MAI-2007-20

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

REPORT OF INVESTIGATION

Underground Metal Mine
(Copper)

Fatal Fall of Ground Accident
July 30, 2007

Genesis Inc., Troy Mine
Genesis Inc.
Troy, Lincoln County, Montana
Mine I.D. No. 24-01467

Investigators

Thomas E. Barrington
Mine Safety and Health Inspector

Richard Larch
Mine Safety and Health Specialist

Raymond A. Mazzoni
Mechanical Engineer

Sandin E. Phillipson
Geologist

Robert V. Montoya
Mine Safety and Health Specialist

Originating Office
Mine Safety and Health Administration
Rocky Mountain District
Denver Federal Center 6th & Kipling
2nd Street, Bldg. 25, E-16
Denver, CO 80225
Richard Laufenberg, District Manager

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OVERVIEW

Michael E. Ivins, underground mechanic, age 55, was fatally injured on July 30, 2007, when a fall of ground occurred, entrapping him in the cab of a service truck. Ivins had completed repairs to a roof bolter and was waiting for another truck to move when three separate falls of ground occurred. The first fall covered the bed of his truck, the second covered the cab, and the third covered the remainder of the truck.

The accident occurred because management failed to ensure that adverse ground conditions identified during the mining cycle were adequately supported. Management provided a ground control plan listing ground support systems that would enhance control of adverse ground; however, these systems were not fully implemented. Supplemental support materials identified in the ground control plan were not readily available.

GENERAL INFORMATION

The Genesis Inc., Troy Mine, an underground copper mine, located near Troy, Lincoln County, Montana, was owned and operated by Genesis Inc. The principal operating official was Douglas P. Miller, general manager. The mine normally operated two 11-hour shifts per day, seven days a week. Total employment was 180 persons.

The rock was drilled, blasted, and moved by front-end loaders and trucks to an underground crushing facility and then to feed bins. The material was transported to the surface by conveyor where it was milled and processed. The finished products were shipped and sold to commercial industries.

The last regular inspection at this operation was completed on May 15, 2007.

DESCRIPTION OF ACCIDENT

On July 30, 2007, Michael E. Ivins (victim) reported to work at 6:00 a.m. at the surface shop. Darryl Moss, maintenance team leader, assigned Ivins several repair projects. Ivins was notified between 9:00 and 9:30 a.m. that a roof bolter had a broken hydraulic hose and needed repaired. He arrived in the Middle East (ME) 162 heading, parked the service truck, and walked to the roof bolter in crosscut ME 163W. Ivins removed the defective hose and went to an underground shop where he made a replacement hose. When he returned to the ME section, Ivins parked the service truck inby crosscut ME 163V in the ME 162 drift and repaired the roof bolter.

Cole Anderson, shift boss, entered the ME 162 heading about 10:10 a.m. and parked his truck below crosscut ME 163V. He walked to Ivins' service truck and spoke to Ivins, who was sitting in the truck. Ivins told Anderson the bolter was repaired. Anderson walked to the face areas and spoke with Josh Peterson, roof bolter operator, and Allen Layer, roof bolter trainee. Both miners reviewed the work they intended to do since the roof bolter was now operable. Peterson and Layer reported loose ground on the east rib line of the pillar, between ME 163V and ME 163W. Both miners stated they were going to work away from the loose corner until it could be supported.

About 10:25 a.m., Anderson examined the area and returned to his truck. He noted that Ivins had backed his service truck into the ME 163V crosscut. Ivins was waiting for Anderson to move his truck so he could leave the area. Ivins signaled to Anderson indicating material had fallen out of the roof where they had been standing when they had spoken earlier. At that time, more rock fell so Anderson yelled to Layer and Peterson to get out of their work area.

Peterson and Layer ran south in drift ME 162 from crosscut W towards crosscut V. Both miners stated Ivins was parked in crosscut V as they ran past him. Anderson reached his pickup as additional falling material struck the back of Ivins' truck causing one of the rear tires to blow out.

Anderson entered the driver's door of his truck and Layer went in the passenger door when another fall of material occurred covering the cab area of Ivins' truck. Additional material fell striking the driver's side of Anderson's truck pushing it hard to the right toward crosscut ME 162U. Peterson was struck by Anderson's truck at the right front fender area and was thrown across the ME162 entry into crosscut U. The fallen material covered Ivins' truck cab leaving only the grille visible. Anderson and Layer exited the pickup truck, ran south in entry ME162, and met Peterson at crosscut V in the ME 161 heading as several other miners responded to the scene. Arc flashes and smoke were observed coming from under the hood of Ivins' truck and a fire ensued. At 10:40 a.m., Jeff Franke, safety engineer, was notified that a fall of ground had occurred trapping Ivins in his truck. Franke notified emergency personnel and the mine was evacuated due to the fire and smoke.

Mine rescue teams were assembled. A plan was submitted to the Mine Safety and Health Administration (MSHA) and approved. Recovery efforts began and at 7:00 p.m., Ivins' truck was recovered and pulled into crosscut V in ME161 heading. At 9:30 p.m., the coroner examined the accident scene and pronounced the victim dead. The cause of death was attributed to blunt force trauma.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at 10:45 a.m. on July 30, 2007, by a telephone call from Jeff Franke, safety engineer, to Curtis R. Petty, supervisory mine safety and health inspector. An investigation was started the same day. An order was issued under the provisions of Section 103(k) of the Mine Act to ensure the safety of the miners.

MSHA's accident investigation team 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 the County Sheriff's office.

DISCUSSION

Location of the Accident

The area where the accident occurred was a small room-and-pillar section located east of the 165 fault zone, which bounded the main ore body. The area was designated as the Middle East or "ME" section. Drifts were aligned in parallel to the strike of the 165 fault in a northwest orientation with crosscuts on approximately 90-foot centers, offset between adjacent drifts.

Each crosscut was designated in an ascending alphabetical order going north with the drifts identified numerically in descending order away from the 165 fault zone. The west pillar rib line of each drift started the next sequential numbering. The fall of ground occurred in the ME 163 V crosscut at the intersection with the ME 162 drift (Figure 1).

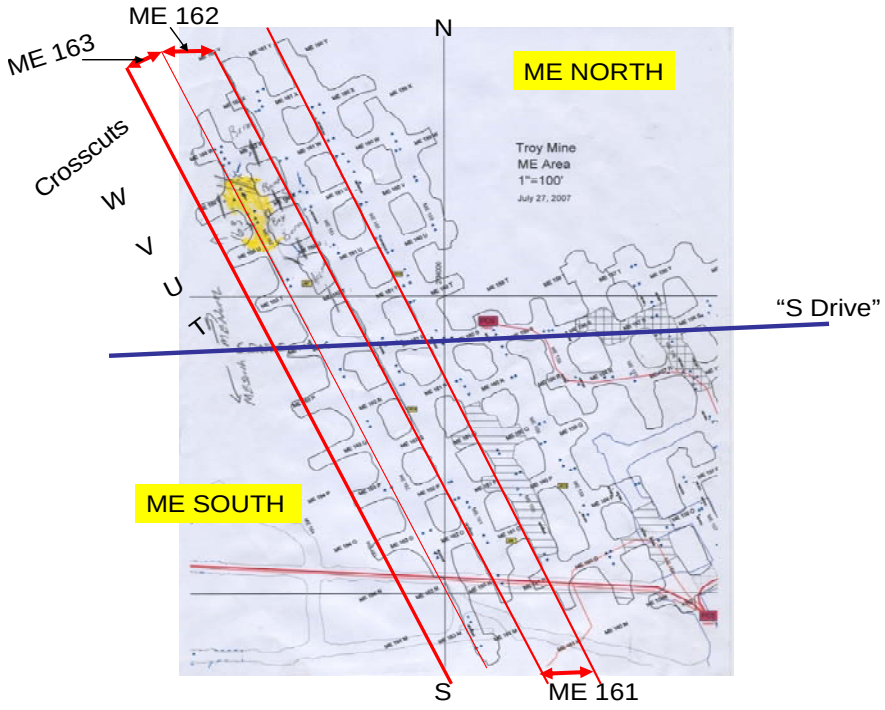

Figure 1

Geology

The mine was developed in three stacked ore bodies, each located in the informally named lower, middle, and upper units of the Mid-Proterozoic-Aged upper Revett Quartzite. The ore bodies were constrained by bedding layers and faults. A dip of 7 to 10 degrees to the southwest was reported.

Mining Practices in Accident Area

The ore body was mined utilizing room-and-pillar extraction methods. Pillars were mostly rectangular in shape and the length and width varied between 40 and 60 feet. Since the pillars were ore, secondary mining of the pillars was common after the initial drift had advanced to a pre-determined depth. Entry widths were initially driven about 27 feet wide. Secondary mining increased the entry width by as much as 13 feet. Pillar sloughing increased the entry width by 3 to 4 feet more. Extraction height measured at several locations averaged 18 feet. Brows and cavities were noted throughout the ME North ore zone. Thicker parts of the middle ore body were mined up to 60 feet high.

The section's orientation was noted to run parallel with the 165 fault with perpendicular joints running from the major units in the section. The face blasting pattern was modified to accommodate the blocky bedded ore making for softer shots to control roof and rib degradation.

Roof Bolter

The roof bolter used to install bolts in the accident area was manufactured by Atlas-Copco/Boltec MC. The carrier was a diesel/electric unit on an articulating frame. The operation station was climate-controlled with a telescoping falling object protective structure and noise reduction added. The drill featured an interactive control system with automatic functions for auto collaring, anti-jamming, drill control, and diagnostic and fault systems. The bolter unit worked as a single feed, multi-function drill.

A variety of bolting units were available from the manufacturer which allowed the installation of different bolt types and sizes. Management optioned for Swellex bolts to control the ground. The roof bolter drilled, inserted, and pressurized the Swellex bolt to bore size. Maximum bolt length was eight feet for this system. The drill boom was designed to rotate 180 degrees with a forward tilt that could install bolts from one rib across the roof to the other rib. Occasionally rib bolts were installed to support utility lines but rib bolts were not installed in the ME section.

Two Sandvik/Tamrock roof bolters, one which could install 7/8 inch resin grouted bolts of varying lengths, among other types of bolts, were available at the mine. These units were not in the ME section during the accident and reportedly had not been used during the section development since the breach of the 165 fault.

When the mine was first developed, fully-grouted rebar was installed to control the ground. When the mine reopened in 2005, the mine operator chose to use Swellex bolts. The bolting pattern consisted of 8-foot long Swellex bolts installed on a 5-foot by 5-foot staggered pattern.

Fall of Ground

The initial fall of ground occurred at a fault zone in the ME 163 at the V crosscut (Figure 2). The fault zone had been encountered in the ME 162 drift between the ME 162T and ME 162U crosscuts. The ME 162 drift was advanced with the fault zone exposed in the back for a distance of approximately 200 feet. The crosscut was advanced westward to the 165 fault contact zone as were all the previous ME 163 crosscuts. Management indicated that ground conditions had been very difficult after encountering the fault zone. Ground water was observed flowing from several joints in the section and a brown stain was noted on fallen material. Difficulties were encountered supporting the back due to stability problems with jointing and spans. To stabilize the fractured back between the Swellex bolts in this fault zone, welded wire mesh was bolted to the back and shotcrete was applied. The shotcrete constituted a thin surface coating that was ineffective for ground stabilization. Management indicated that the fault zone was so problematic that the next pillar (bounded by the ME 162U and ME 162V crosscuts) had not been reduced by secondary mining in an attempt to leave rock to support the fault zone. Mine maps provided by management indicated that the fault zone continued along the ME 162 drift beyond this pillar but the next pillar was reduced in size by secondary mining to extract ore.

The utility truck the victim was operating was parked directly underneath the fault zone where it projected across the mouth of the ME 163V crosscut in the ME 162 drift. Despite recognizing the fault as difficult to control, additional ground support had not been utilized and the ME 162 drift had not been barricaded.

Prior to the accident, records noted that on several occasions the roof and face either had voids, mud slips, or fall of materials. Drift width varied between 25 to 32 feet, with a height of 18 to 20 feet. Wire mesh and 8-foot Swellex bolts had been installed over the brows in the crosscut but rib bolts had not been installed. The continuing deteriorating ground conditions indicated that the current support was inadequate and that different support or supplemental support materials was needed. Since the bolter in this section was limited to installing 8-foot Swellex bolts, another machine would have been needed to install different supports.

After the ground fall, rock fragments ranged in size and were defined by smoother, more regular surfaces indicative of naturally occurring geologic structures. The host quartzite was cut by abundant parallel joint planes spaced 3-10 inches apart, defining a texture of stacked cubes in the back and ribs throughout the ME section. The material that originally fell was estimated at 700 tons.

The initial material removed during recovery placed the break above the anchor point of the 8-foot Swellex bolts. The day after the fall, it had extended south approximately 110 feet, north 70 feet, and across the span of the ME 162 entry to the east pillar line. The apex of the fall could not be accurately calculated from the toe of the fall because the distance exceeded the maximum range of the laser range finder. The fall was estimated to be more than 30 feet above the original roof and the fallen material, after the recovery, was estimated at 3,000 tons.

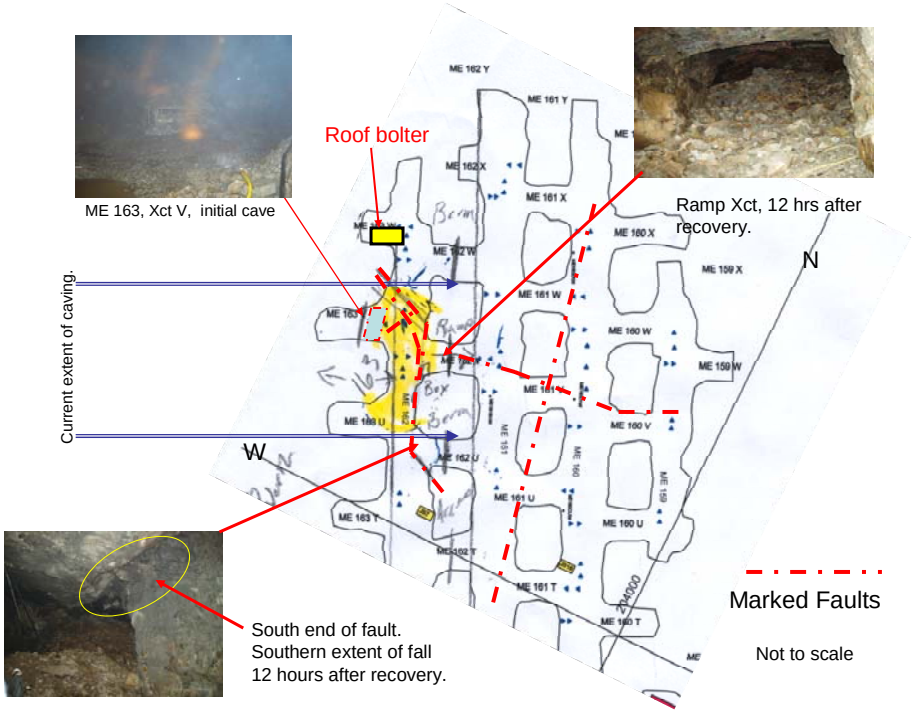

Figure 2

Ground Support Plan

The ground support for typical ground conditions in the mine consisted of the installation of 8-foot Swellex roof bolts, with a 6-inch by 6-inch bearing plate, on a 5-foot by 5-foot staggered pattern.

An additional roof bolt was installed along the open end of the staggered row to keep roof bolts adjacent to the rib line. Roof bolts were installed within 5 feet of the working face.

When adverse conditions were encountered, Swellex bolts were installed on a 4-foot by 4-foot staggered pattern in 1-1/2-inch holes with 6-inch by 6-inch dome embossed, grade 2 plates. Where more difficult ground conditions were encountered, 9 gauge welded wire 4-inch mesh was installed, overlapping, tight to the roof with the Swellex bolts. In some areas shotcrete was applied in a thin layer over the ribs and roof bolts, plates and mesh for additional support.

The ground support plan included grouted Dywidag bolts, steel mats, shotcrete and steel arch sets. When checked, no steel arch support sets were on site.

Training and Experience

Michael E. Ivins had two years, 10 months mining experience, all at this mine. He had received training in accordance with 30 CFR, Part 48.

Cole Anderson had three years mining experience. He had received training in accordance with 30 CFR, Part 48.

Allen Layer had 10 months mining experience, all at this mine. He had received training in accordance with 30 CFR, Part 48.

Josh Peterson had one year, 4 months mining experience, all at this mine. He had received training in accordance with 30 CFR, Part 48.

ROOT CAUSE ANALYSIS

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

Causal Factor: Management policies, procedures, and controls were inadequate and did not ensure that persons were protected from fall of ground hazards where they worked or traveled. Management failed to follow the ground support plan they had established and did not require additional ground support to be installed in the location where the fault existed.

Corrective Action: Management should design and implement a ground support system for the entire mine that controls the ground where persons work or travel. Machinery and materials to provide additional ground support should be readily available underground when ground conditions require their use. Miners should be trained to install additional support when necessary in adverse conditions.

Causal Factor: Management failed to address adverse ground conditions identified and reported during work place examinations. Persons conducting the examinations failed to require additional roof support materials be installed to control the ground where the fault was visible.

Corrective Action: Management should establish procedures to ensure ground examinations are conducted and adverse ground conditions are taken down or adequately supported. Persons conducting the examinations should be trained to recognize and eliminate hazardous ground conditions.

CONCLUSION

The accident occurred because management failed to ensure that adverse ground conditions identified during the mining cycle were adequately supported. Management provided a ground control plan listing ground support systems that would enhance control of adverse ground; however, these systems were not fully implemented. Supplemental support materials identified in the ground control plan were not readily available.

ENFORCEMENT ACTIONS

Order No. 6321797 was issued on July 30, 2007, under the provisions of Section 103(k) of the Mine Act:

A serious accident occurred at this operation on July 30, 2007, when a miner was trapped underground due a ground failure. Additionally, the vehicle he was in caught fire which necessitated evacuating the mine. This order is issued to ensure the safety of all persons at this operation. It prohibits all activity underground with the exception of the mine rescue teams in their efforts to rescue the miner and extinguish the fire. All other activities are to stop until MSHA has determined that it is safe to resume normal mining operations underground. The operator shall obtain prior approval from an authorized representative for all actions to recover and/or restore operation in the mine.

This order was terminated on December 4, 2007. Conditions that contributed to the accident have been corrected.

Citation No. 6319499 was issued on August 22, 2007, under the provisions of Section 104(d)(2) of the Mine Act for a violation of 30 CFR 57.3360:

A fatal accident occurred at this mine on July 30, 2007, when a pickup truck was crushed from falling rocks, caught fire, and trapped the victim inside the cab. Adequate ground support was not installed and maintained in the area to control the ground. The mine operator had knowledge of the unstable ground conditions in the area where the accident occurred. Failure to install and maintain adequate ground support to protect miners from ground fall hazards constitutes more than ordinary negligence and is an unwarrantable failure to comply with a mandatory standard.

This citation was terminated on November 11, 2007. The area where the accident occurred was barricaded to prevent passage of miners.

Approved by: Date: January 22, 2008

Richard Laufenberg
District Manager

APPENDICES

A. Persons Participating in the Investigation
B. Victim Data Sheet

APPENDIX A
Persons Participating in the Investigation

Genesis Inc., Troy Mine

Jeff Franke	safety engineer
Douglas P. Miller	general manager
Bruce Clark	mine superintendent
Donald B. Davis	mine foreman
Larry Erickson	geologist

Lincoln County Sherriff's Department

Shawn Trasher	paramedic
Lt. James Sweet	sheriff's office
Steve H. Schnackenberg	deputy coroner

Mine Safety and Health Administration

Thomas E. Barrington	mine safety and health inspector
Raymond A. Mazzoni	mechanical engineer
Sandin E. Phillipson	geologist
Robert V. Montoya	mine safety and health specialist
Richard Larch	mine safety and health specialist

APPENDIX B
Victim Data Sheet, MSHA Form 7000-50b

Accident Investigation Data - Victim Information
Event Number: 1 1 0 3 8 9 6

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

Victim Information: 1

1. Name of Injured/Ill Employee:	2. Sex	3. Victim's Age	4. Last Four Digits of SSN:	5. Degree of Injury:
Michael E. Ivins	*M*	*55*		*01 Fatal*

6. Date(MM/DD/YY) and Time(24 Hr.) Of Death: *a. Date: 07/30/2007 b.Time: 21:30*

7. Date and Time Started: *a. Date: 07/30/2007 b.Time: 6:00*

8. Regular Job Title: *004 Mechanic*

9. Work Activity when Injured: *039 Maintenance*

10. Was this work activity part of regular job? Yes X No

11. Experience	Years	Weeks	Days		Years	Weeks	Days		Years	Weeks	Days		Years	Weeks	Days
a. This Work Activity:	2	40	2	b. Regular Job Title:	2	40	2	c: This Mine:	2	40	2	d. Total Mining:	2	40	2

12. What Directly Inflicted Injury or Illness? *121 Fall of roof material*

13. Nature of Injury or Illness: *170 Crushing*

14. Training Deficiencies:
Hazard: | New/Newly-Employed Experienced Miner: | Annual: | Task:

15. Company of Employment:(If different from production operator) *Operator*

Independent Contractor ID: (if applicable)

16. On-site Emergency Medical Treatment:
Not Applicable: | First-Aid: X | CPR: | EMT: | Medical Professional: | None:

17. Part 50 Document Control Number: (form 7000-1)

18. Union Affiliation of Victim: *9999 None (No Union Affiliation)*

Victim Information:

1. Name of Injured/Ill Employee:	2. Sex	3. Victim's Age	4. Last Four Digits of SSN:	5. Degree of Injury:

6. Date(MM/DD/YY) and Time(24 Hr.) Of Death:

7. Date and Time Started

8. Regular Job Title:

9. Work Activity when Injured:

10. Was this work activity part of regular job? Yes | No

11. Experience:	Years	Weeks	Days		Years	Weeks	Days		Years	Week	Days		Years	Weeks	Days
a. This Work Activity:				b. Regular Job Title:				c: This Mine:				d. Total Mining:			

12. What Directly Inflicted Injury or Illness?

13.Nature of Injury or Illness:

14. Training Deficiencies:
Hazard: | New/Newly-Employed Experienced Miner: | Annual: | Task:

15. Company of Employment: (If different from production operator)

Independent Contractor ID: (if applicable)

16. On-site Emergency Medical Treatment:
Not Applicable: | First-Aid: | CPR: | EMT: | Medical Professional: | None:

17.Part 50 Document Control Number: (form 7000-1)

18. Union Affiliation of Victim:

Victim Information:

1. Name of Injured/Ill Employee:	2. Sex	3. Victim's Age	4. Last Four Digits of SSN:	5. Degree of Injury:

6. Date(MM/DD/YY) and Time(24 Hr.) Of Death:

7. Date and Time Started:

8. Regular Job Title:

9. Work Activity when Injured:

10. Was this work activity part of regular job? Yes | No

11. Experience:	Years	Weeks	Days		Years	Weeks	Days		Years	Week	Days		Years	Weeks	Days
a. This Work Activity:				b. Regular Job Title:				c: This Mine:				d. Total Mining:			

12. What Directly Inflicted Injury or Illness?

13. Nature of Injury or Illness:

14. Training Deficiencies:
Hazard: | New/Newly-Employed Experienced Miner: | Annual: | Task:

15.Company of Employment:(If different from production operator)

Independent Contractor ID: (if applicable)

16. On-site Emergency Medical Treatment:
Not Applicable: | First-Aid: | CPR: | EMT: | Medical Professional: | None:

17. Part 50 Document Control Number: (form 7000-1)

18. Union Affiliation of Victim: