

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

COAL MINE SAFETY AND HEALTH

REPORT OF INVESTIGATION

Underground Coal Mine

Non-Injury Mine Fire Accident
September 16, 2002

#3 Mine
Fairfax Mining Co., Inc.
Clarksburg, Harrison County, West Virginia
I. D. No. 46-08633

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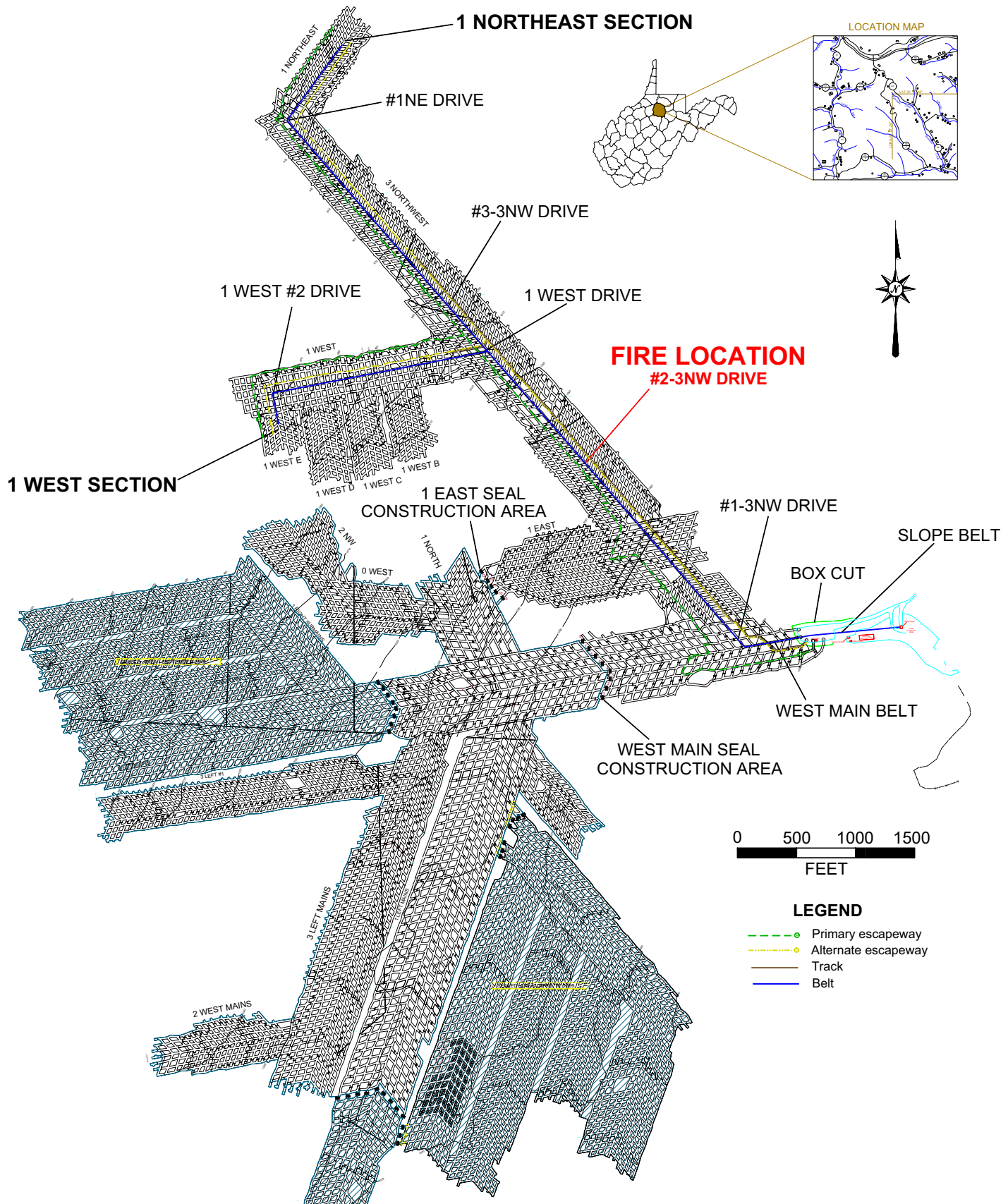
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Non-Injury Mine Fire

September 16, 2002

Fairfax Mining Co., Inc. #3 Mine



OVERVIEW

On September 16, 2002, at approximately 9:20 a.m., a fire occurred at the 3 North West No. 2 (#2-3NW) Belt drive. The fire was discovered when Donald Nickels, Chief Maintenance Foreman, encountered smoke while traveling to his mantrip near the 3 North West No. 1 (#1-3NW) Belt drive. Donald Nickels called outside and reported the smoke to Johnny Nickels, Superintendent. Since the fire detection system had not sounded an alarm, Johnny Nickels attempted to contact the section crews on the mine phone. Although the section crews could hear his call, their replies were not received outside because fire had already damaged the underground mine phone transmission lines. The section crews traveled the track entry to just inby the fire area, where they crossed the belt and entered the primary escapeway, through which they walked the remaining 2,850 feet to the surface.

A construction crew was building seals in the abandoned West Main area when smoke was observed. The construction crew, upon observing the smoke, immediately entered the primary escapeway and walked to the surface of the mine.

The fire was extinguished with water approximately 15 minutes after fire-fighting activities were initiated.

GENERAL INFORMATION

The Fairfax Mining Co., Inc., #3 Mine, I. D. 46-08633, is located ten miles west of Clarksburg, in Harrison County, West Virginia. The mine is accessed by 5 drift openings from a box-cut into the Pittsburgh coal seam, which averages 55 inches in thickness. A single blowing mine fan provided 86,700 cubic feet of air per minute at the drift opening to the main intake air course. The mine liberated 22,395 cubic feet of methane in a 24-hour period. Coal was produced by advancing entries with remote-controlled, scrubber-equipped, continuous mining machines.

Employment was provided for 67 underground and 6 surface employees. The mine operated three shifts per day, five days per week, producing 2,500 tons of raw coal daily from two continuous mining machine units. Coal production was primarily achieved on day and afternoon shifts. Maintenance crews were scheduled on midnight shifts, which occasionally engage in limited coal production.

Coal was transported to the surface via a 9,600-foot long belt conveyor system that consisted of eight flights, the first of which was powered by a drive located on the surface. The #2-3NW Belt, where the fire occurred, was 2,500 feet long. Fire protection was provided by a Pyott-Boone point-type fire detection system and by a deluge-type fire suppression system. Air flowed in the outby direction from the section loading points to the surface in the belt and track entries, which were located in common air courses. Battery-powered track and rubber-tired equipment was utilized for transporting materials and personnel.

The principal officers for the #3 Mine at the time of the accident were:

David Maynard	President
James Simpson	Mine Manager
Johnny Nickels	Superintendent

The last MSHA Safety and Health Inspection was completed on June 6, 2002, and another was ongoing at the time of the accident. The Non-Fatal Days Lost (NFDL) incident rate during the previous quarter was 6.44 for underground mines nationwide and 11.01 for this mine.

DESCRIPTION OF THE ACCIDENT AND EVACUATION

On September 16, 2002, three crews, totaling 24 miners, entered the #3 Mine at approximately 6:45 a.m. and traveled to the following locations: the 1 West E Section, the 1-Northeast Section, and the West Main seal construction site ([refer to Mine Map](#)). In addition to these miners, Barry Fletcher, District Mine Inspector for the West Virginia Office of Miner's Health, Safety, and Training (WVOMHS&T), accompanied Bill Currence, General Mine Foreman, to the 1 West E Section. Upon arrival, the crews on both working sections initiated coal production.

At approximately 9:20 a.m., the section conveyor belts stopped. Donald Nickels, Chief Maintenance Foreman, and Sean Fletcher, Roof Bolter Operator, entered the mine to check the belts and found that the first two belt conveyor flights were still operating. However, the third flight (#1-3NW Belt) had stopped. Each time they reset the control circuit and started the #1-3NW Belt, the belt slippage protective device tripped, stopping the drive motor. Donald Nickels noticed spillage at this belt drive and assigned Sean Fletcher to clean the drive area with a water hose.

Meanwhile, Bill Currence, who was assisting Barry Fletcher during a permissibility inspection of the 1 West E Section roof bolting machine, heard the section belt shut down and traveled outby to the section loading point to determine the cause of the problem. When he reached the loading point, a miner informed him that both section belts were down and that Donald Nickels was checking on the problem.

Donald Nickels intended to check for problems at the #1-3NW Belt tailpiece. However, he smelled smoke as soon as he entered the track entry, which he reported by mine phone to Johnny Nickels, Mine Superintendent. Donald Nickels and Sean Fletcher then entered the adjacent primary escapeway and walked to the surface.

Currence recognized Johnny Nickels' voice paging for both sections over the nearby mine phone, located at the section power center, but was unable to understand Nickels' message. Currence tried answering Johnny Nickels, but Nickels couldn't hear him. Currence was able to communicate with the other working section and, approximately five minutes later, he called Tony Becker, a shuttle car operator on the 1-Northeast Section, who informed Currence that he still had not heard from Donald Nickels.

Meanwhile, Johnny Nickels had radioed Paul Smith, Surface Electrician, and asked him to enter the mine and open the haulage airlock doors, located near the drift openings, to help clear smoke from the track entry. However, Smith did not have a self-contained self-rescuer (SCSR) and could not enter the mine. Bill Currence, who was still at the 1 West E Section mine phone, overheard Smith tell Johnny Nickels that smoke was coming out the track haulage airlock doors. However, Currence was still unable to reply to persons on the surface. He then obtained a track bus and rode outby to assist in locating the problem, accompanied by Craig Currence, General Laborer.

Johnny Nickels checked the fire detection system control box in the maintenance foremen's office, which was showing a line short alarm, as indicated by a light (Line Short Lamp) on the panel cover (no audible signal was provided for this type of alarm). Outside the mine office Johnny Nickels met Richard Herndon, MSHA Coal Mine Inspector, who had finished testing the brakes on the front end loader for the ongoing Safety and Health Inspection. After being informed of the situation, Herndon issued a verbal K-Order and informed Nickels that the miners need to be evacuated from the mine. Herndon accompanied Johnny Nickels into the box cut, where they observed smoke flowing out of the belt entry drift opening. Johnny Nickels tried again to order an evacuation over the mine phone, but he received no response from the sections.

Bill and Craig Currence encountered smoke at the #2-3NW Belt drive (the belt and track entries were adjacent to one another and were not separated by stoppings). They parked the bus and ran to the drive where they found a small fire close to the speed reducer. A nearby fire hose was already connected to the water line, which Bill Currence used to apply water to the fire. He then told Craig Currence to take the bus to both sections and tell the miners to come to the #2-3NW Belt drive so that they could enter the primary escapeway from there and continue evacuating the mine. Bill Currence was able to fight the fire from the inby side, which prevented him from being exposed to the thick smoke that was flowing outby from the drive. After extinguishing the fire at the speed reducer, he saw more flames at the head roller. He fought the fire for approximately 15 minutes before extinguishing all of the flames, which were approximately two feet high.

Meanwhile, both crews heard the warnings from the surface regarding the smoke and evacuated the sections, meeting Craig Currence in the track entry as he traveled inby. By the time the crews reached the #2-3NW Belt drive, the flames had been extinguished, but the track entry was still filled with smoke outby that point. Bill Currence and Barry Fletcher remained at the fire scene and applied additional water to the fire area while the section crews entered the adjacent primary escapeway and walked the remaining 2,850 feet to the surface.

Having received no communications from the sections, Johnny Nickels donned a SCSR and opened both track haulage airlock doors. Johnny Nickels then entered the primary escapeway and was walking inby when he met Craig Currence, who informed him that there was a fire at the #2-3NW Belt drive and that the other section miners were behind him, on their way out of the mine. Light smoke was present in the primary escapeway due to recirculation of air at the mine openings within the surface box cut.

After applying water to the fire area for approximately 40 minutes, the smoke had cleared and no additional hot spots could be found. Bill Currence then left Barry Fletcher, who continued watching the fire area, and traveled in a track bus to the surface to ensure that all persons had been safely evacuated. When he reached the surface, everyone had been accounted for except the West Main seal construction crew. At approximately 10:20 a.m., Bill Currence, Chad Currence (Section Foreman), and William Shomo, (General Laborer), went back into the mine to locate the crew. Shortly after they entered the track entry, the West Main seal construction crew exited the mine from the primary escapeway. Shomo traveled to Barry Fletcher's location at the #2-3NW Belt drive while Bill and Chad Currence traveled to the West Main work site where

they determined that the miners had left the area. The five men then returned to the surface, examining conveyor belts on the way out.

INVESTIGATION OF THE ACCIDENT

The underground investigation of the fire area began on September 16, 2002, after it was determined that area was safe and accessible. The investigation was conducted by MSHA in conjunction with WVOMHS&T. Representatives of Fairfax Mining Co., Inc. accompanied the investigators. MSHA and WVOMHS&T conducted interviews with persons knowledgeable of the facts surrounding the accident. Audio taped interviews were conducted at the mine office. A list of those persons who participated in the investigation is contained in Appendix A of this report.

The investigation team evaluated the areas affected by the fire to determine its probable cause and origin. The team examined all electrical equipment and circuitry in the affected area. Photographs and digital still images were taken to document the fire damage. Examination records were also reviewed.

MSHA received custody of the fire suppression hoses and fire sensor wiring immediately after the accident and made arrangements that these items be analyzed by MSHA technical support. Tests were performed to determine the melt temperatures for the hoses and the insulation of fire sensor wiring.

Enforcement actions for those violations found during the investigation that did not contribute to the accident were issued during the ongoing Health and Safety Inspection.

DISCUSSION

Fire Origin and Fuel Source

Ignition Sources

The following potential ignition sources were identified and evaluated during the investigation:

- *Drive Pulley Slippage* - The lagging of the drive pulley slipping against the belt was the most likely source of ignition for this fire. This is discussed in more detail in the Slippage & Sequence Control section.
- *Electrical Circuits* - Although there were two non-contributory violations issued, the electrical circuits were examined and it was determined that they were not an ignition source.
- *Smoking* - Investigators found no evidence to indicate smoking was the source of ignition. Therefore, smoking was not considered a potential ignition source.

- *Roof Falls* - The immediate mine roof in the area consisted of coal and shale, rather than the type of sandstone that has been associated with this type of ignition source. There was no roof fall in the area. Therefore, a roof fall was not considered a potential ignition source.
- *Welding/Cutting Operations* - There was no welding or cutting operations in the belt drive area. Therefore, welding/cutting operations were not considered a potential ignition source.

Fuel and Extent of Flame

Fuel for the fire was provided by conveyor belting, lagging on the head and drive rollers, coal spillage, and wooden roof support material. Coal spillage (due to a disabled sequence switch) extended up from the floor to and around the head roller. Additional spillage extended along both sides of the belt structure, in and around the drive rollers and motors. The spillage, on the right side of the belt structure facing inby, was 4 feet wide by 18 feet long and up to 4 feet deep. The spillage on the left side of the belt structure facing inby was 16 feet long by 5 feet wide and up to 4 feet deep.

The flames extended inby from the #2-3NW Belt head roller for a distance of 30 feet, to the take-up unit, and across the full width and height of the entry (15' x 7'-2"). The heat of the fire melted the plastic light covers on the belt starter box (four feet from the drive area), charred the cap pieces on the roof bolts (a distance of 30 feet), and charred wood posts alongside the belt (See Appendix B, Figure #2). In addition, heat from the fire melted fire suppression and water supply hoses, communication lines, and electrical cables. Testing indicated that the melting point of the fire suppression hose was 329-343 °F. The insulation on the fire sensor wire was melted off; which, when tested, showed a melting point of 365-385° F.

Slippage & Sequence Control

Slippage and sequence switches were installed on the #2-3NW Belt, as required by 30 CFR 75.1102, but were disabled at the time of the accident (both switches were in the Set-Up position). Slippage switches automatically stop their associated belt conveyor drive pulley when slippage between the belt and the drive pulley is detected. If the drive pulley continues to run during slippage, sufficient frictional heat can be generated between the drive pulley and the belt to ignite the belt and/or coal spillage. Sequence switches prevent belt conveyor flights from dumping coal onto flights that have stopped or slowed sufficiently to cause spillage at transfer points. Coal spillage against the belting can create sufficient drag to cause the belt to slip on the drive pulley.

Starting the slope belt at the #3 Mine initiated a cycle that progressively energized the underground belts. When energized, each drive motor utilized a soft start capability, slowly increasing the conveyor belt speed for approximately one minute, until reaching its normal operating speed. Each belt Sequence Controller monitored the speed of its next outby conveyor belt. When the outby belt reached its normal operating speed, the belt sequence controller sent a

start signal to its associated drive motor. This progression of starting the conveyor belts continued until the most inby underground belts were running.

A Pyott-Boone Model 405A Slip/Sequence Controller was used to receive signal outputs from probes that continuously monitored the speeds of the #1 and #2-3NW Belts. Each probe operated independently of the other and was mounted near a selected roller that was in constant contact with its associated belt. The Controller was electrically connected to the motor controls at the #2-3NW Belt starter box and should have been capable of automatically de-energizing the drive motor if the belt speeds became different.

The #2-3NW Belt Slip/Sequence Controller box contained two toggle switches that could be set in either the Run or Set-Up position. In the Run position, the Controller should have automatically responded to the signals of the speed probes. Thus, if the #2-3NW Belt slowed or stopped while in the Run mode, then the Slip Controller should have shut down the #2-3NW Belt. If the #1-3NW Belt slowed or shut down while in the Run mode, then the Sequence Controller should have shut down the #2-3NW Belt to prevent spillage from piling up and rubbing against moving conveyor belting or equipment.

The Set-Up position was used to disable the automatic slip or sequence protection functions when conducting belt maintenance (such as during calibration of the Slip/Sequence System), during which time the Controller would ignore the speed probe signals. When calibrating the Slip/Sequence System, the toggle switches would be placed in the Set-Up position, permitting the belts to continue running. The individual belt speed input signals would then be matched in the control circuit by adjusting potentiometers, after which the toggle switches would be returned to the Run positions.

After the fire, both toggle switches were found in the Set-Up mode ([See Appendix B, Figure #3](#)). Therefore, neither the Slip nor the Sequence Controllers would have been able to shut down the #2-3NW Belt at the time of the accident. No system was in place on the surface of the #3 Mine to alert the operator that the automatic functions of the Slip/Sequence Controllers were disabled. A green LED on the outside of the Controller box, mounted on the outby side of the #2-3NW Belt starter box, was normally lit when both switches were in the Run position and was the only means for visually determining if the automatic system functions were activated (other than opening the box and looking at the toggle switches). The only time persons were routinely in close proximity of the light was during preshift and on-shift examinations of the belt haulage entry.

Persons interviewed during the accident investigation did not indicate when the Slip/Sequence Switches were placed in the Set-Up position. Belt maintenance was performed during the Day Shift on Sunday, September 15, 2002, when a mechanical splice was made on the #2-3NW Belt under the supervision of Robert Moore, an examiner who was acting as a maintenance foreman. Interviews indicated that the #2-3NW Belt was started with the Slip and Sequence Switches in the Run Mode, and with the #1-3NW Belt running. When the section of belt to be spliced reached the work location near the 1 West Belt transfer point, a miner stopped the belt with the remote electrical switch at this location.

None of the belts operated during the following shift until approximately 10:30 p.m., at which time the slope belt was started. After which, Edward Cummings, Section Foreman, determined that the #2-3NW Belt had failed to start, but all conveyor belts outby that flight were running. He doubled-checked the Run/Off/Auto switch on the #2-3NW Belt starter box and verified that it was in the Auto position. During his interview, Cummings did not indicate that he checked the green LED on the #2-3NW Belt Slip/Sequence Controller box. He then walked from the starter box to the #2-3NW Belt remote switch, located near the #1-3NW Belt tail roller. When Cummings discovered that the remote switch was off, he turned it on, which immediately started the #2-3NW Belt drive motor (this would have been expected with the Sequence/Slippage Switches in either position).

The belts continued running until the next morning until shortly before 9:20 a.m., on September 16, 2000, when the #1-3NW Belt tripped off while coal was being mined on both working sections. Since the Slip/Sequence Switches were in the Set-Up position, the #2-3NW Belt (and all flights inby that point) would have continued to run, spilling coal at the transfer point onto the stopped #1-3NW Belt. The coal spillage accumulated on and around the tailpiece of the stopped #1-3NW Belt and the #2-3NW Belt discharge roller and drive assembly, consistent with the loose coal observed in the affected area during the investigation (See [Appendix B, Figure #1](#)). The spillage contacting the #2-3NW Belt would have been sufficient to slow or stall the conveyor belt, while the drive pulley continued to rotate. A “gob” switch (See [Appendix B, Figure #4](#)) was not installed at the #2-3NW Belt transfer point to detect the coal spillage. Such switches can be utilized to shut down belts when spillage is detected.

Fire Detection System

To meet the requirements of the 30 CFR 75.1103 for automatic detection and warning of fires that could occur on or near their underground belt conveyors, the Fairfax #3 Mine used the Pyott-Boone Model 244 Heat Detection System, MSHA Approval Number 1A No. 346. The three main components of the heat detection system were the Network, Control Panel, and Siren.

The Network consisted of network cables, heat sensors, remote locators, and line monitors. The network cable was installed above each belt flight. The point-type heat sensors were bimetallic thermostats attached to the network cable. Electrical contacts in these heat sensors were designed to close at 135°F and reopen at 90°F (See [Appendix B, Figure #5](#)). Heat sensors were required to be installed at the beginning and end of each belt flight, at the belt drives, and at increments not exceeding 125 feet along each belt flight. The detection system was designed to initiate a fire alarm on the mine phone paging system (which could be heard over the surface and underground speakers) when a heat sensor’s electrical contacts closed.

Remote locators were also attached to the network cable (See [Appendix B, Figure #5](#)) to identify the belt flight where a fire is located. A remote locator was mounted above each conveyor belt head roller. Each locator contained a variable resistor that was calibrated to identify its associated belt flight. When a heat sensor’s electrical contacts close due to the heat of a fire, the

remote locator sends a signal to identify the fire's location by indicating the conveyor belt's number on the Control Panel's flight meter (See Appendix B, Figure #6).

Line monitors were connected at the end of each branch network cable (near each section loading point), which paralleled the branch cables within the network circuit. The internal resistors of each line monitor were adjusted so that the total network resistance measured at the Control Panel equaled 15,000 ohms. During normal operating conditions, the line monitors permitted a small current to flow through the network so that the Control Panel's monitoring circuit could determine the system's ability to detect a fire. For example, when an open circuit condition occurred, the current flow should have dropped to zero and the Control Panel's line monitor meter would display a zero indication (See Appendix B, Figure #6).

The Model 244 Control Panel has four different phases of operation:

- *Phase 1, Monitor the Network for a Resistance Change* - Normally, the Control Panel continuously monitors the network for a resistance change. An open circuit in the network would be indicated by increased resistance; while either a heat sensor contact closure (due to fire) or a network short circuit would be indicated by lower resistance.
- *Phase 2, Determine if The Resistance Change Is Due To A Fire or A Network Malfunction* - The Control Panel instantly reverses the network current when resistance decreases. When lower resistance is caused by closure of a heat sensor's electrical contacts, a diode installed in series with each heat sensor blocks the reversed current (See Appendix B, Figure #7), which prompts the Control Panel to energize the audible fire alarm. When lower resistance is caused by a short circuit in the network cable, the reversed current will not be blocked, prompting the Control Panel to energize the Line Short Lamp. If a heat sensor's contacts close due to heat and the diode is not installed with the proper polarity, the reversed current will not be blocked and the Control Panel will incorrectly react as if a short circuit malfunction has occurred. Once a network short circuit malfunction occurs, the Fire Detection System remains disabled (until the system is restored) and no audible alarm will sound.
- *Phase 3, Indicate the Location of A Fire or A Network Short Circuit* - When the Control Panel initiates an audible fire alarm, the location of the sensor detecting the fire is indicated on the Control Panel's belt flight meter (See Appendix B, Figure #6). The general location of the network short circuit can be found by depressing the RESET button on the Control Panel, while simultaneously depressing the Line Short Locator button inside the Control Panel. When the RESET button is released, while continuing to press the Line Short Locator button, the flight meter on the Control Panel will then show the belt conveyor where the short circuit exists. When a network open circuit malfunction occurs, the needle on the Line Monitor analog meter is deflected to the left of scale center.

- *Phase 4, Wait for a Reset* - A “Reset and Siren Test” Switch is mounted on the Control Panel (See Appendix B, Figure #6). If the condition has cleared, this manual switch will reset the fire audible alarm or turn off the Line Short lamp. Also, this switch can test the siren.

The operator did not provide a means for rapidly evaluating electrical short and open circuit problems on the Fire Detection System, as required by 30 CFR 75.1103-5(b). The Control Panel was designed to initiate an audible alarm for a fire only, while the system’s problem warning devices gave only visual displays. These displays were located on the Control Panel in the maintenance foremen’s office, which was not a normally manned duty post. By manufacturer’s design, this Fire Detection System was also disabled from detecting fire until the problem condition was corrected. As a result, miners were not alerted of a system problem affecting operational capability or warned of a belt fire at the #2-3NW Belt drive until after smoke was observed, prompting the mine superintendent to look at the Control Box.

The following scenarios, none of which were ruled out, were evaluated to determine why the system failed to sound the fire alarm on the day of the accident:

- *A heat sensor at the #2-3NW Belt Head Roller may have been missing* - A Fire Detection System heat sensor was not found over the #2-3NW Belt head pulley. If the fire first intensified at a location where no heat sensor was present (melting the network cable insulation at that point), the most likely response from the Fire Detection System would have been to detect a line short, which would have energized the Line Short Lamp and disabled other sensors from initiating the fire alarm. However, it is more likely that the fire originated near the drive pulley, not at the head pulley. Also, the fire-damaged leads of the heat sensors could have broken off while a fire hose was blasting water onto the fire. A review of the two-year violation history indicated that the mine had been in compliance with 30 CFR 75.1103-4(a)(1) regarding the installed locations of the heat sensors.
- *A diode for the heat sensor at the #2-3NW Belt Drive Pulley may have been missing or improperly installed* - A diode was not found installed to one unattached lead of the network heat sensor nearest the drive pulley, which was near the most likely origin of the fire. If the diode was not properly installed in the sensor that first detected the fire, the Fire Detection System would have detected the reversed current flow and assumed that a short circuit had occurred, energizing the Line Short Lamp and disabling the Fire Detection System from sounding a fire alarm. Although the fire could have destroyed evidence of the diode’s plastic case, interviews indicated that persons installing these sensors at the #3 Mine did not understand the diode’s function and may have improperly installed them.
- *Melted Insulation caused a Short Circuit within the Network Cable at the #2-3NW Belt Fire Area* - The insulation was burned off the two-conductor network cable. This would have caused the Line Short Lamp to energize when the bare conductors contacted each other.
- *No Preventative Maintenance Program to Verify Heat Sensor Reliability* - No preventative maintenance program was being conducted to determine the reliability of individual sensors of the Fire Detection System, which does not monitor the functional capability of the

individual sensors. Sensors should be tested by applying heat to each sensor. Corroded electrical connections between a sensor and the network cable or faulty electrical contacts within the sensor would affect the system's detection capability. Also, a coating of rock dust on a heat sensor can act as a thermal insulator, delaying the reaction time of the heat sensor's electrical contacts ([Appendix B, Figure #8](#) shows such a heat sensor at another location in the #3 Mine). If this condition was present near the fire's origin, it may have delayed the reaction time of the sensor until after the network cable insulation melted.

Fire Suppression System

The fire suppression system for the #2-3NW Belt drive activated during the accident. Although the system failed to extinguish the fire, it did appear to be the most likely cause for the belt shutting down, since the Sequence/Slip Controller at this drive was disabled. The sequence switches would have progressively de-energized all of the inby belts from the #2-3NW Belt to the two active sections. Due to fire damage, an operational functional test of this system, including its Control Box, could not be performed.

The fire suppression system installed at the #2-3NW Belt Drive was a Pyott-Boone Model 235 "Old Faithful" Deluge System. This self-contained system (entirely independent from the mine-wide, point-type, Fire Detection System) was designed to detect fire and automatically shut down the monitored conveyor belt, activate the deluge-type water sprays, and trigger the appropriate alarms. The system should have provided protection for the belt drive and 50 feet of the fire-resistant belt adjacent to the belt drive, as required by 30 CFR 1101-2.

The Fire Suppression System utilized a Pyott-Boone Model 235A Control Box, which was mounted on the #2-3NW Belt starter box. The system's heat sensors were designed to send a signal to the Control Box when heat was detected. Although fire damage prevented the identification of all of the heat sensors within the affected area, observations at other installations confirmed that the operator consistently connected them to the sensor cable near the roof and above the drive roller, drive motor, gear-reducing unit, power take-up unit, and electrical controls. Once the heat sensors detected the fire, the Control Box should have signaled the belt starter box to de-energize the conveyor belt drive motor, signaled a water control valve to provide flow to the Fire Suppression System water sprays, and triggered audible and visual alarms. These alarms were only located on the cover of the Control Box; meaning that the only indication anyone, either on the surface or on the sections, would have had that the fire suppression system had actuated would have been the belts shutting down. The water control valve was found in the open position when persons first responded to the fire, further indicating that the fire suppression system had actuated.

Water supply header pressure measurements indicated that the required water flow rate and distribution would not have been provided by the #2-3NW Belt Drive fire suppression system, as installed at the time of the accident. This lower water flow would have been less effective at extinguishing the fire than if properly installed, contributing to the size and duration of the fire,

which ultimately had to be extinguished using a fire hose. Factors affecting the Fire Suppression System included:

- *The Fire Suppression System contained only one branch line (See Appendix B, Figure #9).* Both the manufacturer's design criteria and 30 CFR 75.1101-4 required the fire suppression system to include at least two parallel branch lines for delivering water to the drive assembly and adjacent belting.
- *Proper water sprays were not installed on the branch line.* Section 30 CFR 75.1101-1(b) states that "Nozzles attached to the branch lines shall be full cone, corrosion resistant and provided with blow-off dust covers. The spray application rate shall not be less than 0.25 gallon per minute per square foot of the top surface of the top belt and the discharge shall be directed at both the upper and bottom surfaces of the top belt and to the upper surface of the bottom belt." The nozzles installed at the time of the fire were 60-degree cone sprays, rated for 1.0 gpm at 10 psi. A typical full cone nozzle has a 120-degree water spray.
- *The branch water line was destroyed by the fire, disabling the Fire Suppression System prior to extinguishing the fire.* Two different types of 3/4 inches diameter fiber-braided hoses were used to assemble the single branch line at the #2-3NW Belt drive. Both were marked as being flame resistant. Thermal tests conducted at the MSHA Approval and Certification Center determined that the outer jacket of the fiber-braided hoses melted at temperatures as low as 329 °F.

The malfunction of heat sensors closest to the fire origin could have also resulted in delayed actuation of the Fire Suppression System. However, sufficient evidence was not found to confirm or rule out this possibility, since the sensors were destroyed by the fire. If a sensor had malfunctioned and the fire continued to intensify, tests indicated that the insulation on the network conductors would have melted at temperatures between 365 °F to 369 °F. The resulting bare electrical conductors shorting together would have then activated the Fire Suppression System. Under these circumstances, the heat of the fire could have destroyed the fiber-braided water supply hose before the water control valve had received the signal to open. Also, preventative maintenance was not being performed by the operator (prior to the accident) to determine the reliability of individual sensors on the Fire Suppression System, which should be individually tested similar to the Fire Detection System sensors for this purpose.

Communication System

The communication wiring going to the two active sections passed by the #2-3NW Belt drive. The wiring included two-way radio antenna wire and the mine phone wires. When the fire occurred, the insulation on the wires was destroyed and communications were disrupted to the working sections. The potential for the loss of communication during mine fire emergencies could be minimized by locating such wiring in entries other than belt entries. If the Fire Detection System had sounded an alarm, the fire may have been detected prior to disrupting the mine communication system. While miners on the working sections could hear orders to

evacuate the mine, persons on the surface could not hear their acknowledgement to the message, underscoring the need for rapid initiation of a mine evacuation at the first sign of fire.

Overcurrent Protection

The overcurrent protective device (required by 30 CFR 75.900) on the starter box for the #2-3NW Belt drive motor was bypassed. The control wires that transmit the overcurrent trip signal to open the circuit breaker were terminated together under the same bolt on the overcurrent protective device. The overload for the electric motor was sized to trip the circuit breaker at currents greater than 125% of the name plate full-load motor rating. Current exceeding this value could cause thermal damage to the drive motor insulation; and to the insulation of the conductors and jacket of the cable providing power to the motor. Thermally damaged insulation on this circuit could expose personnel to a potential 480 Vac shock hazard. Insulation tests with a megger and visual examinations revealed no thermal damage. Neither motor nor cable was replaced and was ruled out as a possible ignition source.

Ground Check Protection

The pilot wire and the grounding conductor on the #2-3NW Belt drive motor did not have separate terminal connections (required by 30 CFR 75.902-4). The pilot wire and grounding conductor were terminated together under the same bolt that was threaded to the motor housing. The ground check device was designed to trip the circuit breaker if the continuity of the monitoring circuit is broken. The power cable's pilot wire and grounding conductor were the two conductors of the monitoring circuit. The ground check device transmits a signal onto the pilot wire and the signal is returned on the grounding conductor. If the signal is lost due to an open circuit, the ground check device causes the circuit breaker to trip open. Examinations of the power cable's pilot wire and grounding conductor terminations were tight and were determined to have good electrical conductivity. This cable was not replaced and was ruled out as a possible ignition source.

Examinations

A preshift exam was conducted on the #2-3NW belt on the morning of the accident and no hazardous conditions were listed in the operator's record of this examination. Although the Slip/Sequence protection for the #2-3NW Belt drive was likely in a disabled condition during this examination, the system indicators for this condition (the lack of an energized green LED on the Control Box) would not have been readily apparent to the examiner.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted. Causal factors were identified that, if eliminated, could have prevented or significantly mitigated the severity of the fire. Corrective actions taken by the operator to prevent a recurrence are also listed.

Causal Factor: The #2-3NW Belt Slippage and Sequence protection was disabled. Toggle switches for the Slippage and Sequence Controller were found in the electrical test mode, causing the Controller to ignore the speed probe signals.

Corrective Action: The Slippage and Sequence protection toggle switches must be returned to the Run position prior to normal operation of the belt. After the accident, the operator installed spring-loaded toggle switches in the Control Box of the Slippage and Sequence Protection System. These replacement switches require constant finger pressure to keep the switch in the Set-Up Mode. Without pressure, the toggle switches would spring back to the Run Mode.

Causal Factor: The #2-3NW Belt continued running after coal spillage accumulated at the conveyor belt's discharge point.

Corrective Action: The operator installed a "gob" switch at each belt transfer point (See [Appendix B, Figure #4](#)). This switch was installed to detect a build-up of coal at the transfer point, shut down the inby belt when such a condition occurs, and restart the belt after the coal build-up clears.

Causal Factor: The Slippage and Sequence Protection System was not provided with a means to alert responsible persons of malfunctions or bypassed conditions. The only indication of the system status (other than the toggle switch positions within the Control Box) was a green LED, which was energized if both the Slippage and Sequence Switches were in the Run Mode. This LED could not be readily observed during examinations of the conveyor belt entry.

Corrective Action: Training should be provided to increase miners' awareness of the purpose for the green LED's on the Slip/Sequence Control Boxes. The miners should be instructed as to what actions are required if the green LED is not energized during normal belt operation. Also, discuss when the switches can be placed in the Set-Up Mode and emphasize the importance of having the switches placed in the Run Mode when maintenance work has been completed.

Causal Factor: The Fire Detection System was not provided with a means for rapidly evaluating electrical short and open circuit problems. The visual displays for indicating a problem in the Fire Detection System were located in an office that was not continuously manned. No audible alarms were provided to alert responsible persons of such conditions.

Corrective Action: The operator provided a means to sound the Fire Alarm on the mine phone paging system when a Line Short or Line Open problem occurs. In addition to alerting affected persons underground, the alarm prompts responsible surface persons to check the visual displays to determine which problem exists.

Causal Factor: The Fire Detection System was disabled after a short circuit was detected, likely caused by the fire itself, either by melted insulation on the network cable or a problem associated with a heat sensor. The system was not capable of sounding an audible warning signal once the short circuit occurred.

Corrective Action: The operator provided a means to sound the Fire Alarm on the mine phone paging system when a problem (Line Short or Line Open) occurs on the fire detection system. The Fire Fighting and Evacuation Plan now states that the audible alarm notifies the responsible outside person. The outside person communicates to all underground personnel the particular belt that has the problem. All areas inby the affected alarm location will immediately evacuate to an outby area. A foreman or a competent person will investigate the incident and will report the cause of the alarm to the outside person. If an alarm occurs due to a system problem and the system is inoperative, all belts will be monitored with CO (carbon monoxide) meters until repairs are made.

Causal Factor: Heat Sensors may have been improperly installed and maintained. A Fire Detection System heat sensor was not found over the #2-3NW Belt head pulley. Also, a diode may not have been properly installed onto the heat sensor located above the #2-3NW Belt drive motor. If the heat sensor was not provided with a properly installed diode when exposed to fire, the monitoring circuit would have reacted as if a short circuit malfunction occurred. When smoke was first observed, the Line Short Lamp was energized and an audible fire alarm had not sounded.

Corrective Action: The operator arranged for a service representative to demonstrate the proper method of installing a diode in series with a heat sensor. The training was provided to miners assigned to maintain the Fire Detection System.

Causal Factor: Preventative maintenance was not being performed to determine the reliability of individual sensors on the Fire Detection System. Corroded electrical connections between sensor leads and the network cable, faulty electrical contacts within the sensor, or a diode not properly installed with the sensor could cause a malfunction in the system's detection capability. A coating of rock dust could have also caused a delayed heat sensor response until after the heat melted the network cable.

Corrective Action: System reliability should be verified by applying heat to each sensor. The applied heat should be above the sensor's set point temperature. Also, examiners and belt maintenance personnel should be trained on the importance of keeping the sensors clean.

Causal Factor: The Fire Suppression System spray water flow was too low and insufficiently distributed to extinguish the belt fire. The deluge-type water spray system installed to protect the

#2-3NW Belt drive area was not provided with two or more branch lines to provide the required fire protection.

Corrective Action: When using deluge-type fire suppression systems, appropriate design standards should be used for sizing branch water lines. Water pressure losses and cone spray nozzle angles should also be considered to ensure proper coverage. After the accident, the operator replaced the #2-3NW Belt deluge system with a sprinkler system, which utilized 1 inch diameter piping. Testing verified that the water flow requirements were satisfactory for the sprinkler system.

Causal Factor: Preventative maintenance was not being performed to determine the reliability of individual sensors on the Fire Suppression System. Like the Fire Detections System, the #2-3NW Belt Fire Suppression System was not designed to monitor the functional capability of the individual sensors. A malfunctioning heat sensor may have delayed the system's response until after the fire destroyed the branch water hose.

Corrective Action: System reliability should be verified by applying heat to each sensor. The applied heat should be above the sensor's set point temperature. Also, examiners and belt maintenance personnel should be trained on the importance of keeping the sensors clean.

Causal Factor: A malfunctioning heat sensor may have delayed the system's response until after the fire destroyed the branch water hose.

Corrective Action: The operator has replaced the rubber hoses of the Fire Suppression System at the #2-3NW Belt with steel pipe.

CONCLUSION

The fire occurred because the #1-3NW Belt shut down while the #2-3NW Belt continued to run, causing coal spillage at the transfer point. The spillage was sufficient to slow or stall the #2-3NW Belt, while the drive pulley continued to rotate. The resulting slippage of the drive pulley on the conveyor belt generated sufficient frictional heat to ignite the lagging on the drive pulley, the conveyor belting, and the adjacent coal spillage. This condition occurred because the #2-3NW Belt was placed in normal operation with its associated Slippage and Sequence toggle switches in the Set-Up position.

Discovery of the fire, fire-fighting, and evacuation procedures were delayed because the Fire Detection System was disabled by an electrical short circuit problem, which prevented the system from sounding an audible fire alarm. The fire continued to intensify before it was discovered because the short circuit problem in the Fire Detection System was not rapidly evaluated and because the automatic Fire Suppression System was not properly installed. The short circuit indication was likely caused by the fire melting the network cable prior to actuating a sensor; or an improperly installed or maintained heat sensor.

The single branch line of sprays provided for the #2-3NW Belt Drive Fire Suppression System could not supply sufficient water flow to extinguish the fire. Total failure of the Fire Suppression System occurred when the branch line hoses were destroyed by the fire. Failure of the Fire Suppression System to automatically extinguish the fire exposed persons to hazards associated with fire-fighting activities and contributed to its size and duration.

The mine evacuation was further complicated by the loss of two-way communication to the working sections when fire melted insulation on the mine phone cable, which was hung in the belt entry near the #2-3NW Belt drive. This disruption in communication caused persons to enter the mine to locate miners who remained unaccounted for during the evacuation.

ENFORCEMENT ACTIONS

Order, 103(k)

The mine has experienced a mine fire at the 3 North West No. 2 (#2-3NW) Coal Conveyor Belt Drive and the tail piece of the 3 North West No. 1 Coal Conveyor Belt. This order is issued to insure the safety of all persons at the mine. All persons not directly engaged in the [fire] fighting activities of the affected area shall be evacuated from the mine. All electrical power circuits for the underground mine shall be deenergized, locked and tagged out. Only those representatives from the Mine Safety and Health Administration, the West Virginia Department of Miners' Health, Safety and Training and personnel from Fairfax Mining Company deemed necessary for the investigation will be permitted into the underground mine and affected area.

Citation, 104(a), 75.1102, S&S, Moderate Negligence. On September 16, 2002, a fire occurred at the drive unit for the 3 North West No. 2 (#2-3NW) underground belt conveyor because it was being operated without the protection of the provided slippage and sequence switches. At the time of the accident, the #2-3NW Belt had been placed in normal operation with its associated Slippage and Sequence toggle switches in the Set-Up position, which caused the Slippage/Sequence Controller to ignore signals from the system probes. As a result, when the #1-3NW Belt shut down, the #2-3NW Belt continued to run, causing coal spillage at the transfer point. The spillage was sufficient to slow or stall the #2-3NW Belt, while the drive pulley continued to rotate. The resulting slippage of the drive pulley on the conveyor belt generated sufficient frictional heat to ignite the lagging on the drive pulley, the conveyor belting, and the adjacent coal spillage.

Citation, 104(a), 75.1103-5(a)(2), S&S, High Negligence. On September 16, 2002, a fire occurred at the 3 North West No. 2 (#2-3NW) Belt drive area. Discovery of the fire, fire-fighting, and evacuation procedures were delayed because the Pyott Boone Model 244 Fire Warning System was disabled by an electrical short circuit problem that prevented the system from sounding an audible fire alarm. The fire continued to intensify before it was discovered because the short circuit condition displayed on the Fire Warning System was not readily detected by anyone at the mine because the device was not installed at a location where a person was assigned a regular post of duty. The Pyott-Boone Model 244 Fire Warning device provided by the operator was designed so that it only gave visual displays to warn of short circuit, open circuit or fault conditions. An electrical short circuit would energize the Line Short Lamp. An

electrical open circuit would cause the Line Monitor analog meter needle to deflect left of scale center. However, these visual warnings were given on a Control Panel in the maintenance foremen's office, which was not a regularly manned location where a person was assigned a post of duty. When utilized in this manner, the Fire Warning device could not rapidly alert personnel of system problems detrimental to the operational capability of the system. Also, the Fire Warning device was not designed so that it could detect and give warning of a fire until a system short or open circuit problem was corrected. As a result the underground miners were not made aware of a system problem that defeated the functional capability of the Fire Warning System, nor were they alerted of an actual belt fire at the #2-3NW Belt drive.

Citation, 104(a), 75.1101-4, S&S, Moderate Negligence. On September 16, 2002, a non-injury fire occurred at the 3 North West No. 2 (#2-3NW) drive area. The deluge-type water spray system installed to protect the #2-3NW Belt drive area was not provided with two or more branch lines to provide the required fire protection. It was determined during an investigation that the deluge-type system had only one branch line of nozzles. On October 8, 2002, the MSHA Fire Preparedness Task Force conducted tests on the #2-3NW Belt Fire Suppression to record the system pressures. These tests revealed that the required spray water flow of 0.25 gpm per square feet could not be provided for the entire 50 feet required to be protected. The lower flow rate was caused by pressure losses in the one 3/4-inch branch line and the assortment of 1/2-inch pipefittings used to attach the spray nozzles. Further, due to the vertical distance between the spray nozzles and the belt, 120-degree cone spray nozzles, each having a flow rate of 1.4 gpm at 10 psi, were required. However, the operator was using 60-degree cone spray nozzles, each having a flow rate of 1.0 gpm at 10 psi. This low water flow in the deluge-type system (as installed by the operator) contributed to the size and duration of the fire, which ultimately had to be extinguished by hand.

Respectfully Submitted:

\s\Daniel L. Stout
Daniel L. Stout
Electrical Engineer

\s\Jason W. Rinehart
Jason W. Rinehart
Industrial Hygienist

\s\Michael P. Snyder
Michael P. Snyder
Mining Engineer (Technical Support)

Approved By:

\s\Kevin G. Stricklin
Kevin G. Stricklin
District Manager

APPENDIX A

Listed below are the persons furnishing information and/or present during the investigation:

FAIRFAX MINING CO., INC. OFFICIALS

David Maynard	President
James Simpson	Mine Manager
Johnny Nickels*	Superintendent
Bill Currence*	General Mine Foreman
Edward Cummings*	Section Foreman
Robert Moore*	Foreman
Donald Nickels*	Chief Maintenance Foreman

FAIRFAX MINING CO., INC. EMPLOYEES

Nathan Nabors*	Beltman
William C. West*	Shuttle Car Operator
Russell McHenry*	Mechanic/Electrician
George Harrison*	Roof Bolter Operator
Craig Currence*	General Laborer

MINE SAFETY AND HEALTH ADMINISTRATION

Daniel Stout	Electrical Engineer
Jason Rinehart	Industrial Hygienist
Michael Snyder	Mining Engineer (Technical Support)

WV OFFICE OF MINER'S HEALTH, SAFETY AND TRAINING

Brian Mills	Inspector-At-Large
John Larry	Assist. Inspector-At-Large
John Collins	District Mine Inspector
Barry Fletcher	District Mine Inspector
Bennie Comer	Electrical Inspector

* Denotes persons interviewed

Appendix B (Images)
FAIRFAX MINING CO., INC
#3 Mine, I.D. 46-08633
Non-Injury Mine Fire Accident of September 16, 2002



Figure #1
Coal Spill from Discharge Roller of #2-3NW Belt onto the #1-3NW Belt



Figure #2
Fire Damage to the Top Area of the #2-3NW Belt

Appendix B (Images)
FAIRFAX MINING CO., INC
#3 Mine, I.D. 46-08633
Non-Injury Mine Fire Accident of September 16, 2002

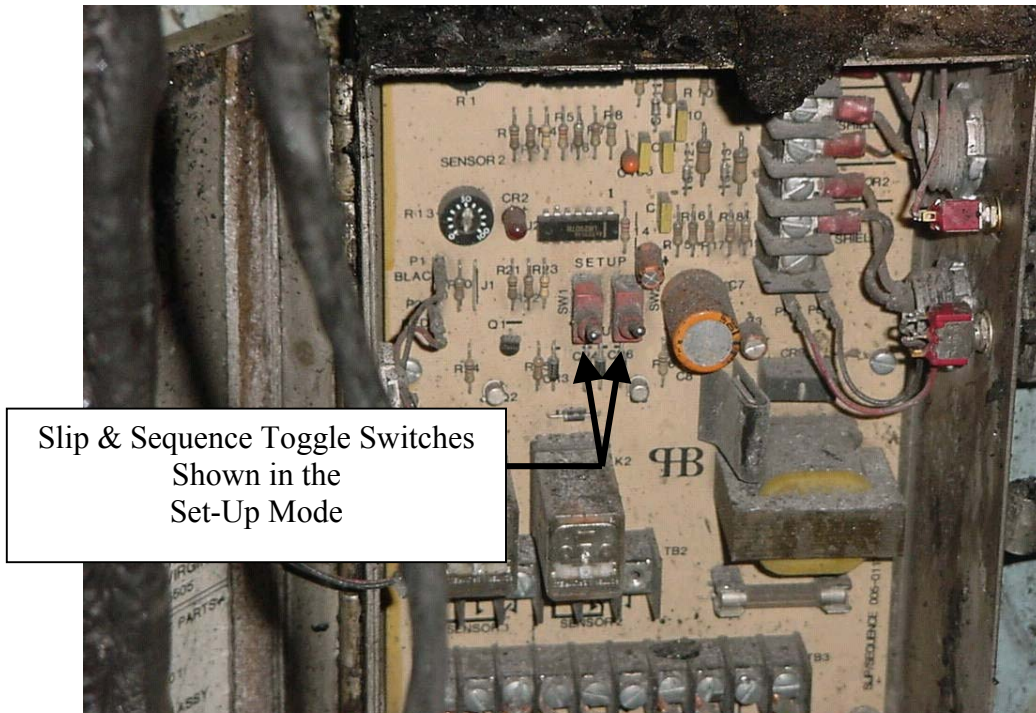


Figure #3
Slip/Sequence Control Box for the #2-3NW Belt
Both Slip & Sequence Switches were found in the Set-Up Position



Figure #4
Gob Switch installed after the Fire

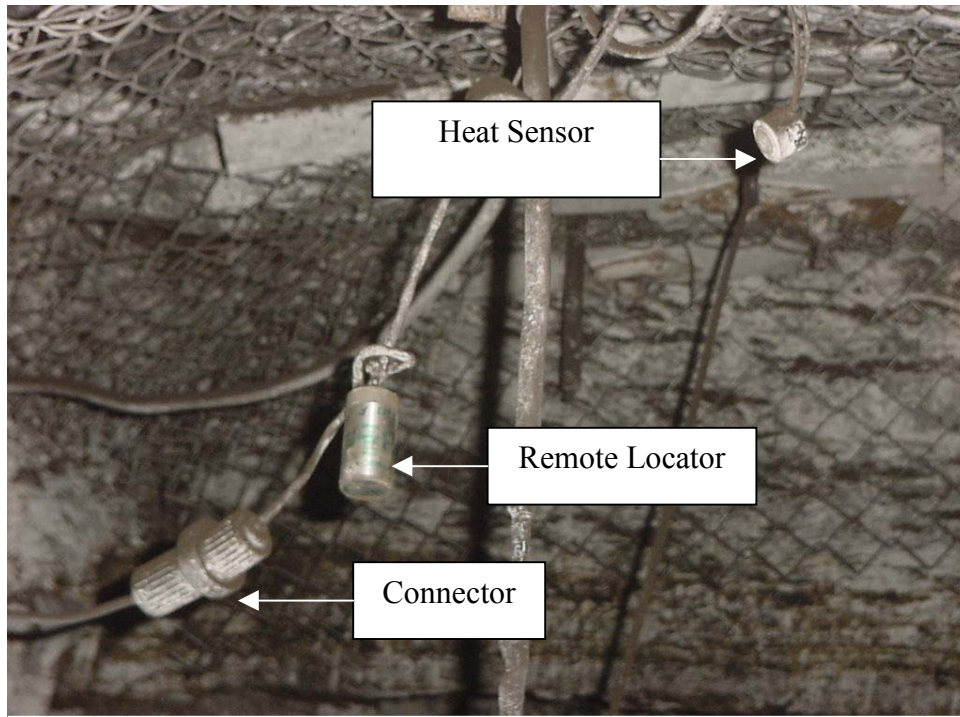


Figure #5
Fire Detection System Components
Shown are Connector, Remote Locator, & Heat Sensor

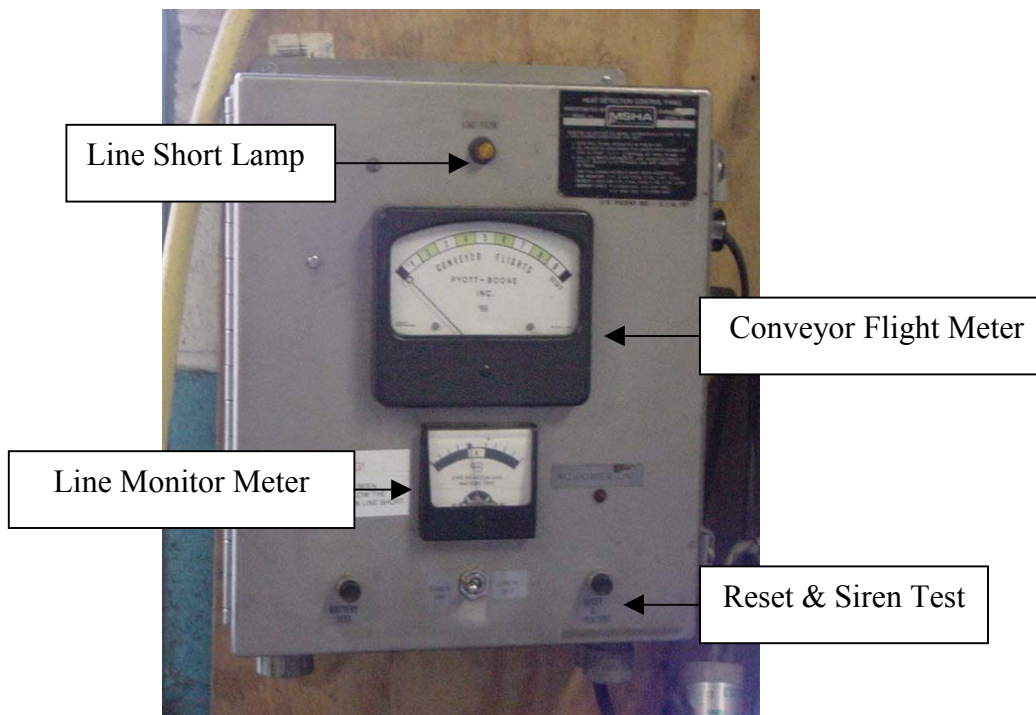


Figure #6
Control Panel for the Fire Detection System
Located on the Surface
In the Maintenance Foremen's Office

Appendix B (Images)
FAIRFAX MINING CO., INC
#3 Mine, I.D. 46-08633
Non-Injury Mine Fire Accident of September 16, 2002

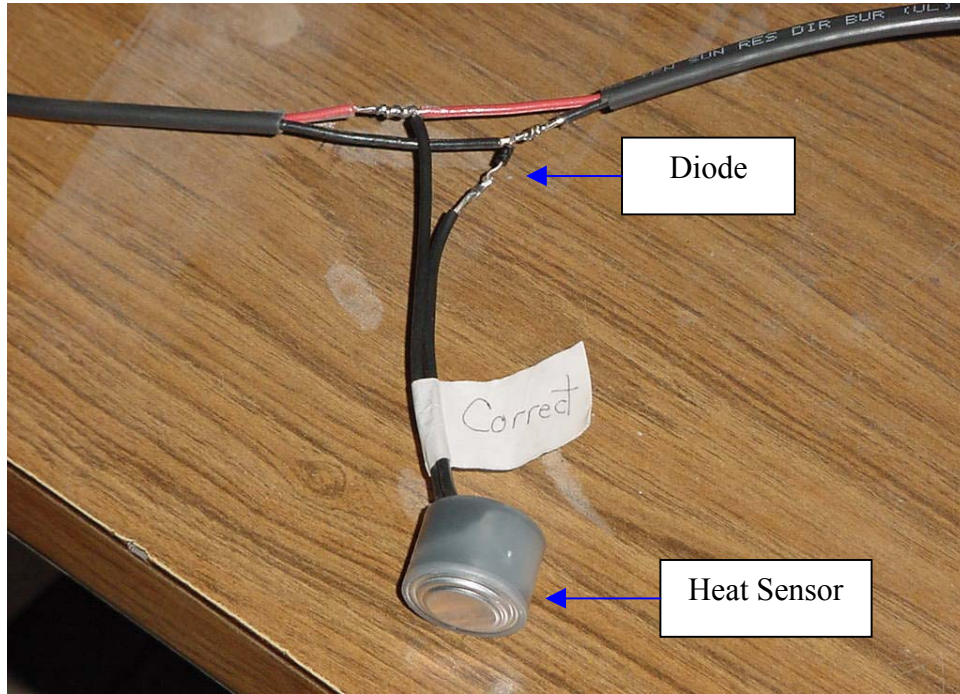


Figure #7
Heat Sensor for the Fire Detection System
Shown is the Diode with the Correct Polarity in Series with the Sensor

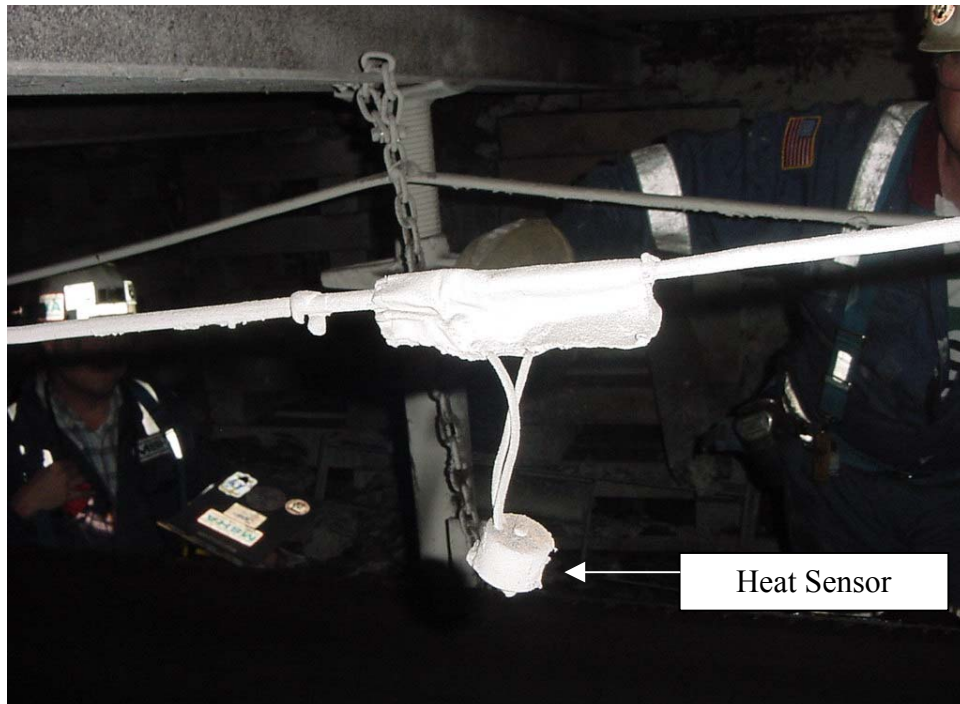


Figure #8
An Example of a Heat Sensor Coated with Rock Dust

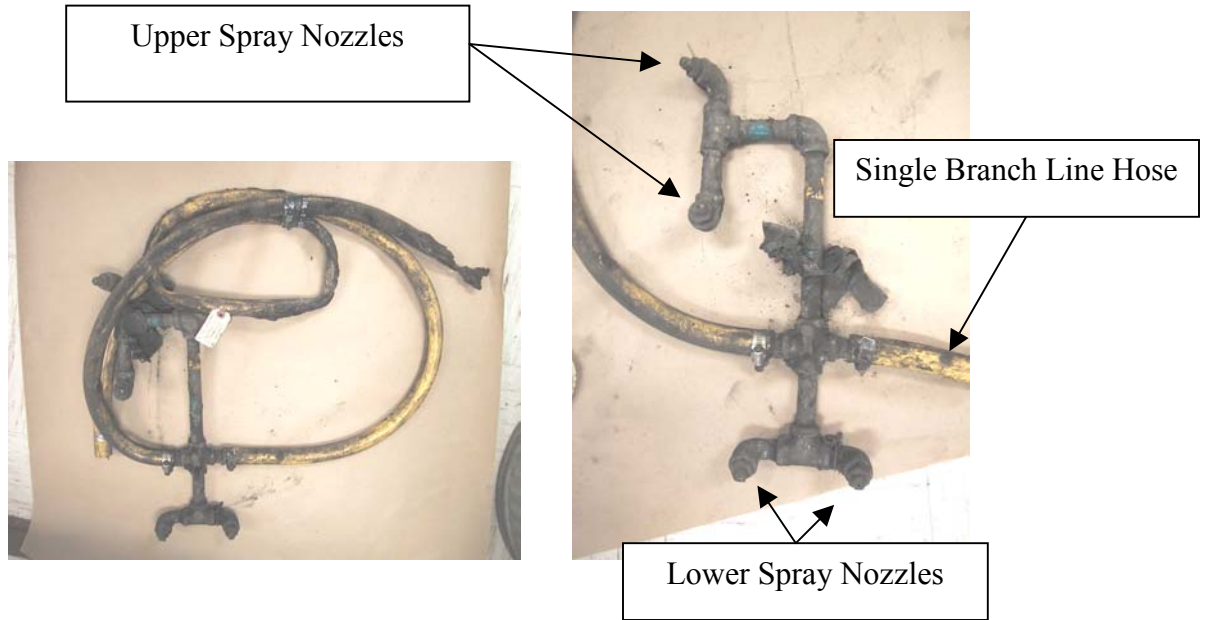


Figure #9
Piping Tees with 1/2" Pipefittings and Spray Nozzles
3/4" Single Branch Line being utilized for Fire Suppression at the
#2-3NW Belt Drive Area