



COMMONWEALTH OF VIRGINIA
DEPARTMENT OF MINES, MINERALS AND ENERGY
DIVISION OF MINES

SOUTHMOUNTAIN COAL COMPANY, INCORPORATED
MINE #3
MINE INDEX NUMBER 14095AA

INVESTIGATION REPORT
(Underground Coal Mine Explosion)

December 7, 1992

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**TRANSMITTAL OF FINAL INVESTIGATION REPORT FOR THE DECEMBER 7, 1992,
MINE EXPLOSION THAT OCCURRED AT SOUTHMOUNTAIN COAL CO., INC. MINE NO. 3**

I acknowledge receipt of the final report of the investigation of the December 7, 1992, fatal mine explosion at the Southmountain Coal Co., Inc. Mine No. 3 from the Division of Mines investigation team. This is the final report of the circumstances and causes of the fatal explosion, along with recommendations for the prevention of similar occurrences.

I commend the team for a thorough and complete report and hereby approve the report as presented. The violations will be issued as recommended. I have directed the Division of Mines staff to conduct safety talks at all mines in the Commonwealth during next quarter's inspections utilizing information from this final report.

In addition, I plan to promptly schedule a meeting with the Wise County Commonwealth attorney to review the final report for his consideration and necessary action.

I also plan to prefer written charges before the Board of Examiners concerning actions of certain persons at the Southmountain Mine who hold certificates issued by the Board of Examiners.


Harry D. Childress


Date

TABLE OF CONTENTS

PURPOSE	1
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COMMENTARY

Explosion Investigation Summary	3
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MINE OVERVIEW

Mine History	6
Mining Methods	7
Ventilation	8
Roof Control	8
Coal Dust/Rock Dust	9
Explosives	10
Smoking Articles	10
Electricity	10
Transportation and Haulage	11
Communication	11
Illumination	12
Fire Protection	12
Mine Rescue	12
Examination and Records	13
Division of Mines Activities	13

EXPLOSION, RESCUE AND RECOVERY, INVESTIGATION

Explosion	15
Recovery Operations	15
Investigation	19

DISCUSSION-EVALUATION:

PHYSICAL FACTORS RELEVANT TO THE EXPLOSION

Methane and Ventilation	22
Smoking Articles	26
Coal Dust/Rock Dust	27
Electricity	28
Roof Control	28
Extent Of Forces	29
Extent of Flames	31
Potential Sources of Ignition	31
Flame-making Devices and Smoker's Articles	31
Battery-Powered Scoop (488)	32
Cap Lamps	33
Flame Safety Lamp	33
Continuous Mining Machine	33
Shuttle Car (Off-Standard)	34
Roof Falls	34
Battery-Powered Scoop (86) and Charger	34
Section Power Center and Cables	35
Shuttle Car (Standard)	35
Conveyor Belt Feeder	36
Communication System	36
Personnel Carrier (Battery)	36
#4 Belt Power Center	37
Electrical System	37
Probable Point of Origin	37
Conclusion	38
Contributing Factors To The Explosion	38
Recommendations	39

- Appendix I - Miner Data Sheets
- Appendix II - Recovery Operations
- Appendix III - List and Summary of Violations
and Orders
- Appendix IV - Maps
 - IV(A) - Map of West Mains
 - IV(B) - Map of One Left Panel
 - IV(C) - Map of Survey Stations, Elevations
and Mining Dates
 - IV(D) - Map of Mine Workings and
Surrounding Area
- Appendix V - Map of Mine Dust Samples, Coal Channel
Sample, Direction of Forces, and Extent
of Flames
- Appendix V(A) - Coking, Forces and Heat; Mine
Dusting Survey
- Appendix VI - Equipment Testing and Examinations
- Appendix VII - Electrical Equipment
- Appendix VIII - Physical Evidence and Personal
Effects
- Appendix IX - Division of Mines' Activities
- Appendix X - Persons Present During or Contributing
Information to Investigation
- Appendix XI - Signature Sheet

Virginia Department of Mines, Minerals & Energy-Division of Mines

**MINE EXPLOSION
INVESTIGATION REPORT
Southmountain Coal Company, Inc.
Mine No. 3
December 7, 1992**

PURPOSE

Under the Mine Safety Laws of Virginia, the Chief of the Division of Mines is charged with the investigation of accidents involving serious personal injury, fatalities and/or explosions. Sections 45.1-5 E and 45.1-21 C of the laws grant authority to the Department of Mines, Minerals and Energy (DMME) to investigate causes, render a complete report and make recommendations for the prevention of similar accidents.

Section 45.1-5 E states, "The mine inspector shall proceed immediately to the scene of any accident at any mine under his jurisdiction that results in loss of life or serious personal injury, and to the scene of any mine fire or explosion regardless of whether there is loss of life or personal injury. He shall make such investigation and suggestions and render such assistance as he deems necessary for the future safety of the employees, and make a complete report to the Chief as soon as practicable...."

Section 45.1-21 C states, "Each operator will report promptly to the Chief the occurrence at any mine of any accident involving serious personal injury or death to any person or persons, whether employed or not. The scene of the accident will not be disturbed pending an investigation, except to prevent suspension of use of a slope, entry or facility vital to the operation of a section or a mine. In cases where reasonable doubt exists as to whether to leave the scene unchanged, the operator will secure prior approval from the Chief before any changes are made. The Chief will go personally or dispatch one or more mine inspectors to the scene of the accident or accidents, investigate causes, and issue such orders as may be needed to insure safety of other persons. Representatives of the operator will render such assistance as may be needed and act in a consulting capacity in the investigation. An employee

designated by the employees of the mine will be notified, and as many as three employees designated as representatives of the employees may be present at the investigation in a consulting capacity. The Department will render a complete report of circumstances and causes of each accident investigated, and make recommendations for the prevention of similar accidents. The Department will furnish one copy of the report to the operator, and one copy to the employee representative when he has been present at the investigation. The Chief will maintain a complete file of all accident reports, and may give such further publicity as may be ordered by the Director in an effort to prevent mine accidents. Each employee shall promptly notify his supervisor of any injury received during the course of his employment."

Under these provisions, Division of Mines representatives completed an investigation of the explosion at Southmountain Coal Company, Incorporated, Mine No. 3 and rendered the following report.

COMMENTARY

EXPLOSION INVESTIGATION SUMMARY

An explosion occurred at approximately 6:15 a.m. on December 7, 1992 at the Southmountain Coal Company, Inc., Mine No. 3. This coal mine is located off Route 620 in the Guest River section of Wise County, Virginia.

Nine coal miners were underground at the time of the explosion. Eight fatalities and one serious injury resulted from the explosion.

The investigation revealed that the volume of air on the active section was inadequate to render harmless and carry away flammable and explosive gases. As pillar recovery mining was conducted throughout the One Left, One Right and Two Right Panels, the roof continued to deteriorate and to fall releasing methane from the gaseous Kelly rider seam of coal, which is located directly above the abandoned workings and active section of the Southmountain Mine No. 3.

The failure to maintain the air flow in its proper volume and direction at the active section and around the abandoned areas allowed methane to accumulate in the abandoned areas and to migrate down the #1 entry to the working section. The methane/air mixture was ignited by a source in the crosscut left of survey station #378 between the #1 and #2 entries of the One Left Panel. The probable ignition source, a butane cigarette lighter, was found in this crosscut. The methane explosion resulted in sufficient forces and flames to suspend and to ignite coal dust which continued to propagate to the surface.

Analyses of mine dust samples revealed that inadequate rock dust was present and that coal dust contributed to the explosion.

Major contributing factors to the explosion were:

- Failure to properly ventilate the active One Left Panel pillar recovery section
- Failure to adequately ventilate the abandoned One Left, One Right and Two Right Panels
- Failure to maintain adequate ventilation controls
- Failure to apply proper amounts of rock dust to the mine roof,

face and ribs to minimize explosion hazards

- Failure to properly conduct weekly examinations of the One Left, One Right and Two Right abandoned areas in their entireties
- Failure to prohibit the use of smoking articles and other flame-making devices underground
- Failure of some of the miners to refrain from carrying smokers' articles underground
- Failure to comply with the stipulations of the approved roof control plan
- Failure to properly conduct preshift examinations

The following summary of orders and violations relating to the explosion were cited during the investigation:

- A total of nine orders were issued. The first order was issued to secure and control the accident scene pending completion of the investigation. The other eight orders were issued for non-compliance in the areas of: sufficient ventilation of the active pillar line, sufficient ventilation of the abandoned area, properly maintaining the permanent stopping line, adequate rockdust applications, properly conducting weekly examinations of abandoned areas, prohibiting the possession and use of smokers' articles underground, the approved five-cut partial pillaring plan in that stumps of coal were removed between cuts, and second mining including taking a sixth cut taken from the back of the pillar blocks.
- A total of four violations were issued for non-compliance in the areas of: preshift examinations, recording the volume of air entering the intake split of the One Left Panel, properly reporting the findings of the preshift examinations to personnel prior to their entering the mine, and accurately recording the results of the preshift examinations.

The following summary of orders and violations not relating to the explosion were cited during the investigation:

- One order was issued for non-compliance with the approved partial pillaring plan whereby workers were exposed to unusual dangers.

Eleven violations were issued for non-compliance in the areas of: roof control, reporting of unintentional roof falls, maintaining an accurate and up-to-date mine map, maintaining accumulations of loose coal and coal dust, maintaining the check-in and check-out system, completing preshift examinations, recording the weekly examinations and daily inspection of the fan, the pushing of supply cars and fusing of electrical circuits.

MINE OVERVIEW

MINE HISTORY

Southmountain Coal Company, Inc., Mine No. 3 was located off State Route 620 in the Guest River area of Wise County, Virginia. This mine was licensed as a new mine on August 8, 1991 with the operator being William R. Elkins. The mine license was renewed on February 6, 1992 with the operator changed to W. Jack Davis.

The mineral resource of the mine is owned by Penn Virginia Resources Corporation and is sub-leased to Virginia Iron Coal & Coke Company. Virginia Iron Coal & Coke Company contracted to Southmountain Coal Company, Inc., owned by Apple Coal Company & Affiliates, Inc. Virginia Iron Coal & Coke Company purchased the coal mined at Southmountain Coal Company and also provided the engineering services.

This one-section drift mine was developed approximately 8,000 feet into the Imboden coal seam which averages six feet in thickness. The elevations in the Southmountain Mine No. 3 varied from 2,340 feet at the surface at the #2 portal to 1,902 feet at the face of the #6 entry of the West Mains. The mine elevation descended 438 feet from the surface to the West Mains. The mine was developed from the surface through four drift openings. The four entries, which were designated as West Mains, were expanded to five entries in the cross-cut inby the surface mine portals. The mine entries were expanded from five entries to six entries seven crosscuts inby the portals. The West Mains were developed to an approximate depth of 7,400 feet. Development of the West Mains was ceased due to adverse roof conditions in December, 1991.

The One Left Panel development started in January, 1992. The One Left Panel was developed approximately 800 feet before development of this area was stopped. The One Right Panel was developed off the One Left Panel and continued for approximately 1,400 feet. The One Right Panel development was stopped due to adverse roof conditions in April, 1992. The One Right Panel was pillared for a distance of approximately 700 feet, or the equivalent of seven rows of pillars. Several pillars were left around the One Right Panel for ventilation.

In May, 1992, the One Left Panel entries were developed for an additional 1,000 feet. The One Left Panel was abandoned due to high reject.

The Two Right Panel was developed off the One Left Panel and extended approximately

1,300 feet before being abandoned due to adverse roof conditions in September, 1992. The Two Right Panel was developed to connect the Two Right entries with the One Right Panel. In addition, rooms were developed to an approximate depth of 150 feet to the left on the Two Right Panel in September, 1992. Areas of the Two Right Panel were pillared to the One Left Panel.

Retreat pillaring of the One Left Panel started in November, 1992. Once the One Left Panel retreated to the area of One Right, the One Right Panel was pillared. After the One Right Panel was pillared, the One Left Panel was pillared to the area of the explosion. During this period, the barrier between the One Right Panel and the West Mains was developed and pillared.

A small portion of this mine lay approximately 300 feet over the Clintwood coal seam in the area of the abandoned Southmountain Coal Company, Inc., No. 2 mine. Two mines overlaid the Southmountain Mine No. 3. The abandoned Dixiana Coal Company, which was mined several years ago, laid approximately 390 feet above this mine in the Taggart coal seam. The other overlying mine, which was active, was the Plowboy Coal Company Mine No. 4. It laid approximately 609 feet above the Southmountain Mine No. 3. The North Fork Mining Corporation No. 2 Mine was developed into the Imboden coal seam. The North Fork mine paralleled the Southmountain Mine No. 3., but was separated from it by approximately 100 feet of coal barrier. Three conventional natural gas wells were located in the area; however, the gas wells did not intersect the Southmountain Mine No. 3. The nearest conventional natural gas well was in excess of 1,200 feet from the Mine No. 3 workings, and gas was not produced from the coal seams.

Adverse roof conditions were encountered in Mine No. 3 in the past due to an unmineable Kelly rider coal seam, which averaged eighteen inches in thickness and lay directly above the Imboden seam at varying distances of seven to thirty-nine feet.

MINING METHODS

The Southmountain Coal Company, Inc., Mine No. 3 employed 34 workers on two production shifts (day and night) and one general maintenance shift (evening). Approximately 1,000 tons of coal were produced daily by continuous mining methods. Section equipment used at this mine included: a Jeffrey 1036 continuous miner, two 10SC Joy shuttle cars, one Acme twinhead roof bolter with ATRS, one 488 S&S scoop, one 86 S&S scoop, one Owens

conveyor belt feeder and conveyor belt haulage. The primary transportation in and out of the mine was by rail using one battery-powered West Virginia Armature personnel carrier and one battery-powered Eimco rail express.

VENTILATION

A 60-inch Joy exhaust fan, powered by a 75 horsepower, 480 volt alternating current (AC) electric motor, ventilated the Southmountain Coal Company, Inc., Mine No. 3. Metal tubing and concrete blocks directly coupled the fan to the #4 entry. The #4 entry was the main return air course at the surface of the mine.

The intake air courses for the active section were the #1 and #2 entries. The belt haulage system and track were located in the #3 entry. The #4 entry was designated as the neutral air course, and the #5 and #6 entries were the main return aircourse.

A ventilation system, consisting of one entry, was established to provide positive movement of air through and around the abandoned pillared areas. The ventilation system extended through the #1 entry, around the abandoned One Left, One Right and Two Right panels and continued through the West Mains to the #5 and #6 return entries.

The gas detecting instruments used at this mine consisted of Industrial Scientific CD 210 and MSA spotter methane detectors. A Koehler flame safety lamp was used for oxygen deficiency. The continuous mining machine was equipped with a General methane monitor, model 420D, designed to continuously monitor the atmosphere during the extraction of coal.

The inspection report dated June 5 through 11, 1992, revealed that 0.2% methane was detected in the #4 and #6 working faces. During the last complete regular inspection completed on September 23, 1992, a quantity of 21,200 cubic feet per minute of air was measured at the last open crosscut of the active section and methane was not detected. The Two Right Panel was rooming to the left during this inspection.

The mine records revealed that on November 30, 1992, the air quantity for the main intake was 69,150 cubic feet per minute and for the main return was 93,700 cubic feet per minute. The mine records revealed that on December 6, 1992, the air quantity for the main intake at the pillar line was 29,460 cubic feet per minute, and methane was not detected.

ROOF CONTROL

The roof control plan for the Mine No. 3 was approved on October 19, 1990. Since that

date, four supplements were approved and added to the plan. The first supplement was approved on April 22, 1992 and consisted of adding a pillar recovery plan for the mine. The pillar recovery plan consisted of a three and five cut partial recovery method and a pocket and wing full recovery method. The second supplement was approved on May 27, 1992 and consisted of adding additional equipment and an additional type of roof support for the mine. The third supplement was approved on August 12, 1992 and consisted of a change in the projection centers. Crosscut and entry centers of 100 feet were approved for areas of possible roof problems. The fourth supplement was approved on August 21, 1992 for the Two Right Panel off the One Left Panel. In the supplement, an additional type of bolt system was added to be used as supplemental support.

The stratigraphic section of the approved roof control plan indicated an immediate shale strata and a main sandstone strata. The immediate roof strata on the One Left Panel along the pillar line consisted of sandstone. The immediate roof strata on the One West Mains adjacent to the One Left Panel consisted of laminated shale. This type of roof strata change indicated that a transitional zone was present. Several roof falls were located in this zone during the investigation.

To support the roof strata, the approved roof control plan required a minimum bolt length of 60 inches. The bolt systems specified in the plan consisted of fully grouted resin rods, point anchor bolts, or a combination anchor system. The fully grouted resin rod bolt system was installed on the One Left Panel along the pillar line. The combination anchor system was installed on the One West Mains.

The five cut partial pillar extraction method was in effect on the One Left Panel at the time of the explosion.

COAL DUST/ROCK DUST

Application of rock dust was the primary method to render coal dust inert. During development of the working places, rock dust was applied by hand during the production shifts. Periodically during the maintenance shift, a portable duster was used to dust the active section and the outby entries.

Loose coal and coal dust were cleaned from the working section and loaded onto the belt conveyor. Loose coal was periodically removed from the belt entry by hand loading it onto the belt conveyor.

Mine dust was controlled at transfer points, loading points, along the belt line, at belt drives, in the face area, and on roadways by ventilation and cleanup. Water was used to control dust at the face, on shuttle car roadways and on the bottom of the conveyor belt.

The water supply was a pond located on the surface. Water was supplied to the mine through a two-inch hard plastic water line laid along the belt conveyor line to the belt feeder. Water was supplied from the end of the hard plastic line to the continuous miner by a 1-1/4 inch flexible waterhose. Watersprays on the miner were used to control dust at the face.

The primary duties of the evening shift crew were to clean, to rock dust and to prepare the section for the next production shift.

EXPLOSIVES

Neither detonators, nor explosives were used or stored at this mine site. This operation utilized a continuous mining method which did not involve the use of explosives.

SMOKING ARTICLES

Records indicated a "Searcher's For Smoking Articles Program" was previously established at the mine. Searches were reportedly conducted on the surface by visual examinations and physical contact to the workers' pockets. Safety talks were reportedly conducted concerning the hazards of using flame making devices and smoker's articles in underground coal mines.

ELECTRICITY

The mine was provided with three-phase power purchased from Old Dominion Power Company at 69,000 volts. The power was reduced from 69,000 volts to 12,470 volts at the substation located at the bottom of the hill near the mine road entrance. The power was transmitted by overhead lines for approximately one mile to a surface substation at the mine site. The power was reduced at the mine site from 12,470 volts to 4,160 volts and 480 volts alternating current.

The surface shop, #1 belt drive, stacker belt and mine ventilation fan were powered by 480 volts alternating current electrical circuits from the surface substation.

Power was transmitted underground by use of a high voltage cable carrying 4,160 volts alternating current. Seven sets of visible disconnects were located along the high voltage

system which allowed distribution to each of the three underground belt conveyor power centers and to the active coal producing section.

The #2 belt drive power center was located at survey station #14 and supplied power to the #2 belt drive located at survey station #22.

The #3 belt drive power center was located two crosscuts outby survey station #156 and supplied power to the #3 belt drive one crosscut outby survey station #156.

The #4 belt drive power center was located at survey station #253 and supplied power to the #4 belt drive and a battery charger located beside the belt transformer.

Each belt drive was provided with a 150-horsepower wound rotor induction motor, belt controller, fire suppression system, and slippage and sequence switches. Mine telephones were provided at all belt drive locations and at the section belt feeder on the One Left Panel.

The One Left Panel power center was located between coal pillars at survey stations #293 and #294.

The One Left Panel active section was equipped with one dual head Acme roof drill, two 10 SC Joy shuttle cars, two battery-powered scoops, one Owens conveyor belt feeder, one scoop battery charger and a Jeffrey 1036 continuous mining machine.

Two battery-powered track mounted personnel carriers were located at the mine site. The Eimco rail express personnel carrier was located on the surface, and a West Virginia Armature personnel carrier was located at the end of the track near the underground One Left Panel. For additional information, see Appendix VII-Electrical Equipment.

TRANSPORTATION AND HAULAGE

Coal was loaded at the working face with a continuous mining machine and hauled to the feeder by shuttle cars. The belt conveyor haulage system transported the coal from the working section to the surface.

Mantrip transportation for the miners was provided by battery-powered scoops and battery-powered rail runners, which were also used to transport supplies to the underground workings.

COMMUNICATION

The mine communication system consisted of battery-powered mine phones located on the surface, at each belt transfer point and at the belt feeder on the active section. In

addition, the surface was provided with a model 152 Pyott-Boone page phone-to-CB radio coupler which allowed communication between the surface mobile equipment operators and the underground battery-powered phones. The communication line extended from the surface through the #3 track and belt entry to the One Left Panel. A commercial telephone was provided in the mine office on the surface.

ILLUMINATION

Illumination was provided on the mobile electric equipment by machine mounted lighting systems. Permissible battery-powered cap lamps were worn by the miners.

FIRE PROTECTION

The mine had a fire fighting and evacuation plan. The mine records revealed that fire drills, which consisted of training in the location and use of fire fighting equipment, location of escapeways and routes of travel, and evacuation procedures, were conducted for day, evening and night shifts. Examinations of the escapeways were recorded in the mine records.

Dry chemical fire suppression systems were provided on all mobile electric face equipment. All electrical installations, oil storage stations and surface areas were equipped with dry chemical fire extinguishers. The belt conveyors were monitored for fire by a system utilizing point-type heat sensors. Also, the belt conveyor drives were protected against fire by water deluge systems.

A two-inch waterline paralleled the belt conveyor and was provided with outlets for fire fighting.

MINE RESCUE

This mine was provided mine rescue services by Mine Technology, Incorporated. Mine Technology, Inc. maintained two (2) mine rescue teams located at Norton, Virginia.

Statements indicated that miners at the Mine No. 3 were provided with one-hour, filter type self-rescuers which were designed to be worn on the miners' belts. Each miner was provided a self-contained self-rescuer (SR 100) which were stored on the working section power center. Two self-contained self-rescuers were stored at each belt transfer point. Records indicated that miners received instructions in the use of the rescuers. A check-in and check-out system was reportedly maintained at the mine. The system reportedly utilized a checkboard

and tags corresponding to similar tags worn on the miners' belts.

EXAMINATION AND RECORDS

Several record books of examinations are required to be maintained on site at all underground coal mines. These examinations are required to be conducted by certified persons. The following is a list of the record books maintained at the Southmountain Mine No. 3:

- Daily and Monthly Examination of Ventilation Equipment
- Preshift, Onshift and Daily Report
- Belt Conveyor Examination
- Fire Drill and Evacuation Record
- Weekly Examination of Methane and Hazardous Conditions
- Examination of Emergency Escapeways and Facilities
- Smokers' Articles
- Fire Doors
- Examination of Electrical Equipment and Monthly Examination of Surface High Voltage Circuit Breakers

The certified persons employed on each shift at the Southmountain Mine No. 3 included first class mine foremen, electrical repairmen, and emergency medical care technicians.

DIVISION OF MINES ACTIVITIES

The Division of Mines' activities at the Southmountain Mine No. 3 from December 12, 1991 to December 7, 1992 included 12 visits during the year. The visits included three complete regular inspections, a ventilation survey, roof evaluations, investigations of roof falls and an electrical survey.

During the first three quarters of 1992, a Division of Mines inspector completed the required inspections. A complete regular inspection was scheduled for Wednesday, December 9, 1992 for the fourth quarter.

DM's Electrical Specialist visited the Mine No. 3 on September 28 and 29, 1992. This was the last visit from a Division of Mines' representative prior to the explosion.

For additional information, see Appendix IX-Division of Mines' Activities.

*EXPLOSION, RESCUE AND RECOVERY,
INVESTIGATION*

EXPLOSION

By December 7, 1992, the night shift had produced coal on seven consecutive calendar days. Coal was produced on consecutive days to respond to the demand for this type of coal.

The night shift was nearly completed when the explosion occurred. This night shift crew produced coal using a five cut pillar plan on the One Left Panel. An accumulation of methane was ignited and resulted in the explosion. The explosion occurred on December 7, 1992 at approximately 6:15 a.m. The night shift end loader operator stationed on the surface was transporting coal with the end loader from underneath the mine stacker belt to the stock-pile area. He noticed the surface lights were extinguished. The end loader operator proceeded to the mine office site where he observed the mine office was partially destroyed.

An underground beltman, who was in the vicinity of the underground #2 belt drive, exited the mine from the belt and track entry. The beltman had suffered burn injuries, and was transported to the hospital by the end loader operator in his personal vehicle. Authorities were summoned to the mine site for rescue and recovery operations.

While leaving the mine to transport the injured beltman to the hospital, the night shift end loader operator met the Mine Superintendent, who was on his way to the Southmountain mine site. The third shift end loader operator informed the Superintendent that a mine explosion had occurred at the mine.

RECOVERY OPERATIONS

The dayshift surface end loader operator stopped a Division of Mines Inspector near the mine road entrance of the Southmountain mine at approximately 7:15 a.m. and informed the inspector that an explosion had occurred at the Southmountain Mine No. 3. The dayshift end loader operator had been to the mine site and verified the explosion. He informed the inspector that 11 employees were unaccounted for in the underground area of the mine.

The inspector informed the Division of Mines' Chief about the information that he received from the dayshift end loader operator. The inspector proceeded to the mine site and arrived at approximately 7:30 a.m. The Division of Mines inspector issued a closure order

under Section 45.1-21 C of the Mine Safety Laws of Virginia to control the scene of the explosion.

After the notification process of his initial observations at the mine site, the inspector observed the following conditions:

- Eight miners were unaccounted for underground.
- Dark, black smoke was being emitted from the #3 and #4 entry portals.
- The fan housing and explosion doors were completely destroyed.
- The conveyor belt assembly located in the #3 entry was severely damaged.
- The mine portal canopies were severely damaged.
- The supply building/office/motor barn located in front of the #2 entry was partially destroyed.
- Debris and parts of the supply building/office/motor barn were blown from 0-to-800 feet from the original location.
- The mine electrical power supply was off due to damage to the surface electrical installation.
- The surface electrical wiring was partially torn down and scattered on the ground outside the mine portals.
- Various types of debris were thrown and scattered throughout the mine portal areas.
- Oxygen and acetylene bottles were partially covered by debris. (These bottles were moved to a secure location.)
- Employees' personal vehicles, that were parked approximately 200 feet from the #1 entry portal, were damaged.

The following events occurred between 8:00 a.m. and 10:00 a.m.:

- Mine rescue teams were notified.
- A command center was established in a trailer located onsite.
- A rescue and recovery group was established consisting of DM, MSHA and company personnel.

Continuous communication was maintained from the command center located on the surface to the mine rescue teams underground. The progress of the teams was plotted on a map maintained in the command center. Each mine rescue team was briefed before entering the mine and debriefed upon their return to the surface. All information was verified with the teams. During exploration, the teams attempted to identify miners by observing the brass identification check tags attached to miners' belts. The rescue teams were under instructions not to disturb mine conditions unless absolutely necessary. If any changes were made, the changes were to be reported by the teams to the command center.

At approximately 9:00 a.m., a mine rescue team proceeded underground to obtain air quality tests and to install monitor tubing in the #3 and #4 entries. The mine rescue team advanced to the #2 belt drive.

Mine rescue teams went underground utilizing the natural flow of ventilation to explore and to install temporary ventilation curtains beginning at crosscut #1. As the the teams advanced, they continued to explore and to install curtains in each crosscut where permanent stoppings were damaged or destroyed.

On December 8, 1992 at 2:05 a.m., mine rescue teams advanced to crosscut #81 at the entrance of the #1 entry of the One Left Panel active section where the night shift was producing coal at the time of the explosion. At the entrance of the #1 entry of the One Left Panel active section, the teams found 6.4% methane, 10,000 parts per million (ppm) carbon monoxide, and rolling smoke and heat coming from the One Left Panel.

At 2:15 a.m., the teams returned to the surface.

A decision was made at 5:15 a.m. by the rescue and recovery officials to drill a ventilation borehole eight inches in diameter into the #3 entry in the area of survey station #370 on the One Left Panel in order to relieve these conditions and to facilitate monitoring of the underground atmosphere.

On December 9, 1992 at 10:28 a.m., the #1 borehole intersected the #3 entry on the One Left Panel. At 11:20 a.m., plastic tubing was inserted into the borehole to monitor the mine atmosphere.

Monitoring operations continued until 5:00 p.m. Borehole monitoring results were: 3.9% methane, 18.2% oxygen and 1,510 ppm carbon monoxide. The borehole monitoring results revealed significant improvements in the mine atmosphere. The methane and carbon monoxide steadily decreased while the oxygen level remained stable.

A mine rescue team re-entered the mine at 5:20 p.m. At 6:20 p.m., the team reached crosscut #81 and went under oxygen.

At 7:46 p.m., the team reported finding the following miners: Claude Sturgill, Palmer Sturgill, Mike Mullins, Brian Owens, James Mullins, David Carlton, and Danny Gentry. The team was unable to locate one miner at that time.

The rescue team encountered 18% oxygen and methane in excess of 10% in the #1 entry, and the team encountered 16.9% oxygen and 7.1% methane in the area between the #1 and #2 entries where a battery-powered scoop was located. At 9:00 p.m., the decision was made to withdraw the rescue team because an explosive mixture was found in an area where the battery-powered scoop, a potential ignition source, was located.

At that time, a decision was made by the rescue and recovery officials to drill a second borehole and to install an exhaust pump on top of the borehole in an attempt to ventilate the working section and gob area. The second borehole was a 12-inch diameter hole drilled into the area of survey station 530 in the back area of the One Left pillared area. The drilling of the second borehole was started on December 10, 1992 at 3:35 p.m. and was completed on December 11, 1992 at approximately 4:05 p.m.

The first monitor results taken at 4:22 p.m. from the #2 borehole were 50% methane and 550 ppm carbon monoxide. Monitoring operations at the #1 borehole, #2 borehole and mine portals continued from 4:22 p.m. on December 11, 1992 until 3:30 p.m. on December 12, 1992. The monitoring results from the #2 borehole revealed significant improvements in the mine atmosphere. By 3:30 p.m. on December 12, 1992, the #2 borehole monitor results were: 3.9% methane, 18.9% oxygen and 240 ppm carbon monoxide.

At that time, preparations were made with mine rescue teams to re-enter the mine to search for the one unaccounted for miner and to recover the miners if conditions were favorable.

Rescue teams returned underground at 4:40 p.m. to continue recovery operations and to continue the installation of ventilation curtains to the #81 crosscut.

A mine rescue team reported that an explosive mixture was not present near the battery-powered scoop located near survey station #378, as previously detected.

At 7:00 p.m., a mine rescue team found the unaccounted for miner, Norman Vanover, near survey station #384.

At 7:42 p.m., all of the miners were prepared for transporting and loaded on the scoop.

The rescue teams arrived on the surface with the miners at 8:57 p.m. For additional information, see Appendix II-Recovery Operations.

The miners were transported to a local funeral home where the Chief Medical Examiner removed personal effects and performed medical examinations on December 13, 1992.

INVESTIGATION

DMME's Division of Mines and MSHA's investigating teams met on December 14, 1992 to discuss the investigation procedures. Investigation teams were established in the areas of:

- Flames and Forces
- Ventilation
- Mapping
- Electrical
- Mine Dust Surveys
- Roof Control
- Photographing
- Collection of Evidence

Investigation teams were composed of experienced investigators, including inspectors, engineers, specialists and supervisors. Representatives of the operator assisted and acted in a consulting capacity. A representative of the employees acted as a consultant. For additional information, see Appendix X-Persons Present During or Contributing Information to Investigation.

An order of closure was issued on December 7, 1992 to secure the accident scene until the investigation was completed. The investigation began on December 14, 1992 by mapping and photographing the surface areas. The underground investigation began on December 18, 1992.

In order to establish a safe mine atmosphere, the One Left Panel was ventilated by utilizing a temporary stopping line directing ventilation to the face region. A surface mechanical fan installed at the #4 entry provided mechanical ventilation for the mine. The abandoned pillared areas were ventilated by using an exhaust pump mounted to the 12-inch borehole,

which was drilled into the pillared areas during the rescue and recovery operations. The surface fan produced 113,090 cubic feet per minute and liberated 0.0% methane. The borehole fan produced 4,076 cubic feet per minute and liberated 2.5% methane, 19.7% oxygen, 22 ppm carbon monoxide, and .18% carbon dioxide. The pillar line, One Left Panel, #1 and #2 boreholes, intakes and returns were continuously monitored for dangerous conditions during the investigation.

The investigation teams entered the mine at approximately 12:20 p.m. on December 18, 1992. All pertinent data was plotted on the mine map. Information plotted included the equipment, electrical installations, stoppings, the extent of flames and forces as could be determined by visual observation, and other pertinent information relating to the explosion.

The flame and forces team initiated the evaluation of One Left Panel. The team started at the face area and progressed to the surface. The flame and forces team examined areas for evidence to determine the direction of forces and extent of flame or heat. This evidence included materials exposed to heat, accumulations of coke, soot and dust on timbers, roof bolt plates, etc. The team examined miner locations and injuries, equipment damages, ventilation controls, results of laboratory analyses of dust samples and other items.

The mapping teams began mapping the One Left Panel. The mapping teams began at the feeder and progressed to the face areas. The mapping teams detailed ventilation controls, electrical equipment, evidence of flames and forces and all pertinent information.

The mine dust samplers started at the surface and progressed toward the One Left Panel. Mine dust band samples were taken from roof, rib and bottom in six entries at every third row of coal pillars. All mine dust samples were sent to MSHA's laboratory and analyzed for combustibility and coking.

The photography and collection of evidence teams assisted the investigation teams as needed. As the investigation was conducted and the groups discovered physical evidence or personal effects that were relevant to determining the cause of the accident and/or explosion source, immediate action was taken to prevent any disturbance of the evidence. The personal effects/evidence team was then contacted and immediately proceeded to the location for the taking of notes, photographs and, when possible, the taking possession of the evidence. This evidence was marked and stored in a controlled area.

The electrical teams began on the surface and progressed toward the One Left Panel. The electrical teams examined all underground electrical equipment and cables for evidence

of arcing, smoke, soot or coking. Permissible enclosures and cables were examined for internal/external damage, arcing or evidence of internal explosion. Some permissible components and material were sent to MSHA's Approval and Certification Center and the Bureau of Mines' Research Center for testing and examination.

The investigation teams completed analyzing, evaluating and mapping the surface and underground areas and equipment at the mine site on December 22, 1992.

Upon completion of the underground investigation, interviews were conducted with thirty-one persons who may have had information pertaining to the explosion. The interviews were conducted by members of DMME's Division of Mines and MSHA's investigation teams. Southmountain Coal Company, Inc. and the employees were represented during the interview process.

DMME's Division of Mines and MSHA's investigation teams re-interviewed eight people associated with Southmountain Coal Company and interviewed a contractor's employee at a later date. The second interviews were formatted to clarify previous statements and address discrepancies.

*DISCUSSION-EVALUATION:**PHYSICAL FACTORS RELEVANT TO THE
EXPLOSION*

METHANE AND VENTILATION

Under the Mine Safety Laws of Virginia, all mines are considered non-gassy unless and until the level of methane required for classification as gassy is found in the mine. The level shall exceed one-fourth of one per centum methane when tested not less than 12 inches from the roof, ribs and face in open workings to classify a mine gassy. Such a level of methane was not found by DM personnel, nor was such a finding brought to the attention of the Division. Therefore, this mine was not classified as gassy. Conflicting testimonies during the investigation indicated methane was detected liberating from roof test holes, and accumulations of methane, ranging from 0-to-14.9%, were detected on the gob area inby the active face and in the immediate face. When ventilation was directed into these areas, the methane was dissipated.

From October 4, 1990 through December 6, 1992, mine records revealed trace amounts of methane were detected on 40 different occasions, which were recorded in the "remarks" section of the preshift record book. The highest level recorded in that section of the preshift record book was 0.3% methane on April 9, 1992 and on April 15, 1992.

From October 4, 1990 through December 6, 1992, trace amounts of methane were recorded on 46 different occasions in the "examination of working places" section of the on-shift record book. The highest level recorded in that section of the onshift record book was 0.3% on April 10, 1992.

From October 4, 1990 through December 6, 1992, trace amounts of methane were recorded on 14 different occasions in the "examination for methane in return air courses" section of the onshift record book. The highest level of methane recorded in that section of the onshift record book was 0.8% on April 5, 1992.

The onshift record book has two different areas for recording methane readings. However, methane was recorded in a different section of the book on April 20, 1992. Methane, in the amount of 9.9%, was recorded in the "violation or hazardous condition"

section of the onshift report as being detected in the #2 heading.

The weekly examination of methane and hazardous conditions record book revealed that on May 14, 1992, methane began to be detected in the bleeder line and abandoned Mains. These findings were recorded as trace amounts on 22 different occasions and as 0.3% on November 21, 1992.

The weekly examination of methane and hazardous conditions record book was also used for the weekly examination of abandoned workings. On November 13, 21 and 30, 1992, the examiner of the abandoned Mains and bleeders recorded these areas as being "ok". The testimonies revealed that on November 13, 1992, the examiner was unable to travel around the abandoned works in their entirety. In addition, on November 21 and 30, 1992, the examiner stated that due to bad roof he only traveled to approximately the ninth, or tenth crosscut in the #1 entry of the One Left abandoned area. The record did not indicate the abandoned One Left, One Right, Two Right and West Mains were examined for the week of November 22 through 28, 1992.

The highest methane concentration detected by a DM representative was 0.5% at the roof test hole on April 21, 1992. In addition, a methane check was made 12 inches from the roof test hole and methane was not detected. A DM representative detected 0.2% methane 12 inches from the roof, face and ribs in the faces of the #4 and #6 entries on the One Left Panel during a regular inspection conducted from June 5 through 11, 1992.

Forces from the explosion destroyed the fan housing of the mine exhaust fan and rendered it inoperative. Also, the majority of the ventilation controls underground were destroyed by the explosion. On the morning of the explosion on December 7, 1992, a natural flow of ventilation of 77,000 cubic feet per minute was entering the #1 and #2 entries and exiting out the #3 and #4 entries. Utilizing the natural flow of ventilation, mine rescue teams explored to crosscut #81 and installed temporary ventilation controls up to crosscut #70 where 52,943 cubic feet of air was present in the #1 and #2 entries. Rescue and recovery operations were delayed on December 8, 1992 when the mine rescue teams detected 6.4% methane, 1% carbon monoxide and smoke rolling from the #1 entry of the One Left Panel at crosscut #81. During the delay, an eight-inch borehole was drilled into the area where the miners were working at the time of explosion in order to sample the atmosphere and to listen for responses.

On December 9, 1992 at 5:20 p.m., mine rescue teams re-entered the mine to continue

recovery operations. The air movement was 13,000 cubic feet per minute at crosscut #81 in the #1 entry. Rescue operations were delayed again when methane in excess of 10% and 18% oxygen were detected in the #1 entry of the One Left Panel and in the area of a battery-powered scoop. During the delay, a twelve-inch borehole was drilled into the bleeder entries inby the working face area in order to ventilate the abandoned pillared area and to reduce the methane and carbon monoxide concentrations. A high pressure exhaust pump was installed on the borehole, which produced 4,076 cubic feet per minute of air flow from the gob area. On December 12, 1992 mine rescue teams re-entered the mine to continue recovery operations and to install the temporary ventilation controls up to crosscut #81. After the ventilation controls were installed, the air flow at crosscut #81 was 44,600 cubic feet per minute. Also, 3.8% methane was detected at the roof fall in the #1 bleeder entry on the One Left Panel.

The main mine fan was restored to operation on the surface prior to the initiation of the underground investigation. The fan produced 113,090 cubic feet per minute without liberation of methane from the return entries and 34,820 cubic feet per minute at crosscut #81. The exhaust pump was maintained operating on the twelve-inch borehole continuously while personnel were underground.

Curtains in the working places and throughout the active face area, which were indicated by testimony to be in place prior to the explosion, were destroyed. However, very few curtains were located at or near the active face during the investigation. According to testimony, the permanent ventilation controls in the #1 and #2 entries between the #83 and #84 crosscuts in the Mains were partially removed. The second shift foreman indicated that at approximately 10:30 p.m. on December 6, 1992, check curtains were installed at the two partially removed stoppings. In addition, the location of the permanent stopping, that was indicated as being installed in the #3 entry between survey stations #304 and #296, was not determined.

During the underground investigation, methane migrated from the pillared area down the #1 entry to the active workings of the One Left Panel. Ventilation controls were installed over to the #2 entry in order to direct more air flow into the #1 entry to dilute the methane content.

The following chart indicates MSHA laboratory analysis of air samples taken during MSHA inspection activities. This chart indicates the methane percentages at the working

faces, section return and bleeder evaluation points. This information was obtained during the investigation.

<u>Date</u>	<u>Working Face</u>	<u>Section Return</u>	<u>Bleeder Evaluation</u>
1/92	.03%	.01%	N/A
5/92	0.00%	.01%	.01%
7/92	.03%	.05%	.25%
8/92	.10%	.05%	.06%
10/92	.14%	.3%	.59%

The air analysis indicated low percentages of methane were present in the mine atmosphere through May of 1992. In May, 1992, an air sample was taken from the return of the One Right pillared area. The result of the analysis of this air sample revealed .01% methane. An air analysis in July of 1992 indicated .25% methane at the return side of the One Right pillared area, at which time the Two Right Panel was being developed. In August of 1992, the barrier block between the One Right and Two Right Panels was connected, and the air analysis of the One Right pillared area indicated .06% methane. In October 1992, while pillar recovery of the Two Right Panel was conducted, the air analysis at the return side of the gob indicated .59% of methane. These analyses indicated an increase in methane liberation that corresponded with the amount of the area that was pillared, and/or to the increased amount of roof falls associated with the pillar recovery.

Testimonies indicated that the gas detecting instruments used at this mine consisted of Industrial Scientific CD 210 and MSA spotter methane detectors. A Koehler flame safety lamp was used for testing for oxygen deficiency. The continuous mining machine was equipped with a General methane monitor, model 420D. This monitor was found with a cloth inserted in the dust guard of the methane sensor. Testimony indicated that the monitor was calibrated weekly. Also, testimony indicated the monitor was calibrated on the second shift on December 3, 1992 with the cloth inserted in the dust guard of the methane sensor, and the monitor functioned properly. For additional information, see Appendix VI-Equipment Test and Examinations.

A review of the barometric readings obtained from a local airport during the period of December 5 through 12, 1992 indicated that the barometric pressure reached a high of 28.633 inches of mercury at 10:50 a.m. on December 6, 1992. The barometric pressure steadily declined from 10:50 a.m. on December 6th until 6:50 a.m. on December 7, 1992 to a pressure of 28.425 inches of mercury. This indicated that the barometric pressure steadily declined for a

period of 20 hours. As pressure decreased, the possibility of methane being released into the mine atmosphere became greater.

The fan chart and interviews indicated that the main exhaust fan for the mine was operating at the time of the explosion. The roof fall found by the mine rescue teams in the #1 entry inby #5 crosscut of the One Left Panel possibly restricted the flow of air through the abandoned area which allowed methane to accumulate in the gob area and to migrate down the #1 entry to the active face. Also, inadequate ventilation controls possibly reduced the quantity of ventilating air being delivered to the active pillar line and abandoned area which allowed methane to accumulate.

SMOKING ARTICLES

The operator's search program for this mine required a systematic examination of the contents of lunch containers and clothing of all persons regularly entering the underground portions of the mine. The Searcher's for Smoking Articles record book indicated that these searches were conducted on a weekly basis, as required. The record books indicated the last searches for smokers' articles were conducted for the night shift on November 30, 1992, for the day shift on December 1, 1992, and for the evening shift on December 3, 1992. However, testimonies during the interviews revealed that some workers were never searched for smokers' articles. Four employees and one foreman declined to answer when asked during the interviews if they had observed or suspected smoking underground.

The underground investigation and the Medical Examiner's report revealed the following smokers' articles were present underground:

- One butane disposable cigarette lighter was located 38.5 feet left of survey station #378 in the crosscut between #1 and #2 entries of the One Left Panel.
- One damaged cigarette butt was located 13.5 feet inby survey station #378 in the #2 entry of One Left Panel.
- One partially smoked cigarette was located ten inches to the right of the acceleration pedal of S&S scoop, serial number 488-1737. The scoop was located in a crosscut between #1 and #2 entries, left of survey station #378 on the One Left Panel.
- Two Bic butane lighters and two full packs of Doral cigarettes were found in a lunch pail located in the operator's deck of 488 S&S scoop, serial number 488-1737. The scoop was located in

the crosscut between #1 and #2 entries, left of survey station #378 on the One Left Panel.

The medical examiner's report revealed that smoking articles were present on three of the eight miners:

- One open package of Doral cigarettes and one Bic butane lighter were present in the left shirt pocket and one cigarette butt was present in the right coverall pocket of one miner.
- One open package of Marlboro cigarettes and one butane lighter were present in the left shirt pocket of one miner.
- One open package of Viceroy Ultra-light cigarettes was present in the left shirt pocket and seven cigarette butts were present in the lower right coverall pocket along with three cigarette butts located in the body bag, but not on the body of one miner.

For additional information, see Appendix VIII-Physical Evidence and Personal Effects.

COAL DUST/ROCK DUST

The extent of coking, combustible content, and rock dust indicated coal dust did contribute significantly to the explosion.

Testimony indicated rock dust was applied as needed. Testimony indicated the belt/track entry was rock dusted from the surface to crosscut #32 on the shift prior to the explosion.

The mine dust analyses of the samples taken after the explosion and analyzed by the Mine Safety and Health Administration laboratory in Mount Hope, West Virginia, indicated that a total of 252 samples were collected, and 228 of the samples were below the acceptable levels for incombustible content, which was 65% for the intake entries and 80% for the return entries.

In the #1 and #2 intake entries, 102 samples were taken. Only 13 of these samples were 65% or higher of incombustible content. In the #3 and #4 entries, which were the belt and trackway, 79 samples were taken. Only 11 of these samples were 65% or higher of incombustible content. In the #5 and #6 entries, which were the return air course, 71 samples were taken. All of the 71 samples had an incombustible content of less than 80%.

The mine dust analyses indicated the presence of coke from the face area to the surface. These analyses indicated the presence of coal dust and the presence of heat from the face to

the surface. For additional information, see Appendix V-Map of Mine Dust Samples, Coal Channel Sample, Direction of Forces and Extent of Flames and Appendix V(A)-Coking, Forces and Heat; Mine Dusting Survey.

ELECTRICITY

Examination and testing of the mine electrical equipment did not reveal evidence that the ignition source of the explosion was provided by the electrical equipment or cables. All mine electrical equipment was examined and/or tested. The examination included all surface and underground electrical equipment, circuit breakers, and cables. The cap lamps, flame safety lamps, and continuous miner methane monitor were tested at MSHA's Approval and Certification Center (A & CC). At areas where evidence of heat or flame were present, the electrical equipment was thoroughly examined for possible ignition sources and permissible condition. The investigation revealed the entire mine high voltage system was energized at the time of the explosion. The high voltage circuit breaker at the bottom of the hill tripped due to debris striking the surface transmission lines. The surface high voltage circuit breaker for the underground electrical circuit tripped as a result of the ground wire being broken. For additional information, see Appendix VII-Electrical Equipment.

ROOF CONTROL

Throughout the underground investigation, roof falls and deteriorating conditions prevented the investigation teams from entering some areas of the mine. The investigation team's progress was stopped by a roof fall that occurred prior to the beginning of the investigation at survey station #392 in the #1 entry on the One Left Panel. The fall restricted further travel around the abandoned areas. The roof conditions continued to deteriorate during the investigation from survey station #392 outby to survey station #380 in the #1 entry of the One Left Panel. The roof in the West Mains inby the #86 line of crosscuts continued to deteriorate which restricted the investigation team from entering the face areas of the West Mains. During the investigation, the roof became unsafe where the 86 S&S scoop, charger and section power center were located. A decision was made to remove the equipment from this area. Later, a roof fall occurred in this location.

One roof fall occurred in the #6 entry of the West Mains outby survey station #307 during the rescue and recovery operations before the investigation began. Another roof fall

occurred during the investigation and was a continuation of a previous fall that occurred in the #5 entry at survey station #399 prior to the explosion. This fall continued outby to survey station #309.

Previous roof falls occurred during development of the mine and were investigated prior to the occurrence of the explosion. Those falls were mapped during the investigation, as follows:

- #4 entry of the West Mains one crosscut inby survey station #223.
- #4 entry of the West Mains at survey station #306
- #5 entry of the West Mains at survey station #299
- #6 entry of the Mains one crosscut outby survey station #232

One unintentional roof fall occurred during development of the mine, but was not reported. The fall occurred in the #5 entry of the West Mains at survey station #281.

Prior to the explosion, the continuous mining machine was located in the pillar line in the #3 entry of the One Left Panel. The continuous mining machine was in position to remove the stump of coal between the cuts of the #2 pillar block.

The investigation revealed that it was a practice to remove the 6, 8 and 10 feet barriers which the approved five cut pillar plan required to be left in place. The investigation also revealed that it was a practice to take a sixth cut from the back of the pillar blocks. This is prohibited by the approved five cut pillar plan. Both practices decrease the support available to the roof. For additional information, see Appendix IV(B)-Map of West Mains.

EXTENT OF FORCES

The development of explosive forces was related to the total volume of methane in the initial gas body and any localized accumulations of methane within the explosion zone. Factors that affected the explosion pressure development included the degree of methane-air concentration mixture, the type of ignition source, the location of ignition source within the mixture and the location of the gas accumulation within the mine. Pressure development was caused by the heating of the atmosphere during the combustion process.

The extent of damage indicated the accident origination was a methane explosion with coal dust as a contributing factor. Damage, as a result of the force of the explosion, was

observed throughout the mine and on the surface. Explosion forces created damage to the electrical system, the belt conveyor haulage system, the permanent stopping line, the surface facilities and other materials on the active section.

The curtains in the working places and throughout the active face area, which were indicated by testimony to be in place prior to the explosion, were displaced.

The explosion did not damage the 488 scoop, the continuous mining machine, or the two shuttle cars located on the One Left Panel.

Three of the four battery tray lids were displaced from their normal position on the 86 scoop located between survey stations #293 and #303 at the section charging station.

The cable plug connections were displaced from the power center at the section power center located between survey stations #294 and #293. Material which was on or near the power center was scattered throughout the #4 and #5 entries for distances greater than 200 feet in by the pillar line.

The belt conveyor system was damaged from the belt feeder to the surface. A belt power center for the #4 belt drive had extensive damage whereby the lids were displaced, the breaker panel was bent, and cable plugs were displaced from the power center. The #4 belt drive was dislodged and turned crossways in the entry.

The battery lids were displaced from the mantrip railrunner located out by the feeder at the end of the trackway.

A majority of the permanent stoppings installed in the mine were completely destroyed. Of 80 stoppings installed on the intake stopping line, 64 were completely destroyed, 6 were partially damaged and 10 were left intact. Of 89 stoppings installed on the return stopping line, 66 were completely destroyed, 7 were partially damaged and 16 were left intact.

On the surface, the mine office was partially destroyed. The surface belt conveyor system was damaged. The #2 and #3 portal canopies were blown down, and the fan housing and weak wall were destroyed. The miners' vehicles, located approximately 200 feet away from the mine portals, were damaged by the explosion forces. The debris from the surface areas was found several hundred feet from the mine site.

Evidence gathered during the investigation, such as the condition of equipment, the displacement of ventilation controls, the medical examiner's autopsy reports, the results of the analyses of the rock dust samples, and the visual observation of coking, revealed that the forces originated in the crosscut between the #1 and #2 entries left of survey station #378.

For additional information, see Appendix V-Map of Mine Dust Samples, Coal Channel Sample, Direction of Forces, and Extent of Flames.

EXTENT OF FLAMES

During the investigation, evidence such as melted brattice cloth, medical examiner's reports, accumulations of coke on timbers, roof bolt plates and equipment, and results of the analyses of dust samples were evaluated to determine the extent of flame and heat.

A piece of melted brattice cloth was found in the #2 entry inby survey station #378 and inby the continuous miner in the #3 entry. The medical examiner's reports revealed that seven of the eight miners on the active section sustained second and third degree burns at different locations on their bodies. Also, the one survivor located at the #2 belt drive sustained second degree burns on his hands and face. Visible coking was present on timbers, roof bolt plates and equipment at the face area extending outby down the Mains. Also, results of the analyses of dust samples revealed coking from the pillar line to the surface. Based on the above, it was determined that heat was present from the pillar line outby to the surface. For additional information, see Appendix V-Map of Mine Dust Samples, Coal Channel Sample, Direction of Forces, and Extent of Flames and Appendix V(A)- Coking, Forces and Heat; Mine Dusting Survey.

POTENTIAL SOURCES OF IGNITION

At the time of the explosion, the mine was actively producing coal. Therefore, there were several possible ignition sources. The following is a list of possible ignition sources and the condition in which they were found during the investigation:

- Flame-making Devices and Smokers' Articles

The investigation revealed one butane disposable cigarette lighter located 38.5 feet from survey station #378 in the crosscut between #1 and #2 entries on the One Left Panel. The lighter's plastic covering indicated exposure to heat. The plastic covering was discolored and rolled back. The lighter had "C-Lite, Thailand" inscribed on the cover. The lighter produced a flame when tested.

The investigation revealed one damaged cigarette butt located 13.5 feet inby survey station #378 in the #2 entry on the One Left Panel. The cigarette butt had some type of fiber material

melted on the filter. The type of cigarette and fiber material could not be determined.

The investigation revealed one partially smoked cigarette was located ten inches to the right of the acceleration pedal of S&S scoop, serial number 488-1737. The scoop was located in a crosscut between #1 and #2 entries, left of survey station #378 on the One Left Panel.

The evidence does not allow the elimination of flame-making devices and smokers' articles as the ignition source of the explosion.

■ Battery-Powered Scoop (488)

The investigation revealed one S&S scoop, model 488, serial number 488-1737, was located in the crosscut between #1 and #2 entries, left of survey station #378 on the One Left Panel. The main circuit breaker was in the "tripped" position and the controls of the 488 scoop were in the "off" position.

The battery plugs were connected to the power receptacles. The batteries were in excellent condition. The covers for the battery compartments were not secured with fasteners.

The permissible pump motor had three bolts missing on the pump inspection cover. Material found inside the compartment was examined for heat exposure. The material was sent to the Bureau of Mines' Research Center for testing and examination. The strand sample did not have evidence of high temperature involvement. For additional information, see Appendix VI-Equipment Testing and Examinations.

The 488 scoop's permissible main control and circuit breaker enclosures had bolts of different lengths used to secure the cover. However, the enclosure cover was secured to .004 inch. The enclosures had a plug and three packing glands which were not secured against loosening.

The light electrical conductors had a splice in the leads going to the battery end of the scoop. The splice was not made in a permissible enclosure. The conduit protecting the light electrical conductors on the bucket end was damaged, but the conductors were not damaged. The light circuit was not properly fused in that 30 ampere fuses were used in place of 10 ampere fuses.

Although deficiencies existed, the absence of evidence of flames, forces or electrical arcing indicated that the 488 scoop did not provide the ignition source of the explosion.

- Cap Lamps The investigation revealed eight Koehler cap lamps were located on the One Left Panel. The cap lamps were sent to MSHA's Approval and Certification Center for testing and examination. The investigation of the eight Koehler cap lamps determined that defects noted during inspection were attributable to use, improper maintenance, or damage from the explosion. In addition, manufacturing discrepancies from the approved design were not identified.

The cap lamps were judged not capable of igniting an explosive methane-air atmosphere based on testing of the most severe available sparking and thermal ignition hazards.

- Flame Safety Lamp The investigation revealed one Koehler flame safety lamp was located on the One Left Panel. The flame safety lamp was sent to MSHA's Approval and Certification Center for testing and examination. The investigation of the Koehler flame safety lamp determined that it was assembled properly and that defects were not identified in any of its components or assembly that could affect its performance.

The absence of evidence of flames or forces indicated that the Koehler flame safety lamp did not provide the ignition source of the explosion.

- Continuous Mining Machine

The investigation revealed one Jeffrey continuous mining machine, serial number 38002, was located in the #3 entry inby survey station #376 on the One Left Panel. The continuous miner was in position to complete the loading of the off-standard shuttle car. The control switches were push buttons, and due to the design of the control switches, it could not be determined if the continuous miner was operating at the time of the explosion.

The permissible main control enclosure was secured with bolts of different lengths. However, the panel cover was secured to .004 inch.

The left side traction motor's permissible packing gland was not secured against loosening.

Loose coal, coal dust and grease had accumulated on the continuous mining machine.

The methane monitor's sintered metal screen filter in the dust guard was removed and a piece of cloth was placed in the dust guard. The monitor was sent to MSHA's Approval and Certification Center for testing and examination. For additional

information, see Appendix VI-Equipment Testing and Examinations.

Although deficiencies existed, the absence of evidence of flames, forces or electrical arcing indicated the continuous mining machine did not provide the ignition source of the explosion.

■ Shuttle Car (Off-Standard)

The investigation revealed one Joy off-standard shuttle car, serial number ET13250, was located in the #3 entry in by survey station #376 on the One Left Panel. The off-standard shuttle car was directly behind the continuous mining machine in position for loading.

Deficiencies were not found in the permissible condition of the off-standard shuttle car.

The absence of evidence of flames, forces or electrical arcing indicated the off-standard shuttle car did not provide the ignition source of the explosion.

■ Roof Falls

The investigation revealed coal was being produced on an active pillaring section. Pillar mining induces roof falls in pillared areas. However, roof falls were not present in the vicinity of mining activities.

There was a roof fall in the #1 entry approximately 130 feet in by survey station #386 on the One Left Panel.

There were two roof falls in the West Mains area in the #4 and #5 entries.

Although roof falls existed, the evidence indicated that flames and forces did not originate in the pillared areas or around the roof falls. Therefore, the pillared areas and roof falls did not provide the ignition source of the explosion.

■ Battery-Powered Scoop (86) and Charger

The investigation revealed one S&S scoop, model BMUAT86, serial number 86BC2-298, and S&S scoop charger, serial number 51267115, were located in the crosscut right of survey station #293 on the One Left Panel. The circuit breaker was tripped and the controls of the 86 scoop were in the "off" position.

The battery plugs were connected to the power receptacles. The

batteries were in good condition.

An opening in excess of .004 inch was present in the permissible circuit breaker enclosure. Four packing glands for lead entrances were not secured against loosening.

An opening in excess of .004 inch was present in the permissible main control enclosure. Five packing glands for lead entrances were not secured against loosening.

The scoop charger did not have electrical deficiencies. The scoop charger controls were in the "on" position.

Although deficiencies existed, the absence of evidence of flames, forces or electrical arcing indicated the 86 scoop or charger did not provide the ignition source of the explosion.

■ Section Power Center and Cables

The investigation revealed one Line Power section power center was located in the #4 entry between survey stations #293 and #294 on the One Left Panel.

One Left Panel equipment cables receiving power from the section power center were examined for electrical arcing, flames and forces.

The absence of evidence of flames, forces or electrical arcing indicated the One Left Panel power center or the section equipment cables did not provide the ignition source of the explosion.

■ Shuttle Car (Standard)

The investigation revealed one Joy standard shuttle car, serial number ET13249, was located one crosscut in by survey station #295 between the #2 and #3 entries of the West Mains. The shuttle car was directly behind the Owens conveyor belt feeder in position of unloading. The panic bar was out and the conveyor switch was in the "run" position.

The permissible control enclosure cover provided for the standard shuttle car was secured by one different length bolt without lockwashers. The bolt was installed in the fourth bolt hole from the bottom left corner. However, an opening in excess of .004 inch was not present in the enclosure cover.

An opening in excess of .004 inch was present in the left side traction motor junction box of the standard shuttle car.

Although deficiencies existed, the absence of evidence of flames, forces or electrical arcing indicated the standard shuttle car did not provide the ignition source of the explosion.

■ Conveyor Belt Feeder

The investigation revealed one Owens conveyor belt feeder, serial number S2543, was located one crosscut inby survey station #295 between #2 and #3 entries of the West Mains. The conveyor belt feeder was placed on the #2 entry side of the section belt conveyor tailpiece. Both toggle switches were in the "run" position.

Deficiencies were not found on the Owens conveyor belt feeder.

The absence of evidence of flames, forces or electrical arcing indicated the Owens conveyor belt feeder did not provide the ignition source of the explosion.

■ Communication System

The investigation revealed one Pyott-Boone mine phone, model 113, was located on the One Left Panel underneath the belt conveyor tailpiece. The mine phone was sent to MSHA's Approval and Certification Center for testing and examination. Evidence revealed that the mine phone was not damaged by the flames and forces.

The investigation revealed the mine phone cable was located in the #3 belt and track entry. The mine phone cable was severely damaged in several places.

Testimony indicated mine phones were at each underground conveyor belt drive. However, the mine phones that were located at each belt drive were not found.

The absence of evidence of flames, forces or electrical arcing indicated the communication system did not provide the ignition source of the explosion.

■ Personnel Carrier (Battery)

The investigation revealed one West Virginia Armature rail personnel carrier, serial number 200-0519, was located near the end of the section track 18 feet inby survey station #295.

Deficiencies were not found in the condition of the personnel carrier.

The absence of evidence of flames, forces or electrical arcing indicated the personnel carrier did not provide the ignition source of the explosion.

- #4 Belt Power Center

The investigation revealed one Line Power #4 belt power center, serial number 6049, was located between #3 and #4 entries at survey station #253. The high voltage disconnect switches were in the "open" position and signs of arcing were not present. The conveyor belt remote control cable was severely damaged from forces of the explosion.

Deficiencies were not observed.

The absence of evidence of flames, forces or electrical arcing indicated the #4 belt power center and belt remote control cable did not provide the ignition source of the explosion.

- Electrical System

The investigation revealed the mine electrical system was energized at the time of the explosion. The high voltage circuit breaker located at the bottom of the hill tripped due to debris striking the surface transmission lines. The surface high voltage circuit breaker for the underground electrical circuit tripped as a result of the ground wire and/or ground monitor wire being broken. The underground high voltage cable was severely damaged as a result of forces from the explosion, rib rolls and small roof falls along the #4 entry.

The absence of evidence of flames, forces or electrical arcing indicated the electrical system did not provide the ignition source of the explosion.

PROBABLE POINT OF ORIGIN

All possible sources of ignition were examined and evaluated. Elimination of equipment and power cables as potential ignition sources was based on the evaluation of the electrical system and the absence of evidence of flames, forces or electrical arcing. One possible ignition source that could not be eliminated was a butane cigarette lighter located in the crosscut between the #1 and #2 entries left of survey station #378. Based on the evidence gathered during the investigation, including the condition of equipment, displacement of ventilation controls, the medical examiner's reports, the results of the analyses of mine dust samples, and the visual observation of coking, it was determined that the explosion originated in the

crosscut between the #1 and #2 entries left of survey station #378.

CONCLUSION

The investigation revealed that the volume of air on the active section was inadequate to render harmless and to carry away flammable and explosive gases. As pillar recovery mining was conducted throughout the One Left, One Right and Two Right Panels, the roof continued to deteriorate and to fall releasing methane from the gaseous Kelly rider seam of coal, which is located directly above the abandoned workings and active section of Mine No. 3.

The failure to maintain the air flow in its proper volume and direction at the active section and around the abandoned areas allowed methane to accumulate in the abandoned areas and to migrate down the #1 entry to the working section. The methane/air mixture was ignited by a source in the crosscut left of survey station #378 between the #1 and #2 entries of the One Left Panel. The probable ignition source, a butane cigarette lighter, was found in this crosscut. The methane explosion resulted in sufficient force and flames to suspend and ignite coal dust which continued to propagate to the surface.

Analyses of mine dust samples revealed that inadequate rock dust was present and that coal dust contributed to the explosion.

CONTRIBUTING FACTORS TO THE EXPLOSION

Based on evidence gathered during the investigation, contributing factors to the explosion were:

- Failure to properly ventilate the active One Left Panel pillar recovery section
- Failure to properly ventilate the abandoned One Left, One Right and Two Right Panels
- Failure to maintain adequate ventilation controls
- Failure to apply proper amounts of rock dust to the mine roof, face and ribs to minimize explosion hazards
- Failure to conduct weekly examinations of the One Left, One Right and Two Right Panels
- Failure to prohibit the use of smoking articles and other flame-making devices underground

- Failure of some of the miners to refrain from carrying smokers' articles underground
- Failure to comply with the stipulations of the approved roof control plan
- Failure to properly conduct preshift examinations
- Failure to record the volume of air entering the intake split of air of the One Left Panel
- Failure to report the findings of the preshift examinations to personnel prior to their entering the mine
- Failure to accurately record the results of the preshift examinations and to properly communicate the findings of these examinations to appropriate personnel
- Roof falls in the #1 entry of the One Left Panel and in the #4 and #5 entries at crosscut #83 in the West Mains
- The gaseous Kelly rider seam which was situated directly above the Mine No. 3 in varying distances of seven to thirty-nine feet
- Failure of the continuous mining machine's methane monitor to operate properly when exposed to moisture

RECOMMENDATIONS

Mines shall be operated in full compliance with the Mine Safety Laws of Virginia, including the following sections which have been identified to prevent a similar occurrence:

- The air current at the working faces shall have a sufficient volume and velocity to readily dilute and to carry away any flammable or harmful gases consistent with the provisions of Section 45.1-56(c).
- All abandoned workings shall either be sealed, or ventilated consistent with the provisions of Section 45.1-62(b).
- Substantially constructed permanent stoppings between intake and return air courses shall be maintained to the second crosscut outby the face consistent with the provisions of Section 45.1-59(e)
- Coal dust shall not be permitted to accumulate excessively in any part of the active workings, including working places to be abandoned. Proper applications of rock dust shall be applied to

coal dust on the ribs, roof and floor to reduce dispersibility and to minimize the explosion hazard consistent with the provisions of Sections 45.1-67(a) and (c).

- Examinations for dangerous conditions, including tests for methane, shall be made at least once each week in the return airway in its entirety and in idle and abandoned workings. If dangerous conditions are found, they shall be reported promptly consistent with the provisions of Section 45.1-65(i).
- Smoking, the carrying of matches, other flame-making devices, and smoker's articles and intentional creation of any arc, spark or open flame shall be prohibited in all mines consistent with the provisions of Section 45.1-98(a).
- The stipulations of the approved roof control plan shall be complied with at all times consistent with the provisions of Section 45.1-40(a).
- During the preshift examination, the fire boss will ascertain that the air is traveling in its proper course and that ventilation appliances are in good condition. Also, he shall visit every live working place in the mine and inactive places adjacent thereto, and during each visit shall test for methane and oxygen deficiency; examine all doors; test and inspect the roof, face and rib conditions in all working places visited; inspect active roadways, travelways, approaches to abandoned workings and accessible falls in active sections for methane and other dangers; be certain that the air is traveling in sufficient volume in each split consistent with the provisions of Section 45.1-65(c).
- The fire boss shall complete the preshift examination and report results to the mine foreman prior to the employees entering the mine consistent with the provisions of Section 45.1-65(e).
- A properly certified person shall, at least once each week, measure the volume of air flow in the mine consistent with the provisions of Section 45.1-56(d).
- The fire boss shall accurately record the results of the examination in the fire boss, preshift and onshift book consistent with the provisions of Section 45.1-65(e).

Additional recommendations to prevent similar occurrences are:

- An open line of communication should be established between all employees, including different shifts, and management. Changes of conditions within the mine, or any hazards found by

any employee should be communicated to appropriate personnel.

- All mines shall establish a system of bleeder openings or air courses designed to provide positive movement of air through and around abandoned or caved areas which is sufficient to prevent dangerous accumulations of gas.
- Substantially constructed line brattice shall be used to provide adequate ventilation of a sufficient volume to keep the working face clear of flammable and noxious gases.
- The operator should establish and maintain an adequate search program to prevent the carrying and use of smokers' articles underground.
- The operator should designate adequate mine personnel to be qualified on the care and use of gas detection instruments. The operator should also instruct designated mine personnel on the requirements, time and locations where methane gas tests are to be conducted.
- Methane monitors should be maintained as designed to function properly.
- No person shall intentionally disturb, disconnect, by-pass, impair or otherwise tamper with methane monitors or other devices capable of detecting the presence of explosives gases underground.
- The operator should provide instruction of the ventilation system to all underground employees. These instructions should include the ventilation law requirements, air flow directions through the mine, ventilation controls, ventilation of abandoned areas and bleeder lines. These instruction should also include the proper detection and control of methane liberation.
- The operator should instruct workers on the contents of mining plans, such as roof control, fire evacuation, fan stoppage, and any other plans.
- Each mine shall have a check-in and check-out system that will provide positive identification upon the persons. An accurate record of the workers in the mine shall be kept on the surface in a place that will not be affected in the event of an explosion. The record shall bear numbers identical to the identification checks carried by the persons underground.
- Mine operators should maintain a record of family members to be contacted in the event of an accident or fatality. Mine

operators should keep family members informed as to rescue and recovery operations.

APPENDICES:

- APPENDIX I - MINER DATA SHEETS
- APPENDIX II - RECOVERY OPERATIONS
- APPENDIX III - LIST AND SUMMARY OF VIOLATIONS AND ORDERS
- APPENDIX IV - MAPS
 - IV(A) Map of West Mains
 - IV(B) Map of One Left Panel
 - IV(C) Map of Survey Stations, Elevations and Mining Dates
 - IV(D) Map of Mine Workings and Surrounding Area
- APPENDIX V - MAP OF: MINE DUST SAMPLES, COAL CHANNEL SAMPLE, DIRECTION OF FORCES, AND EXTENT OF FLAMES
- APPENDIX V(A) - COKING, FORCES AND HEAT; MINE DUSTING SURVEY
- APPENDIX VI - EQUIPMENT TESTING AND EXAMINATIONS
- APPENDIX VII - ELECTRICAL EQUIPMENT
- APPENDIX VIII - PHYSICAL EVIDENCE AND PERSONAL EFFECTS
- APPENDIX IX - DIVISION OF MINES' ACTIVITIES
- APPENDIX X - PERSONS PRESENT DURING OR CONTRIBUTING INFORMATION TO INVESTIGATION
- APPENDIX XI - SIGNATURE SHEET

APPENDIX I

MINER DATA SHEETS

MINER DATA SHEETS

Miners are listed in numerical order as located during rescue recovery operations.

FATALITIES

1. Name: Claude L. Sturgill
Occupation: Repairman
Total Mining Experience: 20 years
Experience With Present Company: 7 years 5 months
Age: 49
Family Status: Married
Dependent Children: 5
2. Name: Palmer E. Sturgill
Occupation: Shuttle Car Operator
Total Mining Experience: 14 years
Experience With Present Company: 5 years
Age: 45
Family Status: Married
Dependent Children: 3
3. Name: Mike D. Mullins
Occupation: Miner Operator
Total Mining Experience: 9 years
Experience With Present Company: 1 year 3 months
Age: 30
Family Status: Married
Dependent Children: 2
4. Name: Brian Owens
Occupation: Scoop Operator
Total Mining Experience: 10 years
Experience With Present Company: 5 years 6 months
Age: 30
Family Status: Married
Dependent Children: 1
5. Name: James E. Mullins
Occupation: Roof Bolter Operator
Total Mining Experience: 15 years
Experience With Present Company: 2 years 3 months
Age: 42
Family Status: Single
Dependent Children: None

Fatalities continued

6. Name: David K. Carlton
Occupation: Shuttle Car Operator
Total Mining Experience: 10 years
Experience With Present Company: 1 year 3 months
Age: 34
Family Status: Married
Dependent Children: 2
7. Name: Danny R. Gentry
Occupation: Miner Operator Helper
Total Mining Experience: 12 years
Experience With Present Company: 3 months
Age: 36
Family Status: Single (Divorced)
Dependent Children: 2
8. Name: Norman D. Vanover
Occupation: Section Foreman
Total Mining Experience: 18 years
Experience With Present Company: 4 months
Age: 43
Family Status: Married
Dependent Children: 2

SERIOUS INJURY

Name: Robert Kevin Fleming
Occupation: Beltman
Total Mining Experience: 2 years
Experience With Present Company: 1 year 10 months
Age: 21
Family Status: Married
Dependent Children: 2

APPENDIX II

RECOVERY OPERATIONS

RECOVERY OPERATIONS

December 7, 1992

On December 7, 1992, at approximately 6:15 a.m., George Phillip Shortt, third shift surface loader operator, was transferring coal from under the mine stacker belt into the coal stockpile using a front end loader. At approximately 6:20 a.m., Shortt noticed that all of the surface lights suddenly went out, but he did not see or hear anything abnormal.

Shortt dismounted the front end loader and walked toward the mine portals which were approximately 150 feet from where he was working. When Shortt reached the area near the mine portals, he saw signs of a mine explosion. Kevin Fleming, underground belt man, exited the mine from the #3 (belt) entry. Fleming, who was underground at the time of the explosion, was injured. Shortt, using his personal vehicle, transported Fleming to St. Mary's Hospital for medical treatment.

Gene Conley, dayshift outside loader operator, stopped a Division of Mines' Inspector near the mine road entrance of the Southmountain Mine at approximately 7:15 a.m., and informed the Inspector that an explosion had occurred at the Southmountain No. 3 mine. Conley had been to the mine site and verified the incident. Conley informed the Inspector that eleven employees were unaccounted for and still underground.

Upon his return to the mine site, Shortt informed Division of Mines' officials that Fleming was located at the #2 belt drive when the explosion occurred and that Fleming had been hospitalized at St. Mary's Hospital.

The Inspector informed the Division of Mines' Chief about the information that he received from Conley. The Inspector proceeded to the mine site, arriving at approximately 7:30 a.m., and observed dark, black smoke coming from the #3 (belt/track) entry and the #4 (fan) entry. The Inspector informed the Chief about his initial observation at the mine site.

After the notification process of his initial observations at the mine site, the following conditions were observed by the Inspector and the following events transpired:

-- There were eight miners (not eleven) unaccounted for underground.

APPENDIX II
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

- Dark, black smoke was being emitted from the #3 and #4 entry portals.
- The fan housing and explosion doors were completely destroyed.
- The conveyor belt assembly located in the #3 entry was severely damaged.
- The mine portal canopies were severely damaged.
- The supply building office - motor barn located in front of the #2 entry was destroyed.
- Debris and parts of the supply building office - motor barn were blown from 0 to 800 feet from the original location.
- The mine electrical power supply was off due to damage to the surface electrical installation.
- The surface electrical wiring was partially torn down and scattered on the ground outside the mine portals.
- Various types of debris were thrown and scattered throughout the mine portal areas.
- Oxygen and acetylene bottles that were partially covered by debris were moved to a secure location.
- The employee's personal vehicles, that were parked to the left of and approximately 200 feet away from the #1 entry portal, were damaged.

The Division of Mines' Chief arrived at the mine site at approximately 8:00 a.m. Donnie Shortt, General Mine Superintendent, was present at the mine site when the Chief arrived. The following events occurred between 8:00 a.m. and 10:00 a.m., that involved Division of Mines, Mine Safety and Health Administration and company officials:

APPENDIX II
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

- The mine rescue teams were notified.
- Virginia Iron Coal & Coke engineering department was contacted for acquiring mine overlays, underlays and 1-inch to 100-foot mine maps for rescue and recovery purposes.
- The number of miners underground were verified.
- The mine site scene and portal areas were secured against unauthorized entry.
- A control order was issued under the Mine Safety Laws of Virginia to secure the accident scene.
- A command center was established in a mine office trailer.
- A rescue and recovery group was established consisting of DM, MSHA, and company personnel.
- A DMME support group was established at the Big Stone Gap office to provide assistance in the rescue and recovery operations.
- Electrical power was re-established to the mine electrical sub-station in order to provide electrical power to the mine fan if necessary for rescue and recovery operations.
- The mine fan was re-positioned so that it would be operational if needed for rescue and recovery operations.
- Mine history information was obtained from mine officials and evaluated.
- The mine examination record books were secured.
- The mine rescue teams were briefed.

APPENDIX II
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

At approximately 9:00 a.m., DM and MSHA, Donnie Shortt, and other mine rescue personnel discussed the situation and agreed to send a mine rescue team underground to obtain air quality tests and to install monitor tubing in #3 and #4 entries.

The Paramont and Westmoreland mine rescue teams had arrived and were preparing to explore underground. The Paramont mine rescue team entered the mine and advanced to the #2 belt drive by 12:15 p.m. while recording the following: #4 entry, first crosscut - 8.2% methane, 18.8% oxygen, carbon monoxide in excess of 3000 ppm; #3 entry at the #2 belt drive - 2.1% methane and dense smoke.

The Paramont team exited the mine as the Westmoreland team entered. The Westmoreland mine rescue team advanced to crosscut #15 by 1:31 p.m. while recording the following: #4 entry - .6% methane with light smoke.

At approximately 3:05 p.m., the Westmoreland team exited the mine as the Mine Technology team entered to install temporary ventilation curtains in the #1 and #4 crosscuts between the #2 and #3 entries. The Mine Technology team exited the mine as the Westmoreland team entered.

The Westmoreland mine rescue team entered the mine at 3:20 p.m., examined all entries at crosscuts #20, #25, and #30. The team reported the following when exploring across at crosscut #30: .7% methane, 19.8% oxygen, 2000 ppm carbon monoxide, and light smoke with a total intake air flow of 67,248 cubic feet per minute.

At approximately 6:00 p.m., the Paramont mine rescue team entered the mine to install temporary ventilation curtains beginning at crosscut #7. Installation of curtains was continued in each crosscut as they advanced toward the Westmoreland team. Curtains were installed up to crosscut #20 by 6:55 a.m. The Westmoreland team exited the mine at 7:15 p.m.

The Paramont team advanced to crosscut #35 by 7:27 p.m. and recorded the following in the #3 entry: .2% methane, 560 ppm carbon monoxide, and 20.4% oxygen. The team continued to crosscut #40 and recorded the following in the #4 entry: .6% methane, 1200 ppm carbon monoxide, and 19.5% oxygen. The Paramont team also installed ventilation curtains up to crosscut #29 by 8:30 p.m.

APPENDIX II
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

At 8:32 p.m., the Westmoreland team entered the mine with instructions to continue the installation of ventilation curtains between #2 and #3 entries. At 8:45 p.m., the Paramount team exited the mine. By 9:25 p.m., the ventilation curtains were installed up to crosscut #35. The Westmoreland team advanced to crosscut #45 by 9:45 p.m., tied across, and reported the following: #6 entry - .5% methane, 1900 ppm carbon monoxide, and 20.8% oxygen. By 10:00 p.m., ventilation curtains were installed up to crosscut #45. At 10:10 p.m., the Westmoreland team advanced to crosscut #50 and recorded the following: #6 entry - .7% methane, 2000 ppm carbon monoxide, and 20.1% oxygen. By 10:35 p.m., the ventilation curtains were installed up to crosscut #45. At 11:05 p.m., the team had advanced to crosscut #55 and reported the following: #6 entry - .7% methane, 1600 ppm carbon monoxide and 20% oxygen.

At 11:20 p.m., the Westmoreland team returned to the surface while the Clinchfield team entered the mine.

December 8, 1992

At 12:30 a.m., the Clinchfield team advanced to crosscut #65 and reported the following: #6 entry - .9% methane, 968 ppm carbon monoxide, and 20.3% oxygen. By this time, ventilation curtains were installed up to crosscut #60. At 1:50 a.m., the Clinchfield team advanced to crosscut #75 and reported the following: #6 entry - 1% methane, 1250 ppm carbon monoxide, and 20% oxygen. By this time, ventilation curtains were installed up to crosscut #70.

At 2:05 a.m., the Clinchfield team advanced to crosscut #81 at the entrance of the #1 entry of the One Left Panel active working section, where the miners were producing coal at the time of the explosion. At the entrance of the #1 entry of the One Left Panel working section, crosscut #81, the team reported the following: 6.4% methane, and 10,000 ppm carbon monoxide, with rolling smoke and heat coming from the working section. The ventilation current was not ventilating the One Left Panel.

At 2:15 a.m., the team returned to the surface.

A decision was made at 5:15 a.m. by the rescue and recovery officials to drill a ventilation borehole, eight inches in diameter, into the #3 entry

on the One Left Panel at survey station #370. Monitoring of the #3 and #4 entries on the surface continued while the borehole was drilled.

On December 8, 1992, at 2:05 p.m., the drilling operations began.

December 9, 1992

On December 9, 1992 at 10:28 a.m., the borehole drilling intersected the #3 entry on the active working section. The following was recorded with hand-held instruments at the top of the borehole when the drill steel was removed: 4.7% methane, 950 ppm carbon monoxide, 17.7% oxygen, and the borehole was exhausting.

At 11:20 a.m., plastic tubing was inserted into the borehole to monitor the mine atmosphere.

At 2:25 p.m., a test was initiated with a seismic locating system. Three surface shots were fired to notify any surviving miners that rescue efforts were in progress. A negative response was recorded after one hour of monitoring.

At 2:30 p.m., the following was recorded from the borehole monitoring: 4.1% methane, 1520 ppm carbon monoxide, and 17.9% oxygen.

Monitoring operations continued until 5:00 p.m. Borehole monitoring results were: 3.9% methane, 1510 ppm carbon monoxide, and 18.2% oxygen.

The borehole monitoring results revealed significant improvements in the mine atmosphere. The methane and carbon monoxide steadily decreased while the oxygen level remained stable.

At 5:00 p.m., the rescue and recovery officials decided to continue recovery operations and to send mine rescue teams underground.

The Clinchfield mine rescue team re-entered the mine at 5:20 p.m. At 6:20 p.m., the team reached crosscut #81 and went under oxygen.

At 7:46 p.m., the team reported finding the following miners: Claude Sturgill, Palmer Sturgill, Mike Mullins, Brian Owens, James Mullins, David Carlton, and Danny Gentry. The team was unable to locate one miner at that time.

The rescue team encountered in excess of 10% methane and 18% oxygen in the #1 entry and 16.9% oxygen and 7.1% methane in the area between the #1 and #2 entries where a battery-powered scoop was located. At 9:00 p.m., the decision was made to withdraw the rescue team because an explosive mixture

APPENDIX II
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

was found in an area where the battery-powered scoop was located. At 9:45 p.m., the Clinchfield mine rescue team arrived on the surface.

A decision was made by rescue/recovery officials that a second borehole with an exhaust pump installed on top of it was necessary. The primary purpose of the second borehole was to ventilate the working section and gob area and to reduce the methane concentration. The secondary purpose was for continuous monitoring.

The second borehole was twelve inches in diameter and was drilled in the area of survey station #530 located in the back of the One Left Panel pillared area.

December 10, 1992

The drilling of the second borehole began on December 10, 1992, at 3:35 p.m.

December 11, 1992

Drilling operations at this second site continued through the night and Friday. The estimated time of completion was December 11, 1992 at 4:00 p.m. Monitoring operations at the #1 borehole and the entry portals continued while the second borehole was drilled. At approximately 4:05 p.m., the second borehole intersected the mine. An exhausting fan was installed immediately over the top of the borehole. The exhausting fan produced 3,500 cubic feet per minute at 38 inches water gauge.

The first monitor results taken at 4:22 p.m. from the #2 borehole were: 50% methane and 550 ppm carbon monoxide.

December 12, 1992

Monitoring operations at the #1 borehole, #2 borehole and mine portals continued throughout the night and Saturday. The monitoring results from the #2 borehole revealed significant improvements in the mine atmosphere. By 3:30 p.m. on December 12, 1992, the #2 borehole monitor results were: 3.9% methane, 240 ppm carbon monoxide and 18.9% oxygen.

At that time, preparations were made with mine rescue teams to re-enter the mine to search for the one unaccounted for miner and to recover the miners if conditions were favorable.

APPENDIX II
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

The Paramont and Westmoreland rescue teams returned underground at 4:40 p.m. to continue recovery operations and to continue the installation of ventilation curtains to crosscut #81. By 6:12 p.m., the Westmoreland team completed installing curtains up to crosscut #81 while the Paramont team continued to search the working section for the unaccounted for miner. The Paramont team reported that the explosive mixture near the battery-powered scoop located near survey station #378 had dissipated.

At 7:00 p.m., the Westmoreland team found the unaccounted for miner, Norman Vanover, near survey station #384.

At 7:42 p.m., all of the miners were prepared for transporting and loaded on the scoop. The rescue teams arrived on the surface with the miners at 8:57 p.m. The miners were transported to Sturgill's Funeral Home located in Coeburn, Virginia.

December 13, 1992

Dr. David Oxley, Chief Medical Examiner for the Commonwealth of Virginia, removed personal effects and performed medical examinations on December 13, 1992.

APPENDIX II
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

The mine rescue teams, trainers and safety officials that participated in the recovery operations following the explosion were:

CLINCHFIELD COAL COMPANY:

Tom Asbury - Trainer	Danny Cromer
Wayne Fields - Captain	Gary Austin
Jack Crawford - Safety Official	Milton Kiser
Jeb Turner	James Stanley
David Asbury	Ronnie Stevenson
Eddie Rudder	Ray Robinette
Danny Mann	Barry Compton

PARAMONT COAL CORPORATION:

Wendell Collinsworth - Trainer	Jeff Petro
Gary Swiney - Captain	Hughie Carter
Donnie Ratliff - Safety Official	Kyle Walker
Lloyd Robinette - Safety Official	Jerry Bledsoe
Leroy Mullins	Charles Ray
Mike Clark	Jerry Perkins
Rick Shelton	William Adams
Jim Rose	Robert Mitchell
Mike Reed	John Richardson
Tim Vicars	

WESTMORELAND COAL COMPANY:

Gary Whisman - Trainer	Charles Rutherford
Gerald Tate - Captain	Maurice Winebarger
Frank Linkous - Safety Official	Scott Kremm
Doug Lester - Safety Official	Keith Smith
Mack Wright	Phil Skorupa
Terry Bryant	Frank Jervis
Teddy Starnes	Keith Hargrove
Gerald Thompson	

JEWELL SMOKELESS COAL COMPANY:

Bill Messick - Trainer	Mitchell Altizer
Elmer Vandyke - Captain	John Parris
Jessie Elswick	Steven Ratliff
Timothy Edwards	Wayne Dye
Paul Thornsbury	Rick Waddell
Steve Vance	

MINE TECHNOLOGY:

Danny Hicks - Trainer	John Mooneyhan
Fred Dotson - Trainer	Robert Edwards
Gerald Vanoy - Captain	Phillip Rumley
Robert Dollerhyde - Captain	Larry Miller
Gary Hill	James Taylor
James Summers	Steven Countiss
Ernie Sexton	Daniel Viers
John Polly	

APPENDIX II
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

Division of Mines' personnel who participated in mine rescue and recovery and establishment of ventilation were:

Harry D. Childress	Chief
Danny Altizer	Mine Inspector
Joe Altizer	Mine Inspector
Clarence Ball	Mine Inspector
J. E. Brown, Jr.	Mine Inspector
Wayne Davis	Technical Specialist - Ventilation
David Elswick	Technical Specialist - Roof
Mitchell Fisher	Mine Inspector
Sammy Fleming	Mine Inspector
Carroll Green	Mine Inspector Supervisor
R. H. Hamrick	Mine Inspector
Charles Jessee	Mine Safety Engineer
Terry Johnson	Mine Inspector
Vernon Johnson	Mine Inspector
Jerry Looney	Mine Inspector
Opie McKinney	Mine Inspector Supervisor
Dwight Miller	Technical Specialist - Electrical
Beaufor Ray	Technical Specialist - Electrical
Doyle Roberts	Technical Specialist - Roof
J. C. Stiltner	Mine Inspector
John Talbert	Mine Inspector
Phillip Willis	Mine Inspector

APPENDIX III

LIST AND SUMMARY

OF

VIOLATIONS AND ORDERS

APPENDIX III
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

LIST AND SUMMARY OF VIOLATIONS AND ORDERS

The following list of orders and violations cited at Southmountain Coal Company, Inc., Mine No. 3, related to the December 7, 1992 explosion:

<u>No. of Orders of Title 45</u>	<u>Section of Title</u>	<u>Reference to Section of Title</u>	<u>Date Issued</u>	<u>Date Corrected</u>
1	45.1-5 G	45.1-56(c)	05/06/93	05/06/93
1	45.1-5 G	45.1-62(b)	05/06/93	05/06/93
1	45.1-5 G	45.1-59(e)	05/06/93	05/06/93
1	45.1-5 G	45.1-67(a),(c)	05/06/93	05/06/93
1	45.1-5 G	45.1-65(i)	05/06/93	05/06/93
1	45.1-5 G	45.1-98(a)	05/06/93	05/06/93
2	45.1-5 G	45.1-40(a)	05/06/93	05/06/93
1	45.1-21 C		12/07/92	05/06/93

<u>No. of Violations of Title 45</u>	<u>Section of Title</u>	<u>Date Issued</u>	<u>Date Corrected</u>
1	45.1-65(c)	05/06/93	05/06/93
1	45.1-56(d)	05/06/93	05/06/93
2	45.1-65(e)	05/06/93	05/06/93

APPENDIX III
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

The following is a summary of the above-listed orders and violations:

1. 45.1-5 G; Ref. 45.1-56(c)

The volume and velocity of air currents ventilating the active pillar section on December 7, 1992 were not sufficient to dilute, render harmless and carry away flammable and harmful gasses which accumulated into explosive quantities in this area.

2. 45.1-5 G; Ref. 45.1-62(b)

The One Left, One Right, Second Right and Mains abandoned areas were not ventilated. The volume and velocity of air currents ventilating the abandoned areas were not sufficient to dilute, render harmless and carry away flammable and harmful gasses.

3. 45.1-5 G; Ref. 45.1-59(e)

Permanent stoppings between intake and return aircourses on the One Left Panel were not maintained to the second breakthrough outby the face. The permanent stopping located between survey stations #294 and #302 was partially removed.

4. 45.1-5 G; Ref. 45.1-67(a),(c)

The analysis of the dust surveys and samples, both coking and combustible content, indicates a large area of coal dust present and inadequate rock dust applications.

5. 45.1-5 G; Ref. 45.1-65(i)

The weekly exam for dangerous conditions was not complete for the weeks of November 8-14, November 15-21, November 22-28 and November 29 through December 5, 1992. A certified person did not examine the One Left, One Right and Second Left abandoned areas in their entirety. Dangerous conditions were not reported promptly.

6. 45.1-5 G; Ref. 45.1-98(a)

Smoking, the carrying of flame-making devices and smoker's articles were allowed at the Southmountain No. 3 mine. The Medical Examiner's report indicated that smoking materials were found on three miners. Smoking materials and butane lighters were found in a dinner bucket and in the crosscut between #1 and #2 entries left of survey station #378. A cigarette butt was located 13.5 feet inby survey station #378 in the #2 entry.

APPENDIX III
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

7. 45.1-5 G; Ref. 45.1-40(a)

The approved 5 cut partial pillaring roof control plan was not complied with in that the three barriers (stumps) required to be left on each side of the pillar blocks were mined on the right side of the No. 2 block. The area affected was the line of blocks inby survey station #379.

The required 8 foot barrier (stump) between the two cuts mined from each side of the pillar blocks was removed on the right side of No. 3 and No. 4 blocks and the left side of No. 5 block. The affected area was the line of blocks inby survey station #376.

8. 45.1-5 G; Ref. 45.1-40(a)

The approved 5 cut partial pillaring roof control plan was not complied with in that a sixth cut, not prescribed in the approved plan, was mined from the inby end of two blocks. The affected area was the line of blocks outby survey station #379 (No. 2 and No. 3 blocks) and two blocks in the line of blocks outby survey station #376 (No. 4 and No. 5 blocks).

9. 45.1-21 C

The above mine is closed pending recovery and completion of an investigation. Only persons involved in the recovery operation shall be allowed in the mine or around portal area. (An order of closure was issued in order to preserve the scene of the explosion pending an investigation.)

10. 45.1-65(c)

The preshift exam was not complete on December 6, 1992 for the third shift. The evening shift fire boss did not preshift the approach to abandoned workings. The fire boss did not examine the #1 entry of the One Left Panel to be certain that the air was traveling in its regular course and in sufficient volume.

11. 45.1-56(d)

The volume of air entering the abandoned intake split of One Left Panel, required for the weekly examination, was not recorded in the mine record books.

APPENDIX III
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

12. 45.1-65(e)

On December 6, 1992, the day shift fire boss remained underground and did not report results of the evening preshift examination, prior to the evening shift entering the mine.

13. 45.1-65(e)

The fire boss did not accurately record the results of examination in the fire-boss, preshift and onshift book. Concentrations of methane were detected on several occasions and not properly recorded in the fire-boss book.

APPENDIX III
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

The following list of orders and violations cited at Southmountain Coal Company, Inc., Mine No. 3, during the investigation did not relate to the December 7, 1992 explosion:

<u>No. of Orders of Title 45</u>	<u>Section of Title</u>	<u>Reference to Section of Title</u>	<u>Date Issued</u>	<u>Date Corrected</u>
1	45.1-5 G	45.1-40(a), (e)	05/06/93	05/06/93

<u>No. of Violations of Title 45</u>	<u>Section of Title</u>	<u>Date Issued</u>	<u>Date Corrected</u>
1	45.1-40(a)	05/06/93	05/06/93
1	45.1-42(d)	05/06/93	05/06/93
1	45.1-27 A	05/06/93	05/06/93
1	45.1-67(c)	05/06/93	05/06/93
1	45.1-97	05/06/93	05/06/93
1	45.1-65(a)	05/06/93	05/06/93
1	45.1-65(i)	05/06/93	05/06/93
1	45.1-54(e)	05/06/93	05/06/93
2	45.1-80(a)	05/06/93	05/06/93
1	45.1-73(d)	05/06/93	05/06/93

APPENDIX III
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

The following is a summary of the above-listed orders and violations:

1. 45.1-5 G; Ref. 45.1-40(a), (e)

The approved 5 cut partial pillaring roof control plan was not complied with which created a serious or imminent danger. Also, the method of mining exposed the workers to unusual dangers.

Timbers were installed 8 to 12 feet in by the last row of bolts during pillar recovery operations on the No. 2 pillar block on the line of blocks in by survey station #379.

2. 45.1-40(a)

The approved roof control plan, 5 cut partial pillaring, was not being complied with in that the cut mined from the No. 3 block, in the right crosscut from survey station #376, was not mined according to the cut sequence prescribed in the approved roof control plans.

3. 45.1-42(d)

An unintentional roof fall was not reported promptly to the Division of Mines. A roof fall occurred in #5 entry at survey station #281 prior to the December 7, 1992 explosion. The roof fall was not marked on the mine map.

4. 45.1-27 A

An accurate map indicating headings, rooms and pillars was not kept at the mine. Two crosscuts right of survey station #372, entries and crosscuts in this area on the One Left Panel were mined and not indicated on the map. The pillar blocks were not accurately indicated on the map. The pillar blocks in the row in by survey station #376 were marked as having been mined prior to mining taking place.

APPENDIX III
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

5. 45.1-67(c)

Loose coal, coal dust and grease had accumulated on the Jeffery 1036 continuous mining machine, serial number 38002, located at the One Left Panel.

6. 45.1-97

The mine check-in and check-out system was not located in a place to afford protection in the event of an explosion. Also, three miners were not provided with a numbered identification check.

7. 45.1-65(a)

The preshift exam was not complete on December 6, 1992 for the evening shift. The day shift fire boss did not use a suitable permissible device capable of detecting oxygen deficiency.

8. 45.1-65(i)

The weekly examination of the return air course in its entirety was not recorded since May 14, 1992.

9. 45.1-54(e)

The daily inspection of the main fan was not recorded for December 5 and 6, 1992.

10. 45.1-80(a)

Fuses of the correct capacity were not installed on the 12,470 volt incoming line on the surface substation. The three phase lines were protected with parallel fuses rated for 5,600 volts.

11. 45.1-80(a)

Fuses of the correct capacity were not installed on the battery powered S&S scoop, serial number 488-1737, light circuit. The light circuit was protected with 30 ampere fuses instead of the 10 ampere fuses as designed.

12. 45.1-73(d)

Pushing of supply cars on the main line was practiced at the No. 3 mine.

APPENDIX IV

MAPS

APPENDIX V(A)

**COKING, FORCES AND HEAT;
MINE DUSTING SURVEY**

I. VISUAL OBSERVATION OF COKING, FORCES AND HEAT

A. One Left Panel Entries

The Flames and Forces Team initiated observations at the face area of the One Left Panel in the #1 heading one crosscut outby survey station #380. Two timbers that were installed prior to the explosion in the intersection outby survey station #380 remained in position. Coke and dust deposits were present on the inby side of these timbers. Coking was present on the inby side of the roof bolt plates extending from the timbers outby to survey station #377.

Coking was present on the inby side of roof bolt plates in the #2 entry beginning at survey station #379 and extending one crosscut outby survey station #371. A melted piece of curtain was located inby survey station #378.

Coking was present in the #3 entry inby survey station #376 on the outby side of the roof bolt plates, and coking was present on the inby side of the roof bolt plates extending from survey station #376 outby survey station #367. Two small pieces of melted curtain were located to the left of the continuous mining machine. Coke was located in the pump compartment of the off-standard shuttle which was located in the intersection outby the continuous mining machine at survey station #376.

In the #4 entry beginning at survey station #375 and extending outby to survey station #293, coke was present on the inby side of the roof bolt plates. The first aid material, stored on or near the power center outby survey station #293, was scattered up the entry inby the breaker timbers at survey station #375. Also, self-contained self-rescuers were scattered inby the breaker timbers.

In the #5 entry beginning inby survey station #369 and extending outby to survey station #303, coke was present on the inby side of the roof bolt plates.

B. One Left Panel Crosscuts

In the crosscut between #1 and #2 entries left of survey station #378, coke was present on the #2 entry side of the roof bolt plates which extended from the #1 entry into the crosscut approximately two-thirds through the crosscut. Coke was present on the #1 entry side of roof bolt plates which extended approximately one-third through the crosscut from the #2 entry.

In the crosscut between #2 and #3 entries between survey stations #378 and #376, coke was present on the #2 entry side of the roof bolt plates. The continuous mining machine which was located in the #3 entry at survey station #376 had dust deposits and debris located on the #2 entry side.

In the crosscut between #3 and #4 entries between survey stations #376 and #375, coke was present on the #3 entry side of the roof bolt plates extending through the crosscut to the breaker timbers in the crosscut.

In the crosscut between #1 and #2 entries from survey stations #377 to #371, coke was present on the #1 entry side of the roof bolt plates. In crosscuts 2 through 6 between survey stations #371 and #372, dust deposits were on the #2 entry side of roof bolt heads.

C. West Mains

The West Mains inby crosscut #81 was examined as far as conditions permitted. In the #1 entry of West Mains between survey stations #293 and #303, a scoop and scoop charger were present. The scoop had two battery tray lids displaced from the scoop and a metal man door was lying on the battery disconnects. Coke was present on the inby side of the roof bolt plates in the #1 entry between survey station #293 and #303.

In the #2 entry, a partial stopping was present just outby survey station #302 with coking present on the inby side.

In the #3 entry beginning at the conveyor belt feeder and extending inby to survey station #304, coking was present on inby

APPENDIX V(A)
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

side of roof bolt plates. A piece of burnt curtain was also located inby survey station #304. From survey station #304 and extending inby to #318, soot was present on roof bolt plates, mine roof, cap wedges, and other objects throughout the area.

In the #4 entry from survey stations #301 to #315, soot was present on roof bolt plates, mine roof, and other objects throughout the area.

In the crosscuts from survey stations #303 to #304, coke was present on survey station #303 side of roof bolt plates. In the crosscut from survey stations #304 to #305 coke was present on both sides of plates. In the crosscut from survey stations #293 to #294, at the power center location, cable plugs were displaced from the power center and coke was present on the #293 side of roof bolt plates. In the crosscut from survey stations #294 to #296, coke was present on #294 side of roof bolt plates. In the crosscuts from survey station #367 to the conveyor belt feeder, coke was present on the survey station #367 side of roof bolt plates. Also, coke was present in the pump compartment of the shuttle car located at the feeder and in the offset in the roof above the shuttle car.

In the #1 and #2 entries extending from crosscut #81 outby to crosscut #70, slight coking was observed on the inby side of the roof bolt plates.

In the belt and neutral, #3 and #4, entries extending outby from the feeder to crosscut #70, coking was present on the inby side of roof bolt plates. Soot was present on roof bolt plates and mine roof in the #4 entry at survey station #260. In the center of the crosscut between #3 and #4 entries at survey station #253, a power center was located with the covers displaced toward the #3 entry. The #4 belt drive located one crosscut inby survey station #253 was turned crossways in the entry.

The mine maps, Appendix IV and Appendix V, indicate additional evidence of flames, forces and heat.

II. MINE DUST EXAMINATION

A. Definitions

Band Sample consists of sweeping the dust from the ribs, roof, and floor in an 8 to 12 inch band around the entry. The contents is sifted through a 200 mesh screen. Then the contents is mixed and quartered with one quarter discarded. This process is repeated until only enough dust remains for a sample.

Channel Sample generally consists of a 6 inch wide by 2 inch deep vertical channel taken from the full height of the coal seam. For example, in a 6-foot seam, the channel sample is 6 inches by 2 inches by 6 feet. A proximate analysis is performed on each channel sample, which identifies the percent: moisture, volatile matter, fixed carbon, and ash. The volatile matter and fixed carbon are used to determine the volatile ratio.

Volatile Ratio is a value established by the Bureau of Mines to evaluate the explosibility of U. S. coals, based on large-scale tests. It has been established that all U. S. coals, having a volatile ratio in excess of 0.12 are considered to present an explosion hazard.

The volatile ratio (VR) of coal is determined as the ratio of its volatile matter (VM) to the sum of its volatile matter and fixed carbon (FC) contents. $VR = VM/(VM+FC)$

A channel sample was taken from the coal seam in a location as shown on Appendix V map.

The results of this sample were:

<u>Ingredient</u>	<u>Composition</u>
Moisture	1.07
Volatile	29.47
Fixed Carbon	68.54
Ash	10.93

The calculated volatile ratio was 0.33 which exceeds the ratio of 0.12 which is used to determine when coal shall be inerted with application of rock dust.

B. Sampling Teams

The rock dust crews consisted of three teams. The samples were taken in all entries at three crosscut intervals with the first station being 50 feet in by the portals. Crosscut samples were taken in every third station.

On the section, samples were taken in every crosscut where conditions permitted.

These samples were taken where possible by taking a full band sample.

C. Analysis

A total of 312 samples were attempted. Due to bad roof, roof falls, and some areas too wet to sample, 252 samples were collected.

The accepted level for incombustible content of the sample for the intake air course was 65%. The accepted level for incombustible content of the sample for the return air course was 80%.

The analysis showed 228 samples were below the industry's accepted level for incombustible content.

#1 and #2 entries

108 samples were attempted

3 were too wet to take

2 were not taken due to bad top

1 entry was not developed

102 samples were taken

13 samples were 65% or higher incombustible

89 samples were less than 65% incombustible

#3 and #4 entries (belt and neutral)

101 samples were attempted
13 were too wet to take
7 had bad top
2 had gob in location
79 samples were taken
11 samples were 65% or higher incombustible
68 samples were less than 65% incombustible

#5 and #6 entries (return)

103 samples were attempted
16 were too wet to sample
13 had bad roof
3 had no entry developed
71 samples were taken
All samples were less than 80% incombustible

The analysis of the samples revealed coking throughout the mine from the active section to the surface.

III. MINE DUST SURVEY - Locations of Mine Dust Samples

At survey station #1, 50 feet inby the portal entries A, C and D were too wet to sample. A full band sample was taken in B entry.

At survey station #1X, first line of crosscuts inby the portal, a full band sample was taken at station #1AX, all other stations for 1X were too wet to sample.

At survey station #2, 50 feet inby break #3, a full band sample was taken at A and B. C, D and E were too wet to sample.

At survey station #3, 50 feet inby break #5, a full band sample was taken at A and B. C, D and E were too wet to sample.

At survey station #3X, #6 line of crosscuts, a full band sample was taken at #3AX. All other stations were too wet.

At survey station #4, 50 feet inby break #8, a full band sample was taken in A and B, a partial (rib and floor) in D. C, E and F were too wet to sample.

At survey station #5, 50 feet inby break #11, A and B, a full band sample was taken. A partial (rib and floor) was taken at C and D. Ribs and 1/2 floor was taken at E. F was too wet to sample.

At survey station #6, 50 feet inby break #14, a full band sample was taken in A and B. Partial (rib and floor) samples were taken and E and F were too wet to sample.

At survey station #6X, #15 line of crosscuts, a full band sample was taken at A and D, a partial (rib and roof) was taken at B and C, and E and F were too wet to sample.

At survey station #7, 50 feet inby break #17, a full band sample was taken at A. A partial (rib and floor) was taken at B, C and D, and E and F were too wet to sample.

At survey station #8, 50 feet inby break #20, a full band sample was taken in A and B, a partial (rib and floor) was taken in C and D, and E and F were too wet to sample.

At survey station #9, 50 feet inby break #23, a full band sample was taken in A and C, a partial (rib and floor) was taken in B and D, and E and F were too wet to sample.

APPENDIX V(A)
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

At survey station #9X, #24 line of crosscuts, a full band sample was taken at A, C and D. A partial (ribs and floor) at B and E was too wet to sample.

At survey station #10, 50 feet inby break #26, a full band sample was taken in E, partial (rib and floor) taken in A, B, C and D. F was too wet to sample.

At survey station #11, 50 feet inby break #29, a full band sample was taken in A, E and F and partial (rib and floor) in B, C and D.

At survey station #12, 50 feet inby break #32, a full band sample was taken in A, E and F and a partial (rib and floor) in B, C and D.

At survey station #12X, #33 line of crosscuts, a partial sample (roof and ribs) at A, B and C. Full band sample was taken at D and a partial (floor only) at E.

At survey station #13, 50 feet inby break #35, a full band sample was taken in A and F, a partial (rib and floor) in B, C and D, a partial (2/3 of ribs and floor) in E.

At survey station #14, 50 feet inby break #38, a full band sample was taken in A and F, and a partial (ribs and floor) in B, C and D and a partial (2/3 ribs and floor) in E.

At survey station #15, 50 feet inby break #41, a partial sample (floor and ribs) was taken in A, B, C and D. Partial (2/3 ribs and floor) was taken in E and F.

At survey station #15X, #42 line of crosscuts, a full band sample was taken at A. Partial (ribs and floor) at B, C and D and a partial (2/3 ribs and floor) at E.

At survey station #16, 50 feet inby break #44, a partial sample (ribs and floor) was taken in A, B, C and D. Partial (2/3 ribs and floor) was taken in E and F.

At survey station #17, 50 feet inby break #47, a full band sample was taken in E, a partial (floor and ribs) was taken in A, B, C and D, and a partial (2/3 ribs and floor) in F.

At survey station #18, 50 feet inby break #50, a partial sample (ribs and floor) was taken in A, B, C and D and a partial (2/3 ribs and floor) was taken in E and F.

APPENDIX V(A)
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

At survey station #18X, #51 line of crosscuts, a partial sample (ribs and floor) was taken at A, B, C, D and F. A partial sample (2/3 ribs and floor) was taken at E.

At survey station #19, 50 feet inby break #53, a partial sample (floor and ribs) was taken in A, B, C and D, and a partial sample (2/3 ribs and floor) was taken in E and F.

At survey station #20, 50 feet inby break #56, a full band sample was taken in A, E and F, and a partial sample (ribs and floor) was taken in B, C and D.

At survey station #21, 50 feet inby break #59, a full band sample was taken in A, B, E and F. A partial sample (roof and ribs) was taken in C and no sample was taken in D due to a roof fall.

At survey station #21X, #60 line of crosscuts, a full band sample was taken at D, E and F. A partial (ribs and floor) was taken at A and B and no sample was taken at C due to a roof fall.

At survey station #22, 50 feet inby break #62, a full band sample was taken in A, E and F, and a partial (ribs and floor) in B, C and D.

At survey station #23, 50 feet inby break #65, a full band sample was taken in A, D, E and F. A partial sample (ribs and floor) was taken in B and C.

At survey station #24, 50 feet inby break #68, a full band sample was taken in B, D, E and F. A partial sample (ribs and floor) was taken in A and C.

At survey station #24X, #69 line of crosscuts, a full band sample was taken at A, D and E and a partial (ribs and floor) was taken at B and C.

At survey station #25, 50 feet inby break #71, a full band sample was taken in B, D, E and F and a partial sample (ribs and floor) was taken in A and C.

At survey station #26, 50 feet inby break #74, a full band sample was taken in A, B, D, E and F and a partial (ribs and floor) was taken in C.

At survey station #26X, #75 crosscut, a full band sample was taken at A, B, C, D and E.

APPENDIX V(A)
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

At survey station #27, 50 feet inby break #75, a full band sample was taken in A, C and F. A partial sample (ribs and floor) was taken in B, and a partial sample (2/3 ribs and floor) was taken in E and D was too wet to sample.

At survey station #28, 50 feet inby break #76, a full band sample was taken in A, C, D, E, F and a partial sample (ribs and floor) was taken in B.

At survey station #29, 50 feet inby break #77, a full band sample was taken in all entries.

At survey station #29X, #78 line of crosscuts, a full band sample was taken at A, B, C and E, and a roof fall was at D.

At survey station #30, 50 feet inby break #78, a partial sample (floor only) was taken in A, and a full band sample was taken in B, C, D, E and F.

At survey station #31, 50 feet inby break #79, a full band sample was taken in A, B, C, E and F. A partial (ribs and floor) was taken in D.

At survey station #32, 50 feet inby break #80, a full band sample was taken in A, B, D and F. No sample was taken in C due to bad roof and a roof fall was in E.

At survey station #32X, #81 line of crosscuts, a partial sample was taken (ribs and floor) at A. Full band sample was taken at E and no samples were taken at B, C and D due to bad roof.

At survey station #33, 50 feet inby break #81, a full band sample was taken in A, B, D and F. No sample was taken in C due to bad roof and there was a roof fall in E.

At survey station #34, 50 feet inby break #82, a full band sample was taken in B, D and E. Partial (ribs and floor) was taken in A and C. A roof fall was in F.

At survey station #35, 50 feet inby break #83, a full band sample was taken in B, C and F. A partial (ribs and floor) was taken in E. There was bad roof in A and D was too wet to sample.

At survey station #35X, #84 line of crosscuts, a full band sample was taken in A, B, C and D. A roof fall was in E.

APPENDIX V(A)
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

At survey station #350, 50 feet inby break #84, a full band sample was taken in B and C. Partial (ribs and floor) was taken in A. Partial (1/2 band - bad roof across half of the entry) was taken in D. Roof falls were in E and F.

At survey station #36, 50 feet inby break #85, a full band sample was taken in B and C. Partial sample (ribs and floor) was taken in A. There was bad roof in D and roof falls in E and F.

At survey station #37, 50 feet inby survey station #367, at mouth of first left, entry A was not developed. A full band sample was taken in B, C, D and F. There was bad roof in E and G.

At survey station #37X, first line of crosscuts inby mouth of first left, a full band sample was taken in A, B, C, D and F. There was bad roof in E and G.

At survey station #38, 50 feet inby first line of crosscuts on first left, a full band sample was taken in A, B, D and F. Partial sample (ribs and floor) was taken in C. There was bad roof in E and G.

At survey station #38X, second line of crosscuts inby mouth of first left, a full band sample was taken at A, B and C. There was bad top in D, E, F and G.

All the samples were boxed up and taken to MSHA office at Wise. From Wise they were sent to MSHA's lab at Mount Hope, West Virginia to be analyzed.

APPENDIX VI

EQUIPMENT TESTING AND EXAMINATIONS

EQUIPMENT TESTING AND EXAMINATION

During the investigation, several pieces of equipment were visually examined for defects or exposure to flames and forces. Many items such as cap lamps, flame safety lamp, gas calibration tank, and paging telephone, were sent to MSHA's Approval and Certification Center for testing and examination. Also, sample pieces of strand and particulate matter taken from the pump motor on the 488 scoop were sent to the Bureau of Mines' Research Center for analysis.

- I. The Approval and Certification Center (A&CC) conducted an investigation of equipment recovered from the mine explosion at the Southmountain Coal Company's No. 3 Mine on December 7, 1992. The investigation included:
 - A. Inspections, tests, and evaluations to identify any potential spark or ignition sources capable of igniting an explosive methane-air atmosphere,
 - B. performance tests, and
 - C. MSHA approval conformance evaluations.

Cap Lamps

The investigation of the eight Koehler cap lamps determined that defects noted during inspection were attributable to use, improper maintenance or the explosion. In addition, no manufacturing discrepancies from the approved design were identified. The cap lamps were judged not capable of igniting an explosive methane-air atmosphere based on testing of the most severe available sparking and thermal ignition hazards.

Flame Safety Lamp

The investigation of the Koehler flame safety lamp determined that it was assembled properly and that no defects were identified in any of its components or assembly that could affect its performance.

Gas Calibration Tank

The investigation of the National Service Center methane gas calibration tank determined that the volumetric methane-in-air concentration was within accepted accuracy limits and could be used to calibrate the methane monitor.

Methane Monitor

The investigation of the methane monitor determined that defects noted during inspection and testing were attributable to use, improper maintenance or the explosion. The only manufacturing discrepancy from the approved design was the omission of the extension identification of the MSHA certification number on the certification plate. The methane monitor was not maintained as approved due to the use of a rag in place of the sintered metal screen filter in the dust guard. The methane monitor was not properly calibrated, as received. If this condition existed at the time of the explosion, the methane monitor would not have been able to accurately detect the presence of methane.

The request for investigation of the methane monitor included performance testing to determine:

1. The operation of the methane monitor using the rag in the dust guard, as received;
2. the operation of the methane monitor using the sintered metal screen in the dust guard with the calibration, as received; and
3. the effect of water on the response when either the rag or metal screen was used in the dust guard.

During the initial testing performed for this investigation, the methane monitor display indicated a higher gas concentration than that of the test gas when either the dry rag or dry metal screen was used in the dust guard. The use of the metal screen resulted in higher displays than when using the rag, for each test gas concentration.

The initial testing to ascertain the effect of water on the response of the methane monitor revealed that water saturation had a significant effect on the response when either the rag or metal screen was used. Therefore, additional testing procedures were developed to assess the effect of varying degrees of dampness on the response of the methane monitor using either the rag or metal screen in the dust guard. As a preliminary step, a small chamber and a hand-operated spray bottle were used. The spray was applied from three directions:

1. Directly on the face (rag or screen) of the sensor,
2. perpendicular to the face of the sensor, and
3. from above and behind the sensor.

The preliminary testing in the small chamber with the hand-operated spray bottle demonstrated that each of the following affected the change in response to a test gas concentration from time responses obtained in the initial testing (i.e., dry rag/dry screen): (1) The direction from which the water spray was applied, (2) the number of water sprays applied, and, (3) whether the rag or metal screen was used in the dust guard. However, these tests did not accurately reflect the actual in-mine conditions.

To simulate the water spray conditions that may be encountered on a mining machine, tests were developed using a larger test gallery with a conical spray. In these tests, the gallery and methane monitor were allowed to stabilize at approximately 4% methane-in-air prior to the start of each test. The water spray was initiated at the beginning of each test. The methane monitor response was compared with a gas sample monitored in the proximity of the methane monitor sensor. Tests were performed with the sensor in various recessed and exposed positions and with the water spray nozzle in various locations. These tests were conducted with a continuous spray for the duration of the test as well as with a water spray on-off cycle to approximate the operating cycle in the working face of a coal mine. Tests were conducted with

durations up to 420 minutes, using both the rag and sintered metal screen.

Following some tests, the dust guard was allowed to set overnight in either the sealed, humid gallery or in ambient conditions. The methane monitor's response to a test gas was then verified the next morning.

In tests conducted, the performance of the methane monitor was shown to be adversely affected by the presence of water on either the rag or sintered metal screen in the sensor. When either the rag or sintered metal screen was wetted with water, the response time increased and the display decreased for a specific test gas concentration. In this investigation, the rag in the dust guard was observed to be more susceptible to the effects of water and the effects were more severe than the sintered metal screen in the dust guard. Once wet, the rag did not recover (dry out) as quickly as the sintered metal screen. The effect of intermittent spraying had a cumulative wetting effect on the rag that was not observed on the screen in the dust guard. The orientation of the water sprays used in the tests had a significant effect on the wetting of the sensor and, therefore, the methane monitor's performance. The adverse affect was proportional to how quickly the face of the sensor was wetted. However, the testing results demonstrated that the sensors of methane monitors can operate in the proximity of water sprays without an adverse affect, under certain conditions.

The degree to which the rag in the sensor would have become wet in use could not be verified in this investigation. All sources of water, such as splashing, sprays, wash-down hoses and moisture in the air that could have wet the rag when installed on the mining machine could not be duplicated. However, it was concluded that the performance of the methane monitor would have been adversely affected by the wetting of the rag in the sensor.

It was also concluded that the adverse effect of the wetting of the rag could become severe enough that the methane monitor would not provide an indication of the presence of methane when the gas was present. If the presence of methane were not indicated, the warning indications and machine shutdown activation features would not operate although they performed as designed and approved in the tests of the methane monitor. The tests verified that the rag could be wetted sufficiently to prevent these functions from performing.

Paging Telephone

The investigation of the Pyott-Boone paging telephone determined that the defects noted during the inspection were attributable to use, improper maintenance, or the explosion. The paging telephone was not intended to be, nor represented as, an MSHA-approved design. Although documentation specific to the subject paging telephone was not available to verify the existence of any manufacturing discrepancies, the design conformed to approval documentation on file at the A&CC for a similar, MSHA-approved paging telephone. No manufacturing discrepancies in common design areas were noted for the subject paging telephone when compared to documentation on file.

A final determination could not be made for the possibility of arcing and sparking at the paging line binding posts. These binding posts are the connecting point for the wires that carry the paging and communication signals to and from the paging telephone. The binding posts and wiring could not be inspected for evidence of arcing and sparking because they were no longer attached to the paging telephone. No evidence of arcing and sparking was noted in the area around the openings for the binding posts. Therefore, it was concluded that arcing and sparking capable of igniting an explosive methane-air atmosphere probably did not occur at the paging line binding posts. No conclusion could be made concerning ignition sources in the wiring and circuitry external to the paging telephone.

Two elements of the design of the paging telephone differed from the MSHA-approved design that had the potential to ignite an explosive methane-air mixture: A loudspeaker and an incandescent indicator light. Based on this potential, spark ignition tests were performed on the loudspeaker and thermal ignition tests (surface temperature and bulb-crush) were performed on the light bulb. These tests determined that the loudspeaker was not capable of igniting an explosive methane-air atmosphere. However, tests on the light bulb determined it does present a thermal ignition hazard capable of igniting an explosive methane-air atmosphere if broken while illuminated.

It was concluded that no explosion was initiated in this device.

For additional information, contact MSHA's Approval and Certification Center in Triadelphia, West Virginia.

- II. The Bureau of Mines' Research Center conducted an analysis of the material removed during the investigation from the 488 scoop pump motor. The research center reported the following information:

A sample of pieces of strand and particulate matter taken from the pump motor enclosure on #488 scoop in Southmountain coal mine No. 3, was received on March 2, 1993 for microscopic and x-ray analysis using PRC's scanning electron microscope (SEM). In addition, pieces of coal from this mine were supplied by MSHA. Some of the latter material was crushed in a mortar, and SEM photomicrographs and x-ray spectra were taken after mounting the particles on an aluminum disk and coating the specimen with a thin conductive film of a gold/palladium alloy. The enclosed photomicrographs of such "virgin" coal particles taken at 100 to 1000 X magnification (figure 1) show many smooth faced chunky particles with fracture marks. Another such particle is shown at 3500 X magnification together with an x-ray spectrum taken from a small area (marked by a + on the photomicrograph) near its edge (figure 2).

Strong to moderate carbon (C) and sulfur (S) peaks, and a weak to moderate oxygen (O) peak are evident, in addition to the strong aluminum (Al) peak from the aluminum disk substrate, and the gold (Au) and palladium (Pd) peaks from the conductive coating. All the "virgin" coal particles that were examined showed a weak to moderate sulfur peak. When such particles were placed on an aluminum disk whose underside was heated briefly by a match to a temperature of less than 400 degrees C, no significant surface change in appearance or x-ray spectra was noted. The presence of Southmountain coal particles not heated above 400 degrees C is therefore indicated by the presence of a strong carbon peak, a weak to moderate sulfur peak, and weak to moderate "mineral" peaks in their x-ray spectra, together with the presence of sharp edges and relatively smooth faces.

On this basis, the examination of some 50 particles from the sample taken from inside the pump motor enclosure, revealed only 1 or 2 that could be identified as intact coal particles. On the other hand, coal particles subjected to flame and explosion temperatures show blow holes and a porous or hollow structure, as shown in the enclosed photomicrograph and x-ray spectrum of Pittsburgh seam coal particles that were subjected to a moderate explosion in the presence of rock dust (figure 3). No such explosion residue was evident in the particles and agglomerates that were examined. The individual particles in the Southmountain mine sample, as exemplified by the enclosed photomicrographs (figure 4), were either low-sulfur organic, copper, or other inorganic material.

The strands taken from inside the pump motor enclosure offer key additional information on the thermal history of the sample. The strands consist of braided substrands of clear monofilaments of about 24 m diameter. The filaments are organic, as evidenced by the strong C peak in their x-ray spectra (figure 5). They, furthermore, flared up and shriveled to a ball when contacted by a flame, and partially melted when heated briefly by a match to less than 400 degrees C, as above

APPENDIX VI
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

(figure 6). No sign of similar exposure to 400 degrees C temperatures is evident in photomicrographs of the as-received strand sample. There is also evidence of the deposition of copper particles throughout the sample.

In summary, we do not see any indication of high temperature involvement of the strand sample. The strands consist of thermoplastic organic filaments which would melt if contacted by a flame for any significant time period. The presence of coal particles is a rarity in the sample, but copper particles are widely distributed.

For additional information, contact the Bureau of Mines, Pittsburgh Research Center, in Pittsburgh, Pennsylvania.

APPENDIX VII

ELECTRICAL EQUIPMENT

ELECTRICAL EQUIPMENT

I. OVERVIEW

During the investigation, all electrical equipment and cables located on the surface and underground were carefully examined by DMME and MSHA electrical personnel for any evidence that the equipment or cables provided the ignition source for the explosion.

The mine was provided with three-phase power purchased from Old Dominion Power Company at 69,000 volts. The power was reduced from 69,000 volts to 12,470 volts at a substation located beside the railroad tracks at the bottom of the hill.

The substation at the bottom of the hill contained a bank of three 1,000 kilovoltampere (KVA) transformers connected delta-wye. This supplied three-phase 12,470 volts to a Pemco self-contained substation which was located at the surface of the #3 mine.

The substation circuit breaker was equipped with relays to provide overload, short-circuit, grounded-phase and undervoltage protection.

The substation was equipped with an automatic reclosure that reclosed twice on instantaneous trips and once on overload.

Power was transmitted by overhead lines for approximately one mile to a surface substation at the mine site.

The mine substation was a self-contained model 1000S, serial number 730, manufactured by Line Power, Bristol, Virginia.

The substation contained a 1,000 KVA transformer connected delta-wye which supplied three-phase 4,160 volts for underground and 480 volts for surface power.

The primary and secondary of this transformer were provided with fused disconnects to allow the visible disconnecting of each underground phase conductor.

The secondary neutral was properly grounded through a 15 ampere current limiting resistor and a mine safety field bed ground to ground metallic frames and enclosures of electrical equipment receiving power

APPENDIX VII
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

from the circuit. The established mine safety field bed provided 2.5 ohms of resistance when checked with a Null Balance Earth Tester.

The input cable was an Anaconda 2/0 AWG 15 kilovolt (KV) Type SGGC. The output cable was a #2 AWG 8 KV Type SGGC.

The General Electric 600 amp HC5 oil circuit breaker, serial number 61582288G211-77, located in the substation, was equipped with General Electric relays designed to provide overload, short-circuit, grounded-phase, and undervoltage protection for the underground high voltage system.

Overload and short-circuit protection was provided by General Electric Time Overcurrent model 121AC53B806A, 50/51 relays. These relays monitored phases one and three of the three-phase system.

The inverse time range was 2-16 seconds. The time dial was set on three.

The instantaneous range was from 10 to 80 amps, set on 22 amps. The actual pick-up current when tested was 660 amps.

The relays were set on tap 6. With a current transformer ratio of 30:1, this provided 180 amps of overcurrent protection. When tested with a multi-amp tester, the actual primary pick-up current was 210 amps for phase one and 195 amps for phase three.

The ground fault relay was a General Electric 50/51G model 121AV5102A, 115 volts. The pick-up range was 10 to 40 volts. The actual pick-up when tested was 10 volts.

Undervoltage and phase loss protection was provided by a General Electric Phase Relay model 121CR53A1A, 120 volt three phase. The adjustment was from 90 to 120 volts.

Ground monitoring was provided by a General Electric Instantaneous Current Relay model 12PJC11AV3A. The operating range was from 2 to 8 amps and set at 3.2 amps.

Note: Flags were not showing on any of the relays.

A 12,470 volt branch circuit was provided in the substation to provide power to the 225 KVA 12,470/480 volt transformer. This transformer was used to provide power to the surface facilities.

APPENDIX VII
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

The transformer was connected delta to delta and protected on the primary by 25 amp, 15.5 KV high voltage fuses, with an interrupting current of 50,000 amps.

Three-phase 480 volt AC power from this transformer provided power for the following equipment located on the surface.

- The shop was powered from a 225 amp 480 volt breaker, serial number 73CB, using a 2/0 600 volt THHN Quadraplex power cable. The shop was destroyed by the explosion.

- The #1 belt drive located on the surface was powered from a 225 amp circuit breaker, serial number 730C. The 75 horsepower Westinghouse motor was controlled by a size 4 Westinghouse line starter. Slip and sequence circuits were provided by a Pyott Boone model 405A, serial number 803, slip and sequence controller. This unit operated from 110-220 volts AC. The power cable supplying power to the motor was a number 2 AWG 8 KV cable.

- The stacker belt located on the surface was protected with a 100 amp circuit breaker. The 50 HP 230/460 volt Lincoln motor was controlled by a size 4 Westinghouse line starter. Thermal overload protection was provided by FH83 heater strips. Slip and sequence circuits were provided by a Pyott Boone model 405A, serial number 2369, slip and sequence controller. This unit operated from 110-220 volts AC. The power cable supplying drive motor was a #2 AWG Anaconda Type G.

- The 75 HP 480 volt ventilation fan was protected with a 150 amp Westinghouse breaker with a trip range of 750-1500 amps. The trip range was set on 2. The motor was controlled by a CA1-60 Sprecher Schuch line starter. Overload protection was provided by FH88 heater strips. The power cable was damaged beyond repair during the explosion. On December 17, 1992 a new cable was installed

from the breaker to the control panel. The new cable was a #1 AWG Quadraplex cable.

There were numerous damaged areas along the length of the high voltage cable. These damages were a result of the explosion.

The following equipment and cables were located underground.

A. High Voltage Cables

- Approximately 4,150 feet of #2 AWG, 8 KV three conductor, Cablec brand high voltage cable.
- Approximately 300 feet of #2 AWG, 8 KV three conductor, Essex brand high voltage cable.
- Approximately 2,050 feet of #2 AWG, 8 KV three conductor, Carol brand high voltage cable.
- Approximately 1,050 feet of #2 AWG, 15 KV three conductor, Anaconda brand high voltage cable.
- Approximately 850 feet of #2 AWG, 15 KV three conductor, Anaconda brand high voltage cable.

B. Low Voltage Cables

- Approximately 200 feet of #4 AWG, 2 KV three conductor, Larribee brand cable which supplied power to a mantrip battery charger.
- Approximately 150 feet of #4/0 AWG, 2 KV three conductor, Tiger brand cable which supplied power to the #2 belt drive/starter.

APPENDIX VII
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

- Approximately 125 feet of #4/0 AWG, 2000 V three conductor, Larrabee brand cable which supplied power to the #3 belt drive/starter.
 - Approximately 125 feet of #4/0 AWG, 2 KV three conductor, Anaconda brand cable which supplied power to the #4 belt drive/starter.
- C. Three belt drive transformers.
- Pemco Silpak model K300, serial number 8810-678.
 - 150 KVA Acutran transformer.
 - Line Power Mfg. model 225, serial number 6049.
- D. Seven sets of visible disconnects, Westinghouse and Cooper power systems, were located along the high voltage to provide HV disconnect access.
- E. Battery Powered Equipment:
- One S&S scoop, model BMUAT86, serial number 86BC2-298.
 - One S&S scoop, model 488, serial number 488-1737.
 - One Eimco Rail Express personnel carrier, serial number 70110039.
 - One West Virginia Armature personnel carrier, serial number 200-0519.
- F. Section Power Center - Line Power, KVA not listed, HP 200, voltage 480 AC multi purpose, AC/DC. DC power supplies from unit were not in service. The power center was located between the coal pillars at survey stations #293 and #294. Due to failing roof conditions,

APPENDIX VII
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

it was moved to between the coal pillars outby survey station #398 for examination purposes. The power center was located approximately 200 feet outby the pillar line in the #4 entry before it was moved.

- Approximately 200 feet of #2 AWG three conductor, type GGC 2000 V, Royal powerflex cable supplied power to the model 438A, 440-550 V AC three phase active section battery charger.

- Approximately 600 feet of #2 AWG three conductor, type GGC 2000 V, Royal powerflex cable supplied power to the dual head Acme roof drill model D12-L, serial number 2554, located at the active section. The roof bolter was located at survey station #292 remote to the active pillar workings and was not in use at the time of the explosion.

- Approximately 550 feet of #4 AWG three conductor, type GGC 600-2000 V, Tiger brand cable supplied power to the model 10SC22-56AHE-1, 440 V AC Joy shuttle car, serial number ET13249, located at the active section.

- Approximately 550 feet of #4 AWG three conductor, type GGC 2000 V, Anaconda brand cable supplied power to the model 10SC22-56AXHE-1, 440 V AC Joy shuttle car, serial number ET13250, located at the active section.

- Approximately 250 feet of 2/0 AWG three conductor, type GGC 2 KV Cablec Anaconda brand cable supplied power to the 460 V AC Owens feeder located at the active section.

- Approximately 500 feet of 4/0 AWG three conductor, type GGC 2 KV Anaconda brand cable supplied power to the Jeffery 1036 continuous miner, serial number 38002, located at the active section.

APPENDIX VII
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

- G. Other cables located underground at the time of the explosion were:
- Approximately 6,500 feet of mine phone cable.
 - Approximately 6,500 feet of Pyott Boone fire detection cable.
 - Approximately 6,500 feet of #14 AWG two conductor S-0 belt control cable.
- H. Four mine phones were in service underground at the time of the explosion and were located at the #2, #3 and #4 belt head drives and at the section feeder/tailpiece.
- I. The following belt drives were located underground:
- The #2 belt drive was manufactured by Mountaineer Mine Service, Inc., Pineville, West Virginia, Model 4647, serial number 1089. The drive was located at survey station #22. The drive was powered by a 150 HP 460 volt three phase Westinghouse motor. The motor was controlled and protected by a size 5 Westinghouse line starter equipped with FH27 heater strips. The cable entrance box on the motor was broken off during the explosion. The drive was controlled by an Ensign Electric control panel, serial number 44WR5-150-27. An ECKO 205H water deluge system was installed. Slip and sequence was provided by a Pyott Boone model 405A, serial number 1147, control unit. The power cable read .1 ohm between the monitor and ground conductor. The receptacle was grounded.
 - The #3 belt drive model T21-3D, serial number S-95-1960, was manufactured by Long Airdox. The drive was located one break outby survey station #153. The drive motor was a 150 HP Reliance 460 volt motor. The power cables were pulled from the entrance glands on the motor as a result of the explosion. The belt

control panel, serial number 3046, was turned upside down during the explosion.

- The #4 belt drive was located near survey station #253. The drive was a Long Airdox model T21, serial number 35-2184. The motor power cable was pulled from the entrance gland. The control panel was turned upside down. The Line Power model 225-PC, serial number 6049, power center supplying power to the #4 belt drive had extensive damage. The covers were missing, the emergency stop switch was pushed in and the visible disconnects were in an open position.

II. EXAMINATION AND FINDINGS

A. INTRODUCTION

Southmountain No. 3 Mine received electrical power at 69,000 volts alternating current (VAC) purchased from Old Dominion Power Company. The 69,000 VAC was reduced to 12,470 VAC at a surface substation located at the bottom of the hill, approximately one mile from the mine site. The 12,470 VAC was transmitted by overhead lines to a surface substation located near the mine portals. A 1,000 kilovoltampere (KVA) transformer was used to transform the 12,470 VAC down to 4,160 VAC. The transformer was connected in a delta-wye configuration and supplied 4,160 VAC to the underground high voltage circuits and 480 VAC for the surface electrical systems. The electrical system was of the three phase type and protected by a resistance grounded system.

The surface shop, #1 conveyor belt drive, stacker conveyor belt and mine ventilation fan were powered by 480 VAC from the surface substation. The surface substation also supplied power for surface lighting and the mine office.

The underground high voltage circuit was protected by a 600 amp high voltage circuit breaker located in the surface

substation. The high voltage circuit breaker was equipped with relays designed to protect the underground circuit against short circuit, overload, grounded phase and undervoltage. The high voltage breaker was also equipped with a ground check monitor designed to ensure the continuity of the ground wire. The high voltage circuit contained a set of visual disconnects.

The 4,160 VAC was transmitted underground using shielded 3 conductor high voltage cable. The high voltage cable extended from the surface to seven sets of open type visual disconnects. The visible disconnects were located along the high voltage system which allowed distribution to each of the three conveyor belt power centers and the section power center. The high voltage cable was installed in the #4 entry and was lying on the mine floor against the coal rib. The high voltage cable was #2 American wire gauge (AWG) with insulating ratings of ,8000 volts and 15,000 volts.

The underground 4,160 VAC circuit supplied power to three conveyor belt power centers and a section power center. The power centers reduced the voltage down to 480 for the belt conveyor drive motors and various low and medium voltages for the section equipment.

The conveyor belt power centers varied in size from 150 kilovoltamperes (KVA) to 300 KVA. The belt conveyor power centers were not designed to be permissible and provided a feed-through for the high voltage circuit. The power center provided 480 VAC circuits which were protected with circuit breakers that had circuits designed to protect against short circuit, overload, grounded phase and undervoltage. The 480 VAC circuits also had ground monitoring circuits. The conveyor belt drives had 460 VAC, 150 horsepower wound rotor induction motors (WRIM). The conveyor belt drive electric controls consisted of the motor controls, belt slippage switch, belt sequence switch and fire suppression system.

The #2 conveyor belt power center was located at survey station (SS) #14 and supplied power to the #2 conveyor belt drive

APPENDIX VII
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

located at SS #22. The #3 conveyor belt power center was located two crosscuts outby SS #156 and supplied power to the #3 belt drive one crosscut outby SS #156. The #4 conveyor belt power center was located at SS #253 and supplied power to the #4 conveyor belt drive and a battery charger which was located beside the belt power center.

The One Left Panel section power center was a non-permissible 750 KVA transformer. The power center was located between SS #293 and #294. The section power center provided 480 VAC for a battery charger, conveyor belt feeder, and two shuttle cars. The section power center also supplied 575 VAC for the continuous mining machine. The circuit breakers protecting the section equipment were equipped with circuits designed to protect against short circuit, overcurrent, grounded phase and undervoltage. The 480 and 575 VAC circuits were protected with ground monitoring circuits.

Southmountain Mine No. 3 used permissible alternating current electrical and direct current battery powered equipment on the section to mine and transport coal and to supply, clean and maintain the section. Electrical equipment used in gassy mines in areas other than intake air shall be permissible equipment approved by the United States Bureau of Mines; Ref. 45.1-83(a). Permissible equipment used in gassy mines shall be maintained in permissible condition. The approved permissible equipment consisted of:

- 1-Jeffrey Manufacturing Continuous Mining Machine Model #1036
- 1-Joy Manufacturing Shuttle Car Model #10SC22-56AHE-1
- 1-Joy Manufacturing Shuttle Car Model #10SC22-56AHE-1
- 1-Acme Machinery Dual Head Roof Bolter Model #D12L
- 1-Simmons-Rand S&S Scoop Model #BMUAT 86
- 1-Simmons-Rand S&S Scoop Model #488

The section also had non-permissible electrical equipment. The non-permissible electrical equipment located on or near the section consisted of:

1-Owens Manufacturing Conveyor Belt Feeder Type FPHH 34140
1-Simmons-Rand S&S Battery Charger Model #438A
1-West Virginia Armature Rail Runner Type #6JSMUXYK36

B. EQUIPMENT LOCATION (see Appendix IV - map)

C. EXAMINATION

Two representatives from the Department of Mines, Minerals, and Energy, three representatives from the Mine Safety and Health Administration, and two company representatives for Southmountain Coal Company, Inc., Mine No. 3, examined the electrical system of the Southmountain No. 3 Mine. The representatives were divided into two teams hereafter referred to as Team A and Team B. The examination included all surface and underground electrical equipment circuit breakers and cables. At areas where evidence of heat or flame was present, the electrical equipment was thoroughly examined for possible ignition sources and permissible condition.

December 18, 1992

Teams A and B

Surface Substation

Both teams arrived at the mine site at 6:00 a.m. After organizing, the teams began the investigation at 8:00 a.m. The surface substation and the substation at the bottom of the hill were visually checked and diagrammed; this information was recorded. The underground high voltage circuit breaker was checked to see if it had tripped under a ground-fault condition. Flags did not indicate a problem existed prior to the power tripping at the bottom of the hill. Two instantaneous trip flags were visible on the high voltage circuit breaker at the bottom of the hill.

December 19, 1992

Team A

Belt Entry

At 8:00 a.m. the electrical investigation Team A traveled underground via the belt entry. The track ran parallel with the belt line. The belt and structure were destroyed. The belt control cable and fire sensor line were intact and hung on insulators. Observation revealed that the insulation on the fire sensor cable was melted. Bare conductors were not observed. At crosscut #3 the fire sensor cable was pulled apart.

#2 Belt Power Center

The transformer for the #2 belt drive was located at crosscut #4, survey station #14. A visual inspection of the transformer was made. The breakers were in the tripped position. Extensive damage to the transformer was not observed.

The receptacle to the belt drive was unplugged and the cable was checked with a Simpson 260 volt meter. A ground-fault condition was not present.

A reading taken between the ground conductor and the male receptacle indicated that continuity was good. A reading of 0.1 ohm was obtained between the monitor and the ground conductor of the belt drive cable. This indicated that both conductors were continuous throughout the cable.

The lids were removed from the transformer and evidence of arcs or sparking inside the transformer was not present. The grounding resistors read 22 ohms on a scale of Rx1 with a Simpson 260 meter.

Team A progressed to survey station #22 to the #2 belt drive. Information such as type, model, serial number and horsepower was recorded.

The cable entrance box on the slip-ring end of the belt drive motor was broken off. Evidence of arcing was not present. The belt drive and structure were still intact. A properly charged

fire extinguisher was provided. Grounds and monitor circuits were checked. The belt drive was properly grounded.

The control panel was opened and visually checked. Proper over-current protection was provided. The fuses and breaker were not bridged out and evidence of arcing or sparking inside the control panel was not present.

The telephone was not found. The water deluge system and the belt control system were still intact.

The team progressed up the belt and track entry observing the cables and structure for evidence of a possible ignition source. Evidence of arcing or sparking was not observed.

At survey station #87 the belt control cable was pulled apart. Both ends of the cable were inspected. Evidence of arcing or sparking was not observed.

Damage to the fire sensor cable was noted at break #14. At break #16, heat damage to the outer jacket of the fire sensor cable was noted. At break #17, the fire sensor cable was pulled apart. At break #18, the phone line and belt control cable were pulled apart. All belt structure and cables were severely damaged from break #18 to survey station #123.

Tests were made along the belt/track entry at regular intervals for oxygen and methane content. The findings were 21% oxygen and 0% methane.

#3 Belt Power Center

The electrical team arrived at the #3 belt drive located one break outby survey station #153 and began to inspect this area. The drive was visually inspected for type, model, serial number and horsepower. This information was recorded.

The belt drive and structure were severely damaged. The belt control panel was upside down on the track. The belt control panel was visually examined, and signs of arcing were not observed.

The motor leads were pulled 12 inches from the entrance gland. Evidence of arcing on the cables was not present. The damage was too severe to check the slip and sequence switches.

The water line and deluge system were damaged. The #3 belt drive telephone was not found.

The power center for #3 belt drive did not have a name plate. All breakers were in the center trip position. The high voltage visual disconnects were closed.

The belt drive cable was checked for a ground-fault condition. A ground fault condition did not exist. The male receptacle was properly grounded.

The lids to the transformer were removed. Evidence of arcing was not present. The grounding resistors read 22 ohms.

Tests for methane and oxygen were taken using a model MX240 detector. The methane level was 0%. The oxygen content was 21.5%.

#4 Belt Power Center

The team traveled to the #4 belt drive transformer near survey station #253. Extensive damage was present at the #4 transformer. Three of the top covers were missing. The visible disconnects were in the open position. Evidence of arcing on the disconnect knife blades was not present. The emergency stop switch was engaged.

The components inside the transformer were covered with dust. Evidence of arcing was not present.

The emergency stop switch was checked with an ohm meter. It read open in both positions. The emergency stop switch was visually examined. Evidence of arcing was not present.

The 225 amp breaker for the #4 belt drive was in the center trip position. The team visually examined the control panel, and evidence of arcing or flames was not present.

The drive was visually checked for model, type, serial number and horsepower. This information was recorded.

The motor lead entrance gland box was destroyed. The motor leads were pulled from the box. Evidence of arcing was not present.

A battery charger was located in the same crosscut as the belt transformer. The investigation revealed that the volt meter was torn apart and the amp meter was stuck on 25 amps. The battery charger breaker was tripped in the "neutral" position.

The cable was checked with an ohm meter. A ground-fault condition did not exist. The cable was properly ground monitored.

Team A left the #4 drive at 3:15 p.m. and traveled to break #81. A water deluge box was found at break #80. Cables were not attached and evidence of arcing was not present.

The team traveled from break #81 to the surface via the intake entry.

Team B

High Voltage Cable

The electrical investigation Team B traveled underground in the #4 neutral entry examining the high voltage cable circuit. The cable entered the mine through the fan portal and continued to a set of disconnects at survey station #12. The disconnects were in good condition. The area was guarded and a high voltage sign was in place. The cable entered and exited at the #2 belt transformer at survey station #14. A fire extinguisher was in place at the transformer.

From the #2 belt transformer, the high voltage cable was connected to disconnects two crosscuts in by survey station #62. The disconnects at survey station #62 were guarded and a high voltage sign was in place. The disconnects were in good condition. The high voltage cable continued to another set of disconnects at survey station #108. The guarded area was destroyed, but the disconnects were in good condition. The high voltage cable continued to the #3 belt transformer, and then to disconnects located at survey station #176. The guarded area and

disconnects at survey station #176 were damaged. The high voltage cable entered and exited disconnects at one crosscut outby survey station #218 and survey station #231. Both sets were destroyed and blown toward the #5 entry. The high voltage cable entered and exited the #4 belt transformer located at survey station #256. The lids were blown off the top and side of the transformer. The high voltage cable continued from the #4 belt transformer to a set of disconnects one crosscut outby survey station #283. The guarded area was destroyed and disconnects were blown toward the #5 entry. From the disconnects one crosscut outby survey station #283, the high voltage cable continued inby to the section power center.

The high voltage cable was damaged at numerous locations from the first set of disconnects to the last set of disconnects. Most damage was present from survey station #108 to survey station #283. Evidence of arcing was not present at any damaged area of the cable, disconnects or transformer connections. The roof conditions along the #4 entry were stable; some rib rolling had occurred on the cable. The cable was examined in its entire length by removing it from underneath the rock and other concealed locations. Coal dust was present the entire length of the #4 entry. Coal dust was heaped up in some locations from survey station #108 to survey station #283.

December 20, 1992

Team A

Battery Powered 488 Scoop

Electrical Team A arrived at the mine site at 7:00 a.m. The team grouped together, planned their strategy and continued the investigation at the scoop. The investigation revealed one S&S scoop, model 488, serial number 488-1737, was located in the crosscut between #1 and #2 entries, left of survey station #378 on the One Left Panel.

APPENDIX VII
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

Air quality checks were taken. The oxygen was 21% and methane 0%.

The investigation began by visually evaluating the scoop. Pertinent information such as make, model and serial number was recorded.

The main circuit breaker was in the tripped position. The pump motor and light switches were in the "off" position. The batteries were unplugged. The covers for the battery compartments were not secured with fasteners.

The control deck panel flame arresting path was checked with a .004 inch filler gauge. The opening was in compliance. Three packing glands and one entrance gland plug on the deck control panel were not secured against loosening. The panel cover was removed. Evidence was not present of any arcing or of any flame exit around the flame arresting paths. The wiring associated with the panel was in good condition. There was slight corrosion on the flame path. The control fuses were good. The lighting circuit had 30 amp fuses where 10 amp fuses were approved.

The motor control panel was checked with a .004 filler gauge. An opening could not be detected. All bolts and lockwashers were in place. The bolts were removed. The bolts were not uniform in length. Evidence of arcing or heat was not present inside the panel. Evidence was not present of an exit of flame around the flame arresting path. All hydraulic controls were in the "neutral" position.

The rear headlight conduit was damaged in the center section. The light electrical conductors had a splice in the leads going to the battery end of the scoop. The splice was made without proper connectors. The conduit protecting the light electrical conductors was damaged, but the conductors were not damaged.

The permissible enclosure for the circuit breaker was checked for permissibility and found to be in compliance. The panel cover was removed and checked for arcing. The bolts in the circuit breaker panel were not uniform in length. Arcing was not found.

The batteries and battery plugs were inspected and found in good condition.

The permissible pump motor had three bolts missing on the pump inspection cover. Material found inside the compartment was examined for heat exposure. The material was sent to MSHA laboratories for analysis.

The Reliance 40 HP tram motor enclosure on the scoop was examined and found to be in compliance.

Although deficiencies existed, evidence of flames, forces or electrical arcing was not present.

Power Center

At 10:00 a.m., the section power center was examined. The breakers were in a tripped position. The power center was moved due to adverse roof conditions.

Continuous Mining Machine

The continuous miner was examined. The investigation revealed the Jeffrey continuous mining machine, serial number 38002, was located in the #3 entry inby survey station #376 on the One Left Panel. The continuous miner was in position to complete the loading of the off-standard shuttle car.

The control switches were self-centering. Due to the design of the control switches, it could not be determined if the miner was running at the time of the explosion. Due to adverse roof conditions, the left side of the continuous miner could not be checked until additional support was added.

The methane monitor was inspected. A piece of cloth was found in the end of the methane sensor. The methane sensor was checked with an ohm meter and found in good condition. The methane monitor was removed and taken to the surface for further testing.

Team B

86 Scoop

The S&S scoop, serial number 86BC2-298, was moved to one crosscut inby survey station #298 due to adverse roof conditions. The investigation revealed one S&S scoop, model BMUAT86, serial number 86BC2-298, and S&S scoop charger, serial number 51267115, were located in the crosscut right of survey station #293 on the One Left Panel. Before the scoop was moved, the position of switches and the circuit breaker was examined. The panic switch was "off" and the circuit breaker was tripped. The headlight switch was in the "off" position and the disconnect switch was in the "on" position. When the machine was started it did not move until the operator pushed the tram control pedal. The deck control permissible enclosure did not have any openings in excess of .004 inch. The hydraulic controls in the operator's deck were in the centered position.

Three of the battery lids were missing. These were located and replaced on the batteries.

An opening in excess of .004 inch was present in the circuit breaker permissible enclosure. The cover was removed from the circuit breaker enclosure. Indication of arcing or soot inside the enclosure was not observed. The excessive opening was repaired.

An opening in excess of .004 inch was present on the permissible main controller. The cover was removed. Indication of arcing or soot inside the enclosure was not present. Cables and conduits were in good condition. The tram and pump motors were in good condition. The lights, panic switch and brakes were in operating condition.

Although deficiencies existed, evidence of flames, forces or electrical arcing involving the electrical circuits was not present.

December 20 and 21, 1992

Team B

Battery Charger

The S&S machinery battery charger, serial number 51267115, was moved from the left crosscut at survey station #303 to survey station #292 for examination. The roof conditions in the area of survey station #303 were deteriorating. Signs of arcing in the charger or at the charger battery plugs were not observed. The cable plugs were grounded and frame ground clips were present. The charger had coal dust inside the housing. Some debris was packed against the screen on the end of the charger located on the return side of the One Left Panel. The dust was blown into the charger. Some coking was present on the control leads inside the charger housing.

December 21, 1992

Team A

Team A arrived at the mine site at 7:00 a.m. and went underground to continue the investigation.

The S&S 488 scoop logic box was inoperative. The S&S 488 scoop was repaired and moved. The shuttle car behind the miner was moved.

Continuous Mining Machine

Cribs were set on the left side of the continuous mining machine to allow the team to complete examinations.

The permissible circuit breaker and operator's deck enclosures were checked with a .004 inch filler gauge and found to be in compliance.

The left side traction motor's permissible packing gland was not secured against loosening. Power leads were connected directly to the tram motor leads and the miner was trammed back by using scoop batteries and 225 amp breakers.

All of the panels were checked with a .004 inch filler gauge. The permissible main control enclosure was secured with bolts of different lengths. However, the panel cover was secured to .004 inch. The covers were removed and the flame arresting path was checked for a flame exit. Evidence of flame exiting or of arcing or heat inside the enclosures was not observed.

The #16 AWG, five conductor cable supplying power to the methane monitor was checked with a Blasters multimeter. The cable was in good condition.

The covers were removed from the miner. Evidence of fire under the lids was not present. Loose coal, coal dust and grease were accumulated on the continuous mining machine.

The permissible electric motors were checked and found to be in compliance.

The trailing cable was checked for damage and ground-fault condition. The trailing cable was clear and in good condition.

Although deficiencies existed, evidence of flames, forces or electrical arcing was not present.

Off-Standard Shuttle Car

The off-standard shuttle car was inspected for permissible conditions. The investigation revealed that Joy off-standard shuttle car, serial number ET13250, was located in the #3 entry inby survey station #376 on the One Left Panel. The off-standard shuttle car was directly behind the continuous mining machine in position for loading. The shuttle car was in compliance.

The panel boards were removed and checked for signs of arcing and sparking. Evidence was not found.

The permissible covers were removed and checked for evidence of fire. Evidence of fire was not observed.

The two shuttle car cables were checked for ground-fault condition. The two shuttle car cables were clear.

Team B

Roofbolter

A dual-head Acme roof drill, serial number 2554, was located in the crosscut between survey stations #291 and #292. The drill was located remote to active coal production at the pillar line and indications were that it was idle. The complete roof drill power cable was coiled up beside the machine.

One Left Panel Power Center

The investigation revealed the 750 KVA Line Power section power center was located in the #4 entry between survey stations #293 and #294 on the One Left Panel. The section power center was moved outby survey station #398 due to deteriorated roof conditions in the area of the power center. All lids were in place on the power center, all circuit breakers were tripped and coal dust was present on the top, sides and ends. The direct current side of the power center was not in use and was disconnected from the transformer inside the power center. One circuit breaker would re-set under open pilot conditions. At a later date, the circuit breaker was removed for further examination. The tape labels over the power center circuit breakers, which resembled furnace tape, were scorched and partially melted. The top lids were removed from the power center. Coal dust ranging from one to four inches was present in the high voltage switch gear and fuse end. The side cover where the high voltage fuses were located was damaged and indications were that the coal dust was blown into the side and end of the power center. The plexiglass viewing window was forced inward. Coal dust was present in the remainder of the power center, but was not heaped. All ground-monitor and over-current relays were visually examined. Indications of arcing or burning inside the power center were not observed.

Standard Shuttle Car

The investigation revealed that Joy standard shuttle car, serial number ET13249, was located one crosscut inby survey station #295 between the #2 and #3 entries of the West Mains. The shuttle car was directly behind the Owens coal feeder in position of unloading. The shuttle car had a thin coating of coal dust on the frame, deck and motors. The panic switch was in the run position, the foot switch controls were centered, and the brake was set according to gauges. An opening in excess of .004 inch was present in the left, opposite the operator side, traction motor junction cover plate. Indications of arcing or soot inside the motor were not present.

The permissible control enclosure cover provided for the standard shuttle car was secured by one different length bolt without lockwashers. The bolt was installed in the fourth bolt hole from the bottom left corner. However, an opening in excess of .004 inch was not present in the enclosure cover.

Although deficiencies existed, evidence of flames, forces or electrical arcing involving the electrical circuits was not present.

Conveyor Belt Feeder

The investigation revealed that an Owens coal feeder, serial number S2543, was located one crosscut inby survey station #295 between #2 and #3 entries of the West Mains. The coal feeder was placed on the #2 entry side of the section belt conveyor tailpiece. Both toggle switches were in the "run" position. The feeder was partially filled with coal. Coal dust was present on and inside the starter and control panels. Indications of arcing or soot inside the panels were not present.

December 22, 1992

Surface Substation

Both A and B Teams participated in the examination of the surface substation.

The mine safety field bed ground was tested with a Biddle Earth tester. The field bed ground measured 2.5 ohms resistance.

The grounding resistors were checked with an ohm meter. The grounding resistor was continuous and read 166 ohms.

The over-current and ground-fault relays were tested by passing a current through them with a multi-amp tester. The relays operated properly.

Information gathered during these tests was recorded.

488 Scoop

One MSHA and one DMME representative examined the pump motor on 488 scoop, serial number 488-1737. The motor was permissible and arcing or soot was not present inside the motor.

January 5, 1993

The number three from the left circuit breaker was removed from the section power center and brought to the surface. The trip mechanism was inoperative. Coal dust was packed inside the linkage. The linkage was cleaned. The trip mechanism worked properly. The ground-fault and monitor relays were tested and found to operate properly.

APPENDIX VIII

PHYSICAL EVIDENCE AND PERSONAL EFFECTS

PHYSICAL EVIDENCE AND PERSONAL EFFECTS

I. The Collection of Physical Evidence and Personal Effects Team consisted of one DM representative and one MSHA representative. The team received record books, fan charts, and the wall map from the mine site.

A. Daily/Monthly Examination of Ventilation Equipment

DM received records of this examination dating from March 2, 1992 through December 4, 1992. Type of information recorded in this book:

- Type fan - Joy 5 ft. high pressure.
- The fan was located on the return side at the #4 portal.
- The mine was using an automatic pressure recording gauge mounted to the fan housing. The pressure recording gauge was dislodged from the fan, however, the fan chart was still intact and undamaged. DM received charts from January 27, 1992 through December 7, 1992. The fan chart was installed the week prior on Monday at approximately 10:00 a.m. The pressure remained stable at 4.2 psi until Monday at approximately 7:00 a.m.

B. Preshift, Onshift and Daily Report

Preshift, Onshift and Daily Report were all combined in one record book. DM received records of this book dating from October 4, 1990 through December 6, 1992.

- Under remarks of the preshift report, methane was recorded numerous times as "a trace". Also, the highest level of methane recorded was .3% on April 9, 1992.
- Under the violation of hazardous conditions of the onshift portion of the record book, on April 20, 1992, methane in the amount of 9.9%, found in the #2 heading, was recorded.

APPENDIX VIII
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

- Examination for methane in working places portion of the onshift reports indicates the highest level of methane recorded was .3% in the #3 heading on April 10, 1992.
- On April 5, 1992, methane in the amount of .8% in #3 heading, .3% in #1 heading, and .3% in #6 heading was recorded in the examination for methane in return aircourses portion of the onshift records.

C. Belt Conveyor Examination

DM received records dating from November 26, 1990 through December 6, 1992.

D. Fire Drill and Evacuation Record

DM received records dating from October 12, 1990 through November 20, 1992.

E. Weekly Examination of Methane and Hazardous Conditions

DM received record books dating from December 8, 1990 through November 30, 1992.

- Examination of pillar falls, seals, idle workings, abandoned areas. This portion of the record book revealed on May 14, 1992 a trace of methane was detected in the bleeder line and abandoned Mains. On November 21, 1992 a trace was entered as three tenths.

F. Examination of Emergency Escapeways and Facilities, Smokers Articles, and Fire Doors

DM received records dating from November 27, 1990 through November 30, 1992.

G. Examination of Electrical Equipment

DM received records dating from November 22, 1990 through December 3, 1992. DM also received records of the rail equipment from November 26, 1990 through December 3, 1992.

H. Monthly Examination of Surface High Voltage Circuit Breakers
DM received records dating from March 9, 1991 through November 4, 1992.

I. Wall Map

This map, which was received from the mine site, was used to show the daily progress of advance or retreat mining.

II. Collection of Evidence

December 13, 1992

The Evidence and Personal Effects Team witnessed the medical examination of the eight miners who were recovered from the Southmountain explosion.

The medical exam was performed by Dr. David W. Oxley, Deputy Chief Medical Examiner for Department of Health, Commonwealth of Virginia. He was assisted by Richard M. Delpierre, Administrative Manager, Western District. During the medical examinations, the following was observed:

-- Miners were identified by name tags. They were also identified by names on uniforms, personal effects (wallets) and visually by a Southmountain representative. All miners had personal effects that are normally found on miners. The only items received were items which were relevant to the investigation.

-- Miner #1

There was second and third degree burns of the hands.

Cause of death: Flame, smoke and hot gas inhalation, and carbon monoxide poisoning.

Items received from this miner: one mining belt, one W-65 self rescuer, and one brown memo book.

APPENDIX VIII
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

-- Miner #2

The hands and forearms showed third degree burns.

Cause of death: Smoke and flame inhalation and carbon monoxide poisoning.

Items received from this miner: one Koehler cap lamp and one mining belt.

-- Miner #3

There were second and third degree burns on both hands, upper body, and facial features.

Cause of death: Inhalation of flame and hot gas combined with second and third degree burns and carbon monoxide poisoning.

Items received from this miner: one mining belt, one Koehler cap lamp, and one small piece of paper containing unreadable writing.

-- Miner #4

The skin on the right hand showed third degree burns.

Cause of death: Inhalation of flame, smoke and hot gas, and carbon monoxide poisoning.

Items received from this miner: one mining belt, one Koehler cap lamp, one open pack of Doral cigarettes, one purple butane lighter and one cigarette butt.

-- Miner #5

There was third degree burns on the right hand. The left hand was partially protected by a glove and showed second degree burns.

Cause of death: Inhalation of flames, smoke and hot gas, and carbon monoxide poisoning.

Items received from this miner: one Koehler cap lamp, one mining belt, one W-65 self rescuer on mining belt, ten Viceroy cigarette butts, one open pack of Viceroy cigarettes.

APPENDIX VIII
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

-- Miner #6

The face showed reddish flashburn. The skin on the hands showed third degree burns.

Cause of death: Inhalation of flame, smoke, coal dust and hot gas and carbon monoxide poisoning.

Items received from this miner: one mining belt and one Koehler cap lamp.

-- Miner #7

There were third degree burns on the hands.

Cause of death: Inhalation of flame and hot gas and carbon monoxide.

Items received from this miner: one watch stopped at 4:50, one open pack of Marlboro cigarettes, one yellow butane lighter, and one mining belt.

-- Miner #8

There was a left sided temporal skull fracture.

Cause of death: Left temporal skull fracture with associated rib fractures due to the mine explosion.

Items received from this miner: one mining belt, one W-65 self rescuer, and one hammer.

These items were tagged and placed under DM and MSHA's control. The cap lamps were sent to MSHA's Approval and Certification Center for testing and analysis.

December 18, 1992

The Evidence and Personal Effects Team received one cigarette butt located in the deck of a S&S scoop, serial number 488-1737, 10 inches to the right of the accelerator pedal. The scoop was located in the left crosscut between #1 and #2 entries of the One Left Panel to the left of survey station #378.

APPENDIX VIII
MINE EXPLOSION INVESTIGATION REPORT
SOUTH MOUNTAIN COAL COMPANY, INC., MINE NO. 3

The team received two Bic butane lighters, two full packs of Doral cigarettes, and one bottle of Tylenol located in a yellow dinner bucket. The dinner bucket was located in the deck of the 488 scoop on the left side of the operator's seat.

December 19, 1992

The Evidence and Personal Effects Team received items as they were discovered. Location and description of the items received on this date are as follows:

- One small piece of paper which appeared to be part of a roof control plan, located 12 feet inby survey station #378.
- One miner's hard hat located 11 1/2 feet outby survey station #378, near the outby corner of the right crosscut.
- One Koehler cap lamp located at survey station #384. The lens on the cap lamp was broken.
- One Koehler cap lamp located in crosscut 35 feet to the right of survey station #376 on the right rib.
- One Koehler cap lamp located 15 feet inby survey station #368 in the #4 entry of One Left Panel. The head piece had been dislodged and the light cord was damaged. We could not locate the head piece.
- One Koehler flame safety lamp, located 7 1/2 feet to the right of survey station #375 in the #4 entry of the One Left Panel.
- A small piece of paper which appeared to be a part of the section map, located between #2 and #3 entries of the Mains, 22 feet to the left side of survey station #295.

The flame safety lamp and the cap lamps were sent to MSHA's Approval and Certification Center for testing.

December 20, 1992

The Evidence and Personal Effects Team received the following items:

- One hard hat located in the crosscut between #1 and #2 entries of One Left, to the left of survey station #378, beside the left front tire of the S&S scoop.
- One miner's hard hat located near the right side of the continuous mining machine ripper head.
- One cigarette butt, located 13.5 feet in by survey station #378 in #2 entry of One Left Panel.
- One cigarette lighter located 38.5 feet from survey station #378 in the crosscut between #1 and #2 entries of the One Left Panel, 5 feet and 8 inches from the left rib. This lighter was found immediately after the S&S scoop, serial number 488-1737, was moved from the crosscut. The lighter was lying on the bottom which was underneath where the right side of the scoop battery compartment was located. The outer part of the lighter's plastic covering was peeled back showing heat damage. The lighter had "C-Lite, Thailand" inscribed on it.
- One methane monitor and sensor head model 420D which was attached to the Jeffrey continuous mining machine. A rag had been placed into the dust cover where methane enters the sensor. The methane monitor was sent to MSHA's Approval and Certification Center for testing.

December 21, 1992

The Evidence and Personal Effects Team received:

- Approximately two-thirds of a hard hat with no head liner, located underneath the section coal feeder.

January 19, 1993

The Evidence and Personal Effects Team received:

- One underground phone, Pyott Boone model 113, which was found underneath the section tailpiece. The phone was sent to MSHA's Approval and Certification Center for testing.

APPENDIX VIII
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

Additional evidence and information were received apart from the on-site investigation such as:

- Division of Mines' files of Southmountain, which include license application, roof control plan, regular inspection reports, technical specialist reports, maps, fire evacuation plan, accident reports, and correspondence (seal construction, change in mine projection, etc.).
- Southmountain timesheets for the period ending December 12, 1992.
- Copies of certified person certificates who were working at Southmountain.
- Medical record of the injured person who was involved in the explosion.
- A copy of all contracts concerning the minerals and mining thereof for Southmountain.
- Copy of the section foreman's report dated November 23, 1992.
- Transcripts of the interviews which were conducted on January 12, 13, 14, 15, 19, 20, 21 and March 25 and 26 of 1993.
- Barometric pressures from December 5 through 25, 1992.
- MSHA's legal identity for Southmountain.
- MSHA's ventilation plan for Southmountain.

APPENDIX IX

DIVISION OF MINES' ACTIVITIES

DIVISION OF MINES' ACTIVITIES
Inspections, Roof Falls, Specialist Visits

OVERVIEW

The Division of Mines' activities at the Southmountain No. 3 Mine from December 12, 1991 to December 7, 1992, included twelve visits during the year. The visits included three complete regular inspections, a ventilation survey, roof evaluations, investigations of roof falls and an electrical survey.

The investigation team reviewed the activities and discussed the reports with DM representatives who made the twelve visits in 1991-92. During the first three quarters of 1992, Division of Mines Inspector completed the required inspections. A complete regular inspection was scheduled for Wednesday, December 9, 1992, for the fourth quarter.

DM's Electrical Specialist visited the No. 3 mine on September 28 and 29, 1992. This was the last visit from a Division of Mines' representative, prior to the explosion.

A review of each activity follows:

December 12, 1991

DM Roof Control Specialist visited the No. 3 mine for a roof evaluation. The operator requested assistance in formulating a full recovery roof plan. The Mains was stopped and dandered off, because of adverse roof conditions. No methane was detected during the visit.

March 13, 1992

DM Ventilation Specialist visited the No. 3 mine for a ventilation survey. The One Right Panel was advancing. No methane was detected during the ventilation survey.

March 16 to 20, 1992

DM Inspector conducted a regular inspection at the No. 3 mine. The Mine Inspector made five visits to the mine during the complete regular inspection. The One Right Panel was being advanced. No methane was

detected during the inspection. The Inspector documented air readings as follows: 14,150 cfm in the last open crosscut; 93,200 cfm in main intake; and 96,360 cfm in main return.

April 15, 1992

DM Roof Specialist visited the mine to assist in formulating a pillar recovery plan.

April 21, 1992

DM Roof Specialist visited the No. 3 mine to evaluate a pillar recovery plan. A closure order was issued for the One Right Panel, one break outby survey station #479. The roof control system had failed and the rider seam was within 10.5 to 13 feet. The test hole drilled in the #2 entry was blowing and emitting methane .5% and higher. A check was made 12 inches from the test hole and no methane was detected.

May 11, 1992

DM Inspector investigated a roof fall at the No. 3 mine. The fall occurred in the outby West Mains area one crosscut inby survey station #223. No methane was detected.

June 5 to 11, 1992

DM Inspector conducted a regular inspection at the No. 3 mine. The Mine Inspector made five visits to the mine during the complete regular inspection. The One Left Panel was advancing near survey station #508. In the face of the #4 and #6 entries 0.2% methane was detected. The Inspector documented air readings as follows: 21,200 cfm in last open crosscut; 86,250 in main intake; and 89,900 in main return.

June 11, 1992

DM Roof Specialist visited the No. 3 mine and corrected the order written on April 21, 1992. The area was pillared and abandoned.

August 19, 1992

DM Roof Specialist visited the No. 3 mine to investigate a roof fall. The fall was located on the Two Right Panel in the last open crosscut at survey station #572. The section was advancing. A 12.5-foot test hole was drilled in the adjacent intersection, but did not penetrate the rider seam. No methane was detected.

September 10, 1992

DM Inspector investigated a roof fall at the No. 3 mine. The fall was located in the #1 entry, 100 feet in by survey station #585 on the Two Right Panel. The area was abandoned and the section was being roomed to the left. Ventilation was not affected by the roof fall.

September 10 to 23, 1992

DM Inspector conducted a regular inspection at the No. 3 mine. The Mine Inspector made five visits to the mine during the complete regular inspection. The Two Right Panel was rooming to the left. Two 12-foot test holes were drilled, but did not penetrate the rider seam. No methane was detected. DM Inspector and third shift electrician traveled abandoned works. The air readings were documented as follows: 21,200 cfm in the last open crosscut; 69,570 cfm in the main intake; and 89,700 cfm in main return.

September 28 and 29, 1992

DM Electrical Specialist visited the No. 3 mine to survey the electrical system and equipment. No methane was detected during this visit.

APPENDIX X
PERSONS PRESENT DURING
OR
CONTRIBUTING INFORMATION TO INVESTIGATION

APPENDIX X
MINE EXPLOSION INVESTIGATION REPORT
SOUTHMOUNTAIN COAL COMPANY, INC., MINE NO. 3

PERSONS PRESENT DURING OR CONTRIBUTING INFORMATION TO INVESTIGATION

SOUTHMOUNTAIN COAL COMPANY, INC.

Donnie Shortt	General Superintendent
Kenneth Brooks	Section Foreman
Paul D. Ramey	Section Foreman
Freddie Deatherage	Superintendent
William Ridley Elkins	Consultant
Lenton Gleason Silcox	General Inside/Foreman
Robert Kevin Fleming	Belt Cleaner
George Phillip Shortt	Surface
Richard Adams, Jr.	General Inside
David L. Goode	General Inside
Donnie A. Mullins	Electrician/Miner Operator
Foy Dane Meade	Chief Electrician
Jackie E. Davis	Section Mechanic/Electrician
Danny R. Mullins	Surface
Ronnie L. Hensley	Continuous Miner Helper
Joseph P. Steele	Roof Drill Operator
Isaac J. Willis	Roof Drill Operator
Dewey Buron Cox	Shuttle Car Operator
Mark Randy Sutherland	Shuttle Car Operator
James E. Mullins	Belt Cleaner
Shane A. Adams	Belt Cleaner
Billy Ray Davis	Shuttle Car Operator
Tony W. Parrigan	Roof Drill Operator
Larry C. Mullins	Mine Clerk
Allen G. Conley	Surface Loader Man
Roger Combs	General Inside
Clearsy France	Former Employee
Charles Ernest Duncan	Former Employee

MINERS' REPRESENTATIVE

Jessee Darrell Cooke	Continuous Miner Operator
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VIRGINIA IRON COAL & COKE

Ed Burns	Senior Engineer
Ray Lawson	Production Engineer

MINE SAFETY AND HEALTH ADMINISTRATION

Tim Thompson	District 7 Manager
John Pyles	Staff Assistant to District 7
Ed Morgan	Senior Special Investigator
Leighton Farley	Coal Mine Health & Safety Specialist, Arlington
Clete Stephan	Technical Support, Pittsburgh
Al McFarland	Ventilation Supervisor
John Urosek	Technical Support, Pittsburgh
Bob Rhea	Coal Mine Inspector
Dewey Dunsford	Coal Mine Inspector
Tom Meredith	Coal Mine Inspector
Allan Dupree	Technical Support, Pittsburgh
Charles Grace	Ventilation Specialist, District 7
Tim Watkins	Technical Support, Pittsburgh
Joey Velina	Electrical Supervisor, District 4
Roy Davidson	Electrical Engineer, District 5
Mike Jackson	Electrical Engineer, District 5
Robert Painter	Coal Mine Health & Safety Specialist, Arlington
Earl Owens	Coal Mine Inspector
Ruby Owens	Coal Mine Inspector
Dennis Carter	Coal Mine Inspector
Ralph Reasor	Coal Mine Inspector
William Strength	Coal Mine Inspector
Clarence Sloan	Coal Mine Inspector
Larry Meade	Coal Mine Inspector

VIRGINIA DIVISION OF MINES

Harry D. Childress	Chief
Opie S. McKinney	Mine Inspector Supervisor
Wayne Davis	Technical Specialist - Ventilation
John Thomas	Mine Inspector
Danniy Altizer	Mine Inspector
Joe Altizer	Mine Inspector
David Elswick	Technical Specialist - Roof
Mitchell Fisher	Mine Inspector
Sammy Fleming	Mine Inspector
Dennis Harrison	Mine Inspector
Vernon Johnson	Mine Inspector
Jerry Looney	Mine Inspector
Dwight Miller	Technical Specialist - Electrical
Jerry Scott	Mine Inspector
Phillip Willis	Mine Inspector

APPENDIX XI

SIGNATURE SHEET

SIGNATURE SHEET

This report is hereby submitted by Opie S. McKinney, John L. Thomas,
and Wayne Davis and approved by Harry D. Childress:

Opie S. McKinney
OPIE S. MCKINNEY
Mine Inspector Supervisor

John L. Thomas
JOHN L. THOMAS
Mine Inspector

L. Wayne Davis
L. WAYNE DAVIS
Technical Specialist - Ventilation

Harry D. Childress
HARRY D. CHILDRESS
Chief

May 7, 1993
DATE

