CAI-2003-27

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

COAL MINE SAFETY AND HEALTH

REPORT OF INVESTIGATION

UNDERGROUND COAL MINE

FATAL MACHINERY ACCIDENT
October 22, 2003

at

VICC No. 7 Mine
Paramont Coal Company Virginia, LLC
Coeburn, Dickenson County, Virginia
ID No. 44-06503

Accident Investigator

Russell A. Dresch
Electrical Engineer

Originating Office
Mine Safety and Health Administration
District 5
P.O. Box 560, Wise County Plaza
Norton, Virginia 24273
Edward R. Morgan, District Manager

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OVERVIEW

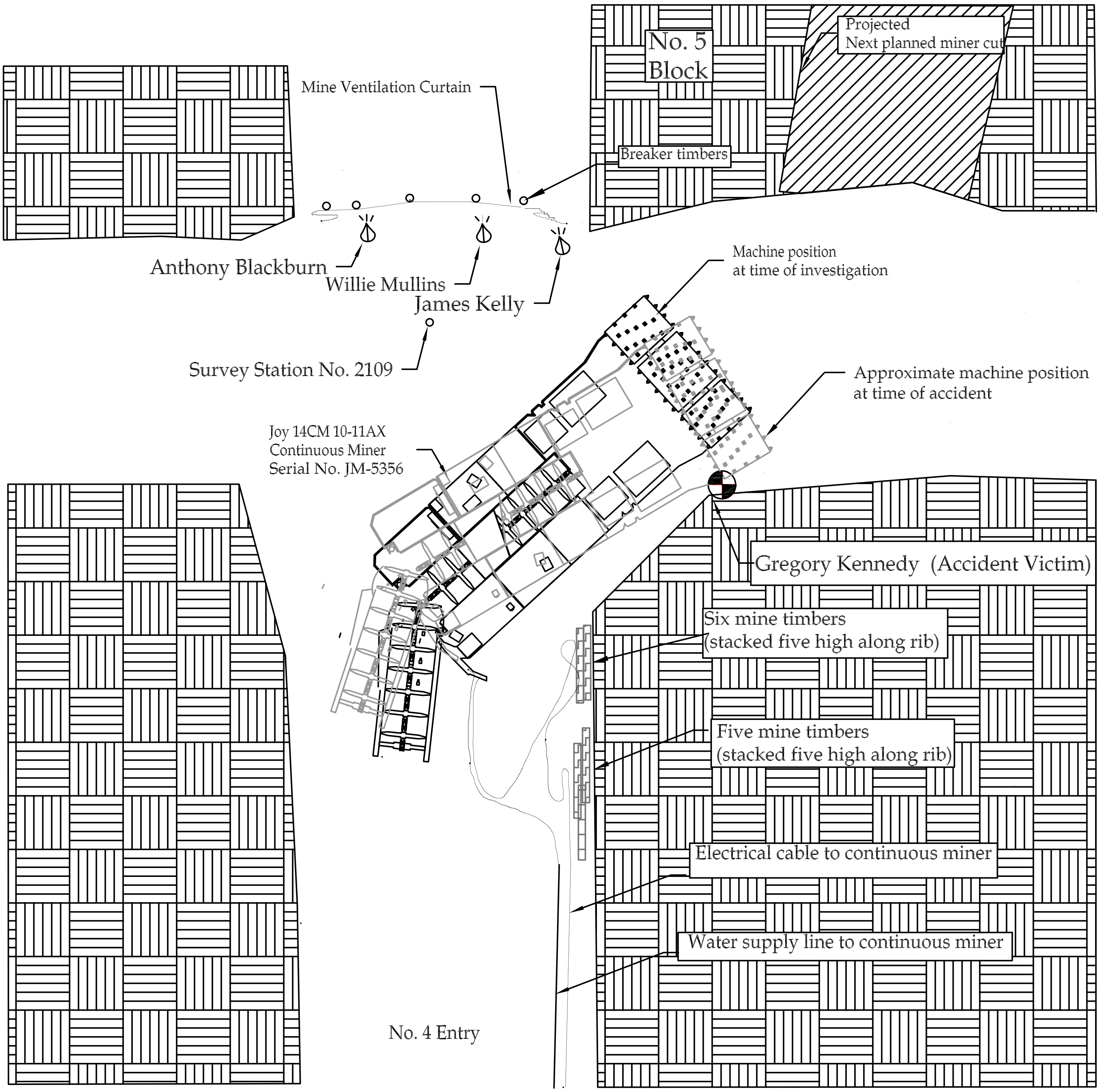
At approximately 10:00 a.m. on Wednesday, October 22, 2003, Gregory Kennedy, age 41, a continuous mining machine operator with 23 years of mining experience was fatally injured at Paramont Coal Company Virginia, LLC's VICC No. 7 Mine. The victim was crushed between a Joy, model 14-10A, remotely controlled continuous mining machine and the coal rib.

The most likely explanation for this continued operation is a build up of debris in the left side track operating lever's socket, located on the remote controller, which prevented the lever from returning to its neutral position.

Another factor which contributed to the fatal accident was the operating position of the victim. Management failed to ensure that personnel were operating remotely controlled equipment from outside the turning radius of the machine. The victim was located in a pinch point created by the machine and the coal rib.

Figure 1

No. 1 Right Section off Mains



Fatal Machinery Accident
VICC No. 7 Mine (ID No. 44-06503)
Paramont Coal Company Virginia , LLC
Nora, Dickenson County, Virginia
October 22, 2003

GENERAL INFORMATION

Paramont Coal Company Virginia, LLC's VICC No. 7 Mine, I.D. No. 44-06503, is an underground coal mine located adjacent to State Route 652 in Dickenson County, Virginia near Coeburn. Maxxum Carbon Resources, LLC has ownership interest in this mine. The principal officers for the mine at the time of the accident were:

Anthony Yates	Mine Superintendent / Miner Representative
Tim Keen	Mine Foreman
Candace Morgan	Safety Department

Mining under current management began approximately 8 months ago. This underground mine has 5 drift openings into the Splashdam coal seam. The only active section is located approximately 3,100 feet from the portals. The mining height averages 4 feet. The last air sample collected showed 9,655 cubic feet of methane liberation in a 24-hour period. The immediate and main mine roof is typically shale.

Thirty-three underground miners and four surface personnel are employed at this mine. The mine operates with three, eight and a half-hour shifts, five days per week. Coal is produced on the 1 Right off Mains Section on the day and midnight shifts. Maintenance and utility work is performed on the afternoon shift. The mine produces an average of 1,170 tons of material per day.

The method of mining is room-and-pillar. Coal is produced by alternating between two remotely controlled continuous mining machines. Coal is hauled by 4 shuttle cars from the face areas to the belt conveyor system for transport to the surface. Trucks haul the raw product from the mine to the preparation plant. Two roof-bolting machines are used to install roof support. Employees and supplies are transported to the section via battery-powered, rubber tired equipment.

At the time of the accident, the section was retreating (pillaring). The mining sequence was from right to left. The right side mining machine extracts coal from Block Number 7, 6 and 5, and then the left side mining machine cuts Block Number 4, 3, 2 and the left side barrier. The two continuous mining machines are not operated simultaneously.

Size of the pillar determines whether 3 or 4 cuts are taken from the left side of the block. After the side cuts the operator takes an end cut from the outby end of the block. This leaves an 8 by 8 foot stump (outby left corner of the block). Additional roof support is installed before each cut. A double row of timbers is set on 4 foot centers near the pillar line across all openings to pillared areas.

The Mine Safety and Health Administration (MSHA) completed the last regular health and safety inspection of the mine on August 25, 2003. The Non-Fatal Days Lost (NFDL) injury incidence rate for the mine in 2002 was 0.00 compared to a National NFDL rate of 6.62.

DESCRIPTION OF THE ACCIDENT

On October 22, 2003, up to the time of the accident, personnel from the Paramont Coal Company Virginia, LLC's VICC No. 7 Mine performed normal work functions. The 1 Right Section crew was retreat mining (pillaring) blocks of coal inby spad number 2109. The day shift crew finished mining Block Number 6 and proceeded to mine the Number 5 Block.

Gregory Kennedy (victim) and Anthony Blackburn are continuous mining machine operators. Kennedy operated the Number 1 Joy 14-10A Continuous Mining Machine using a Joy TX3 remote controller and Blackburn acted as the helper. Kennedy repositioned the machine into the Number 4 Entry with the Number 5 Block toward the right. After he finished the cuts to the left side of the Number 5 Block, he backed the machine past the intersection to position the machine to mine the end cut from the block.

Johnny Kiser, Section Foreman, was located 2 crosscuts outby spad 2109 in the Number 5 Entry. He was traveling toward the Number 4 Entry in a small, battery-powered, rubber tired mantrip.

Tony Layall and Barry Miller, Shuttle Car Operators, were sitting in their respective shuttle cars waiting for the continuous mining machine to be positioned for the end cut to the Number 5 Block. Both were near the intersection that Kiser was driving toward.

Three other men, Okey Grimett, Wayne Johnson and Darrell McGlothlin, Roof Bolting Machine Operators, were in the area. These men were located in the Number 7 Entry, one crosscut outby spad 2109. They were measuring and sawing timbers to be used during mining of the next row of blocks.

Blackburn along with Willie Mullins, Shuttle Car Operator, and James Kelly, Repairman, were near Kennedy and the continuous mining machine. They were located at the pillar line in the Number 4 Entry. As they installed timbers and line curtain, they were facing away from Kennedy and his machine.

At about 10:00 a.m. Blackburn described hearing the machine tram forward and then, without pause, the noise changed indicating the machine was spinning in place. This alerted Blackburn to turn and look for Kennedy. Blackburn noticed something was wrong.

Kennedy had trammed the continuous mining machine toward the end cut of the Number 5 Block. As the machine was trammed in the Number 4 Entry, angled to the right toward Number 5 Block, the right side of the machine was close to the inby, left corner of the outby block, with part of the machine in the intersection. Kennedy was located close to the inby, left corner of the outby block (see Figure 1) when the machine pivoted to the right. He was crushed between the machine's motor compartment of the ripper head and the coal rib. He was standing with his back against the coal rib and the machine against his abdomen. The bottom of the remote controller was against the right portion of Kennedy's abdomen. The controls of the remote controller were not depressed by any means. Neither his hands nor any other objects were on the controls. The left side track on the machine was still spinning in the forward direction.

Blackburn yelled at Kennedy and ran around the front of the machine to reach him. Mullins followed Blackburn. Blackburn hit the emergency stop button on the remote controller causing the track to stop spinning and the machine to de-energize. He then attempted to energize the machine using the remote controller but it would not operate. Blackburn tried to free the remote controller from Kennedy but the straps used to hang the device on the operator prevented him from freeing the device. Mullins ran around the machine and attempted to aid Blackburn from the other side. Mullins was unsuccessful so Blackburn told him to get help. Blackburn cut the straps with his utility knife and freed the remote controller. He connected the remote controller to his battery, but the device would not operate.

Mullins ran toward the two men on the shuttle cars, alerted them and continued to the mine phone. Kiser approached the Number 4 Entry and heard about the accident. As he ran toward the accident site, Kiser heard Blackburn yell for someone to bring the remote controller from the other continuous mining machine. Kiser changed direction and headed for the other machine located in Entry Number 3, inby spad 2109.

Mullins called outside and informed Mike Cox, Mine Clerk, of the situation. An ambulance service and Med Flight were contacted as well as other responsible parties. Anthony Yates, Superintendent and Tim Keen, Mine Foreman, went underground to the accident site.

Kiser arrived at the other machine and located the remote controller. He gave it to Kelly and instructed him to give it to Blackburn. Once Kiser arrived at the accident scene, he asked Layall to get the first-aid box. Blackburn installed the power cord from the other remote controller onto his battery and Kennedy's remote controller. He was then able to energize the machine and rotate it away from Kennedy.

Kiser removed Kennedy's jacket and mine belt and then assessed his condition. Yates and Keen arrived at the accident scene. Keen (who is certified in Advanced First Aid) placed Kennedy on his back and was able to initiate mouth to mouth respiration. They moved him onto the mantrip and continued mouth to mouth during the ride to the surface. Upon reaching the surface Mullins (who is certified in Advanced First Aid) began cardiopulmonary resuscitation (CPR).

Two rescue workers from Sandy Ridge Rescue Squad took over care of the patient and continued mouth to mouth and CPR. The Med Flight landed on mine property, assumed care of the patient and transported him to St. Mary's Hospital. The emergency room physician, Dr. Stephan Heinz, pronounced him dead at 10:55 a.m.

INVESTIGATION OF THE ACCIDENT

On October 22, 2003, at about 10:38 a.m. Candace Morgan, Safety Department, called Andrew Moore, MSHA Electrical Supervisor, to inform the Agency of the accident. Information concerning the accident was gathered and an accident investigation team was assembled. All team members came from the MSHA office located in Norton, Virginia. The initial team consisted of Russell A. Dresch, Electrical Engineer; Arnold D. Carico, Mining Engineer; Richard Salyers, Coal Mine Inspection Supervisor; and Jack Bartley, Coal Mine Safety and Health Inspector. Dresch acted as team leader while Carico was assistant team leader.

The team arrived at the mine around 12:00 noon. A 103(k) Order was issued to ensure the health and safety of persons in the affected areas of the mine until the investigation could be completed. Officials from Paramont Coal Company Virginia, LLC; Virginia Department of Mines, Minerals, and Energy (DMME); and MSHA arranged a joint investigation at the mine. The investigation team collected information, questioned pertinent personnel, made a preliminary examination of the accident scene and photographed the area.

On October 23, 2003, at about 6:45 a.m. the investigation resumed at the mine site. The following MSHA personnel were present:

Edward Morgan	District Manager
Norman Page	Assistant District Manager
James W. Poynter	Conference and Litigation Representative
Russell A. Dresch	Electrical Engineer
Arnold D. Carico	Mining Engineer
Kevin Hedrick	Technical Support
Patrick Retzer	Technical Support

James R. Baker	Educational Field Services Specialist
Jack Bartley	Coal Mine Safety and Health Inspector
Fred Martin	Coal Mine Safety and Health Inspector

The scene of the accident was inspected, photographed and videoed. A scale drawing was also developed. The continuous mining machine involved in the accident was put through a series of operational tests to determine if it was functioning properly. The following components were obtained from the machine in order to examine and test them under laboratory conditions:

Remote Controller	Power cord used on midnight shift
Power cord used during accident	Power cord used after accident
Receiver	Firing Package
Demux	Cap Lamp
Methane Monitor	Left Tram Knob

Interviews were conducted with nine people on October 23, 2003. Three follow-up interviews were conducted on November 6, 2003. The interviews were tape recorded and later transcribed.

The investigation resumed at the mine site on December 4 and 5, 2003. The following MSHA personnel were present:

Roy D. Davidson	Coal Mine Safety and Health Inspector, Supervisor
Russell A. Dresch	Electrical Engineer
Robert Holubeck	Technical Support
Patrick Retzer	Technical Support

The continuous mining machine involved in the accident had replacement components and was operational. The machine was inspected and tested. The following components were obtained from the machine in order to examine and test them under laboratory conditions:

Remote Controller	Power cord
Left Bridge (SCR Package)	Right Bridge (SCR Package)
Receiver	Firing Package
Demux	Antenna
Firing Package Harness	White Lead "B" Phase

Red Lead "C" Phase

Personnel from the MSHA Approval and Certification Center (A&CC), located in Triadelphia, West Virginia, examined and tested the components.

The machine was restored to operational condition with the components that were in use after the accident. The machine was then taken by the mine operator to a shop in order to rewire it. The following components were obtained from the machine in order to examine and test them under laboratory conditions:

Left Contactors	Cable Number 53
Cable Number 54	Cable Number 56
Pump Switch	Control Switch
Left Hand Traction Switch	Right Hand Traction Switch

These components were also examined and tested at MSHA's A&CC.

A continuing regular safety and health inspection (AAA) was conducted concurrently with the investigation to address any enforcement issues not related to the accident.

DISCUSSION

Physical Factors

1. There were no eyewitnesses to the accident.

2. The mine floor in the immediate area was dry and relatively even.

3. The height (mine floor to roof) in the immediate area averaged 57 inches.

4. No other remotely controlled equipment was being operated at the time of the accident.

5. No one stated the continuous mining machine would make unexpected movements prior to the accident.

6. The mine Roof Control Plan prohibits anyone from being located inside the turning radius of the continuous mining machine while tramming. The mine workers have been instructed during frequent safety talks to avoid this area.

7. No one stated Kennedy had been previously observed within the turning radius of the machine.

Equipment Involved in the Accident

8. The victim was operating a Joy 14-10A, serial number JM 5356, remotely controlled continuous mining machine. The methane monitor module on board the machine was not in permissible condition. The bolts used to attach the module's step flange cover to its enclosure were not engaged. The male/female electrical connector was the only means used to keep the module in place.

9. The victim was operating the continuous mining machine via a Joy Mining Machine Remote Controller; model TX3, serial number 75203AC02313. An inspection of the remote controller revealed the following defects. The circuit breaker trip (CB trip) button on the box would de-energize the machine, but not de-energize a circuit breaker. Engaging this button would stop the machine, but leave the control circuits on the machine energized. The remote controller has handles on top of the box at both ends. Not only are these handles used for carrying the box, they also protect the controls from damage. The left handle was broken off the box. Each of the 2 tram levers on the box, used to operate the 2 tracks on the machine, consists of a bi-directional lever with a knob attachment. The knob on the left tram lever was not attached.

10. Both the left handle and the knob were found at the accident scene which indicates they were both detached during the accident.

Continuous Mining Machine Shutdowns

11. On Tuesday, October 21, 2003, the day shift crew experienced problems with the Number 1 Continuous Mining Machine. The machine could not be energized. The maintenance crew on the evening shift replaced the methane monitor module and its sensor. The midnight crew was able to resume operation of the machine. However, the machine shut down numerous times during its operation. Each time the machine shut down it could be restarted without delay.

12. The remote controller gets its power from the operator's light battery. This power cord was thought to be damaged, causing the machine to shut down. A new power cord was brought in during the morning shift change. Kennedy replaced the power cord on the remote controller but still encountered unplanned machine shutdowns.

Continuous Mining Machine Unexpected Movement

13. The Number 1 Continuous Mining Machine was restored to operating condition with the following replacement parts.

Remote Controller	Power cord
Receiver	Firing Package
Demux	Cap Lamp
Methane Monitor	

14. On October 29, 2003, it was observed functioning normally and allowed to resume production.

15. Six weeks after the accident, on December 2, 2003, the Number 1 Continuous Mining Machine's left side track activated unintentionally. The operator backed the machine from a cut and proceeded to tram to the right side corner to round it down. As he released both levers from forward tram, in order to initiate the cutting head, he noticed the left side track was moving in the forward direction. He observed the controls in their rest position before pressing the shutdown control.

Test Results

16. The executive summary from the examination and testing of components can be found in Appendix C.

ROOT CAUSE ANALYSIS

An analysis was conducted to identify the most basic causes of the accident that were 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 root cause of the accident was the failure to ensure that all workers followed the safety precautions specified in the approved Roof Control Plan in regard to not being positioned inside the turning radius of the machine.

The primary cause was the victim's position within the turning radius of the continuous mining machine while it was being trammed.

Corrective Action: An Action Plan was submitted to MSHA by the coal company. The plan states that all employees will be given additional training. Mine management should appropriately supervise employees to ensure compliance with the approved Roof Control Plan.

Causal Factor: The remote control transmitter could have caused the left tram drive to continue after the machine operator released the tram lever due to debris lodged between the tram lever and the plate.

Corrective Action: A Standard Operating Procedure was submitted to MSHA to maintain the remote transmitter. The plan included a place to store the transmitter to prevent debris from fouling controls.

CONCLUSION

The left side track of the machine apparently continued to move due to a fouled tram lever on the remote controller. Debris accumulated in the lever's socket prevented the lever from returning to its neutral position.

The other factor necessary for this accident to occur was the operating position of the victim. Management failed to ensure that personnel were not positioned inside the turning radius of the machine. The victim was located in a pinch point created by the machine and the coal rib.

ENFORCEMENT ACTIONS

1. Section 103(k) Order No. 7332992 issued October 22, 2003, to Paramont Coal Company Virginia, LLC; VICC No. 7 Mine: This mine has experienced a fatal machinery accident on the 001-0 MMU. This Order is issued to assure the safety of any person in the coal mine until an examination or investigation is made to determine that the working section is safe. Only those persons deemed by MSHA to have information relevant to the investigation may enter or remain in the affected area.

2. Section 104(a) Citation No. 7335084 of 30 Code of Federal Regulations (CFR) 75.220(a)(1) issued May 17, 2004, to Paramont Coal Company Virginia, LLC; VICC No. 7 Mine: Management did not ensure personnel were complying with the approved Roof Control Plan. The plan requires that when the continuous mining machine is being trammed from place to place with the remote control unit, no one will be inside the turning radius of the machine. While investigating a fatal accident that occurred on October 22, 2003, it was found that Gregory Kennedy was located within the turning radius of the machine while tramming it.

Approved:

____

Edward R. Morgan
District Manager

APPENDIX A – Persons Participating In The Investigation

The following people provided information and/or were present during the investigation:

Paramont Coal Company Virginia, LLC

Eddie Bateman	President
Ram Tankersley	Safety Director
Jerry Bledsoe	Safety Department
Candace Morgan	Safety Department
Jeff Smith	Safety Department
Marty Stanley	Secretary, Safety Department
Robert Gordon	Operations Manager
Rick Shelton	Manager of Maintenance
Anthony Yates	Mine Superintendent / Miner Representative
Tim Keen	Mine Foreman
Harold Keen	Section Foreman, midnight shift
Mike Cox	Mine Clerk
Steve Hodges	Attorney at Law, PennStuart
Suzan Moore	Attorney at Law, Alpha Natural Resources, LLC

Joy Mining Machinery

Gabe Johnson	Serviceman

Virginia Department of Mines, Minerals and Energy

Frank Linkous	Chief, Division of Mines
Carroll Greene	Mine Inspector Supervisor
John Thomas	Mine Inspector Supervisor
Robert Garrett	Coal Mine Technical Specialist –Electrical
Sammy Fleming	Coal Mine Inspector
Danny Mann	Coal Mine Inspector
Daniel Perkins	Coal Mine Inspector
Jerry Scott	Coal Mine Inspector

Mine Safety and Health Administration

Edward Morgan	District Manager
Norman Page	Assistant District Manager
James W. Poynter	Conference and Litigation Representative
Roy D. Davidson	Coal Mine Safety and Health Inspector, Supervisor
Richard Salyers	Coal Mine Safety and Health Inspector, Supervisor
Russell A. Dresch	Electrical Engineer
Arnold D. Carico	Mining Engineer
James R. Baker	Educational Field Services Specialist
Jack Bartley	Coal Mine Safety and Health Inspector
Fred Martin	Coal Mine Safety and Health Inspector

Approval and Certification Center

Kevin Hedrick	Technical Support
Robert Holubeck	Technical Support
Patrick Retzer	Technical Support

APPENDIX B – Persons Interviewed

The following people were interviewed during the investigation:

Bryon Salyers	Chief Electrician
Bill Brooks	Maintenance Foreman, evening shift
Johnny Kiser	Section Foreman, day shift
James Kelly	Repairman, day shift
Ricky Roark	Repairman, midnight shift
Anthony Blackburn	Continuous Mining Machine Operator, day shift
Danny Fannon	Continuous Mining Machine Operator, midnight shift
David Jessee	Continuous Mining Machine Operator, midnight shift

Willie Mullins	Shuttle Car Operator, day shift

APPENDIX C – Test Results

April 23, 2004

MEMORANDUM FOR RUSSELL A. DRESCH
Mine Safety and Health Specialist, Coal Mine Safety and Health, District 5

FROM: STEVEN J. LUZIK
Chief, Approval and Certification Center

SUBJECT: Executive Summary of Evaluation of Control Cables and Control System Components for a Joy 14CM Continuous Mining Machine Recovered from a Fatal Mine Accident and a Non-fatal Incident at Paramont Coal Company Virginia, LLC's VICC No. 7 Mine

The Approval and Certification Center (A&CC), as requested by Coal Mine Safety and Health, conducted field and laboratory investigations of control system components and machine power components recovered from a fatal mine accident at Paramont Coal Company Virginia, LLC's VICC No. 7 Mine (I.D. 44-06503) that occurred on October 22, 2003 and from a non-fatal incident that occurred on December 2, 2003.

BACKGROUND

A continuous mining machine operator was fatally injured when he was pinched between a continuous mining machine and the coal rib. It was reported by an eyewitness that the victim was positioning the machine with the remote control transmitter for an end-cut while second mining a coal pillar. As the continuous mining machine was being trammed toward the next cut, it pivoted to the right; crushing the victim between the machine's motor compartment of the ripper head and the rib of the outby coal pillar.

Furthermore, it was reported by coworkers of the victim that while the victim was operating the continuous mining machine during the shift in which the accident occurred, and while at least one other operator on the midnight shift before the accident was operating the same machine, that the machine had experienced power interruptions, or drop-outs. The drop-outs were described by some parties as momentary; others reported that the machine could not be restarted until approximately 10-15 seconds had elapsed.

An eyewitness reported that, at the time of the accident, the left tram drive continued to operate without corresponding operation of the tram control lever on the remote control. The remote control transmitter, receiver, demultiplexer and SCR firing package were recovered from the machine along with the cap lamp that supplied power to the transmitter and various interconnecting cables. Replacement components were installed on the machine by the operator, and the machine was returned to service.

Subsequent to the accident, the A&CC was informed by CMS&H District 5 personnel of an incident that occurred on December 2, 2003. It was reported that the left side tram drive of the continuous miner involved in the October 22, 2003, fatal accident continued to operate after both tram levers on a replacement remote control transmitter were released, causing the machine to slew to the right. The control system components (remote control transmitter, antenna, receiver, demultiplexer, and firing package) were recovered along with the SCR diode bridges for the tram motor drives. A field inspection noted some damage to two of the power cables feeding the left side SCR diode bridge. The power cables were recovered along with the harness for the firing package.

In late December 2003 and early January 2004, other cables, selector switches, and contactors associated with the machine tramming controls were recovered from the machine and delivered to the A&CC for inspection and evaluation. The purpose of this work was to examine and test each of these to identify any areas where insulation failure or mechanical or electrical faults could have caused the machine's tram controls to not operate as expected.

Attachment 1 is a listing of all equipment recovered and tested.

LABORATORY TESTING AND EXAMINATION

Tests and examinations of the recovered equipment were performed at various locations in December 2003; January, February, March, and April 2004. These locations were MSHA's Approval and Certification Center in Triadelphia, WV; Matric Limited's manufacturing facility in Seneca, PA; Magnetek's manufacturing facility in Pittsburgh, PA; and Joy Mining Machinery's manufacturing facility in Franklin, PA. Attachment 2 is a listing of the results of all tests and examinations performed.

Equipment from October 22, 2003, Accident

The equipment from the October 22, 2003, accident consists of equipment that was recovered on October 23, 2003, and equipment that was recovered later that was reported to have been in use at the time of the accident. In the following list, the equipment with identification numbers of PE-1 through PE-9 was recovered on October 23, 2003. The methane monitor module designated PE-20 was recovered on October 29, 2003. All other equipment was recovered on various dates in December 2003 and January 2004.

- PE-1, Remote Control Transmitter,
- PE-2, Left tram knob for Remote Control Transmitter,
- PE-3, Power cord for TX3 used to move CM after the accident,
- PE-4, Power cord for TX3 used by midnight shift operator
- PE-5, Power cord for TX3 used during accident
- PE-6, Joy/Matric receiver
- PE-7, Joy/Matric demultiplexer
- PE-8, Joy/Magnetek firing package
- PE-9, Koehler Cap Lamp
- PE-14, Joy/Magnetek SCR bridge, left side
- PE-15, Joy/Magnetek SCR bridge, right side
- PE-16, P2C Firing Package Harness
- PE-17, White lead "B" phase between traction breaker and overload block for left SCR bridge
- PE-18, Red lead "C" phase between traction breaker and overload block for left SCR bridge
- PE-19, Joy/Matric Antenna
- PE-20, General Monitors Methane Monitor Module,
- Cable #53,
- Cable #54,
- Left traction control switch,
- Right traction control switch,
- Pump control switch, and
- Left tram motor contactors.

The inspection and testing of the control components revealed that one fault which could have allowed the left tram function to continue upon release of the tram lever. A rubber gasket was found between the cover plate over the switch actuators and the case of the remote control transmitter seen in Figure 1 in Attachment 4. The areas of the gasket around the tram levers, as shown in Figure 2 in Attachment 4, did not conform to the actuator stems. The tram levers measured 6.25 mm x 6.25 mm, and the openings in the cover plate were 15.65 mm x 7.93 mm. As shown in Figure 3 of Attachment 4, the margins of the gasket material at the opening for the tram levers were uneven and did not occupy the space between the lever and cover plate. This allowed an accumulation of dust in the sockets for the tram levers, as shown in Figure 4 of Attachment 4. The socket for the left tram lever was nearly full of dust and dirt, restricting its free travel. The results of the switch calibration test seemed to verify this, as the full range of the output of the left tram switch was only 78% of that of the right tram switch. This accumulation could have also caused the left tram lever to fail to return to its centered position. This could have then caused a forward signal to continue to be transmitted to the continuous mining machine after the tram lever was released.

The left tram lever was reportedly centered during the fatal accident, and the left tram drive continued operating. Therefore, testing was conducted to determine the minimum forward lever travel required for the remote control transmitter to send a tram signal to the machine. This travel was measured 12^{o} from the centered position of the lever. When viewed from various angles, it was difficult for the observer to distinguish between the tram lever at this position and a tram lever in the centered position.

The gasket was not included in the original approved design of the remote control transmitter. The original design concept was that the switch actuators were positioned in open wells which could be periodically flushed with water to remove any accumulated debris. However, after receiving complaints from mine operators at two mines concerning the potential for switches to stick or operate sluggishly, MSHA contacted Joy and requested that the wells for the actuators be protected from wet debris accumulation. In response, Joy provided a gasket to users of this model remote control transmitter in 2001. Initially, this gasket was neoprene, but was later changed to latex to enhance the life of the gasket. Field trials revealed that the gasket failed to solve the problem; therefore, the gasket was not added to the approval documentation. Subsequently, a switch "boot" was designed to cover the open pockets of the remote. A field trial was begun in January 2002, and Joy stated that they would perform retrofits between June and September of 2002. In December 2002, MSHA approved the design that included the boots on all toggle switches on the remote control transmitter.

Because of screws missing from the printed circuit board, a loose internal antenna, and hardware loose inside the case, it appeared that the unit had been previously disassembled. The presence of the loose washers between the hall-effect sensors for the left tram function and its magnet actuator caused the unit to either (a) fail to provide the tram signal or (b) provide a tram signal later than expected or stop the tram signal earlier than expected. This was dependent on the number of washers in that area. Additionally, it was found to be unlikely that the loose conductive parts could have short-circuited the power supply leads of the hall-effect switch to its output.

Testing revealed two possible causes for the machine drop-outs. First, dirt was present on the remote control transmitter contacts for the power cord that connected the remote control transmitter to the cap lamp battery. This dirt was sufficient to cause power interruptions to the remote control transmitter, which led to a lack of signal to the receiver, causing the machine tramming and hydraulic functions to stop. Second, the methane monitor module was loose in its base. This could cause a momentary power interruption to the machine, or an interruption of power to the machine and methane monitor, requiring the monitor to repeat its 19.5 second power-up cycle.

With the exception of the cap lamp, the components that were involved in the fatal accident that were also MSHA-approved were compared with the approval documentation. The cap lamp was not compared with the approval documentation because it was determined that it did not play a role in the accident. There were several discrepancies that could be attributed to mismanufacture or improper maintenance; none of these were judged to have contributed to the fatal accident. Attachment 3 is a listing of the discrepancies that were found.

<u>Equipment from December 2, 2003, Incident</u>

The equipment from the December 2, 2003, accident consists of equipment that was recovered on December 5, 2003, and equipment that was recovered later that was reported to have been in use at the time of the incident and also at the time of October 22, 2003, fatal accident. In the following list, the equipment with identification numbers of PE-10 through PE-19 were recovered on December 5, 2003. All other equipment was recovered on various dates in January 2004. All equipment except that with identification numbers of PE-10 through PE-13 were reported to have been use at the time of the October 22, 2003, fatal accident.

- PE-10, Joy/Matric radio transmitter,
- PE-11, Joy/Matric receiver,
- PE-12, Joy/Matric demultiplexer,
- PE-13, Joy/Magnetek Firing Package,
- PE-14, Joy/Magnetek SCR bridge, left side,
- PE-15, Joy/Magnetek SCR bridge, right side,
- PE-16, P2C Firing Package Harness,
- PE-17, White lead "B" phase between traction breaker and overload block for left SCR bridge,
- PE-18, Red lead "C" phase between traction breaker and overload block for left SCR bridge,
- PE-19, Joy/Matric Antenna,
- Cable #53,
- Cable #54,
- Cable No. 56,
- Left traction control switch,
- Right traction control switch,
- Pump control switch, and
- Left tram motor contactors

The inspection and testing of the control components recovered after the incident on

December 2, 2003, revealed no faults that could have contributed to the incident.

Inspection of Wires and Cable

The examination of the wires and cables did not reveal any conditions that would have caused the tram control circuits to malfunction by allowing the left tram function to continue upon release of the left tram lever on the remote control transmitter. The insulation damage to the wires supplying power for the left side SCR bridge, as seen on Figures 5 and 6 of Attachment 4, could have been sufficient to interrupt or reduce current flow to the left tram motor, if a short circuit occurred between the two phase conductors with damaged insulation. It is unlikely that operation of the tram control components would have been adversely affected by this type of short circuit. Testing also showed that it was unlikely that a short circuit between the damaged B-phase power conductor and ground would result in unintended operation of the left tram drive.

SUMMARY

To summarize the significant findings of this investigation:

- One potential fault with the remote control transmitter from the fatal accident could have caused the left tram drive to continue after the tram lever was released. Debris could have lodged between the tram lever and cover plate
- Two potential causes of the reported power interruptions of the machine are an unsecured mounting of the methane monitor module and a dirty power connection for the remote control transmitter.
- No causes were identified for the December 2, 2003, incident.

Comprehensive test results can be obtained from the Chief of the A&CC, RR 1, Box 251, Industrial Park Road, Triadelphia, West Virginia 26059.

ATTACHMENT 1
LIST OF EQUIPMENT RECOVERED

Exhibit Number	Description	Model Number	Serial Number
PE-1	Joy/Matric radio transmitter	TX3	75203AC023B
PE-2	Left tram knob for a Joy/Matric Model TX3	-	-
PE-3	Power cord for TX3 used to move CM after the accident	-	-
PE-4	Power cord for TX3 used by midnight shift operator	-	-
PE-5	Power cord for TX3 used during accident	-	-
PE-6	Joy/Matric receiver	100017329	83502AD026D
PE-7	Joy/Matric demultiplexer	100042863	90205AC013D
PE-8	Joy/Magnetek firing package	601849-124	4041102-27
PE-9	Koehler Cap Lamp	-	-
PE-10	Joy/Matric radio transmitter	TX3	75207AD001D
PE-11	Joy/Matric receiver	100017329	83511AD042D
PE-12	Joy/Matric demultiplexer	100042863	90207AE003F
PE-13	Joy/Magnetek Firing Package	601849-0124	4041003-01
PE-14	Joy/Magnetek SCR bridge, left side	RP601849-0121	34736-001
PE-15	Joy/Magnetek SCR bridge, right side	RP601849-0121	42350-108
PE-16	P2C Firing Package Harness	-	-
PE-17	White lead "B" phase between traction breaker and overload block for left SCR bridge	-	-
PE-18	Red lead "C" phase between traction breaker and overload block for left SCR bridge	-	-
PE-19	Joy/Matric Antenna	601843-0251	5016373-000
PE-20	General Monitors Methane Monitor Module, unique identifier ABE9626	S800	E48683
-	Cable #53 identifier 53	-	-
-	Cable 54 identifier "54'	-	-
-	Left traction control switch, identifier "left trac switch"	-	-

Exhibit Number	Description	Model Number	Serial Number
-	Right traction control switch, identifier “right trac switch”	-	-
-	Pump control switch, identifier “pump switch”	-	-
-	Left contactors, identifier “left”	-	-
-	Cable No. 56, identifier “Cable 56”	-	-

ATTACHMENT 2
TESTING/EXAMINATION RESULTS

1 Equipment Recovered From Fatal Mine Accident

1.1 Control System. The system, consisting of the PE-1 transmitter and PE-2 tram lever knob, PE-5 power cord, PE-6 receiver, and PE-7 demultiplexer gave the expected outputs when tested as a system after the connector on the PE-5 power cord was cleaned.

1.2 Matric Limited Model TX3 Transmitter, PE-1 and tram lever knob, PE-2. This unit, and the associated PE-2 knob from the left tram lever, gave the expected outputs, with few exceptions, during testing. The exceptions are detailed below.

The switch calibration testing revealed that the left tram switch gave a smaller-than-expected output voltage range across the full travel of the lever. The range was 78% of the range of the right tram switch. This suggested that the travel of the actuator for the left tram was restricted as compared to that of the right tram. The same test revealed that orientation of the transmitter had little effect on the operation of the tram levers.

Inspection of the knob and left tram lever revealed no damage to the internal threads of the lever or to the screw hole through the knob. Additionally, the inspection revealed that the socket for the left tram lever was packed with coal dust, as was the socket for the right tram lever, albeit to a lesser extent. A rubber gasket was found between the cover plate over the switch actuators and the case. The areas of the gasket around the tram levers, and especially the left tram lever, were not tight against the actuator stems. The lever measured 6.25 mm x 6.25 mm, and the opening in the cover plate was 15.65 mm x 7.93 mm. The gap between the lever and the cover plate allowed an accumulation of dust in the sockets for the tram levers. The gasket material was not effective for excluding dust and other contamination at the area of the tram levers.

The frequency and power output of the transmitter were within the manufacturer's specifications. The unit continued operating properly under low voltage conditions; once its low voltage threshold was reached, it turned off. It was not possible to accidentally operate the controls of the unit by introducing an external magnetic field in the vicinity of the controls using small magnets, such as those on small screwdrivers or those used during calibration of the methane monitor.

Because of screws missing from the printed circuit board, a loose internal antenna, and hardware loose inside the case, it appeared that the unit had been previously disassembled. Among the hardware found were three small washers.

Testing was conducted to determine the effect of these loose washers if placed between the hall-effect sensors for the left tram function and its magnet actuator. This caused the remote control transmitter to either (a) fail to provide the tram signal or (b) provide a tram signal later than expected or stop the tram signal earlier than expected. This was dependent on the number of washers in that area. Additionally, it was found to be unlikely that the loose conductive parts could have short-circuited the power supply leads of the hall-effect switch to its output.

Testing was conducted to determine the minimum forward left tram lever travel required for the remote control transmitter to send a tram signal to the machine. This travel was measured 12^{o} from the centered position of the lever. When viewed from various angles, it was difficult for the observer to distinguish between the left tram lever at this position and a tram lever in the centered position.

Several discrepancies were found between the PE-1 and the MSHA approved design of the unit. The most significant were: the inclusion of the rubber gasket between the cover plate and case; and the fact that the internal antenna and hardware were loose.

1.3 Matric Limited Receiver, PE-6. The unit operated within the manufacturer's specifications and provided the expected functions during testing. Several discrepancies were found between the PE-6 and the approved design of the unit. None of these discrepancies were significant to this investigation.

1.4 Matric Limited Demultiplexer, PE-7. The unit operated within the manufacturer's specifications and gave the expected outputs during testing. An LED labeled 'MAINTENANCE' was on. Data stored in the unit indicated that the temperature to which it had been exposed was abnormally low and that an internal CPU communication error had occurred or noise had been present at some time on the serial data. These errors were found not to cause a left tram forward signal to continue to be transmitted to the continuous mining machine after the tram lever was released. Several discrepancies were found between the PE-7 and the MSHA approved design of the unit. None of these discrepancies were significant to this investigation.

1.5 Power Cords, PE-3, PE-4, AND PE-5. The power cord used to operate the continuous mining machine during the shift before the accident (PE-4) had no physical or electrical faults. The power cord in use at the time of the fatal accident (PE-5) was missing an O-ring at the connector for the transmitter and the strain relief for the cap lamp connector was missing; it had no electrical faults. The power cord used to move the machine after the fatal accident (PE-3) was bent at the cap lamp connector and the strain relief was not connected; it had no electrical faults. Even with the damage, it was possible to power the transmitter with this power cord. No comparison with approval documentation was possible, as these cables are not shown on the approval documents.

1.6 Koehler Cap Lamp, PE-9. The unit gave an output voltage of 3.27 volts approximately 6 ½ weeks after the accident; the electrolyte level was noticeably low. The output voltage was insufficient to operate the TX3 transmitter at the time of testing. The unit was not compared with the approval documentation, because it was determined that it did not play a direct role in the accident.

1.7 Magnetek Firing Package, PE-8. The unit met the manufacturer's specifications when tested. This included testing at ambient temperature and 80ºC. It was not affected by the electromagnetic fields or noise generated in their test, nor was it affected negatively by variations in power supply voltage. It was not compared with approval documentation, as it was neither MSHA-approved nor required to be approved.

1.8 General Monitors S800 Methane Monitor, PE-20. Only the module and its associated mounting bracket, along with short lengths of the cables were recovered. The bracket was found to be broken, and the module was not secured to the base when inspected in the field. Before the module was broken during testing, the testing of the module revealed that it could be dislodged so as to cause an interruption of power to the machine, requiring machine power to be recycled. Testing on similar equipment showed that the interruption could be momentary. Several discrepancies were found between the PE-20 module and its approved design. None of these discrepancies were significant to this investigation.

2 Equipment Recovered From Non-Fatal Incident

2.1 Control System. The system, consisting of the PE-10 transmitter, PE-11 receiver, and PE-12 demultiplexer gave the expected outputs when tested as a system.

2.2 Matric Limited Model TX3 Transmitter, PE-10. This unit operated properly during testing. The switch calibration testing gave the expected range of values for all functions. The same test revealed that orientation of the transmitter had little effect on the operation of the tram levers.

The unit featured boots around all switch actuators to protect against dirt entry; these boots were intact.

The frequency and power output of the unit were within the manufacturer's specifications. The unit continued operating properly under low voltage conditions; once its low voltage threshold was reached, it turned off.

The unit was not compared with the approval documentation, as this part was not involved in the subject accident.

2.3 Matric Limited Receiver, PE-11. The unit operated within the manufacturer's specifications and gave the expected functions during testing. The unit was not compared with the approval documentation, as this part was not involved in the subject accident.

2.4 Matric Limited Demultiplexer, PE-12. The unit operated within the manufacturer's specifications and gave the expected outputs during testing. Data stored in the unit indicated that it had not been exposed to abnormally high temperatures and that no internal errors had occurred. The unit was not compared with the approval documentation, as it was not involved in the subject accident.

2.5 Magnetek Firing Package, PE-13. The unit met the manufacturer's specifications when tested. This included testing at ambient temperature and 80ºC. It was not affected by the electromagnetic fields or noise generated in their test, nor was it affected negatively by variations in power supply voltage. It was not compared with approval documentation, as it was neither MSHA-approved nor required to be approved.

3 Equipment Recovered After Non-Fatal Incident, And Also Reported To Be In Use At The Time Of The Fatal Accident

3.1 Magnetek SCR Bridge, Left Side, PE-14. The unit met the manufacturer's specifications when tested. This included testing at ambient temperature and 80ºC. What had appeared to be insulation damage on the wiring for a current transformer was apparently a splice featuring heat-shrink tubing. The current transformer was not damaged, nor was there evidence of arcing on the busbar adjacent to the spliced wire. The unit was not compared with approval documentation, as it was neither MSHA-approved nor required to be approved.

3.2 Magnetek SCR Bridge, Right Side, PE-15. The unit met the manufacturer's specifications when tested. This included testing at ambient temperature and 80ºC. There was no apparent damage to the unit. It was not compared with approval documentation, as it was neither MSHA-approved nor required to be approved.

3.3 Firing Package Wiring Harness, PE-16. Only minor physical, and no electrical, issues were noted with this harness, which was assembled by Magnetek. A connector did not completely cover the insulation on one wire, and the insulation was flattened on several others. These issues could not have caused the machine's tram controls to not operate as expected.

3.4 Antenna, PE-19. The housing for the antenna was damaged, but the antenna was not.

3.5 B-Phase Cable, PE-17. The cable had a damaged area that had conductor strands that appeared to be fused or melted together, having a copper-like appearance. The insulation material in the immediate vicinity of the damaged area appeared to be discolored. The effect of grounding the damaged area of the cable was tested by bringing it into continuous contact, and intermittent contact, with the grounded machine frame at the mine site. The left tram function did not continue to operate after the tram levers were released during this testing. Tests were also conducted on a similar machine, with the PE-8 firing package, and the PE-13 and PE-14 SCR bridges installed, by intermittently grounding using controlled contacts at higher frequencies, with no continuation of left tram function.

3.6 C-Phase Cable, PE-18. The cable had insulation damage in one area. The conductor strands did not appear to be fused. The wire strands had a silver-like appearance. The insulation material in the immediate vicinity of the damaged area did not appear to be discolored.

3.7 Cable 53. Insulation resistance tests in the field showed that the insulation between conductors was at least 100 megaohms. Laboratory inspection revealed that none of the wires or terminal connections showed signs of insulation failure or other conditions, such as frayed wire strands, that could provide alternate paths for current flow.

3.8 Cable 54. Insulation resistance tests in the field showed that the insulation between conductors was at least 4.8 megaohms. Laboratory inspection revealed that none of the wires or terminal connections showed signs of insulation failure or other conditions, such as frayed wire strands, that could provide alternate paths for current flow.

3.9 Cable 56. Insulation resistance tests in the field showed that the insulation between conductors was at least 100 megaohms. The conductor insulation for several of the wires in the area where the conduit housing the cable was damaged was found to be deformed, but not visibly damaged. Laboratory inspection revealed that none of the wires or terminal connections showed signs of insulation failure or other conditions, such as frayed wire strands, that could provide alternate paths for current flow.

3.10 On-Board Pump/Control, Left Traction, and Right Traction Switches. No unexpected operations of the switches were noted during laboratory testing. The insulation withstand between unconnected terminals was at least 2500 volts. No damage was noted.

3.11 Left Traction Contactors. The contactors operated as expected during field testing and within the manufacturer's specifications during laboratory testing. Inspection did not reveal any significant damage, and the resistance of the contacts was less than 0.08 ohms when closed and greater than 20 megaohms when opened.

ATTACHMENT 3
COMPARISON TO APPROVAL DOCUMENTATION

1 Matric Limited Model TX3 Transmitter, PE-1

1.1 From Drawing Number MA 500-752 Rev 1:

1.1.1 Several components in different areas on the printed circuit board shown in the upper left of the drawing were different on the unit. Review of the parts layout on sheet 2 of drawing number MA 95-1206 Rev 2 seems to indicate that the layout sketch on MA 500-752 Rev 1 was not revised from Rev 0.

1.1.2 A sleeve was found covering the wiring from the external connector to J1 and J2 on the printed circuit board; this sleeve is not shown on the drawing.

1.1.3 Note 6 indicates that "Enclosure connectors and switches are dust-tight." Varying amounts of dust were found in the sockets for the switch actuators.

1.1.4 The right side carrying handle was broken off; this most likely occurred during the accident.

1.1.5 The knob for the left tram lever was not on the lever and its securing screw was missing. There was no evidence that its securing screw was broken or that the threads inside the lever were stripped.

1.1.6 There was a Joy logo on the lower right side of the enclosure near the controls that is not shown on the drawings.

1.1.7 The content of a label is given on the drawing as: "MATRIC LIMITED, TYPE TX3 TRANSMITTER, MUST BE POWERED BY AN MSHA APPROVED 4 VOLT CAP LAMP, 250 MILLIAMPS MIN. ACCESSORY CAPACITY." The content of the label on the unit, which was partially obstructed by a reflector, was: "WARNING (illegible) EXTERNAL CO(illegible) ACCORDANCE (illegible) SYSTEM CONNE(illegible) MA001096-0036. IN (illegible) CAP LAMP CONNEC(illegible) TO AN MSHA APPROV(illegible) LAMP WITH 250 MILLI(illegible) ACCESSORY RECEPTACLE (illegible).

1.1.8 Two screws, two star washers, one flat washer and one nylon clamp were found loose inside the unit. While not documented completely, the internal antenna is apparently normally held in place with the nylon clamp, one of the screws, and the flat washer. The drawing shows twelve screws securing the printed circuit board to the case; only eleven were in place. This seems to indicate that the second screw found loose inside the unit was intended for this purpose. Also, there were star washers associated with eight of the eleven screws. In the location of the other three screws, there were markings in the conformal coating suggesting that the star washers had been in place previously. This seems to indicate that the three star washers had been removed and not reinstalled, with two of them left inside the case.

1.1.9 There was a rubber gasket material between the case and the switch cover plate; this is not shown on the drawing.

1.2 From Drawing number MA 205-1629, Sheet 1, Rev 2: Component R52 is shown as “NP”; however, this component was installed on the board.

1.3 From Drawing number MA 205-1629, Sheet 3, Rev 2: Component U46 is shown on the drawing as “MAX338”; however, the component in the unit was marked “DG408DY”. It should be noted that the markings on several components were not legible due to the conformal coating on the board.

2 General Monitors S800 Methane Monitor,PE-20, Unique Identifier ABE9626

2.1 From Drawing Number 21029 Rev D:

2.1.1 Item 20 (#6 split lock washer) and item 21 (#6 flat washer) were missing from unit.

2.1.2 Item 22 (pad, neoprene) was missing from the unit.

2.1.3 The “bar code and part number” shown on the left side view of the electronics assembly was missing.

2.2 From Bill of Material 21010-1 Rev A:

2.2.1 Item 17 is listed as ‘IC PRPHL DRVR 80P UCN5801’; the component in the unit was ‘MIC5801.’

2.2.2 Item 18 is listed as ‘IC PRPHL DRVR 40P UCN5800’; the component in the unit was ‘MIC5800.’

3 Matric Limited Demultiplexer, PE-7

3.1 From drawing number MA 500-200, sheet 3 of 3, Rev 2: A gasket, not shown on the drawing, was between the enclosure and base on the unit.

3.2 From drawing number MA 205-1520, sheet 1 of 2, Rev -:

3.2.1 Component C16 is shown glued to the circuit board; it was found on the unit to be glued to the circuit board and to Transformer T1.

3.2.2 Components Q1 and Q2 are shown as ‘NPD6060’; they were ‘NDP6060’ on the unit.

4 Matric Limited Receiver, PE-6

4.1 From drawing number MA001096-0028, Rev 5 June 1998:

4.1.1 The 125Ma/125-Volt fuse shown in the wiring for the T/L connector was not found in the unit.

4.1.2 The wording shown on the cover plate of the unit was different from that shown on the drawing. The information in the "APPROVAL INFORMATION AREA" was in a different location. The marking "TYPE RX1 RECEIVER" was in a different location and modified. Other markings present on the unit are not shown on the drawing.

4.1.3 The marking "MA001096-0029" was not found on printed circuit board in the unit.

4.2 From drawing number MA001096-0029, Rev 5 June 1998: Note 4 states "PCB ASSEMBLY IS CONFORMAL COATED"; an additional unnumbered note indicates "PRINTED WIRING BOARDS ARE TO BE PROTECTED BY AT LEAST TWO LAYERS OF AN ADHERENT INSULATING COATING HAVING A VOLTAGE RATING OF 200 VOLTS PER 0.025mm (0.001 in) OF THICKNESS." The areas around D1, J1, J2, J3 and LK1 were not coated.

ATTACHMENT 4
PHOTOGRAPHS

Figure 1. PE-1 Transmitter Front Panel

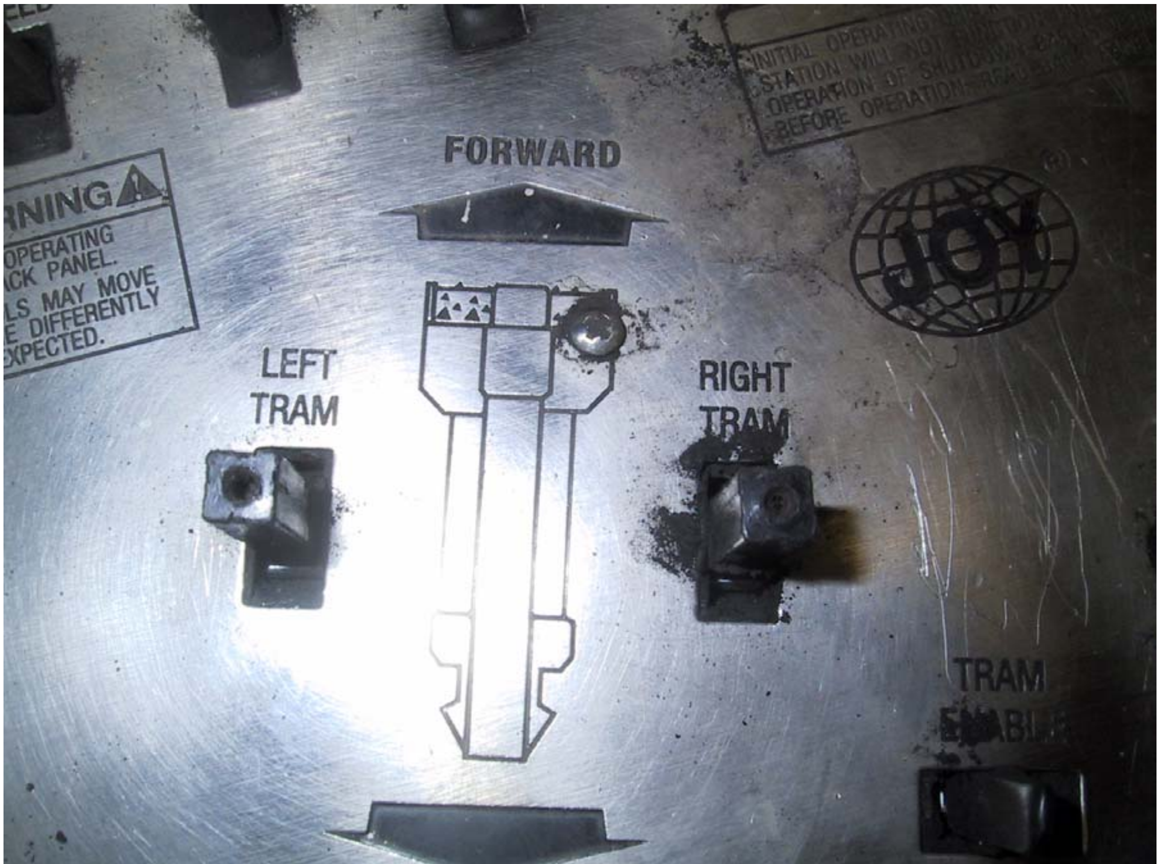


Figure 2, PE-1 Transmitter, tram levers with knobs removed

Figure 3. PE-1 Transmitter, Front Panel cover plate, gasket side view, detail, tram lever openings

Figure 4. PE-1 Transmitter, tram lever sockets (two in center top)


Figure 5. Damaged Area of B-Phase Power Cable

Figure 6. Damaged Area of C-Phase Power Cable