

**UNITED STATES  
DEPARTMENT OF LABOR  
MINE SAFETY AND HEALTH ADMINISTRATION  
Metal and Nonmetal Mine Safety and Health**

**REPORT OF INVESTIGATION**

**Underground Metal Mine  
(Silver)**

**Fatal Fall of Roof Accident  
April 15, 2011**

**Lucky Friday Mine  
Hecla Limited  
Mullan, Shoshone County, Idaho  
Mine I.D. No. 10-00088**

**Investigators**

**Rodric B. Breland  
Supervisory Mine Safety and Health Inspector**

**Stephen P. Rogers  
Supervisory Mine Safety and Health Inspector**

**Bryan Chaix  
Mine Safety and Health Inspector**

**Paul Tyrna  
Geologist**

**Keith Palmer  
Mine Safety and Health Specialist**

**Originating Office  
Mine Safety and Health Administration  
Western District  
991 Nut Tree Road, Second Floor  
Vacaville, California 95687  
Wyatt Andrews, District Manager**



**Note: Timbers installed after ground fall.**

## OVERVIEW

On April 15, 2011, Larry Marek, miner, age 53, was killed while watering down a muck pile in a stope. A rock fall approximately 90 feet long, 20 feet wide, and 30 feet high struck him.

The accident occurred because management did not have policies and procedures that provided for the safe mining of split stopes in a multi-vein deposit. Management failed to design, install, and maintain a support system to control the ground in places where miners worked and traveled. Additionally, management failed to ensure that appropriate supervisors or other designated persons examined or tested the ground conditions where the fall occurred.

## GENERAL INFORMATION

The Lucky Friday Mine, a multi-level, underground silver mine, owned and operated by Hecla Limited, is located in the Coeur d'Alene mining district approximately one mile east of Mullan, Shoshone County, Idaho. The principal operating officials are Phil Baker, CEO; John Jordan, Vice-President; and Scott Hogamier, Safety Coordinator. The mine normally operates two 12-hour shifts per day, six days a week. Total employment is 270 persons.

Silver, lead, and zinc bearing ore is drilled and blasted in open stopes. Broken material is transported from the stopes with diesel powered load-haul-dump units and underground haulage trucks to ore chutes, and then hoisted to the surface for crushing and beneficiation. Concentrates are sold to an off-site smelter for final processing.

The last regular inspection at this mine was completed on March 3, 2011.

## DESCRIPTION OF THE ACCIDENT

On the day of the accident, Larry Marek, (victim) started his shift at 4:00 p.m., his normal starting time. Dale Stepro, shift boss, assigned Larry Marek and Michael Marek, miner, (victim's brother) to work in the 6150-15 stope. They were both production miners assigned to perform various tasks to advance the stope.

The two miners arrived at the 6150-15 stope around 4:30 p.m. to start their work day. They fixed a spray chamber in the ventilation raise to help cool the stope and then watered down the muck in the stopes to cool the work area. They spent about 20 minutes spraying the muck with a water hose. Larry Marek watered the muck in the west stope and Michael Marek watered the east stope.

At approximately 5:30 p.m., Michael Marek finished watering the muck and started rolling up a hose. He could see Larry Marek's cap lamp's light as he rolled up a hose in the west stope. He heard the ground caving in over in the west stope and felt a tremendous rush of air. He stated it occurred very quickly, filling the stope with dust and debris. He immediately ran over to the west side, saw the failure of the stope, and ran down the slot access to the ventilation raise. At this time, he did not know where his brother was so he ran back to the stope and found the west stope completely caved in. He ran back up the slot access and flagged down Daren Stein, haul truck operator, to report the fall of ground. Michael Marek ran back to the fall and tried to move rocks by hand while Stein contacted the hoist ramp crew for assistance. At approximately 5:45 p.m., the crew arrived at the stope and began removing the fallen ground.

The Mine Safety and Health Administration, (MSHA) was notified of the accident on April 15, 2011, at 5:57 p.m. by the National Call Center. Rodney Gust, Staff Assistant, was then informed of the accident. An order was issued under the provisions of section 103(j) of the Mine Act, to ensure the safety of persons.

Personnel from MSHA were immediately dispatched to the mine. A command center was established to coordinate efforts with the rescue crews. Rescue crews worked around the clock removing material from the ground failure location, drilling probe holes into the failed area and installing timbered roof support as they advanced into the ground fall area. A rescue drift was also mined in an attempt to reach the accident area from the west side. After an extensive effort, the victim was recovered on April 24, 2011. The cause of death was attributed to blunt force trauma.

## INVESTIGATION OF THE ACCIDENT

MSHA's accident investigation team was assembled on April 15, 2011. They traveled to the mine, conducted a physical inspection of the accident scene, interviewed employees, and reviewed documents and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management, employees, and miners' representatives.

## DISCUSSION

### Location of the Accident

The accident occurred at the 6150-15 stope, cut # 3. Each working level is designated by the depth of the level below the shaft collar; i.e. the 6150 level was approximately 6,150 feet from the surface. The stopes were numbered, with stopes 11, 12, 14, 15, and 16 active. Each level was driven with a slot access to the stope, which ramped up for two 10-foot cuts, level for one cut, and ramped down for two 10-foot cuts, for a total of 50 vertical feet of mining before offsetting the slot access for the next set of five cuts. The location of the accident, cut # 3, was the third cut down on the present slot access.

### Mining Methods

Prior to 2010, both overhand and underhand cut-and-fill mining methods were used. In mid-2010, overhand operations were no longer used at the mine. The active mining areas were vertically separated by an approximately 200-foot thick sill pillar, between the 5700 and 5500 levels. Currently, the sill pillar is being extracted from the top down with the descending mining front divided into the 12 stope on the west side of the

reserves and the 14 stope on the east side. Underhand mining beneath the sill occurs along three mining fronts: the 12 stope to the west, the 16 stope to the east, and the 15 stope in the center of the reserves. All three of the lower mining fronts are at or near the 6150 level.

Ore veins at depth are accessed via the Silver shaft, which served as the principal shaft for the formerly mined Lucky Friday vein. A mile long drift (Gold Hunter) at the 5900 level connects the Silver shaft to the Gold Hunter vein system which is the focus of current production. The bulk of production is from the 30 vein. Veins are labeled in multiples of 10 (i.e. 10, 20, 30...) to allow splays and splits or newly discovered veins to be designated with an additional digit (i.e. 11, 21, 31...). Spiral ramps allow access to depth and sublevel access drifts are developed on 50-foot vertical intervals off the ramps.

A typical underhand cut-and-fill extraction sequence consists of five successive 10-foot high cuts which are developed from a single slot access midpoint in the 5 cut sequence (cut 3). The slot is ramped up to intersect cuts 1 and 2 and ramped down to intersect cuts 4 and 5. Stope heights are typically limited to 10 feet in order to control stope wall deflection and rib failure. Mining widths vary depending on the width and spacing of ore veins.

Production faces are advanced in opposite directions on either side of the slot, typically for distances of 200 to 600 feet. After the cut is advanced to the predetermined stope length, a wood bulkhead is constructed near the access slot. The stope is then backfilled with a slurry consisting of water, cement, and milled mine tailings, (paste fill) pumped from a surface plant. Prior to backfilling, a 1-1½ foot thick layer of muck (prep muck) is placed on the floor. Six-foot long Dywidag bolts on 4-foot centers (maximum) are then inserted vertically into the muck through welded wire mesh. Bearing plates are attached to the upper end of the bolts and the stope is backfilled to a level above the bearing plates. A 2-4 foot gap is left above the top of the fill to allow for deflection of the cured backfill as stope walls converge. Thus, when the next cut is taken below, the back consists of an engineered, pre-supported paste beam. Completing a typical five cut mining sequence in the 15 stope requires approximately one year.

### Geology

The Gold Hunter vein system is hosted by the Wallace formation, which is part of a series of Precambrian low grade metamorphic sediments in the Belt super group. In the vicinity of the mine, these units have been tectonically deformed and tilted to a sub-vertical inclination with a generally southward dip. The Wallace formation in the current mining horizons consists of thin bedded argillites, argillite alternating with silt caps, and local siltites. The Gold Hunter deposit occurs as multiple veins between, and roughly parallel to, the Independence fault and the Paymaster fault, both of which

trend west-northwest and dip 80° to 85° south. The veins consist principally of siderite (tan-colored iron carbonate) with quartz and sulfide minerals, including silver bearing galena (lead sulfide) tetrahedrite (a silver-rich, copper-antimony sulfide), sphalerite (zinc sulfide), and chalcopyrite (copper-iron sulfide). Current mineable reserves extend horizontally approximately 2,500 feet and the current lower limit of mining occurs at the 6150 sublevel ( $\approx$  2,750 feet elevation). Recent exploration drill holes have intercepted high grade ore at depths exceeding 8,000 feet.

### **6150-15-3 Failure Description**

The mining method in the 6150-15-3 west stope represented a departure from typical mining methods. In the stopes immediately above 6150-15-3 (6150-15-2, 6150-15-1), a minor ore vein (41) splayed off the main 30 vein on the north side. The barren rock between the 30 and 41 veins was left intact as a waste pillar. The 30 and 41 veins converged within the 6150-3 cut and both were extracted in the same production face.

Consequently, the waste pillar in the overlying stopes was undercut. At the time of the accident, the exposed surface of the undercut waste pillar in the 6150-15-3 west cut extended 72 feet from the face and was 3 to 9 feet wide. The 3 cut stope was 18 to 24 feet wide. In the overlying 6150-15-2 and 6150-15-1 cuts (backfilled), the waste pillar width ranged from approximately 3 to 20 feet.

Unlike a typical underhand stope in which the back is composed of a pre-supported, laterally continuous paste beam, the back in the 6150-15-3 west stope failure zone consisted of the undercut waste pillar bounded on either side by paste fill.

Undercutting of waste pillars had been done in two other locations prior to the failure in 6150-15-3 west cut: The east cut of 6150-15-3, and the intersection of 6100-12-1/32 slot intersection. The 6150-15-3 east cut had been backfilled to stabilize the ground; therefore, it could not be examined. The bottom surface of the undercut pillar in the back of the 6100-12-1 cut was partially visible in the 3-foot gap between the pillar and the upper surface off the 6100-12-1 backfill. The limited observations of the undercut pillar did not reveal any significant ground control hazards.

### **6150-15-3 Details**

- Prior to the accident, the 6150-15-3 west cut had been advanced approximately 154 feet from the 35 slot.
- The failure zone was 74 feet long.
- The failure zone, as measured from the west rib line of the 6150-35 slot, extended from a point 58 feet inby to 132 feet inby.
- The failure zone extended to a point approximately 22 feet from the face.

- The fall cavity as determined by the Cavity Monitoring Survey ( CMS) was approximately 25 feet high as measured from the original paste back.
- Post-accident Geotech holes drilled to determine the extent of ground failure indicate that significant fracturing did not appear to occur more than 28 feet above 6150-15-3 cut.
- The fall debris consisted mainly of large (>10 feet x 10 feet) angular blocks from the waste pillar with failed paste fill on either side.
- Within the failure zone, the stope was 20-25 feet wide. Field measurements taken between the 35 slot and the failure zone ranged from 18 - 23.5 feet.
- Within the failure zone, the waste pillar (as projected from 6150-15-2) ranged from 3-9 feet wide. The pillar was narrowest at the inby limit of failure. The waste pillar was roughly centered in the back of 6150-15-3.
- The exposed underside of the waste pillar extended 50 feet into the open cut from the face to the approximate center of the failure zone and varied in width from 3-9 feet with the narrowest portion occurring at the inby limit of failure.
- The pillar in the 6150-15-2 projection was 7-12 feet wide.
- The pillar in the 6150-15-1 projection was 6-20 feet wide.

A waste pillar was under cut in the 6150-15-3 east cut also. However, a bulkhead had been constructed 50 feet east of the 35 slot and the cut was partially backfilled to prevent further caving immediately prior to the investigators' examination of the cut. A separate citation was issued for this mining method under a subsequent inspection in conjunction with the fatal investigation.

- The bulkhead in the east cut was constructed near the nose of the under cut waste pillar precluding the examination of any conditions.
- Five prep timbers were visible in the paste backfill between the east cut bulkhead and the failure zone in the west cut (~118 feet). Maximum spacing between prep timbers was 33 feet. While the location of prep timbers coincided with areas in the 6150-15-2 that exceeded 20 feet, several areas in the 6150-15-3 also exceeded 20 feet where no timbers were observed.



### **Ground Support**

The ground support plan used at the mine was developed by mine management. Ground support used in underhand stope design consists of an engineered designed paste fill which is prepped and installed in the cut above. The stope prep consists of putting down one foot of prep muck on the stope floor and installing 6-foot Dywidag rock bolts into the prep muck on 4-foot centers. Plates and nuts are installed on the tops of the bolts and wire is used to ensure the bolts remain vertical when the paste fill is poured around them.

After the stope is advanced in the cut below, split set bolts are installed with screen on a five-spot pattern as needed to hold up the screen. When stopes exceed 20 feet in width, the ground support plan requires that the paste beam be further reinforced with 10-inch x 10-inch x 16-foot long prep timbers installed transversely on 8-foot centers prior to backfilling. The mine's ground support plan was not being followed because a waste pillar in the overlying cuts precluded the installation of prep timbers and no other supports were installed.

### **Training and Experience**

Larry Marek (victim) had more than 26 years of mining experience and had worked at this operation for 8 years.

A representative of MSHA's Educational Field Services conducted an in-depth review of the mine operator's training records. The training records for Larry Marek were examined and found to be in compliance and up-to-date with MSHA training requirements.

Management developed new ground support standards that include narrower stope widths and prohibits mining under intervening waste pillars. All affected miners were given training regarding the new standards.

## **ROOT CAUSE ANALYSIS**

A root cause analysis was conducted and the following root causes were identified:

Root Cause: Management did not conduct an evaluation, engineering analysis, or risk assessment to determine the structural integrity of the stope back. The back that struck the victim was comprised of a combination of paste fill and waste pillar. As shown on projection maps, geologic structure in the form of joints, faults, and fractures intersected the waste pillar at various angles. These intersecting discontinuities cut the pillar rock mass into angular blocks and wedges which facilitated gravity failure. The large blocks and wedges observed in the fall rubble were not sufficiently supported by the 6-foot long rock bolts installed in the undercut surface of the waste pillar.

Corrective Action: Management developed and implemented new ground control standards that prohibit mining under intervening waste pillars and also established a maximum stope width. Management trained miners regarding these new standards.

Root Cause: Management policies, procedures, and controls failed to ensure appropriate supervisors or other designated persons examined and tested ground conditions to determine if additional ground control measures needed to be taken to ensure the safety of miners prior to commencing work in the stope.

Corrective Action: Management developed and implemented new ground control standards that include guidance on who is responsible for examining and testing the ground conditions. Management trained miners regarding these new standards.

## CONCLUSION

The accident occurred because management did not have policies and procedures that provided for the safe mining of split stopes in a multi-vein deposit. Management failed to design, install, and maintain a support system to control the ground in places where miners worked and traveled. Additionally, management failed to ensure that appropriate supervisors or other designated persons examined or tested the ground conditions where the fall occurred.

## ENFORCEMENT ACTIONS

### Issued to Hecla Limited

Order No. 8603187 was issued on April 15, 2011, under the provisions of Section 103(j) of the Mine Act:

An accident occurred at this operation on April 15, 2011, at approximately 5:35 p.m. As rescue and recovery work is necessary, this order is being issued, under Section 103(j) of the Federal Mine Safety and Health Act of 1977 to assure the safety of all persons at this operation. This order is also being issued to prevent the destruction of any evidence which would assist in investigating the cause or causes of the accident. It prohibits all activity in the 6150-15 West stope except to the extent necessary to rescue an individual or prevent or eliminate an imminent danger until MSHA has determined that it is safe to resume normal mining operations in this area. This order applies to all persons engaged in the rescue and recovery operation and any other person on-site.

This order was initially issued orally to the mine operator at 6:16 p.m. and then reduced to writing when an authorized representative arrived at the mine. The order was

subsequently modified to Section 103(k) after an authorized representative arrived at the mine. The order was modified further to allow rescue/recovery efforts to be performed.

This order was terminated on October 14, 2011, after management developed a 53- foot sill pillar between the stope where the accident occurred and the next cut below. This pillar creates a safety buffer between these two areas.

**Citation No. 8559607** was issued on August 8, 2011, under the provisions of Section 104(d) of the Mine Act, for a violation of 30 CFR 57.3360:

A fatal accident occurred at this mine on April 15, 2011, when a miner was struck by falling material while working in the 6150-15-3 West stope. A substantial quantity of material (measuring approximately 25 feet in width, 74 feet in length, and 25 feet in height) fell 10 feet from the stope back after portions of a supporting pillar were removed to extract ore. Ground support was necessary in the stope to mine safely but the ground support utilized was not adequate. The ground control was not designed, installed and/or maintained in a manner that was capable of supporting the ground in such a wide stope when the support pillar was removed. Mine management has engaged in aggravated conduct constituting more than ordinary negligence by directing the pillar to be mined as the stope advanced and allowing miners to work under inadequately supported ground. This is an unwarrantable failure to comply with a mandatory standard.

This citation was terminated on October 21, 2011, after management developed new ground support standards that include narrower stope widths and prohibits mining under intervening waste pillars. All affected miners were given training regarding the new standards before the citation was terminated.

**Order No. 8559608** was issued on August 8, 2011, under the provisions of Section 104(d)(1) of the Mine Act, for a violation of 30 CFR 57.3401:

A fatal accident occurred at this mine on April 15, 2011, when a miner was struck by falling material while working in the 6150-15-3 West stope. A substantial quantity of material (measuring approximately 25 feet in width, 74 feet in length, and 25 feet in height) fell 10 feet from the stope back after portions of a supporting pillar were removed to extract ore. Management failed to adequately examine and test the ground conditions to determine if additional measures needed to be taken. This was necessary due to constantly changing ground conditions; they were mining a wide stope and removing the support pillar. The operator has engaged in aggravated conduct constituting more than ordinary negligence, as they needed to make examinations and conduct tests to ensure

that all feasible precautions were taken. This is an unwarrantable failure to comply with a mandatory standard.

This order was terminated on October, 21, 2011, after management developed new ground support standards that prohibits mining under an intervening waste pillar and the practice of mining wide stopes. The new standards address miners designated by the operator to examine and test the ground conditions. All affected miners were given training regarding the new standards before the order was terminated.

Approved By:

  
Wyatt Andrews  
District Manager

12/17/2011  
Date

## APPENDICES

- A. Persons Participating in the Investigation
- B. 6150-15 cut 3 Stope Map
- C. Victim Data Sheet

## APPENDIX A

### Persons Participating in the Investigation

#### Hecla Limited

John Jordan.....General Manager  
Doug Bayer..... Mine Superintendent  
Ron Krusemark.....Chief Engineer  
Mike Clary..... House Counsel  
Scott Hogamier.....Safety Coordinator  
Cindy Moore.....Chief Engineer  
Rick Decker.....Miners' Representative  
Jerry Ploharz.....Miners' Representative  
Rick Valerio.....Miners' Representative

#### Jackson Kelly PLLC

Karen Johnston..... Attorney

#### United Steel Workers Local 338, AFL-CIO-CLC

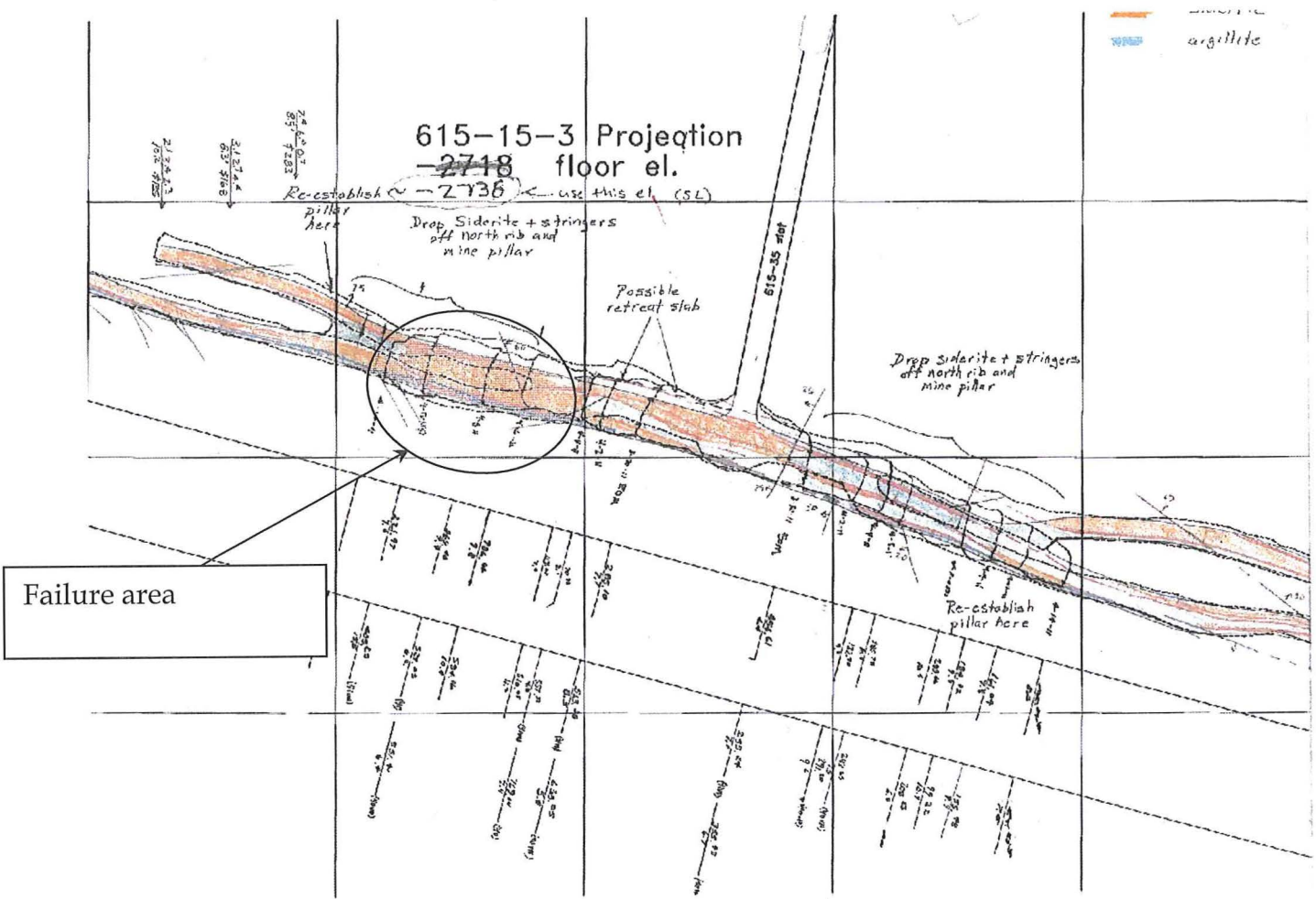
Richard Prete.....Labor & Education Chair Safety Advisor-SW/TMC  
Instructor

#### Mine Safety and Health Administration

Rodric B. Breland..... Supervisory Mine Safety and Health Inspector  
Stephen Rogers..... Supervisory Mine Safety and Health Inspector  
Bryan Chaix.....Mine Safety and Health Inspector  
Paul Tyrna ..... Geologist  
Keith Palmer.....Mine Safety and Health Specialist

# APPENDIX B

## 6150-15 cut 3 Stope Map



NOT TO SCALE

# APPENDIX C

## Victim Data Sheet

**Accident Investigation Data - Victim Information**

**U.S. Department of Labor**  
**Mine Safety and Health Administration**



Event Number: **1 1 5 5 2 5 4**

<b>Victim Information:</b> <b>1</b>														
1. Name of Injured/ill Employee: <i>Larry L. Marek</i>			2. Sex: <i>M</i>		3. Victim's Age: <i>63</i>		4. Degree of Injury: <i>Of Fatal</i>							
5. Date(MM/DD/YY) and Time(24 Hr.) Of Death: a. Date: <i>04/15/2011</i> b. Time: <i>17:30</i>						6. Date and Time Started: a. Date: <i>04/15/2011</i> b. Time: <i>16:00</i>								
7. Regular Job Title: <i>087 Full cycle miner</i>				8. Work Activity when injured: <i>091 prep work to repair ventilation cooler</i>				9. Was this work activity part of regular job? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>						
10. Experience			a. This			b. Regular			c. This			d. Total		
Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days
0	37	1	0	37	1	0	37	1	0	37	1	26	36	4
11. What Directly inflicted injury or illness? <i>121 Ground/roaf fall</i>						12. Nature of injury or illness: <i>170 crushed by rock material</i>								
13. Training Deficiencies:														
Hazard:			New/Newly-Employed			Experienced Miner:			Annual:			Task:		
14. Company of Employment. (If different from production operator) <i>Operator</i>						Independent Contractor ID: (If applicable)								
15. On-site Emergency Medical Treatment:														
Not Applicable:		First-Aid:		CPR:		EMT:		Medical Professional:		None:				
<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>				
16. Part 50 Document Control Number: (form 7000-1) <i>220111110031</i>						17. Union Affiliation of Victim: <i>2605 United Steel Workers of America</i>								