hill to the I-90 Taft exit. Rainy Creek Road was blocked from the access road to the highway to keep traffic out. The EMS vehicles had just arrived and set up when the truck reached the highway. LM-1 was moved from the bed of the truck and the paramedics took over CPR and began advanced life support. EMS personnel consulted with medical control and LM-1 was pronounced dead at 1221.

Table 2 provides a brief chronology of the significant activities during the rescue. The fully developed chronology is included as Appendix D.

Table 2: Chronology of Rescue Activities

Date/Time	Rescue Activities
~1102	TLFM-I called "Emergency 911" on the radio.
~1105 - 1141	LM-2 and LM-4 reached LM-1 and administered first aid including CPR and use of the AED.
~1110 - 1141	The work crews developed a rescue plan to move LM-1 from tower to fly yard.
~1110	TLFM-III contacted National 911 system using satellite phone.
~1115 - 1118	TLFM-III was patched to Mineral County, MT EMS by National 911.
1122 - 1148	BPA dispatcher attempted to coordinate medevac response.
1132	Ambulance dispatched by Mineral County, estimated ETA 1210.
~ 1133 - 1135	Helicopter lifted backboard and LM-5 from the fly yard to the tower. Pilot landed backboard and LM-5 at LM-1's location.
~1141 to 1142	Helicopter transported LM-1 with LM-5 into the truck bed.
~1142 to 1200	Truck transported LM-1 from the tower area to near the I-90 Exit 5 - Taft to meet the emergency vehicles while work crews continued to administer first aid.
~1146 to 1150	Helicopter returned to fly yard and landed.
1221	EMS personnel consulted with medical control and LM-1 was pronounced dead.
~ 1330	Crew members completed written statements and returned to hotel.
~1341	Helicopter returned to Spokane.

Finding: The Board determined that CPR protocol and BPA's short-haul/rescue procedures were followed and that the decision to use the truck to transport LM-1 was appropriate.

2.3.2. Investigative Readiness

Immediately following the accident, all work stopped at the accident scene. After all rescue activities had been completed, the TLFM-III and LFM-III asked all of the crew members to write

down statements of what happened from the start of the day. They also wrote separate statements for the Deputy Coroner (DC). The crews returned to the motel at approximately 1330.

TLFM-III notified Dittmer Dispatch at 1120, who notified the Safety Office and Dispatch management; and Transmission Line Maintenance Specialist (TLMS) notified Transmission Field Services (TFS) management about the accident. The Mineral County Coroner's office was notified and the DC was dispatched to the scene. As the accident occurred in the Lolo National Forest, a Forest Service Law Enforcement Officer (FSLEO) also arrived on site. TLMS and the Helicopter Mechanic (HM) took the DC and FSLEO to the accident site where it was documented. TLMS and HM locked the gate at the access road to secure the site.

The BPA's Chief Safety Officer (CSO), Regional Safety Manager, and Senior Management traveled to Wallace, ID, arriving late in the evening on September 20, 2012 to meet with the crew.

The Safety Office assembled the Accident Investigation Board (Board) on Thursday evening, September, 20, 2012, and the Board arrived at the accident scene Friday, assumed control, and began to document the accident.

The CSO notified the Occupational Safety and Health Administration (OSHA) and Department of Energy Health, Safety and Security Officer on Thursday, September 20, 2012. OSHA dispatched a Safety and Health Specialist from their Billings, MT area office, who arrived on Saturday morning.

Board members met with the OSHA specialist Saturday morning and escorted him to the site, where he documented the site, and Board members took follow-up photographs and measurements.

Finding: The Board determined the immediate response actions taken following the accident were appropriate. As required by BPA Accident Prevention Manual, the scene was preserved, photographed and the witness statements completed in a timely manner.

2.4. Medical Analysis/Fitness for Duty

2.4.1. Work Schedule

The Board reviewed the work schedule of both the Bell and Kalispell line crews to determine if extended work schedules may have had an effect on this accident.

The Kalispell crew averaged less than two hours of overtime per week in the three weeks preceding the accident on September 20, 2012.

The Bell crew worked the following hours:

- Period ending September 1, 45 hours total, working 5 days of the 7 day period;
- Period ending September 8, 46.5 hours total, working 5 days of the 7 day period; and
- Period ending September 15, 80 hours total, working 7 days of the 7 day period.

The Bell crew's days off included Sept 1, 2, 3, and 9. A workweek is 40 hours within a 7 day period.

The reason for the increased overtime for the Bell crew was to provide assistance to the Grand Coulee Line crew to restore damaged structures caused by recent fires in the area. During the week ending September 15, 2012, no Bell crew member worked more than 16 hours in a 24 hour work day and each crew member was afforded their eight hours of rest between shifts during this emergency restoration. From September 16, 2012 through the date of the accident, overtime hours averaged three hours per day.

Although the Bell crew had worked extended hours in the weeks prior to the accident, the hours worked did not exceed those as defined in the BPA Transmission Field Services Policy, Procedures and Information, *Extended or Unusual Work Hours*, dated September 27, 2010.

The Board acknowledges that 80 hours worked in a seven day period is higher than normal. Based on the evidence presented to the Board and interviews with the workers, the Board could not determine that the Bell crew's work schedule was a factor in this accident.

2.4.2. Coroner's Report

The Board reviewed the autopsy report and toxicology report provided by the Coroner's Office of Mineral County. Results indicated there were no conditions affecting LM-1's ability to perform lineman duties.

2.4.3. Manager's Medical Assessment

The Board, through correspondence with LM-1's management and BPA's Occupation Health Nurse, determined that LM-1 had no known medical conditions that would have prevented him from performing the duties of a lineman.

Finding: Based on the information provided to the Board, the Board determined there were no known medical conditions that contributed to this accident.

2.5. BPA's Safety Management Processes

BPA manages its safety processes through policies, standards, guides and manuals. These policies, standards, guides and manuals lay out management's expectations in increasing detail

of how BPA employees are expected to perform work safely. The Board reviewed the policies, standards, guides and manuals which were relevant to the work being performed at the time of the fall accident.

2.5.1. 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. In the course of the investigation, the Board found four areas of the APM that were relevant to the accident. These areas, in order of the work to be performed, were:

- Rule J-1, Job Briefing;
- Rule F-1 Fall Protection;
- Rule G-2 Grounds, Portable Protective, Voltage Testing; and
- Rule G-9 Grounds, Portable Protective, Static Wire.

2.5.1.1. ***Job Briefing***

APM 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*".

Through the documented job briefing forms, employee statements, and employee interviews, the Board concluded that the crew did hold a job briefing and did document that briefing. The Board concluded that the job briefing reflected the day's work, and as a result, the hazards, the work conditions, personal protective equipment (PPE), and special precautions surrounding the helicopter were discussed.

Although the job briefing was executed and documented, an outdated Job Briefing Notebook was used. The most current version (March 2010) contains additional information including a rescue plan review, rescue equipment check, local emergency medical facility location known, and location of worksite known for 911 (GPS, address). Use of the updated form may have prompted the crew to discuss a rescue plan in detail, and what would need to be done in the event of an emergency.

Finding: The Board found that the job briefing met the intent of the APM Rule J-1 requirement, however was not recorded on the most current form that indicates that a rescue plan was discussed.

Recommendation: The Board recommends that BPA management shall ensure all workers will utilize form 5480.25e (Job Briefing Information Sheet) or most current version of the Job Briefing Notebook (March, 2010). The Job Briefing shall include a thorough discussion of a rescue plan.

Section X.P-1 (2.a) of BPA Work Standard, Section X, *Miscellaneous* discusses the requirements of a rescue plan as a critical part of the job briefing. A rescue plan is a required part of the job briefing performed prior to all work. *"Hazards that may result in a potential rescue situation with the possible techniques shall be discussed. Crews shall have the necessary equipment on the job site..."* The Board was unable to determine if a rescue plan was discussed prior to the work that morning, however the technique using the LLSH rescue method was discussed immediately prior to the actual rescue.

Finding: The Board found that currently within the agency, there is no requirement to have a backboard as part of rescue equipment inventory. A backboard on site may have expedited the rescue efforts.

Recommendation: BPA shall evaluate the need for and provide backboards where necessary to assure crews are able to comply with the requirements for rescue equipment as stated in Section X.P-1 (2.a) of BPA Work Standards, Section X, *Miscellaneous*.

2.5.1.2. ***Fall Protection***

APM Rule F-1 Fall Protection states that *"approved fall protection shall be used when working aloft above four feet on all towers, poles, and similar structures"*

BPA Work Standard, Section X –Miscellaneous, Section X.C-1: Fall Protection Policy states *"Fall protection shall be used by all employees working at elevated locations more than four feet above the ground on transformers, dead-end bay structures, towers, poles, or similar power system structures and aerial lifts."* However, *"fall protection* ***is not required*** *by qualified climbers while climbing, changing work or rest locations, unless conditions, such as, but not limited to, ice, high winds, etc., could cause the employee to lose their grip or footing."*

At the time of the accident, the Board determined there were no adverse environmental conditions. LM-1 was changing work location unattached which is consistent with the work rules and policies.

Finding: All crew members were following all applicable rules, standards, and policies concerning fall protection.

Recommendation: BPA shall review the current rules, standards, and policies to determine if the Agency should adopt a 100 percent fall protection requirement.

2.5.1.3. ***Grounds, Portable Protective, for Work on De-energized Circuits***

APM Rule G-1 Grounds, Portable Protective, for Work on De-energized Circuit states:

"When grounding overhead transmission lines where workers are not protected by a ground mat, step-and-touch voltages shall be measured in accordance with TLM Standards and Guides, I.A.3, Protection of Electrical Workers from Induced Currents and Voltages."

Transmission Line Maintenance Standards and Guides, Section I.A.3.a states:

"*Applying Portable Protective Grounds*

After obtaining the required work clearance, use the following procedure to apply grounds at the work site: Immediately before applying grounds, a voltage test shall be made on each phase with a "voltage detector" instrument that produces both a visible and audible signal.

- *Drive a working ground (rod) at any work site where there are no tower legs or anchor rods.*
- *Install a metallic ground probe 15 feet from the working ground, anchor rod, or tower leg. The probe shall be 3/8 inches to 1/2 inches in diameter and long enough to be driven about 18 to 24 inches into the ground.*
- *Attach the Step and Touch Kit ....."*

Finding: The Step-and-Touch Kit was not utilized during this work.

Recommendation: BPA Management shall review APM Rule G-1 and TLM Standards and Guides Sections I.A.2 and I.A.3 with the Bell and Kalispell crews.

2.5.1.4. ***Grounds, Portable Protective, Voltage Testing***

APM Rule G-2 Grounds, Portable Protective, Voltage Testing states;

"*Immediately before applying grounds, a voltage test shall be made on each phase with a voltage detector" instrument that produces both a visible and audible signal.*"

BPA Work Standard Section VI – Grounding & Bonding, VI.B. Voltage Testing Procedures, states:

"Immediately before applying grounds, a voltage test shall be made on each phase with a "voltage detector" instrument that produces both a visible and audible signal.

Voltage testing is the final precaution to assure that the worker is about to place the protective grounds on a de-energized circuit.

Therefore, an approved voltage tester shall be used to determine that the circuit is de-energized."

The Board concluded that no voltage detector instrument was used to test the line before it was grounded. The line was "fuzzed" using the metal end of a hot stick to verify that the line was de-energized before applying grounds.

Finding: Proper voltage testing procedures were not used when verifying the line as de-energized.

Recommendation: BPA Management shall review APM Rule G-2 and BPA Work Standard VI.B with the Bell and Kalispell crews.

2.5.1.5. ***Grounds, Portable Protective, Static Wire***

APM Rule G-9 Grounds, Portable Protective, Static Wire states:

"Before touching or coming within the Minimum Approach Distance (MAD) of overhead static (ground) wire, unless an approved barrier is in place (see Rule B-1) or the worker is insulated from any other exposed conductive object while conducting live-line bare-hand work, it must be grounded at that location by either a portable protective ground or a permanent ground connection. Except: At 500 kV or above a portable protective ground must be installed."

The insulated overhead ground wire was not grounded per the written helicopter step plan before work began. The crew was not going to come within the MAD distance of the insulated overhead ground wire. The use of the helicopter and the long line would have violated that distance.

Finding: The insulated overhead ground wire was not grounded.

Recommendation: BPA management shall review APM Rule G-9 with the Bell and Kalispell crews.

2.6. Personnel Training

The Board examined the training records for LM-1 and determined that LM-1 had completed all required training, certification and refresher training. LM-1 started at BPA in 2004 as an apprentice lineman, and attained journeyman level in 2007.

BPA's training program complies with OSHA required training. Below is a list of BPA's required training for linemen. LM-1 completed the required training on:

- Climber Recertification/Rescue, June 20, 2012;
- Comprehensive Rigging, March 28, 2012;
- First Aid/CPR/AED, February 28, 2012;
- Grounding, August 13, 2012;
- Job Briefing, February 29, 2012;
- Personal Protective Equipment, March 01, 2005; and

- Long Line/Short Haul, June 18, 2012.

Finding: LM-1 had completed all required training and was a qualified climber in accordance with BPA requirements.

2.7. ANALYSIS

This investigation was conducted using the processes described in the *BPA Accident Prevention Manual* and the *DOE Handbook, Accident Investigation and Prevention, DOE-HDBK-1208-2012, Volume 1 - Accident Analysis Technique.*

2.7.1. Barrier Analysis

Barrier analysis is based on the premise that hazards are associated with all tasks. A barrier is any management or physical means used to control, prevent, or impede the hazard from reaching the target (i.e., persons or objects that a hazard may damage, injure, or harm). The results of the barrier analysis are integrated into the events and causal factors chart to support the development of causal factors. Appendix A contains the complete Barrier Analysis of physical and management barriers.

The Board determined that there were no physical or management barriers that would have prevented the fall accident (loss of footing while changing positions). The Board did, however, determined that a physical and management barrier may have mitigated the consequences of the fall (fatal injury) would have been to use 100 percent attachment.

2.7.2. Change Analysis

Change analysis examines planned or unplanned changes that caused undesirable results related to the accident. This process analyzes the difference between what is normal, or expected, and what actually occurred before the accident. The results of the change analysis conducted by the Board are integrated into the events and causal factors chart to support the development of causal factors. Appendix B contains the Change Analysis, which reinforces the Barrier Analysis.

The Board examined changes relative to the work being performed and identified the use of the helicopter as the most significant change in how this work was previously accomplished. The Board determined that the use of the helicopter did not contribute to the accident. The Board acknowledges that 80 hours worked in a seven day period is higher than normal. Based on the evidence presented to the Board and interviews with the workers, the Board could not determine that the Bell crew's work schedule was a factor in this accident.

2.7.3. Causal Factors Analyzed

The Events and Causal Factors Analysis is a systematic process that uses methods to determine Causal Factors of an accident. Causal Factors are the significant events and conditions that

produced or contributed to the Direct Cause, the Contributing Causes and the Root Cause(s) of the accident.

The Board concluded, based upon the available evidence, that the Direct Cause of the fall was LM-1's loss of contact with the tower while being unbelted and changing positions on the tower.

The Board determined the Root Cause of the fatal injury was not using the fall protection function (safety strap) incorporated into the safety harness to remain attached to the tower. However, it must be emphasized that changing locations unattached is a common practice and is in compliance with BPA's work rules and policies.

Upon examination of all available facts and evidence, the Board was not able to determine other contributing factors, which would have increased the likelihood of the fall and fatal injury. The Board notes this is inherently dangerous work and BPA provides training and guidance to mitigate the dangers of this work. LM-1 was trained, qualified, and capable of performing this work.

3. EXAMINATION OF EVIDENCE

3.1. Findings and Recommendations

The Board determined the facts of the accident and analyzed the facts to determine what happened, why it happened, and what needs to be done to prevent recurrence. The Board used Barrier Analysis, Change Analysis and Causal Factors Analysis to arrive at Findings and Recommendations, which if implemented should prevent a similar accident.

The Board concluded, based upon the available evidence, that the Direct Cause of the fall was LM-1's loss of contact with the tower while being unbelted and changing positions on the tower.

The Board determined the Root Cause of the fatal injury was not using the fall protection function (safety strap) incorporated into the safety harness to remain attached to the tower. However, it must be emphasized that changing locations unattached is a common practice and is in compliance with BPA's work rules and policies.

Upon examination of all available facts and evidence, the Board was not able to determine other contributing factors, which would have increased the likelihood of the fall and fatal injury. The Board notes this is inherently dangerous work and BPA provides training and guidance to mitigate the dangers of this work. LM-1 was trained, qualified, and capable of performing this work.

Table 3: Findings and Recommendations

Findings	Recommendations
All crew members were following all applicable rules, standards, and policies concerning fall protection.	BPA shall review the current rules, standards, and policies to determine if the Agency should adopt a 100 percent fall protection requirement.
Based on the information provided to the Board, the Board determined there were no medical conditions that contributed to this accident.	None.
LM-1 had completed all required training and was a qualified climber in accordance with BPA requirements.	None.
The Board found that the job briefing met the intent of the APM Rule J-1 requirement, however was not recorded on the most current form that indicates that a rescue plan was discussed.	BPA management shall ensure all workers will utilize form 5480.25e (Job Briefing Information Sheet) or most current version of the Job Briefing Notebook (March, 2010). BPA management shall ensure the Job Briefings include a thorough discussion of a rescue plan.
The Board determined that CPR protocol and BPA's short-haul/rescue procedures were followed and that the decision to use the truck to transport LM-1 was appropriate.	None.
The Board determined the immediate response actions taken following the accident were appropriate. As required by BPA Accident Prevention Manual, the scene was preserved, photographed and the witness statements completed in a timely manner.	None.
The Board found that currently within the agency, there is no requirement to have a backboard as part of rescue equipment inventory. A backboard on site may have expedited the rescue efforts.	BPA shall evaluate the need for and provide backboards where necessary to assure crews are able to comply with the requirements for rescue equipment as stated in Section X.P-1 (2.a) of BPA's Work Standards, Section X, *Miscellaneous.*
The Step-and-Touch Kit was not utilized during this work.	BPA Management shall review APM Rule G-1 and TLM Standards and Guides Sections I.A.2 and I.A.3 with the Bell and Kalispell crews.

Findings	Recommendations
Proper voltage testing procedures were not used when verifying the line as de-energized.	BPA Management shall review APM Rule G-2 and BPA Work Standard VI.B with the Bell and Kalispell crews.
The insulated overhead ground wire was not grounded.	BPA management shall review APM Rule G-9 with the Bell and Kalispell crews.

4. WORK HISTORY OF BPA LINE PERSONNEL

TLFM-III	12 years as BPA lineman, last four as Foreman I. Temporarily upgraded to Foreman III due to retirement of standing Foreman III.
TLFM-I	7 years with BPA, started with BPA in 2005 in the line apprenticeship. Four years as journeyman lineman.
LM-1	8 years with BPA, started with BPA in 2004 in the line apprenticeship. Five years as journeyman lineman.
LM-2	12 years in line trade prior to joining BPA in 2000. 12 years as BPA journeyman lineman.
LM-3	4 years in line trade prior to joining BPA, started with BPA in 2005 in the line apprenticeship. Four years as journeyman lineman.
ALM-1	3 years in BPA line apprenticeship, Step 7 apprentice.
ALM-2	3 years in BPA line apprenticeship, Step 7 apprentice.
LEO-1	12 years as a BPA heavy mobile equipment mechanic, nine years as BPA line equipment operator.
LFM-III	23 years at BPA in the line trade, started with BPA in 1989 in the line apprenticeship. Seven years as a Foreman III.
LFM-I	17 years with BPA, started in the line apprenticeship in 1995. Four years as a Foreman I.
LM-4	15 years with BPA, started the line apprenticeship in 1997.
LM-5	18 years with BPA, started the line apprenticeship in 1994.
LM-6	4 years in line trade prior to joining BPA, 6 years as a BPA lineman.

5. BOARD OF AUTHORITY LETTER

DOE F 1325.8a Electronic Form Approved by CILR – 09/25/2001
(8-89)

United States Government **Department of Energy**
Bonneville Power Administration

memorandum

DATE: September 21, 2012

REPLY TO ATTN OF: NF/WHSE-E

SUBJECT: Level I Accident Investigation Board

TO: Larry Buttress, Acting 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 Lineman fatality that occurred on September 20, 2012.

Steven J Goins	Manager, Construction and Maintenance Services, Transmission Field Services. Board Chairperson.
Garret D Rehbein	Manager, District Operations and Maintenance Longview, Transmission Field Services. Board Member
Kurt R Syverson	Transmission Line Maintenance Specialist, Transmission Engineering Services. Board Member
Angus D Campbell	Safety & Occupational Health Manager, Internal Business Services. Board Member
Bill McQuiston	Department of Energy Liason.

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.

Brad Bea
Chief Safety Officer

cc:
K. Leathley – K-7
L. Bekkedahl – T/Ditt2
R. Furrer – TF/Ditt2
D. Hunter – TFB/DOB1
M. Kjelland – TELM/TPP3
K.Howell – TF/DOB-1
D. Wolfe – NF/BELL-1
D. Labrosse – TFS/BELL-1
Official File – NF

6. BOARD MEMBERS' SIGNATURES

Steve J. Goins,
Board Chairperson
Manager, Construction and Maintenance Services
Transmission Field Services

Garett D. Rehbein,
Board Member
Manager, District Operations and Maintenance
Longview
Transmission Field Services

Kurt R. Syverson
Board Member
Transmission Line Maintenance Specialist
Technical Services

Angus D. Campbell
Board Member
Safety & Occupational Health Manager
Internal Business Services

BOARD MEMBERS, ADVISORS AND CONSULTANTS

Board Members

Board Chairperson	Steve J.Goins Manager, Construction and Maintenance Services, Transmission Field Services.
Board Member	Garett D.Rehbein Manager, District Operations and Maintenance Longview, Transmission Field Services.
Board Member	Kurt R.Syverson Transmission Line Maintenance Specialist, Transmission Engineering Services.
Board Member	Angus D. Campbell Safety & Occupational Health Manager, Internal Business Services.

Advisors

Advisor:	William McQuiston, MAS Consultants

Administrative Coordinator

Consultant	Susan Keffer, Project Enhancement Corporation

Appendix A. 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.

TableA-1: Barrier Analysis

Barrier Analysis Worksheet			
Hazard: (Describe the hazard) **Fall from tower**		**Target:** (Describe the target - person/object endangered) **LM1 (injured worker)**	
What Were the Barriers?	**How Did Each Barrier Perform?**	**Why Did the Barrier Fail?**	**How Did the Barrier Affect the Accident?**
Fall protection equipment – safety harness/belt.	LM-1 was wearing a harness; he was not tied off.	The barrier did not fail.	LM-1 was changing position on the tower without being tied off (free climbing) which is permitted by OSHA regulations and BPA standards. Not using 100% tie-off provided the opportunity for the fall accident.

Barrier Analysis Worksheet			
Hazard: (Describe the hazard) **Fall from tower**		**Target:** (Describe the target - person/object endangered) **LM1 (injured worker)**	
What Were the Barriers?	**How Did Each Barrier Perform?**	**Why Did the Barrier Fail?**	**How Did the Barrier Affect the Accident?**
Fall protection equipment – 100% tie-off with PPE	LM-1 was wearing a harness; he was not tied off.	OSHA regulations and BPA standards do not require the use of fall protection equipment by qualified employees while climbing or changing position, such as in the case of this accident. [29CFR1910.269(g)(2)(v)]	Not using 100% tie-off provided the opportunity for the fall accident.
Fall protection equipment – Safety net	Not used.	Not required.	Could have mitigated consequences.
Training provided to linemen to assure they possessed the skills and abilities to climb and work safely at heights.	LM-1 had completed and was current in all training associated with climbing.	There is no evidence that the barrier failed.	There is no evidence that training was a contributing factor to this accident.
"Tailboard"/job briefing (J-1) meeting was used to review the work and hazards associated with the tasks to be accomplished.	A job briefing was performed and considered effective by work crew.	There is no evidence that the barrier failed.	There was no evidence that the job briefing was contributing factor in this accident.

Excerpt: 29 CFR 1910.269(g)(2)(v)

Fall arrest equipment, work positioning equipment, or travel restricting equipment shall be used by employees working at elevated locations more than 4 feet (1.2 m) above the ground on poles, towers, or similar structures if other fall protection has not been provided. Fall protection equipment is not required to be used by a qualified employee climbing or changing location on poles, towers, or similar structures, unless conditions, such as, but not limited to, ice, high winds, the design of the structure (for example, no provision for holding on with hands), or the presence of contaminants on the structure, could cause the employee to lose his or her grip or footing.

Note 1: This paragraph applies to structures that support overhead electric power generation, transmission, and distribution lines and equipment. It does not apply to portions of buildings, such as loading docks, to electric equipment, such as transformers and capacitors, nor to aerial lifts. Requirements for fall protection associated with walking and working surfaces are contained in Subpart D of this Part; requirements for fall protection associated with aerial lifts are contained in 1910.67 of this Part.

Note 2: Employees undergoing training are not considered "qualified employees" for the purposes of this provision. Unqualified employees (including trainees) are required to use fall protection any time they are more than 4 feet (1.2 m) above the ground.

Appendix B. 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 B-1: Change Analysis Worksheet

Change Analysis Worksheet			
Accident Situation	**Ideal, or Accident-Free Situation**	**Difference**	**Evaluation of Effect**
Platforms were lifted to the crew atop the tower structure using a helicopter.	Prior to May 2012 cranes were used to lift platforms to the work crew atop the tower.	• Use of a helicopter introduced changes in – • Load is not as stable. • Some noise level. • The possibility of rotor wash affecting the positioning of the platform. • Use of helicopter versus the crane requires less setup efforts and time.	• Stability of the load had no effect on the accident. • Communications were not affected by noise levels. • The Board determined through interviews and analysis that the movement of the platform was not specifically attributed to rotor wash and had no impact on the accident. • Reduces job time.
The use of the helicopter vs. crane to perform this work was new to the Bell crew.	The Kalispell crew had used the helicopter technique to perform this work since May 2012.	The Kalispell crew had experience using the helicopter for this work practice.	The knowledge and experience gained by the Kalispell crew was passed on to the Bell crew prior to and during the job,

Change Analysis Worksheet			
Accident Situation	**Ideal, or Accident-Free Situation**	**Difference**	**Evaluation of Effect**
The Bell crew work schedule prior to accident included higher than normal overtime due to emergency situations.	Forty hour work week with no emergency response.	Longer than normal work schedule, working consecutive days with no days off.	Based on the evidence presented to the Board and interviews with the workers, the Board could not determine that the Bell crew's work schedule was a factor in this accident.

Appendix C. Chronology and Conditions of the Accident and Rescue Scenario

Table C-1: Accident Chronology

ACCIDENT CHRONOLOGY			
Date/Time	**Tower Event**	**Conditions**	**Fly Yard Events**
09/20/2012 ~0600	Work crews gathered in the motel parking lot to begin the day's work.	Work crew was on travel status in Wallace, ID.	
09/20/2012 ~0610	Work crew traveled to the "Osborne yard".	Travel was approximately five miles. Rigging trailer, other equipment and insulators were stored at the Osborn yard.	
09/20/2012 ~0730 - 0800	Work crews began arriving at fly yard.	Began assembling tools and equipment for the day's work.	
09/20/2012 0816	TFM-1 picked up clearance from Dittmer Control Center.	Clearance was picked up by radio. LM-4 also had a clearance, but did not pick it up due to working with TFM-1.	
09/20/2012 ~0816 to 0900	TFM-1 conducted job briefing for changing tower insulators.	J-1 Job briefing notebook documented with "Helicopter" in the block labeled "Hazards Associated with the Job." Safety was discussed during the briefing. Crew discussed rigging methods, platform attachment and cross-checked rigging for the insulator replacement job.	
09/20/2012 ~0816 to 0900	Pilot conducted aviation pre-job briefing for helicopter operations portion of work to be accomplished.	Aviation hazards analysis was meant to cover the time period required for the insulator replacement operations.	

ACCIDENT CHRONOLOGY			
Date/Time	**Tower Event**	**Conditions**	**Fly Yard Events**
09/20/2012 ~0900	The work crew traveled from fly yard to tower structure 83/4.	Access road and right of way was rough and bumpy with switch-backs. Travel path was about approximately five miles from fly yard.	
09/20/2012	Tower crew donned fall protection PPE for climbing tower.		
09/20/2012	Tower crew ascended tower structure 83/4.	All crew wearing fall protection PPE.	
09/20/2012 ~1030	Tower crew called for grounds and hot stick to be sent up.	"Step & Touch" meter was not set up.	
09/20/2012 ~1030	LM-6 and FM-1 set up grounds in the fly yard for transport		
09/20/2012 1037 to 1048	Helicopter flew grounds and hot stick to tower crew		
09/20/2012	Tower crew "fuzzed" lines	No voltage tested was used – no "known power source" to check operability.	
09/20/1012	Tower crew positioned at work locations.	TFM-1 on AHOL conductor at Position 3. LM-1, LM-2 LM-3 at AHOL Position 3. ALM-1 on AHOL conductor at Position 1. ALM-2 and LM-4 at AHOL Position 1.	
09/20/1012	Tower crew installed ground on three phases.	ALM-1 assisted with grounds on Position 1 & 3.	

ACCIDENT CHRONOLOGY			
Date/Time	**Tower Event**	**Conditions**	**Fly Yard Events**
09/20/2012 ~1050	Helicopter flew platform to tower structure	Load line was about 75 feet long.	
09/20/2012 ~1100	Helicopter delivered platform to tower crew.	TFM-1 on wire, LM-1, LM-2, LM-3 on tower at Position 3, AHOL. ALM-1 on wire, LM-5, LM-4 on tower at Position 1 AHOL.	
09/20/2012 ~1100	Platform approached the tower	Platform was initially parallel to the conductor. TFM-1 momentarily grabbed tag line and it was the wrong end of the platform.	
09/20/2012 ~1100	Platform slowly rotated at right angle to insulators.	Platform continued lowering went between insulators and jumpers at Position 3. Platform bumped tower.	
09/20/2012 ~1100	LM-1 told LM-3 something like 'I'm going to spin it…'		
09/20/2012 ~1100	LM-1 unbelted to change position.	LM-1 put safety strap over his shoulder and fastened it to D-ring.	
09/20/2012 ~1101	LM-1 went around (behind) LM-3.	LM-3 moved in tight against structure. LM-3 saw both hands of LM-1 on the structure to his left and right when LM-1 passed behind. LM-2 saw LM-1 go behind LM-3.	

ACCIDENT CHRONOLOGY			
Date/Time	**Tower Event**	**Conditions**	**Fly Yard Events**
09/20/2012 ~1102	ALM-1 saw LM-1 lose footing and fall.		
09/20/2012 ~1102	LM-1 fell from tower.		
09/20/2012 ~1102	TFM-1 called "Emergency 911" on the radio.	Pilot advised TLMF-III to request "life flight" when he called 911.	LM-6 and LEO-1 heard call from the fly yard and took off in truck for the tower. LM-5 & FM-1 heard emergency call and turned around.
09/20/2012 ~1102	All crewmen except TFM-1 began descent from tower.	TFM-1 remained in tower for communications.	
09/20/2012 ~1105 - 1142	LM-2 and LM-4 reached LM-1 and administered first aid including CPR and use of the AED.	LM-1 located ~30-40 feet downhill from tower.	
09/20/2012 ~1110 - 1142	The work crews developed an evacuation plan to move LM-1 from tower to fly yard.	The work crew at the tower were preparing to use a winch to get LM-1 up the hill to the truck and transport to fly yard. The work crew at the fly yard were preparing to make an improvised backboard and fly LM-1 to fly yard to meet emergency vehicles. A fiberglass hook ladder and trailer sideboards used to make improvised backboard.	Helicopter rigging was changed to LLSH rigging. Pilot, LM-5, FM-1, LEO-2 rig improvised backboard.

ACCIDENT CHRONOLOGY			
Date/Time	**Tower Event**	**Conditions**	**Fly Yard Events**
09/20/2012 ~1110			TLFM-III contacted National 911 system using satellite phone.
09/20/2012 ~1115 - 1118		TLFM-III provided information to Mineral County dispatcher; call was dropped.	TLFM-III was patched to Mineral County, MT EMS by National 911.
09/20/2012 ~ 1118		TLFM-III requested Dittmer to call Mineral County, MT for MedStar. GPS coordinates relayed in inconsistent format. (Life flight would have responded to a location ~16 miles away from the actual location using the coordinates given.)	TLFM-III called Dittmer via radio.
09/20/2012 ~1122		Mineral County dispatcher informed Dittmer dispatcher that they could not dispatch Missoula MedStar because of smoke in the Missoula location.	Dittmer contacted Mineral County.
09/20/2012 1122 - 1148	Dittmer called TFM-1: Life flight not available from Missoula, MT.		BPA dispatcher attempted to coordinate medevac response.
09/20/2012 1132		Informed by dispatch that they were forty three miles away with 20 to 40 minutes to arrival.	Ambulance dispatched by Mineral County, estimated ETA 1210.
09/20/2012	TFM-1 descended tower – moved trucks.		

ACCIDENT CHRONOLOGY			
Date/Time	**Tower Event**	**Conditions**	**Fly Yard Events**
09/20/2012 ~ 1130 to 1133			Pilot conducted LLSH briefing with those in the fly yard. Pilot requested FM-1 to inspect LM-5's rigging and safety equipment.
09/20/2012 ~ 1133 to 1135	Helicopter lifted backboard and LM-5 from the fly yard to the tower. Pilot landed backboard and LM-5 at LM-1's location.	Pilot recognized CPR in progress prior to landing the backboard and LM-5. CPR protocol requires continuing once started. LLSH standard prohibits CPR in flight.	
09/20/2012 ~1133 - 1137	Backboard and LM-5 unhooked from helicopter.		Pilot conducted test run to assure sufficient clearance for lift backboard to truck on access road.
09/20/2012	LM-1 secured to backboard.	AED placed on LM-1's chest.	
09/20/2012 ~1141 to 1142	Helicopter transported LM-1 with LM-5 into the truck bed.	AED fell from backboard. (Wire was found severed when recovered. Pads were still on LM-1.)	
09/20/2012 ~1142 to 1200	Truck transported LM-1 from the tower area to near the I-90 Exit 5 - Taft to meet the emergency vehicles.	CPR continued in truck bed.	
09/20/2012 ~1146 to 1150	Helicopter returned to fly yard and landed.		
09/20/2012 1221	EMS personnel consulted with medical control and LM-1 was pronounced dead.		

ACCIDENT CHRONOLOGY			
Date/Time	**Tower Event**	**Conditions**	**Fly Yard Events**
09/20/2012 1330	Crew members completed written statements and returned to hotel		
09/20/2012 ~1341	Helicopter returned to Spokane.		
09/20/2012 1345	TC, FSLEO, DC, and HM went to accident scene	FSLEO& DC documented scene for their reports.	
09/20/2012 1800	The Board Appointed		
09/21/2012 0800	The Board assembled and inspected accident scene.		
09/22/2012 0730	Federal OSHA arrived – inspected scene with AIB.		

Appendix D. Accident Investigation Terminology

Table E-1: Accident Investigation Terminology

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.
The **direct cause** of an accident is the immediate events or conditions that caused the accident. The direct cause should be stated in one sentence, as illustrated in the examples below. Typically, the direct cause of the accident may be constructed or derived from the immediate, proximate event and conditions next to or close by to the accident on the ECF Chart.
Root causes are the causal factors that, if corrected, would prevent recurrence of the same or similar accidents. Root causes may be derived from or encompass several contributing causes. They are higher-order, fundamental causal factors that address classes of deficiencies, rather than single problems or faults.
Contributing causes are events or conditions that collectively with other causes increased the likelihood of an accident but that individually did not cause the accident. Contributing causes may be longstanding conditions or a series of prior events that, alone, were not sufficient to cause the accident, but were necessary for it to occur. Contributing causes are the events and conditions that "set the stage" for the event and, if allowed to persist or re-occur, increase the probability of future events or accidents.
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.