CAI-2004-10

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
COAL MINE SAFETY AND HEALTH

REPORT OF INVESTIGATION

Surface Coal Mine

Fatal Powered Haulage Accident
February 10, 2004

Colony Bay Surface Mine
Colony Bay Coal Company
Wharton, Boone County, West Virginia
I.D. No. 46-06272

Accident Investigator

Bobby G. Moreland
Accident Investigator/
Coal Mine Safety and Health Inspector (Electrical)

Originating Office
Mine Safety and Health Administration
District 4
100 Bluestone Road, Mount Hope, West Virginia 25880
Jesse P. Cole, District Manager

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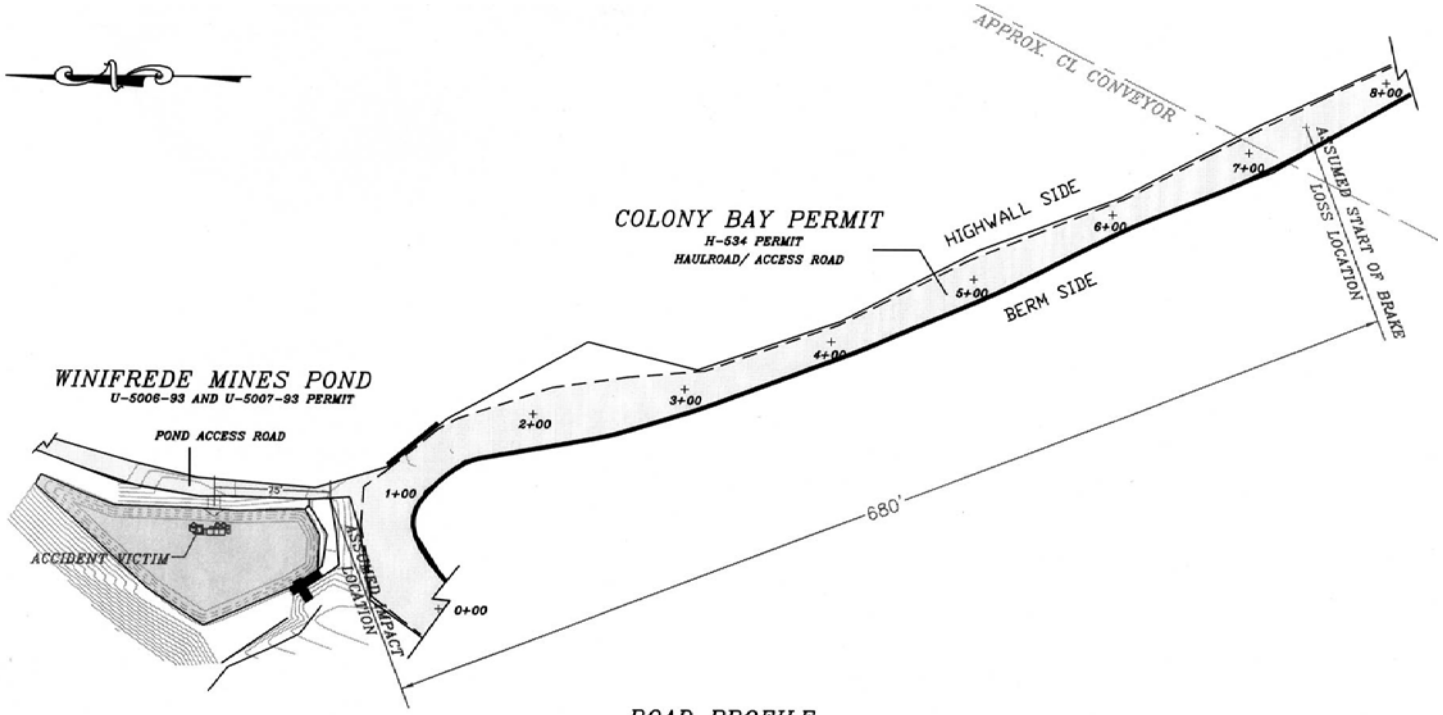
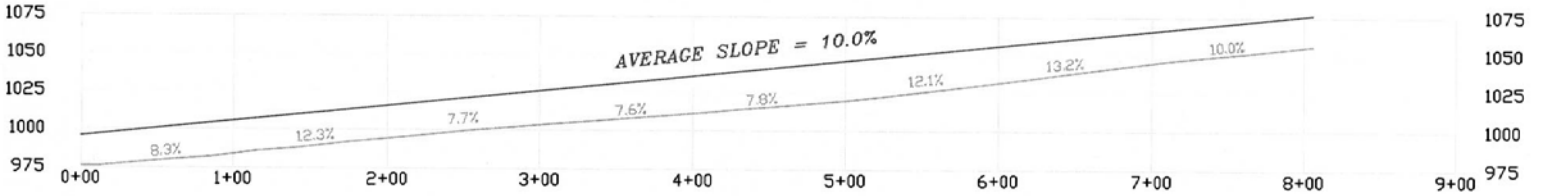


ROAD PROFILE



MAP SHOWING
LUB-TRUCK ACCIDENT
COLONY BAY COAL COMPANY
FEB. 10, 2004

OVERVIEW

At 6:30 p.m., on Tuesday, February 10, 2004, Robert Littreal, a 54-year old truck driver with more than 22 years of mining experience received serious injuries at the Colony Bay Coal Company, Colony Bay Surface Mine. Mr. Littreal was descending the main access road in a 1993 Chevrolet (Kodiak) service truck, when the truck lost use of the braking system. The brake system failure resulted in the truck traveling approximately 680 feet down a 10% grade, hitting a 24-inch pipe and berm beside a sediment pond, traveling an additional 75 feet up the pond access road and sliding into the pond.

The service truck landed on the driver's side in approximately ten feet of water. The driver was submerged beneath the water for two to three minutes before being reached by company personnel. First aid was administered by company emergency medical technicians and Boone County Ambulance medical personnel. The victim was then transported to the Charleston Area Medical Center, General Division, Charleston, Kanawha County, West Virginia. The victim died on February 26, 2004.

The accident occurred because the brakes on the service truck failed. The operator failed to provide an adequate preoperational examination of the truck which would have identified multiple brake system safety defects. Work procedures specified in the safety program to ensure that equipment was in safe operating condition were not adequately monitored by mine management.

GENERAL INFORMATION

The Colony Bay Surface Mine is a bituminous coal surface mine located near Wharton, Boone County, West Virginia. Mining operations began December 16, 1980. The mine is currently being operated by Colony Bay Coal Company. The mine operates two 7-1/4-hour shifts, five days per week. The mine employs 38 people, including seven supervisors.

There are four coal seams within the boundaries of the mining property. Seam thicknesses range from approximately 3 to 6 feet. Parting between the seams varies from a few inches to 60 feet.

The mine has three inactive pits on a 1,200-acre site. Reclamation work with highwall development for several projected underground mines is being completed with Caterpillar, Model 992; front endloaders; Ingersoll Rand, highwall drills; and Caterpillar, Model 777, rock trucks. The coal stockpile is being loaded with Caterpillar, Model 992, front endloaders, into tractor trailers for transportation to a draw-off tunnel stockpile area. The coal is then loaded onto a conveyor belt system and transported to Eastern Associated Coal Corporation's Rocklick Preparation Plant.

The principal officers of the mine at the time of the accident are:

Fred Connors ---------- Director
C.B. Howell ---------- Mine Manager
Jeffrey Andrews -------- Supervisor
George Taylor ---------- Supervisor
Mike Elkins ---------- Manager Safety and Training

Prior to the accident, the Mine Safety and Health Administration (MSHA) completed its last regular safety and health inspection on November 13, 2003. The non-fatal days lost (NFDL) incidence rate for the year prior to the accident was 13.65 at the Colony Bay Surface Mine compared to the nation rate for surface coal mines of 1.76.

DESCRIPTION OF THE ACCIDENT

At approximately 2:30 p.m., Tuesday, February 10, 2004, the second shift crew arrived at the portal area. The work assignments were given by George Taylor, Foreman. Barry Rider and Robert Deweese, day shift equipment operators, were working the evening shift at the slip area, (a road construction area located beside the main access road, under the new belt line, near Checkpoint 3 (CP3)). At the slip area Deweese and Rider were loading dirt and rock material into a truck being operated by Michael Bell. Al Proffitt, Mechanic, and Robert Littreal, Truck Driver (victim), were assigned to fuel the equipment in the slip area by using the Caterpillar 777 truck. Several other second shift crew members were working at various locations on the mine property.

At approximately 5:00 p.m., Proffitt and Littreal were sent to the slip area to cut a piece of metal off of the excavator. During the cutting operation, a hydraulic hose was burned and needed to be replaced. Proffitt and Littreal made several trips in a mechanics truck from the excavator to the shop in order to locate and make the correct hose and fitting. Proffitt remained at the shop to complete the hose and fitting, while Littreal started down the main access road in the service truck. Littreal was traveling from the shop to the slip are in order to refill the excavator with hydraulic fluid which was lost during the repair work.

Shortly before 6:30 p.m., Bell and Rider were sitting in a rock truck at the slip area when Littreal yelled over the CB radio, “Michael, is anybody coming up the hill?” Bell responded, “No”. Littreal said, “I’ve lost my brakes. I’m going to ride it out.” About the same time, both Bell and Rider looked above the slip area and saw the service truck coming under the new belt line at a high rate of speed. They said it appeared that the truck turned sharply to the right at the sediment pond, hit the berm, traveled the pond road, and slid into the sediment pond. The service truck landed on the driver’s side in approximately ten feet of water.

Bell and Rider immediately traveled to the accident site. While traveling they notified Taylor that Littreal had wrecked the service truck in the sediment pond. Bell also

notified Deweese to come to the sediment pond to help. Taylor notified the other crew members to contact 911, continue monitoring, and assist as needed.

Bell said he only saw the rear wheels of the service truck out of the water when he got to the pond. Rider immediately jumped into the pond and opened the passenger (right side) door, where he found the victim and pulled his head above the water. The victim had been under water for two to three minutes and was not breathing. Bell jumped into the water to assist in removing the victim from the service truck. Proffitt threw a tow chain to Bell and Rider to attach to the victim's shirt, in order to pull him to the side of the pond. The victim was being pulled up the side of the pond, when he started to breath again. Oxygen was administered to the victim and he appeared to be alert and understood what was happening.

Shortly thereafter, the Boone County Ambulance Authority medical personnel arrived and continued medical treatment. About 7:00 p.m., the victim was transported by the Boone County Ambulance Authority to the Wharton ball field, where he was transported via Health Net to the Charleston Area Medical Center (General Division) at Charleston, Kanawha County, West Virginia.

The victim died on February 26, 2004, from complications resulting from the February 10, 2004, accident.

INVESTIGATION OF THE ACCIDENT

The Mine Safety and Health Administration was officially notified at 7:30 p.m., on February 10, 2004, that a powered machinery accident had occurred. MSHA personnel were dispatched to the mine at 6:00 a.m., on February 11, 2004. The Mine Safety and Health Administration and the West Virginia Office of Miners' Health, Safety and Training, jointly conducted the investigation, with the assistance of mine management and the miners of Colony Bay Coal Company. A list of those who were present and/or participated in the investigation is included in Appendix A.

DISCUSSION

SERVICE TRUCK

The truck involved in the accident was a 1993 Chevrolet (Kodiak) tandem drive axle truck, Model C7H, Vehicle Identification Number (VIN) 1GBS7H4JXPJ102730. It is designated as company truck number 365. The truck was equipped with a Caterpillar, Model 3116, 6.6 Liter, six-cylinder diesel engine rated for 215 Gross HP at 2,600 RPM and a 5-speed Allison MT 650 automatic transmission. The manufacturer's recommended gross vehicle weight rating (GVWR) was 47,180 pounds. The service

truck was not equipped with an engine or transmission retarder to assist in downhill braking.

Transmission

The transmission was an Allison 5-speed automatic, Model MT 650, Serial No. 056457 with five forward speeds and one reverse speed. The transmission selector was such that six different positions could be selected. This included: 1^{st}, 2^{nd}, 2^{nd} - 4^{th}, 2^{nd} – 5^{th}, neutral; and reverse. The 1^{st} and 2^{nd} selector positions held the transmission in the selected gear during normal operation. The 2^{nd} – 4^{th} and 2^{nd} – 5^{th} selector positions would initially select 2^{nd} gear. The transmission would then automatically shift throughout these speed ranges during normal operation. However, the transmission automatically up shifts whenever an engine overspeed condition exists, regardless of the transmission selector position. When tested manually the transmission selector operated properly in all positions.

Service and Park Brake

An examination of the braking system showed that the system was not being maintained. A summary of the examination results are as follows:

1) All four of the tandem drive axle (rear) brake drums were worn beyond the manufacturer's maximum allowable wear limit. The oversize brake drum diameters on the tandem drive axle brakes would increase the rate of deterioration of the braking capacity for these brakes due to reduced heat absorption capacity. Brake shoe linings on all three of the left side brakes showed physical characteristics of excessive heat conditions.

2) The push rod lengths on the tandem drive axle (rear) brakes were longer on the right side than those on the left side of the truck. With the brakes at similar stroke adjustments and under normal braking conditions, the inconsistency of push rod lengths between the left and right side drive axle brakes would result in a brake imbalance. The right side drive axle brakes would provide approximately 20% more braking in comparison to the left side drive axle brakes, thus increasing the wear rate of the right side drive axle brakes in comparison to the left side drive axle brakes.

The condition of brake system components was the result of poor maintenance and ineffective pre-operational checks. Service manuals which would outline proper brake maintenance procedures were not available on mine property to instruct maintenance personnel. Operating the truck with compromised service brakes affected the victim's ability to control the truck on the downhill grade. Additionally, the combined effects of a lacking engine retarder and an automatic transmission design characteristic (automatic upshifting to protect the engine), increased the dependency on the service brakes to control the truck during descent.

EXAMINATIONS

Records for the past 30 days were examined and no completed pre-operational checklist forms could be found for the service truck. As previously mentioned, several safety defects were found during an inspection of the service truck brake system after the accident. Each of the defects contributed to the accident and would have been present during the pre-operational examination at the beginning of the shift. A preoperational examination record book was recovered from within the truck, however it was found to be illegible due to submersion beneath the water. During interviews it could not be determined if other persons had operated the truck prior to the accident. This was largely due to the operating schedule of the truck. The truck is operated on an irregular basis, only one to two times per week.

MINE ROADS

The road profile was measured by management personnel where it was reported the victim started to lose control of the truck. The road was approximately 1.5 miles long consisting of varying grades (1% to 13.2%) that averaged a 10 % descent. The main access road was asphalt construction, with dry conditions and good visibility. The pond road was constructed with rock and dirt, 12 to 15 feet wide, approximately 175 feet long, with an average uphill grade of 6.1%. It was being used as an access road to the water treatment chemical tanks located at the back side of the sediment pond.

SEDIMENT POND (PADDED POND)

The Padded Pond is a sediment pond constructed with rock, dirt and manufactured concrete pads. The pond is approximately 130 feet wide x 170 feet long x 15 feet deep and is used as a water storage and treatment area for water from two underground operations. Three chemicals were found at or in the drainage system for the Padded Pond. All were being used for water treatment. The chemicals present and the manufacturer were:

1) O'B Floc Pac 100 – Zinkon Enterprise / O'Brien Products
2) O'B Defoamer – Zinkon Enterprise / O'Brien Products
3) Sodium Hydroxide – P B & S Chemical Co., Inc.

The constituents of the water in the Padded Pond were determined to be at safe concentrations.

SAFETY PROGRAM

At the time of the accident, Colony Bay Coal Company, had a comprehensive safety program (required by 30 CFR, Part 77.1708). Copies of the safety program were not distributed to each employee and posted in conspicuous places throughout the mine. The employees interviewed did not understand what the safety program was or the relevant program requirements.

ROOT CAUSE ANALYSIS

An analysis was conducted to identify the most basic causes of the accident, that are correctable through reasonable management controls. During the analysis, causal factors were identified that, if eliminated, would have either prevented the accident or mitigated its consequences.

Listed below are causal factors identified during the analysis and their corresponding corrective actions implemented to prevent a recurrence of the accident:

Causal Factor: The service truck was not equipped with adequate brakes. Management failed to monitor policies and work procedures to ensure the 1993 Chevrolet (Kodiak) tandem drive axle truck was provided with adequate brakes.

Corrective Action: Management should routinely observe work habits, monitor communications, and enforce safety rules to ensure compliance with all such procedures. Management should provide manufacturer's service manual to ensure that all inspections, repairs, and manufacturer equipment recommendations are being complied with at all times. Following the accident, management proposed that truck braking systems should be maintained to the original equipment specifications and designed a maintenance plan that incorporates the manufacturer's brake system specifications.

Causal Factor: The defective truck brakes were not identified before the truck was placed into service. Management failed to enforce established work procedures to ensure pre-operational checks were being performed on equipment. The pre-operational checks are required by the company safety program and were not being consistently performed as required. No record of the pre-operational checks could be found for the previous 30 days. An adequate pre-operational check would have identified the inoperative brakes and prompted corrective measures prior to operating the truck on steep grades.

Corrective Action: Management should evaluate the current pre-operational inspection guidelines and out-of-service criteria. A system should be implemented to ensure that pre-operation checks are being properly conducted and company guidelines are being followed. The guidelines and accountability system should be monitored on a continuing basis, utilizing the frontline supervisors, safety department, and other members of management for consistency, effectiveness, and accountability. Brakes should be maintained on all equipment operating on mine property. Following the accident, management proposed that all truck braking systems should be maintained to the original equipment specifications and designed a maintenance plan that incorporates the manufacturer's brake system specifications.

CONCLUSION

The accident occurred because the brakes on the service truck failed. The operator failed to provide an adequate preoperational examination of the truck which would have identified multiple brake system safety defects. Work procedures specified in the safety program to ensure that equipment was in safe operating condition were not adequately monitored by mine management.

Approved By:

ORIGINAL SIGNED BY **OCTOBER 5, 2004**
Jesse P. Cole Date
District Manager

ENFORCEMENT ACTIONS

1. A 103(k) Order was issued to Colony Bay Coal Company to ensure the safety of persons at the mine until an investigation of the accident could be completed.

2. A 104(d) (1) Citation was issued to Colony Bay Coal Company for a violation of 30 CFR, Part 77.1605(b). During a fatal accident investigation it was determined that the 1993 Chevrolet (Kodiak) Tandem Drive Axle Truck, Model C7H, Vehicle Identification Number (VIN) 1GBS7H4JXPJ102730, company truck number 365, being operated on the elevated access road to the Colony Bay Surface Mine was not equipped with adequate brakes. The following safety defects were observed:

   Brake System:
   1. Right side, steering axle air canister, push rod, with no air applied, was at full stroke.
   2. Right side, steering axle, brake shoe lining had excessive wear with exposed rivet heads.
   3. Left rear tandem drive axle, brake shoe lining was off set in the drum with tapered wear on the bottom shoe (worn into rivets on the wheel side).
   4. All four of the tandem drive axle's drum diameters were oversized or worn beyond the manufacturer's allowable wear.
   5. The right front tandem drive axle and the left rear tandem drive axle would turn freely with the park brake applied.

   The failure to provide an adequate braking system contributed to the accident that occurred on 02/10/2004.

3. A 104(d) (1) Order was issued to Colony Bay Coal Company for a violation of 30 CFR, Part 77.1606(a). During a fatal accident investigation it was determined that the 1993 Chevrolet (Kodaik) Tandem Drive Axle Truck, Model C7H, Vehicle Identification Number (VIN) 1GBS7H4JXPJ102730, company truck number 365, being operated on the elevated access road to the Colony Bay Surface Mine was not provided with an adequate inspection before the truck was placed in operation. The following safety defects were observed:

   Brake System:
   1. Right side, air canister, push rod, with no air applied, was at full stroke.
   2. Right side, steering axle, brake lining worn with exposed rivets.
   3. Left side, rear drive tandem, brake lining offset in the drum and the bottom of the shoe had tapered wear (worn into the rivets on the wheel side).
   4. Right rear, front drive tandem axle and the left rear, rear drive tandem axle would turn freely with the park brake applied.

   The failure to provide an adequate inspection prior to placing the service truck into service contributed to the accident that occurred on 02/10/2004.

APPENDIX A

The Mine Safety and Health Administration conducted an investigation and those who were present and/or participated were:

Colony Bay Coal Company

Chetty Howell	Mine Manager
Jeff Andrews	Supervisor
Leland Taylor[1]	Supervisor
Bard Accords	Engineer
Michael Bell[1]	Truck Driver
Chuck Albu[1]	Blaster
Bobby Deweese[1]	Dozer Operator
Barry Rider[1]	Excavator Operator
Charles Proffitt[1]	Mechanic
John Halsey[2]	Dozer Operator
Gary Walker[1]	Mechanic
James Carpenter	Mechanic

Peabody Energy

Fred Conner	Director/Conservancy
Terry Hudson	Director/Safety

Eastern Associated Coal Corporation/Colony Bay Coal Company

Mike Elkins	Safety Supervisor

United Mine Workers of America

Richard Glover	International Representative
Edward Kincaid	Safety Committee Chairman
Gene Saunders	Mine Committee

[1] Persons interviewed.

[2] Persons providing written statement only.

West Virginia Office of Miners' Health, Safety and Training

Terry Farley	Administrator
Harry T. Linville	Inspector-at-Large
Randall Bailey	Surface Inspector
Steve Cox	Inspector
Willie Barker	Inspector

Mine Safety and Health Administration

Bobby G. Moreland	Accident Investigator
Fred T. Marshall	Technical Support - Mechanical Engineer
George Nelson	CMS&H Inspector
Vaughan Gartin	CMS&H Inspector
Terry D. Price	CMS&H Supervisor

APPENDIX B

Colony Bay Surface Mine
Colony Bay Coal Company
Wharton, Boone County, WV
I.D. Number 46-06272

APPENDIX C

EQUIPMENT-RELATED PHYSICAL FACTORS FOR A FATAL ACCIDENT AT COLONY BAY SURFACE MINE IN BOONE COUNTY, WEST VIRGINIA

PAR NO. 89617

LOCATION: Colony Bay Coal Surface Mine, Mine ID No.46-06272, Boone County, West Virginia.

EMPLOYER OF ACCIDENT VICTIM: Colony Bay Coal Surface Mine, Mine ID No. 46-06272, Boone County, West Virginia.

EQUIPMENT: 1993 Chevrolet Kodiak Tandem Drive Axle Lube Truck, VIN 1GBS7H4JXPJ102730.

DATE OF ACCIDENT: February 10, 2004.

EQUIPMENT PRINCIPAL INVESTIGATOR: Terry Marshall, Mechanical Engineer, Applied Engineering Division, Approval and Certification Center.

ACCIDENT SUMMARY: A 54 year old truck driver was seriously injured when the lube truck he was driving failed to negotiate a sharp curve as he was descending the main access road of the mine. An access road to a pond intersected the main access road of the mine at the beginning of this curve. The truck apparently struck a pipe within the earthen berm at the intersection, continued traveling up the pond road, and slid into the pond after traveling approximately 75 feet past the pipe. He had reportedly just picked the truck up from the maintenance building, to take it to perform service on a piece of equipment located near the bottom of the access road. On the way down the hill, eyewitnesses stated that the victim communicated over the CB radio that he was having brake problems and that he was riding it out. The accident victim died approximately sixteen days later, reportedly due to complications from the accident.

PURPOSE OF EVALUATION: Determine if any equipment-related factors contributed to the accident.

DATES OF EQUIPMENT FIELD EVALUATION: February 17–20, 2004.

Note: A technical investigation and disassembly of the machine was initiated by MSHA inspectors prior to MSHA Technical Support starting a field investigation. The brake chamber stroke measurements and removing of the brake drums were completed prior to Technical Support's invitation to join the field investigation.

PHYSICAL FACTORS:

1) MACHINE INFORMATION: The service truck was a 1993 Chevrolet Kodiak Tandem Drive Axle Truck, Model C7H, Vehicle Identification Number (VIN) 1GBS7H4JXPJ102730. It was designated as company truck No. 365. The truck was equipped with a Caterpillar Model 3116, 6.6 Liter, six cylinder diesel engine rated for 215 Gross HP at 2,600 RPM and a 5-speed Allison MT 650 automatic transmission. The manufacturer's maximum recommended gross vehicle weight rating (GVWR) was 47,180 pounds. The service truck was not equipped with an engine or transmission retarder to assist in downhill braking and Original Equipment Manufacturer (OEM) build code options indicate that the tandem drive axles were equipped with a 6.14 axle ratio.

2) MINE ROAD AND VISIBILITY INFORMATION: The mine road leading to the area, where it was reported the victim started to lose control of the truck, was an approximately 1½ mile long descent, with varying grades. The road profile was measured by mine personnel and the results are summarized in Table #1. The highlighted section of downgrade denotes the approximate area where the victim reported that the truck lost its brakes. The time of the accident was reported to be approximately 6:30 p.m.

Grade (%)	Slope Length (ft)	Total Downhill Distance Traveled (miles)	Total Uphill Distance Traveled (feet)
- 1.0	1,640	0.3	
- 1.6	632	0.4	
- 11.3	496	0.5	
- 8.7	580	0.6	
- 7.6	660	0.8	
- 7.5	680	0.9	
- 6.9	728	1.0	
- 8.4	600	1.1	
- 8.1	608	1.3	
- 6.4	800	1.4	
- 11.3	444	1.5	
- 13.2	380	1.6	
- 10.1	996	1.8	
- 10.5	700	1.9	
0	0		0
3.9	25		25
12.1	33		58
8.4	48		106
0	30		136

Table #1: Access road profile from maintenance shop to area where truck slid sideways

over embankment, into pond.

3) TRANSMISSION: The transmission was an Allison 5-speed automatic, Model MT 650, Serial No. 056457 with five forward speeds and one reverse speed. The transmission selector was such that six different positions could be selected. This included: 1st; 2nd; 2nd-4th; 2nd-5th; Neutral; and Reverse. The 1st and 2nd selector positions held the transmission in the selected gear during normal operation. The 2nd-4th and the 2nd-5th selector positions would initially select 2nd gear. The transmission would then automatically shift throughout these speed ranges during normal operation. However, the transmission automatically upshifts whenever an engine overspeed condition exists, regardless of the transmission selector position. The transmission selector was operated throughout all positions with no complications, and the selector lever could not be moved into another position without first depressing the thumb-operated selector lever's release mechanism.

4) SERVICE AND PARKING BRAKE SYSTEMS: The truck had a dual-circuit air brake system with s-cam type drum brakes at all six wheels. All six of the drum brakes were 16.5 inch Rockwell Q-type brakes. It had air-actuated service brakes at all six wheels and spring-applied, air-released parking brakes on the 4 tandem drive axle wheel positions, or rear wheels. The drums on these six brakes had 16.5 inch nominal inside diameters with a manufacturer's maximum specified wear limit of 16.620 inches, or 0.120 inches over the nominal diameter.

The service brakes were functionally tested using the foot valve (service brake pedal). All six service brakes cycled when the foot valve was cycled. Service brake pressures at each of the three axles were consistent with the primary and secondary tanks' system pressures.

The brakes on the steering axle (front brakes) were 16.5" X 5" (Brake Diameter X Shoe Lining Width) with Type 24 single-chamber service brake actuators. The slack adjuster effective lengths for both front brakes are shown in Table #2.

	Left Side (inches)	Right Side (inches)
Steering Axle	5 ½	5 ½

Table #2: Steering Axle Service Brake Slack Adjuster Lengths

The service brake pushrod strokes for the Type 24 chambers on the steering axle were measured by MSHA Inspectors and the brake drums were removed, at their request, prior to Technical Support being invited to participate in the field investigation. Both the left and right side brake drum diameters of the steering axle were relatively within manufacturers wear limits.

The four brakes on the tandem drive axles (rear brakes) were 16.5" X 7" brakes with Type 30-30 combination actuators. These combination actuators had two chambers, one

was an air-activated (applied) service brake chamber and the other was a spring-applied, air-released, park brake chamber.

The measured slack adjuster effective lengths for tandem drive axle brakes are shown in Table #3.

	Left Side (inches)	Right Side (inches)
Front Drive Axle	5	6
Rear Drive Axle	5	6

Table #3: Tandem Drive Axles' Slack Adjuster Lengths

The spring-applied parking brake pushrod strokes for the Type 30-30 chambers on the tandem drive axles were measured by MSHA inspectors, and the brake drums were removed at their request, prior to Technical Support being invited to participate in the field investigation.

All four of the tandem drive axles' drum diameters were oversized, or worn beyond the manufacturer's allowable wear. The device used to measure the drum face diameters had a maximum limit of 16.750 inches. This made it capable of measuring 0.250 inches over the nominal face diameter of 16.5 inches. In comparison, this device was capable of measuring over twice the amount of the manufacturer's allowable wear of 0.120 inches. The measured effective drum face diameters for the tandem drive axle brakes are shown in Table #4.

	Left Side (inches)	Right Side (inches)
Front Drive Axle	> 16.750	> 16.750
Rear Drive Axle	> 16.750	> 16.750

Table #4: Tandem Drive Axles' Effective Drum Face Diameters

Visual observations of the shoe linings indicated that all three left side brakes had experienced various degrees of melting of the lining surfaces, sometimes referred to as glazing. Glazed surfaces of the brake linings of left side steering axle brake and the left front tandem drive axle brake were visible. However, the layer of glazing on the left rear tandem axle brake appeared to have been sheared off by the rotational movement of the drum. This visibly left small grooves worn into the lining material in the direction of drum rotation and small bead-like pieces of lining material on some areas of the lining surfaces, leaving a sandpaper-like texture on some areas of the grooved linings. Lining conditions for the brake shoes are summarized in Table #5. In comparison, a new lining has an approximate thickness of ¾ inch.

	Left	Side		Right	Side
	Approximate	Lining Condition		Approximate	Lining

	Lining Thicknesses at Shoe Center (inches)	Comments		Lining Thickness (inches)	Condition Comments
Steering Axle	⅜	Visibly Glazed		See comment	Worn to rivet heads
Front Drive Axle	½	Visibly Glazed		½	None
Rear Drive Axle	⅜	Lining damage, shoes offset in drum, and bottom shoe had tapered wear (worn to rivets on wheel side)		½	None

Table #5: Brake Shoe Lining Conditions

The parking brake valve was functionally tested. All four parking brake chambers cycled when the parking brake valve was cycled. Parking brake release pressures for both of the tandem drive axles were consistent with the primary and secondary tanks' system pressures. The parking brake valve automatically set when the primary air tank's system pressure dropped to approximately 30 psi. The combination (service and parking brake) air chamber on the right front tandem drive axle had an audible leak with the parking brake released. One of the clamps was visually damaged and the air leak was determined to be coming from this area. This damage was reportedly done during the accident and/or recovery. The air leaking from the clamp area audibly changed, depending on system pressure, and no significant audible leaks were detected during some of the tests when the primary air tank's system pressure fell below 70 PSI. The secondary air tank's system pressure experienced approximately a 2 PSI per minute loss of air pressure with this brake chamber removed from the system at an initial pressure of approximately 110 PSI.

SUMMARY:

1) All four of the tandem drive axle (rear) brake drums were worn beyond the manufacturer's maximum allowable wear limit. The oversized brake drum diameters on the tandem drive axle brakes would increase the rate of deterioration of the braking capacity for these brakes, due to reduced heat absorption capacity.

2) Shoe linings on all three of the left side brakes showed physical characteristics that these brakes experienced excessive heat conditions.

3) The slack adjuster lengths on the tandem drive axle (rear) brakes were longer on the right side than those on the left side of the truck. With the brakes at similar stroke adjustments and under normal braking conditions, the inconsistency of slack adjuster lengths between the left and right side drive axle brakes would result in a brake imbalance. The right side drive axle brakes would provide

approximately 20% more braking in comparison to the left side drive axle brakes, thus increasing the wear rate of the right side drive axle brakes in comparison to the left side drive axle brakes.

4) The drums had been removed from the truck prior to MSHA Technical Support personnel being invited to join the field investigation. As a result, Technical Support personnel could not independently measure the effective brake chamber pushrod strokes for either the air-applied service brakes or the spring-applied parking brakes.

5) There is a need to recognize that there is a difference between parking brake and service brake pushrod travel for the tandem drive axles. The information provided to Technical Support personnel only consisted of the spring-applied parking brake chamber strokes on the tandem drive axles. Although both the service and parking brake actuators on the tandem drives actuate the same brake, the spring-applied parking brake chambers typically apply the brakes with a force approximately equivalent to an air-actuated service brake application of 60 PSI. In some cases, spring condition could cause the actual spring force to be less than this value. In comparison, air-applied service brake chamber strokes are measured with an application pressure of 90-100 PSI. This means that the measurements taken for the spring-applied parking brakes were done with approximately 33–40 percent less torque applied to the brake than that which would have been applied if the air-applied service brake chamber were used. Pushrod travel measurements taken at brake application pressures between 90 and 100 PSI, which is the industry-wide recognized correct method, would have resulted in longer strokes than the method that was used.

The maximum recommended service brake pushrod strokes for the brake chambers installed on this truck included:

Type 24 - - 1¾ inches (Steering Axle)
Type 30 - - 2 inches (Tandem Drive Axles)