United States
Department of Labor
Mine Safety and Health Administration
Coal Mine Safety and Health

Report of Investigation
Underground Coal Mine Explosion
Dutch Creek No. 1 Mine – I.D. No. 05-00301
Mid-Continent Resources, Inc.
Redstone, Pitkin County, Colorado
April 15, 1981

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e unassisted. The names of sification, and mining experience are listed in Appendix A.

MSHA investigtors concluded that the explosion originated in the face area of the No. 1 entry in the 102 Section, when a methane-air mixture within an explosion-proof compartment on a continuous mining machine was ignited by an electric arc. The compartment, containing electrical components of the mining machine, had not been maintained in a permissible condition. Flame and major forces of the explosion propagated from the face area of the 102 Section, and split in the main slope entries at the mouth of the 102 Section. Flame and forces traveled inby in the Nos. 7, 6 and 5 entries of the slopes to the Slope Section, and then moved outby in the slope entries. The flame extended as far as the No. 56 crosscut, and the major forces traveled further outby to the No. 48 crosscut.

PART I

GENERAL INFORMATION

GENERAL INFORMATION

The Dutch Creek No. 1 Mine is located about 9 miles southwest of Redstone, Pitkin County, Colorado, off State Highway No. 133. The mine is wholly owned by Mid-Continent Resources, Inc., whose corporate officers were:

John A. Reeves, Sr.	President
Robert Delaney	Executive Vice President
Don J. Joyce	Executive Vice President
Rodney J. Freitag	Senior Vice President

The Dutch Creek No. 1 Mine management officials at the time of the explosion were:

M. J. Turnipseed	Manager of Mines
John A. Reeves, Jr.	Assistant Manager of Mines
William R. Martin	Mine Superintendent
Edward J. Cerise	General Mine Foreman
Jesus Meraz	Master Mechanic
Ronald L. Henderson	Safety Engineer

The Dutch Creek No. 1 Mine is one of five mines in a complex operated by Mid-Continent. The mine, at an elevation of approximately 10,000 feet above sea level, was opened in 1956 into the Coal Basin "B" coalbed by six entries (slopes) driven from the surface, and are numbered 1-4 and 6 and 7. The No. 5 entry was not driven from the surface but was picked up after the entries were developed approximately 1,300 feet. The No. 1 entry was dropped at the 5th South entries, and the slope entries by are currently numbered 2 through 7. The main slope entries e now being driven in a southwest direction. The average ope on the main entries is 9.5 degrees, or 16.7 percent. e slope is steepest near No. 42 crosscut, where it is approxitely 17.4 degrees, or 31.3 percent. The main entries had en driven for a distance of approximately 7,000 feet and re being advanced by a coal-producing unit referred to as e Slope Section. Production sections were driven in a generally rth or south direction from the main slope entries.

ring the development of the 2nd North, an additional opening s made for the disposal of mine water by advancing one of e entries to the outcrop. Three other openings were made the surface during the development of the 3rd North.

d-Continent was mining the top 7 to 8 feet of the Coal Basin " coalbed, leaving a coal floor of varying thickness, interlaced th rock and with limited stability. The Coal Basin "B" coalbed

was underlain by the Upper "A" and the Lower "A" coalbeds. The overburden of the Coal Basin "B" coalbed ranged up to 2,700 feet. This ov other geological conditions in and adjacen d exerted extreme stresses on the coal fa , causing numerous "outbursts" and "bumps" while mining. These conditions have historically presented problems in this coalbed.

A total of 83 persons, 79 working underground, were employed on two coal-producing shifts and one maintenance shift per day, 5 to 6 days a week, producing a daily average of 450 tons of coal.

During the investigation, standard channel samples of coal were taken by MSHA in the No. 1 entry on the 102 Section, 50 feet outby the face, Sample No. ISB 173, and in the No. 2 entry of the 102 Section, 35 feet outby the face, Sample No. ISB 172. The locations of the samples are shown on the map in Appendix E. These samples were analyzed by the Industrial Safety Division Laboratory, Bruceton Safety Technology Center, Pittsburgh, Pennsylvania. The proximate analysis of these two channel samples was as follows:

	Percent	
	ISB 172	ISB 173
Moisture	0.4	0.5
Volatile Matter	23.5	22.7
Fixed Carbon	69.0	70.1
Ash	7.1	6.7

Numerous tests by the Bureau of Mines have established that coal dust having a volatile ratio of 0.12 and higher is explosive. The average volatile ratio of the coal in the face area of the 102 Section at the time of the explosion from analysis of the two samples was 0.25.

The last MSHA inspection of the entire Dutch Creek No. 1 Mine was conducted from January 5, 1981 through January 19, 1981. Rehabilitation work in the Slope Section and in 6th South was being conducted while this inspection was in progress. There was coal production from the faces only on the last day of this inspection. During the inspection a total of 11 citations were issued, and one imminent danger order of withdrawal was issued for a methane accumulation in a crosscut in a return aircourse.

An MSHA inspection of the entire mine was begun on March 30, 1981, and was in progress at the time of the explosion. A total of 21 citations and 1 failure-to-abate withdrawal order had been issued. On the day shift of April 15, 1981, a Federal inspector was present in the mine and performed limited inspections on both producing sections.

Because of high methane liberation, Dutch Creek No. 1 Mine had been placed on a 5-day spot inspection schedule pursuant to Section 103(i) of the Mine Act, and was also assigned a resident inspector.

There were no oil or gas wells on the mine property.

MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods

The main slope entries were developed on 100-foot centers and driven in a generally north or south direction from the main slope entries, and were developed for a room and pillar method of mining using ripper-type continuous mining machines. Although room and pillar mining had been discontinued, continuous mining machines were still being used for longwall and main entry development.

Generally, the immediate roof over the coalbed was approximately 10 to 15 feet of laminated shale, with a main roof of shale and sandstone. The depth of cover ranged up to 2,700 feet. Resin-anchored roof bolts, six feet in length, installed on 5-foot centers and line posts were the principal means of roof support.

During 1975, an experimental single-entry advancing longwall mining method was started in the mine. The 101 Longwall Section was advanced for a distance of 3,750 feet, until interception of a major fault zone forced discontinuance. At the time of the explosion, the mine had two active working sections, the 102 Section and the main Slope Section. The main slope entries were being driven on 100-foot centers with crosscuts projected on 100-foot centers.

The 102 Section was being advanced with 2 entries on 40-foot centers with a 20-foot pillar between the entries, and crosscuts on 200-foot centers. The belt conveyor was installed in the return air course. The 102 Section entries would later be utilized as the headgate entries for a retreating longwall panel.

Due to the amount of overburden and other geological conditions which created extreme stresses, outbursts and bumps of coal from the face and rib frequently occurred during mining, especially in development sections. Pressures exerted on the ribs outby the face areas or in the face areas when no coal was discharged were locally referred to as "bumps" or "bounces," and were evidenced by noises and tremors. The outbursts, which were referred to locally as "pushes" or "pushouts" when they occur in the face area, released varied amounts of methane, coal, and fine coal dust into the ventilating air current. According

to statements of the miners and mine officials these outbursts occurred as often as two or three times a shift. When these outbursts occurred the coal and methane was described as "flowing' rapidly from the face out into the entries. In most instances, the outburst discharged approximately 30 to 40 tons of coal, but there were instances of outbursts which expelled sufficient coal from the face to cover the continuous mining machine and shuttle car behind it. The flow of coal was often accompanied by a release of methane, varying considerably in quantity. At times hazardous methane concentrations were found in the intake aircourses 100 feet or more outby the faces, indicating that sufficient methane was released by these outbursts to overcome the intake air current. The area between the line curtain and the rib was also sometimes blocked by the pushouts disrupting ventilation. The practice at the mine when a push occurred was to send a person to the power center to deenergize all the face equipment and trailing cables, to then examine the working place for methane, and when necessary to reinstall and wing the line brattice to dilute and carry away the accumulated methane.

Mid-Continent had installed remote controls on the continuous mining machine and the shuttle car conveyor in order to remove the machine operators from the dangers in the immediate face area. The continuous mining machine operator normally operated the machine from a location approximately 40 feet outby the shuttle car. The shuttle car conveyor chain was also advanced from a location approximately 40 feet outby the shuttle car as the shuttle car was loaded.

Several approaches to reduce the severity of outbursts and to predict their occurrences had been attempted at this mine. The Bureau of Mines, for one, had on-going research projects using both seismic and sonic technology. Mid-Continent had utilized "volley firing," a shooting of the faces in a predetermined drill pattern to relieve the coalbed stresses. Other mining methods, using varying entry and pillar configurations, and an advancing longwall system, had also been used. However, a method of predicting the time or severity of an outburst had not been developed.

Ventilation and Examinations

Mine ventilation was induced by two exhaust fans installed on the surface, which were equipped with automatic closing doors and explosion relief doors. The No. 1 fan, installed and connected with ducting to the No. 7 Slope entry, was a Jeffrey Model 8HU84 Aerodyne, set in the No. 5 blade position and driven at 1,200 rpm by a 500-horsepower electric motor. Prior to the explosion the fan exhausted 423,752 cubic feet per minute (cfm) of air from the mine at a pressure of 7.5 inches of water. The No. 2 fan, installed and connected with ducting to the No. 1 Slope entry, was a Jeffrey Model 8H60

Aerodyne, set in the No. 5 blade position and driven at 1,200 rpm by a 150-horsepower electric motor. Prior to the explosion the fan exhausted 104,800 cfm of air from the mine at a pressure of 5.3 inches of water. The total mine airflow was 528,552 cfm and the mine liberated 1,612,000 cubic feet of methane in 24 hours during the last MSHA inspection of the entire mine conducted in January, 1981. In addition, methane was removed from the 101 Longwall Section of the mine through a methane drainage system and had been used for heating purposes on the mine property.

There were six main air openings into the mine, two intake aircourses, a track-hoist intake aircourse, a belt haulage intake aircourse, and two return aircourses. In addition, intake air entered the mine through the 2nd and 3rd North entries. Each of the two active working sections was ventilated with a separate air split. There was an air split ventilating the worked-out 101 Longwall Section, and another air split ventilating the 6th South entries. The mine map, which shows the airflow directions, air quantities, and other information gathered from previous inspections, inspectors notes and the investigation is in Appendix C.

Permanent stoppings and overcasts were used to provide the required separation between the various aircourses. The stoppings were "Kennedy" stoppings and were constructed of steel panels and the overcasts were constructed of prefabricated metal sections. Abandoned areas of the mine were sealed. The seals were 4 feet thick and constructed of mine timbers laid skin-to-skin with the interstices filled with rock dust and the exposed side covered with 1/4 inch of "Stoppit" or equivalent fire-resistant material.

The 102 Section was being developed with two entries. The lefthand No. 2 entry was an intake aircourse; the righthand No. 1 entry was the return aircourse containing the belt conveyor. The 102 Section development was in accordance with the approved Ventilation System and Methane and Dust Control Plan. The entries had been developed as an experimental section to lessen the severity and the number of bumps and outbursts that had been caused by the heavy overburden and other geological conditions present at this mine. According to statements of both mine officials and miners, the method of mining in the 102 Section had reduced the severity of the outbursts.

The Slope Section was being developed with six entries. The outside entries, Nos. 2 and 7 (numbering from left to right), were return aircourses; the No. 4 entry contained the belt conveyor; and the Nos. 3, 5, and 6 entries were intake aircourses. At the time of the explosion, the Nos. 6 and 7 entries were not being advanced, and the faces of the Nos. 2, 3, 4, and 5 entries were ventilated with a single air split. MSHA had approved the use of belt haulage entry airflow to ventilate

the working faces of the Slope Section so that all available intake air could be used to dilute the high methane liberation encountered when mining this coalbed. Two escapeways were maintained, one of which was ventilated with intake air. The aircourses were maintained adequately but some areas of the slopes required continuous grading of the bottom to prevent interference with adequate airflow due to the heaving of the bottom.

According to the mine record books, preshift, onshift, and weekly examinations had been made by certified persons. The results of these examinations were recorded in approved books on the surface.

A Ventilation System and Methane and Dust Control Plan for the mine was approved on September 3, 1980. An updated plan was being reviewed by MSHA at the time of the explosion. Bleeder systems and methane drainage systems were provided for second mining areas until such areas were sealed.

Coal Dust

Applications of rock dust were the primary means used for inerting coal dust. Rock dust was applied throughout the mine by a system of hoses and pipelines connected to a pressurized underground bulk storage tank. Rock dust was applied by hand during mining operations in the section faces, and later additional rock dust was applied using the bulk rock dust system. A clean-up program was in effect whereby dust accumulations were wetted, loaded and transported from the mine. Dust on the roadways was controlled by the application of calcium chloride and water. Dust, generated at the belt conveyor transfer points and drives, was prevented from entering the belt conveyor entries by enclosures around these areas. Fog sprays, delivering water with a wetting agent, were installed in these enclosures. Dust in the working faces was controlled by jet fog sprays located on the continuous mining machines, and by hand-held water hoses with spray nozzles. Although significant amounts of water seeped into the mine, areas outby the faces were generally dry because the slope of the entries created drainage to the faces where the water accumulated and was pumped out of the mine.

Mine dust samples were collected on September 16, during an MSHA inspection of the entire mine which was conducted from September 5 through September 30, 1980. The analyses of the mine dust samples showed that 10 of the 18 samples collected had less than the required incombustible content. A citation for inadequate rock dust, a violation of Section 75.403, 30 CFR, was issued on October 8, 1980, and terminated on October 9, 1980. A mine dust survey was not conducted during the MSHA inspection of the entire mine conducted in January 1981, because there had not been sufficient entry development since the last dust survey. During the MSHA inspection of the entire mine

which began on March 30, 1981, a violation of Section 75.403, 30 CFR was cited on April 1, 1981, for inadequate rock dust in the last open crosscut of No. 3 slope in the Slope Section. The condition was corrected and the citation terminated on April 2, 1981.

Electricity

Three-phase electric power was purchased from the Public Service Company of Colorado at 23,000 volts and transmitted to a surface substation near the mine portal. At the surface substation the electric power was reduced for underground distribution to 7,200 volts by two banks of three 333-kVA transformers connected in parallel. The parallel banks of transformers were connected delta-delta. A bank of three 100-kVA delta-wye connected transformers was utilized to derive a neutral for grounding purposes. The neutral was properly grounded through a 25-ampere current-limiting resistor. A grounding circuit, originating at the grounded side of the resistor, was used to ground the metallic frames of all underground high-voltage equipment receiving power from the underground distribution circuit.

A 600-ampere oil-filled circuit breaker in the surface substation was equipped with a ground-check circuit and relaying designed to provide overload, short-circuit, grounded-phase, and undervoltage protection for the high-voltage circuit extending underground.

The three-phase, high-voltage circuit entered the mine by means of Nos. 1/0 and 2/0 AWG three-conductor, type SHD G-GC cable installed in the No. 2 slope. The Y-boxes (fused, three-pole, air-break switches) were installed at the beginning of each branch line and at three locations in the main high-voltage circuit to provide additional electrical protection for the branch circuits and transformers. These switches provided visual evidence that the circuit was deenergized when maintenance work was to be performed on the high-voltage equipment. Current-limiting fuses rated at 63 to 200 amperes were installed in each of the Y-boxes protecting branch lines. The design of the switches was such that, when one fuse opened, the three-pole switch opened, deenergizing all three conductors. The underground high-voltage cables consisted of Nos. 2/0 and 1/0 AWG, three-conductor high-voltage cable, equipped with metallic shields around each power conductor. A one-line diagram of the entire underground high-voltage system from the surface substation to the two section power centers is contained in Appendix J.

The Y-boxes installed at the beginning of each branch circuit extending to the coal-producing sections, belt conveyor transformers and pump transformers contained ground-check circuits designed to monitor continuity of the high-voltage grounding circuits.

Nine portable power centers reduced the 7,200-volt alternating current power to 480 volt alternating current power for operation of eight belt conveyor drive units, four drainage pumps, a

hydraulic power pack, several small battery chargers, and an air compressor. The power centers were rated at either 300 kVA or 400 kVA. The portable power centers, which supplied power to the belt, were equipped with molded-case circuit breakers complete with devices that provided short-circuit, grounded-phase, undervoltage protection, and ground-check circuits to monitor continuity of the grounding circuits for the 480-volt circuits originating at the power centers. Overload protection for the loads served by the power centers was provided in the controllers.

Two 750-kVA portable power centers reduced the 7200-volt alternating current to 550 volts for operation of the continuous mining machines and to 480 volts for operation of the shuttle cars and belt feeders on the two coal-producing sections. These section power centers were equipped with molded-case circuit breakers complete with devices to provide ground-check circuits and grounded-phase, short-circuit and undervoltage protection for the trailing cables of mobile equipment receiving power from the power center. The low-voltage circuit breakers in these two section power centers were not properly marked for identification so that a person could readily identify the circuit receiving power from a particular circuit breaker.

The electric face equipment was of a permissible type and, according to the mine record books, was examined weekly. A record of these examinations was kept in a book in the mine office on the surface.

Transportation

Coal was transported from the face areas in shuttle cars to Stamler feeders where it was transferred to belt conveyors on which the coal was transported to the surface storage bin. The belt conveyor flights were driven by 200-horsepower, 480 volt, three-phase induction motors, except the 102 Section belt conveyor flight which was driven by two 150 horsepower, 480 volt, three-phase induction motors. The coal was transported by auto trucks from the mine to a central preparation plant near Redstone, Colorado, then by auto trucks to Carbondale, Colorado, where it was loaded into unit trains on a side track of the Denver and Rio Grande Railway.

The mine hoisting installation consisted of a mine hoist located on the surface, brake car, a one-inch rope, and rail cars operating on mine track installed in the No. 6 entry. The hoist and brake car were both equipped with overspeed devices and automatic stop controls. The mine hoist was equipped with an overwind device. The hoist was operated by a hoistman on the surface and under the direction of a trip rider who signaled to the hoistman by means of a bare wire, 30-volt signal circuit, and/or a two-way radio (transceiver).

Personnel and mine supplies were transported into the mine by means of the mine hoist and rail cars or rubber-tired diesel-powered vehicles. Supplies and equipment were also transported within the mine by rubber-tired battery-powered utility trucks and diesel-powered end loaders.

Communication

The mine communication system consisted of permissible Comtrol "Loudmouth" telephones, Model No. LM101, Approval No. 9B-71, and permissible Gaitronics Corporation telephones, Approval No. 9B-29, installed at the mine office on the surface, on each coal-producing section, at belt conveyor drives and at strategic locations throughout the mine. The telephone circuit consisted of No. 16, two-conductor cable. A nonpermissible Pyott-Boone phone coupler, Model 232, located in the mine office on the surface, was connected into the mine telephone system for the purpose of connecting the mine telephone system to the commercial telephone system; however, the mine telephones were not installed in areas of the mine where permissible equipment was required. The hoistman could communicate with the trip rider by means of a two-way radio.

Fire Protection

The company's program of instruction, location and use of fire-fighting equipment, location of escapeways, exits and routes of travel, and evacuation procedures and fire drills were approved by the District Manager on November 13, 1974.

According to mine records, all escapeways were examined weekly by a certified person and the results of the examinations were recorded in a book kept on the surface for that purpose. A map showing the designated escapeways was posted in a conspicuous place in each working section of the mine. Escapeway drills were conducted every ninety days and the escapeways were traveled to the surface by the section supervisors and two miners every six weeks.

Fire suppression devices were mounted on all mining equipment which used hydraulic fluid. These devices were dry chemical and self-activating, with the exception of the continuous mining machines, which had water suppression devices that were continuously connected to the mine water supply and were manually activated.

Section fire protection consisted of two fire extinguishers, one portable dry chemical cart of 150-pound capacity, 240 pounds of rock dust in bags, rock dust pipelines connected to a centralized pressure tank of about 10,000 pound capacity and hoses sufficient in length to reach the working places. Two-inch waterlines were installed throughout the mine with enough fire hose to reach the working places. Persons on each shift were trained in the use of the firefighting equipment.

Fire extinguishers of the proper capacity were located at all electrical installations and oil storage areas. Surface areas were supplied with suitable fire extinguishers. The belt conveyors were continuously monitored for fire by fire sensor systems utilizing point-type heat sensors. Belt conveyor drives were protected by dry-powder type fire suppression systems.

Arrangements were made with the Redstone and Carbondale, Colorado fire departments to provide firefighting equipment if needed.

Explosives

Supplies of permissible explosives and electric detonators were stored in an approved storage magazine about 2 miles from the mine site. Explosives and detonators were transported from the storage magazine to surface or underground work sites in approved containers.

Training Program and Medical Assistance Program

On April 19, 1979, the operator submitted a Training and Retraining Plan which was approved on May 9, 1979, as meeting the requirements of Part 48, 30 CFR. In-house training was conducted at the Mid-Continent Training Center, located 4-1/2 miles southwest of Redstone, Colorado. All courses were taught by certified instructors. Training consisted of the following:

1. All newly hired inexperienced miners received 40 hours of training, broken into 32 hours of classroom work and 8 hours of underground orientation.

2. The company's training plan included training for all newly hired experienced miners, new task training for persons assigned to new work tasks, and annual refresher training.

The operator employed an Emergency Medical Service Coordinator and persons were trained as Emergency Medical Technicians (EMT) to assist him when necessary. Two fully-equipped ambulances were maintained at the mine for the transportation of injured persons. Arrangements, had been made with the Valley View Hospital in Glenwood Springs, Colorado, for medical treatment of injured persons. Two-way radio communication was maintained with the hospital.

Illumination and Smoking

Illumination was provided in the face areas of the mine by permissible lighting systems mounted on the electric face equipment. Headlights were installed and maintained on each end of all other self-propelled equipment. Battery-powered permissible cap lamps were worn by each person underground.

An approved search plan for smoking articles was in effect at the mine, requiring a weekly search of all persons before entering the mine. New employees were informed of the plan. Random searches were performed during the shift if smoking was suspected. "No Smoking" signs were posted at the portals of the mine.

Mine Rescue

The operator maintained two mine rescue teams of seven persons each, with six standby persons, and reportedly trained them in all phases of mine rescue and the maintenance of their equipment. These teams were equipped with Draeger four-hour self-contained breathing apparatus, spare parts for these apparatus, a Haskel Engineering and Supply Company pump for filling oxygen cylinders, 2-way communication phones (portable), first-aid supplies, flame safety lamps, methane detectors, Draeger multi-tester and detector tubes, and a supply of oxygen. Training of mine rescue personnel was scheduled on a monthly basis, with the last training session before the explosion held on March 21, 1981. All persons, before entering the mine, were provided with a one-hour filter-type self-rescue device and trained in its use.

A check-in and check-out system was maintained in the mine office, using a checkboard and brass tags with the miner's name, corresponding to a similar tag worn on the miner's belt. This check-in and check-out board was checked by the mine foreman at the beginning and end of each shift.

PART II

EXPLOSION AND RECOVERY OPERATIONS

PARTICIPATING ORGANIZATIONS

Officials of the several organizations who assisted in directin the recovery operations included: John A. Reeves, Sr., Preside John Turner, Vice President, and M. J. Turnipseed, Manager of Mines, Mid-Continent Resources, Inc.; J. Arthur Haske, Chief Coal Mine Inspector, Colorado Division of Mines; John W. Barton District Manager, J. Lamar Bishop, Subdistrict Manager, and William Ward, Federal Coal Mine Inspection Supervisor, Mine Safety and Health Administration.

Seven mine rescue teams from the following organizations partic pated in the recovery operations:

Mid-Continent Resources, Inc., Redstone, Colorado (2 teams)
Colorado-Westmoreland, Inc., Paonia, Colorado (2 teams)
U.S. Steel Mining Co., Inc., Somerset, Colorado
Price River Coal Company, Helper, Utah
Emery Mining Corporation, Huntington, Utah

The mine rescue team members who participated in the recovery operations are listed in Appendix B.

MINING CONDITIONS IMMEDIATELY PRIOR TO THE EXPLOSION

The weather was mild and clear on April 15, 1981, in the Redsto region of Colorado. Records of barometric pressure recorded at the nearby Aspen, Colorado, airport from 11:00 a.m., April 1 to 6:00 p.m., April 15 are as follows:

Date	Time	Barometric Pressure
April 14	11 a.m.	30.43
	3 p.m.	30.34
	6 p.m.	30.32
April 15	7 a.m.	30.34
	11 a.m.	30.32
	4 p.m.	30.27
	6 p.m.	30.24

In the opinion of MSHA investigators, this slight lowering of atmospheric pressure had no bearing on the explosion.

On the 7:00 a.m. to 3:00 p.m. "A" shift of April 15, the mine operated normally. At the start of the shift, Federal Coal Mine Inspector Louis Villegos was continuing an inspection of the entire mine. He rode the mantrip into the mine and proceeded to the 102 Section.

The 102 Section crew had to complete a belt conveyor move prior to commencing coal production. Villegos inspected the No. 2 entry outby the last open crosscut to determine if the roof in this area was adequately supported. He had issued a citation for inadequate support on April 13, 1981. He found the roof support still inadequate and issued a withdrawal order requiring the roof to be properly supported before any other work could be done in the area.

After issuing the order, Villegos went to the Slope Section. He observed that the crew was not producing coal but was bolting the roof in a faulted area. He checked the ventilation and then returned to the 102 Section.

Upon returning to the 102 Section at about 10:15 a.m., he found the roof adequately supported and terminated the order. Villegos took an air reading about 11:15 a.m., at a location approximately 300 feet outby the last open crosscut in the intake entry. The air quantity was 116,622 cfm. He observed that the line canvas in the No. 1 entry was installed over the belt conveyor feeder and along the right rib to within 6 feet of the working face. Work was being done to complete the permanent stopping in the next to last open crosscut. The telephone and belt conveyor feeder and switch had not yet been moved.

Villegos, prior to entering the mine, had reviewed the mine examiner's record book and noted that methane in the 102 Section had exceeded 1.0 percent at least once a day from April 6 to April 10. No methane in excess of 1.0 percent was recorded for April 13 and April 14. Before leaving the section at 11:30 a.m., he checked for methane, finding 0.7 percent at the face of No. 1 entry and 0.6 percent in the section return. Villegos then rode the mantrip to the surface and left the mine.

According to John Jerome, 102 Section foreman on the "A" shift, the belt move was completed at 1:00 p.m., and coal was produced for 45 minutes. The investigators were unable to determine the exact number of shuttle cars of coal loaded on this shift or the time they stopped loading coal. The mine personnel who were interviewed differed on the number of shuttle cars they thought were loaded, giving from 10-28 cars as the number of cars loaded. Also, the time that they thought coal loading ceased varied from 1:45 p.m. to 2:30 p.m.

According to Danny Anderson, the continuous mining machine operator, there had been a small push of about 40 to 80 tons of coal at 2:00 p.m. He said there was no gas with this push so he continued to load the coal. Anderson stated that about 10 shuttle cars from the push and face were loaded and about 2 shuttle cars of loose coal remained in the left side of the face at the end of the shift. The crew trammed the miner back from the face prior to quitting at 2:25 p.m. At the end of the shift the right side of the face was advanced 5 feet ahead

of the left side and the face was "tight" (under stress) on the right side. According to Anderson, this "tightness" normally occurs prior to a push.

Jerome stated that he performed the preshift examination and initialed a wing brattice between 1:00 and 2:30 p.m.

During the "A" shift, the crew in the Slope Section installed roof bolts. The section was advancing through a fault which forced modifications to the normal mining plan. The No. 2 and No. 3 entries had been connected, and No. 4 entry had been driven approximately 80 feet. The continuous mining machine was not operated during this shift, remaining parked at the face of No. 4 entry.

ACTIVITIES OF MSHA PERSONNEL

At 4:26 p.m. MST, April 15, 1981, M. J. Turnipseed, Manager of Mines, notified J. Lamar Bishop, Subdistrict Manager, Price, Utah, that an explosion had occurred in the Dutch Creek No. 1 Mine, and that 18 of the 22 men underground were unaccounted for. William Ward, Federal Coal Mine Inspection Supervisor, Delta, Colorado; Louis Villegos, Phillip Gibson and Lee Smith, Federal Coal Mine Inspectors, Glenwood Springs, Colorado, were dispatched to the mine. Harold Dolan, Acting District Manager, District 9, Denver, Colorado, was notified. Dolan notified Joseph A. Lamonica, Acting Administrator, Arlington, Virginia, at 4:50 p.m. MST. Dolan then called for the assistance of mine rescue teams from nearby coal mining companies and dispatched other MSHA personnel to the mine. John Barton, District Manager, Coal Mine Safety and Health, District 9, Denver, Colorado, was in Beckley, West Virginia, on official business. Dolan notified Barton at 6:40 p.m. MST.

The MSHA Mine Rescue Teams in Morgantown, West Virginia, and Pittsburgh, Pennsylvania, were placed on standby on the evening of April 15, 1981, for possible deployment to the Dutch Creek No. 1 Mine. When it was determined that there were sufficient rescue teams available for the recovery operations, the MSHA rescue teams were removed from standby during the afternoon of April 16.

The first MSHA official to arrive at the mine following the explosion was Villegos. He arrived at the mine at approximately 5:55 p.m., April 15, and issued a Section 103(k) order, covering the entire mine, to insure the safety of any person in the mine, and to require the operator to obtain the approval of MSHA of any plan by the operator to recover any person in the mine, or to return the affected areas of the mine to normal. A copy of the 103(k) order is in Appendix O.

A short time later, Smith and Gibson arrived and immediately checked both fans and found them to be operating. The discharges of both fans were checked for smoke, methane, and carbon monoxide

content. Smoke was not observed coming from either fan. The methane content was 0.3 percent and the carbon monoxide content was 500 parts per million (ppm) at the No. 1 fan. At the No. 2 fan the methane content was 0.4 percent and the carbon monoxide content was 1000 ppm.

Ward, accompanied by Calvert Browning, Matthew Biondich, and George C. Moore, Jr., Federal Coal Mine Inspectors, Delta, Colorado, arrived at the mine at approximately 9:15 p.m. Federal inspectors and company officials had been monitoring the fans continuously. A surface control center was established in the mine office and Ward assumed direction of MSHA activities. A system to record all recovery operation activities was established.

At approximately 10:30 p.m., April 15, Bishop accompanied by Jack Matekovic, Federal Coal Mine Inspection Supervisor, Orangeville, Utah, arrived at the mine. Bishop assumed direction of MSHA activities at the mine. Other MSHA personnel arrived throughout the recovery operations and were assigned various duties.

Barton arrived at the mine about 5:00 p.m. on April 16, and assumed the direction of MSHA activities.

THE EXPLOSION AND RECOVERY OPERATIONS

Information obtained in interviews conducted during the investigation revealed the following activities and sequence of events.

On April 15, 1981, the "B" shift, 3:00 p.m. to 11:00 p.m., consisting of 23 men, 22 of whom worked underground, entered the mine at 3:00 p.m. Coal production was commenced in the 102 Section and the Slope Section crew also commenced mining. The Slope Section crew apparently started by backing the continuous miner from the face and mining the rock in No. 4 entry.

A Bristol recording ammeter located on the surface recorded the current of the No. 1 belt conveyor motor. By counting the current surges, company officials could estimate the number of shuttle cars of material loaded on the belt conveyor. There were 6 or 7 surges recorded on the chart between 3:55 and 4:10 p.m. According to statements, one or two cars of rock had been loaded from the Slope Section. The remaining shuttle cars were apparently coal loaded out of the 102 Section before the explosion occurred.

At the start of the shift, Lee McBride, Jack Anderson, Bob Randall, Brett Tucker and Dan Litwiller, bullgang members, helped Pat Menke, the rope rider, load trash on the trip. Art Cordova, "B" shift maintenance foreman, and Darrell Clark, electrician-mechanic, were also there. Randall then loaded the front end loader with supplies at approximately 3:35 p.m. McBride and Anderson accompanied Menke and J. Black, Bureau of Mines, on the trip to No. 17 crosscut where they got off

and went to the north return. Menke an
the trip to the surface.

Cordova stopped at the mechanic's bench in the slopes, and telephoned the Slope Section to advise them that he and Clark were going into the worked-out 101 Longwall Section for a disconnect, and that if the section had maintenance problems, they could reach him there. Cordova attempted to telephone the 102 Section but could get no answer. Immediately thereafter he stated that he felt wind, heat and dust and was knocked down by the force of the explosion. He hit his head on something as he fell and was rendered unconcious.

According to McBride, at approximately 4:10 p.m., he and Anderson were in No. 3 entry at No. 17 crosscut when he felt a pressure build-up. He realized "the mine was blowing up" and told Anderson to get in the crosscut. They immediately dived into a crosscut and the blast went by, filling the entry with dust going out of the mine, and they were unable to see. They joined hands and started walking out. The air cleared as they were walking and at No. 10 crosscut they crossed over to No. 4 entry where they jumped on the moving conveyor belt and rode to the surface, arriving there at approximately 4:20 p.m.

The first signs of the explosion were observed on the surface by Quentin Rees, hoist operator, as he was helping Menke unload trash off of the hoist cars. Rees felt wind whipping around his head and then he saw dust blow out past the trip cars 50 to 75 feet. Brown dust also came out the intakes and out of the fans. Rees, who had experienced an explosion at this mine in 1965, said he knew immediately that an explosion had occurred. He telephoned Bill Martin, Superintendent, who was at an Emergency Medical Technician (EMT) training class, notifying him of the explosion. M. J. Turnipseed, Manager of Mines, who was attending a training session in the Mid-Continent district office concerning the new roof control plan, was telephoned by Donald Ford, Health and Safety Instructor, who was at the EMT class. Ford, who was also the trainer of Mid-Continent rescue teams, began contacting the team members and preparing for recovery operations. Turnipseed, meanwhile, had telephoned J. Lamar Bishop, MSHA Subdistrict Manager, Price, Utah, and the Redstone Workers Association to inform them that an explosion had occurred. Turnipseed also contacted the Colorado Division of Mines.

The mine fans continued to operate following the explosion. The fan chart for the No. 1 fan had been put on the recorder at 7:30 a.m., April 13, 1981. At approximately 9:00 p.m. April 14, the recording gage apparently malfunctioned and it was not recording properly at the time of the explosion. Prior to the point where it malfunctioned, the fan chart indicated that the fan was operating at 7.5 inches water gage. After the explosion, when the gage was again recording, the fan chart

showed that the fan was operating at 6.9 inches, for a net drop of 0.6 inches. The No. 2 fan operated normally at 5.3 inches water gage. At the time of the explosion, the pressure dropped to 4.1 inches, and then immediately leveled off at 4.5 inches, a net drop of 0.8 inches. The mine fan charts are shown in Appendix I.

After returning to the surface, McBride called Turnipseed and was instructed to inspect the fans. He found 0.5 percent methane at the No. 1 fan and 0.4 percent at the No. 2 fan. The recovery notes of M. J. Turnipseed indicated that 3,000 ppm carbon monoxide was measured at the No. 1 and No. 2 fans at 4:35 p.m. Martin arrived at the mine and measured 500-600 ppm carbon monoxide at the No. 1 fan and 1,700 ppm carbon monoxide at the No. 2 fan at 4:59 p.m. Martin stated that he removed the power from the main circuit extending underground at 4:37 p.m. The time may be in error because David Chiarello stated that he rode the belt to the No. 5 belt drive at approximately 5:00 p.m.

The following sequence of events was related by Chiarello, pumper-beltman, who walked the beltline in the No. 4 entry and was at the No. 5 drive near No. 41 crosscut at the time of the explosion. When the explosion occurred, Chiarello heard a sound like a gunshot; and then dust and wind blew up the slope for about 20 seconds. His hat was blown off and he crouched down to avoid the dust. He immediately went to the telephone at the No. 5 belt drive to call outside. When he arrived at the telephone, Rees was already trying to call underground. Chiarello told Rees that the mine had blown up and that he was going to proceed down the slope. After the dust cleared he found his hard hat, went over to the track entry, and started walking down the slope. He noticed on his way down that the Kennedy stoppings had been blown out toward the belt, but in his opinion "the air was good."

When Chiarello reached No. 50 crosscut he heard labored breathing. He found Cordova at the mechanic's bench face down against the rib. He checked his breathing and pulse and turned him over. Cordova appeared to have hit his head and was unconscious. Chiarello tried to telephone outside from No. 53 crosscut but the telephone was not working.

He then proceeded down the track slope another 100 feet and again heard labored breathing. He found Clark, whom he didn't immediately recognize because he was covered with soot, unconscious and propped up against the rib on the right side of a scoop, near the front wheel. Chiarello checked Clark's eyes and breathing, noted that his pulse was regular but slow, and that the hair on the back of his head had been burned off.

Chiarello looked around for a telephone, but not finding one, he went back to the track entry. He walked down the track another 60 feet and found Randall, equipment operator, in the

middle of the track near No. 55 crosscut. Randall, who apparently had been walking down No. 6 entry, was unconscious and had mucus in his mouth, his arms and legs were tucked in tight, his hair was singed, and his skin was burned. Chiarello checked his vital signs and tried to get him to respond but he was unconcious. He then attempted to go to the telephone, located in No. 55 crosscut in No. 4 entry. Chiarello entered No. 56 crosscut from the track toward No. 5 slope, and encountered air that burned his lungs. He returned to No. 54 crosscut and attempted to walk over to No. 4 slope, but again encountered air that burned his lungs. He tried using his self-rescuer, but it did not seem to provide adequate protection, and he still could not get to the telephone. He then retraced his steps, checking on each man as he went.

Chiarello walked up the track to No. 50 crosscut, crossed over and rode up the belt to the No. 5 belt drive at No. 41 crosscut. He reached the telephone at this location approximately 5:00 p.m., called outside and talked to Ed Cerise, the "A" shift mine foreman. Cerise first instructed Chiarello to stay near the telephone but then told him to come outside. Chiarello instead returned to the injured men.

When he went back down the slope he found that Cordova had gotten to his feet and put on his hard hat. Chiarello and Cordova walked down to Clark, and found him conscious but dazed. Chiarello left the two men together and walked to Randall, who was now conscious, but was babbling and incoherent, and appeared to be going into shock. He returned to Clark and Cordova, and took them back to the mechanic's bench to wait for the rescuers who were on their way into the mine.

After management personnel gathered at the mine, Turnipseed, after discussions with MSHA officials on the telephone, decided that two Mid-Continent rescue team members would enter the mine and bring Chiarello, Cordova, Randall and Clark to the surface.

Tim Cole and McBride, using oxygen breathing apparatus ("under oxygen"), entered the mine on the hoist mantrip at 5:17 p.m., and rode to No. 48 crosscut, where debris had covered the track. They cleared the track and had the mantrip lowered to near the mechanic's bench in No. 53 crosscut. They administered oxygen to Cordova and Clark. They then proceeded down the slope with a stretcher to rescue Randall. They had to strap Randall in the stretcher to carry him to the mantrip because he was delirious and resisted. Chiarello helped the rescuers take Randall to the mantrip. The four men and the rescuers were hoisted to the surface, arriving at 6:39 p.m. Fifteen men remained unaccounted for at this time.

At approximately 5:30 p.m., mine rescue teams at the U.S. Steel Mining Co., Inc. and Colorado-Westmoreland, Inc., operations

were notified of the emergency and indicated they would respond. The two Colorado-Westmoreland teams arrived at the mine at 9:00 p.m. The U.S. Steel team arrived at 9:30 p.m. The Price River Coal Company team was contacted by telephone and put on standby at 7:00 p.m. At 4:45 a.m., April 16, 1981, they were called and asked to respond, and arrived at the mine at 1:00 p.m. The Emery Mining Corporation team was telephoned and placed on standby at 6:00 p.m., April 15. At 4:45 a.m. April 16, they were also asked to respond, and arrived at the mine at 12:30 p.m.

The Mid-Continent No. 1 rescue team and Jesus Meraz, master mechanic, entered the mine at 7:38 p.m. via the hoist mantrip car. The team stopped in the track entry opposite the No. 5 belt drive located at No. 41 crosscut, and began exploring barefaced. They proceeded to No. 48 crosscut, noted that the overcasts had been damaged, and went under oxygen. Meraz and a team member went to the telephone near the mechanic's bench, made the necessary repairs to the system, and contacted the surface. The team noted slight damage to the overcasts at Nos. 51 and 52 crosscuts. Grant Brady, Jr., the team captain decided to split the team with two men exploring down No. 2 slope and two men exploring down No. 3 slope, and meeting at each connecting crosscut. All stoppings inby No. 51 crosscut were damaged to some degree, and were destroyed inby No. 55 crosscut. The team continued in this manner until No. 56 crosscut, where they moved to Nos. 4 and 5 slope entries and explored back to No. 53 crosscut. The team then moved over to Nos. 6 and 7 slope entries and explored down the entries. They continued to explore the slope entries in this manner until they had explored the main slope areas of the mine to No. 63 crosscut. They detected 50 to 100 ppm carbon monoxide in the No. 7 slope entry (return) near No. 63 crosscut.

The team found the overcast destroyed in the No. 63 crosscut at the mouth of the 102 Section. Smoke was coming out of the No. 1 return entry of the 102 Section. They found 2.5 percent methane in the intersection. The team walked down to No. 64 crosscut in the main slopes and found dense smoke coming out of the No. 2 intake entry of the 102 Section. They also detected 3.0 percent methane in No. 2 slope near No. 63 crosscut. They returned to the mantrip at No. 51 crosscut, and rode to the surface at 10:30 p.m.

After being briefed, the Colorado-Westmoreland No. 1 team entered the mine at 11:58 p.m., April 15, accompanied by Bishop; Woods Talman, a consultant for Mid-Continent; Ford, trainer for the Mid-Continent teams; and Andy Wanatowicz, Mid-Continent rescue team member. After further exploring under oxygen the No. 3 slope down to No. 56 crosscut, and finding 0.6 percent methane and 10 ppm carbon monoxide, they carried brattice material from the No. 6 track slope at No. 53 crosscut to where the brattice would first be needed at Nos. 52 and 53 crosscuts

between the No. 2 and No. 3 slopes. They built a temporary stopping in No. 52 crosscut and began one in No. 53 crosscut. While the team was working, Bishop and Talman went to No. 56 crosscut on the right side of the main slopes, and signaled by tapping on a water line for approximately 1 hour, trying to contact the missing miners. No response was received to these signals, and everyone returned to the surface at 3:20 a.m. on April 16.

The Colorado-Westmoreland No. 2 team was briefed by the No. 1 team and entered the mine at 3:47 a.m., April 16, accompanied by Jack Matekovic, Federal Coal Mine Inspection Supervisor, and Richard Garner, Mid-Continent rescue team member. MSHA had requested that the team go to No. 60 crosscut in No. 2 slope to take a vacuum bottle air sample of the mine atmosphere. Analysis of this sample showed 18.52 percent oxygen, 0.19 percent carbon dioxide, 0.74 percent methane, and 14 ppm carbon monoxide. After obtaining this sample, the team retreated and, while bare-faced, erected a temporary stopping between the Nos. 2 and 3 entries at No. 55 crosscut. After an examination by Link Derrick, Westmoreland's briefing officer, had revealed damage to the ventilation controls, the team split up and made repairs to the overcast at No. 50 crosscut in the No. 2 slope; repaired the stoppings between Nos. 50 and 51 crosscuts in the No. 3 slope; and repaired the stopping between Nos. 6 and 7 slopes in No. 52 crosscut. Derrick also reported to Matekovic that the overcast at No. 51 crosscut was undamaged but water was flowing out from under it and running down the slope. Matekovic reported to the outside that water was running freely down No. 2 slope entry. Everyone returned to the surface at 7:30 a.m.

The Mid-Continent No. 2 team entered the mine at 8:10 a.m., April 16, accompanied by Matthew Biondich, Federal Coal Mine Inspector. To prevent stray currents from being conducted into the inby areas when the pump near No. 31 crosscut was energized to control the water at the sump, all pipes, power cables, and belt ropes extending into the explosion area were cut and separated for a distance of at least 10 feet near No. 31 crosscut. The telephone cables extending into the mine, and the hoist signal circuit were not disconnected because they were necessary to the recovery operation. The methane drainage pipe from the 101 Longwall Section was not disconnected. Everyon returned to the surface at 11:40 a.m.

The U.S. Steel team entered the mine at 12:20 p.m., April 16, accompanied by Ward, Federal Coal Mine Inspection Supervisor, Browning, Federal Coal Mine Inspector, and Talman. The team went under oxygen at No. 53 crosscut, explored to No. 57 crosscut in No. 7 slope, and from there across No. 57 crosscut to the No. 2 slope. Finding no hazardous gases, they took off their apparatus and worked bare-faced. They built a temporary stopping

in No. 56 crosscut between Nos. 2 and 3 slopes. They then sprayed a urethane foam coating on the temporary stoppings built by the other teams. The team repaired the damaged overcasts in No. 7 slope at Nos. 54 and 55 crosscuts. They built a regulator in No. 7 slope between Nos. 55 and 56 crosscuts to split the air and change No. 7 slope inby this point to intake air. They also built stoppings in Nos. 57 and 58 crosscuts between Nos. 2 and 3 slopes. Everyone returned to the surface at 5:12 p.m.

The Mid-Continent No. 1 rescue team, accompanied by Archie Vigil, Federal Coal Mine Inspection Supervisor, Alexander Kendzerski, Federal Coal Mine Inspector, Martin and several members of a construction crew, entered the mine at 6:05 p.m., April 16. Their purpose was to establish ventilation, and then to explore the remainder of the main slopes inby No. 64 crosscut. The team explored as far as No. 68 crosscut, then remained underground to assist in the recovery operations.

At 8:20 p.m., a group of persons including Barton, Reeves, Sr., Turner, Turnipseed, Brad Bourquin, Mid-Continent Chief Engineer, and more construction crew members entered the mine. The Mid-Continent No. 1 rescue team and other persons throughout the main slopes of the mine were working bare-faced by this time.

Up to this point, it was believed that the explosion had originated in the Slope Section. MSHA and company officials decided that the rescue team should now explore under oxygen the 102 Section, where it was believed that miners might have barricaded themselves.

At 10:30 p.m. the Mid-Continent team traveled up the No. 2 intake entry of the 102 Section. They observed little evidence of damage until they reached the power center. Because of the damage observed at the power center, the team members concluded that there was no hope of finding any survivors. They continued up the No. 2 entry until they encountered water near the face. They retreated and entered the No. 1 entry through the second crosscut outby the face. They approached the face area and found the body of Ron Patch along the right side of the shuttle car. They failed to notice the body of Gene Guthrie, who was subsequently found lying beside Patch. The team went into the face area and found the bodies of Glenn Sharp and Brett Tucker. They did not discover the other four bodies in the immediate face area.

Meanwhile, the bullgang crews, MSHA, and company officials had advanced ventilation in the main slopes to No. 67 crosscut. Bourquin, Vigil, Kenderski, and several other people traveled through the No. 68 crosscut to No. 4 slope, where they located the body of Robert Ragle at approximately 10:00 p.m. Immediately thereafter the bodies of Richard Lincoln, Kyle Cook, John Ayala and Loren Mead were found in the No. 4 slope entry. John Rhodes was then found in the immediate face of No. 4 slope inby the

continuous mining machine. Rhodes had inserted a filter-type self-rescuer into his mouth, the outer shell of which was found on the mine floor near the bumper of the continuous mining machine. Self-rescuers of the other victims were found on their belts; there was no indication the miners had attempted to use them. The location of the victims in the Slope Section is shown on the maps in Appendices D and F. The victims' age, job classification and mining experience are listed in Appendix A.

The Price River mine rescue team entered the mine at 11:00 p.m., April 16, to assist the mine rescue team and other personnel underground. They left their breathing apparatus at No. 63 crosscut and started to build temporary stoppings in the 102 Section. Tests for methane during this construction ranged from 1.7 to 4.1 percent near the second crosscut outby the face.

The Emery Mining Corporation mine rescue team entered the mine at 12:20 a.m., April 17. At this point in time, all areas of the mine had been explored, no fires or hazardous gases had been found. The Emery team decided to leave their breathing apparatus outside and assist in the recovery of the bodies which had been located.

Rescue team members, the bullgang crews, MSHA, and company officials finished reestablishing ventilation in the 102 Section and made a more thorough search of the section. They located Guthrie lying face-up along the right side of the shuttle car and the other four bodies in the face area of the No. 1 entry. Terry Lucero, Hugh Pierce and Dan Litwiller were found along the left side and near the front of the continuous mining machine. Tom Vetter was found lying on the cutting head of the continuous mining machine. Finally, only Kelly Greene was unaccounted for. Workmen were sent to search for Greene in the old 101 Longwall Section and also the faces of Nos. 2 and 3 slope entries, a fault area. It was then decided to search the flooded area at the face of the No. 2 entry in the 102 Section. A raft was built from mine timbers and an improvised hook was used to drag the water. Greene's body was found in the water at approximately 6:00 a.m. on April 17th. The location of the victims in the 102 Section is shown on the maps in Appendices D and E. The victims' age, job classification and mining experienc are listed in Appendix A.

The self-rescuers of all the victims, with the exception of Rhodes, were found unused either on their belts or near their bodies. Those self-rescuers which were not on the victims belts had apparently been torn off by the explosion.

The victims were transported to the surface and all personnel were withdrawn from the mine aby 7:00 a.m., April 17, 1981.

ELECTRIC CIRCUITS AND EQUIPMENT IN THE EXPLOSION AREA

102 Section

The investigation revealed the following energized electric circuits and equipment that was present in the two longwall development entries of the 102 Section, at the time of the explosion:

1. One Ensign Hubbell 750-kVA section power center, located three crosscuts outby the face, and the 7200-volt supply cable.

2. One permissible Stamler belt feeder, Model BF-14-0-10, Serial No. 10643 (approval plate missing), equipped with a non-permissible General Electric No. J201C control switch.

3. Joy Model No. 12CM-5-8BKK continuous mining machine, Approval No. 2G-2833A-43, Serial No. JM2228, with remote control unit.

4. One Joy 10SC 26B-1H shuttle car, Approval No. 2F-1974A-28, Serial No. ET 10000.

5. Belt conveyor control circuit (480 volts), terminating in a nonpermissible General Electric No. J201C control switch.

6. Pyott-Boone Model GK fire sensor system, Serial No. 11200.

7. Nonpermissible voltohmmeter, VIZ, TECH-VOM, WV 5478, SN 108609.

8. Laser alignment system, Lodestar Laser Alignment, Inc., Approval No. 2G-2711.

9. Gaitronics Corporation telephone, Approval No. 9B-29.

10. One MSA M-402 methane detector, Approval No. 8C-18.

11. One MSA Spotter methane detector, Approval No. 8C-45.

12. One torch igniter.

13. One permissible Koehler flame safety lamp.

14. One Dupont Model 101 Blaster's Multimeter.

A drawing showing the location of all energized electric circuits in the 102 Section at the time of the explosion is in Appendix K.

Slope Section

The investigation revealed the following electric circuits that were energized, and the following equipment that was present in the Slope Section at the time of the explosion:

1. One Ensign Hubbell 750-kVA section power center located in No. 66 crosscut and the 7200-volt supply cable.

2. A permissible Stamler feeder, Model BF-14-0-10, Approval No. 2G-2851A, Serial No. 10643.

3. Belt conveyor control circuit (480 volts), terminating in a nonpermissible General Electric No. J201C control switch.

4. Joy Model 12CM-5-8BKK continuous mining machine, Approval No. 2G-2833A-51, Serial No. JM2613, with remote control unit.

5. Joy 14BU10-11DH loading machine, Approval No. 2G-2384A-10, Serial No. 10274. This machine was apparently not energized at the time of the explosion.

6. Two Joy 10SC-22 shuttle cars, Approval No. 2G-2585A-8, Serial Nos. ET 10863 and ET 10864.

7. Gaitronics Corporation telephone, Approval No. 9B-29.

8. Pyott-Boone Model GK fire sensor circuit, Serial No. 11200.

9. Two MSA Spotter methane detectors, Approval No. 8C-45.

10. Two permissible Koehler flame safety lamps.

No. 56 Crosscut to Slope Section

The investigation revealed the following energized electric circuits and equipment that was present between No. 56 crosscut and the Slope Section at the time of the explosion:

1. High-voltage cable, energized at 7200 volts, installed in No. 5 slope, extending to all high-voltage equipment in the slope entries, in the Slope Section and in the 102 Section.

2. A fused, air-break, three-pole, high-voltage switch (Y-box) located in No. 61 crosscut, No. 5 slope.

3. A 200-horsepower pump located near No. 64 crosscut, No. 5 slope.

4. A fused, air-break, three-pole, high-voltage switch (Y-box) supplying power to the 102 Section, located in No. 61 crosscut, No. 5 slope.

5. A fused, air-break, three-pole, high-voltage switch (Y-box) and a 400-kVA power center, located in No. 62 crosscut, No. 5 slope.

6. The 102 Section belt conveyor drive unit with two 150-horsepower motors, located in No. 63 crosscut, between Nos. 4 and 5 slope entries.

7. A battery charger located in No. 63 crosscut, between Nos. 4 and 5 slope entries.

8. A 75-horsepower motor and control equipment, driving a hydraulic power pack, located in No. 63 crosscut, between Nos. 4 and 5 slopes.

9. A 125-horsepower pump and control equipment located in No. 64 crosscut, No. 6 slope.

10. A 15-horsepower pump and control equipment located inby No. 65 crosscut, No. 6 slope.

11. A fused, air-break, three-pole, high-voltage switch (Y-box) supplying power to the Slope Section, located in No. 64 crosscut, between Nos. 5 and 6 slopes.

12. Two National Mine Service fire-suppression systems, located at No. 7 belt drive and at the 102 Section belt conveyor drive units.

13. Pyott-Boone Model GK fire sensor system, Serial No. 11200.

14. Several Gaitronics Corporation telephones, Approval No. 9B-29.

15. Denver Mining Research Center permissible microseismic roof fall warning system, Model P-1412 DAU, Approval No. 9B-107-0. U. S. Department of Labor, MSHA, approval includes Model P-1413 battery pack, Model P-1415 preamp transducer, and Model P-1416 functional test set inby No. 65 crosscut, No. 5 slope.

MINE EMERGENCY OPERATIONS (MEO)

On April 15, 1981 at 7:00 p.m. EST, Robert G. Peluso, Chief, Pittsburgh Health Technology Center (PHTC), was notified by Lamonica that an emergency existed at the Dutch Creek No. 1 Mine. Peluso immediately alerted James L. Banfield, Jr., Chief, Ventilation Division, PHTC; James Moore, Westinghouse Baltimore Operations Support Center; and Jeffrey Kravitz, Chief, Mine Emergency Operations, PHTC. By 8:20 p.m. EST, these support centers were manned and preparations were made to depart to the mine site. At 11:45 p.m. EST, these persons left Pittsburgh, Pennsylvania, on a chartered airplane, taking surface communications equipment and handheld air contaminant sampling equipment. They arrived at the Dutch Creek No. 1 Mine at 8:00 a.m. MST, April 16, 1981.

The Denver Safety and Health Technology Center (DSHTC) was alerted at 6:20 p.m. MST, April 15, 1981. At 9:25 p.m. MST, a team from DSHTC, consisting of William E. Bruce, Chief, Ventilation Division, Jerry W. Gregory, Chemist, and James F. Stewart,

Mining Engineer Technician, departed Denver in government vehicles with a gas chromatograph and other sampling equipment. They arrived at the mine about 1:30 a.m. MST, April 16, 1981.

The first results from analyzing vacuum bottle air samples were obtained at 5:30 a.m. This analysis, as well as subsequent analyses, were reported to the appropriate Mid-Continent and MSHA personnel. William W. Lutzens, Mining Engineer, Dennis N. Poffenroth, Electronics Engineer, and Robert A. Tunstead, Electronics Engineering Technician, all from the DSHTC, arrived at the mine site at 6:00 a.m., April 16, with the MEO communications van. The communications van, which is equipped with a mobile radio-telephone, was positioned as near to the mine portal as possible, and radio-telephone communications were established between the van, the mine portal, and the commercial telephone system. In addition, a trailer was set up for MSHA's use and regular commercial telephone communications were established by 2:45 p.m. MST, April 16, between the mine portal, the trailer, and existing commercial telephone systems.

Electronic equipment to continuously measure air contaminants at the mine fans, with a team to install, operate, and maintain the equipment, was sent from PHTC and arrived in Glenwood Springs, Colorado about 2:00 a.m., MST, April 17. By then, however, this equipment was not needed.

By 12:00 p.m., April 17, all technical support personnel except Kravitz and Hartman had been released and were returning to their permanent duty stations. The MEO communications van and the trailer, manned by Hartman, remained on site until May 9, 1981, serving as a base for MSHA personnel during the underground phase of the investigation.

PART III

INVESTIGATION, DISCUSSION AND EVALUATION

ORGANIZATION AND INTERVIEWS

During the period from April 15 to April 19, 1981, while the rescue and recovery work was being done and the mine was being reventilated, MSHA selected and organized an investigation team and appointed its coordinator. The investigators met in Glenwood Springs, Colorado, on April 20, 1981, and together, developed detailed plans and procedures for investigating the explosion.

On April 22, 1981, mine dust surveys were commenced throughout the mine from the mine portal to encompass all active, accessible areas of the mine following standard MSHA procedures for making these surveys. On April 23, 1981, the investigation team entered the mine to start a comprehensive investigation and evaluation of existing conditions in the affected areas. All observed conditions were recorded by the team members, either on a map or in a notebook. Maps showing the detailed information gathered in the 102 Section and the slope entries are contained in Appendices E, F, and G. Where necessary, photographs were taken and sketches were made of conditions and equipment. In conjunction with the underground portion of the investigation, interviews of mine officials, mine workers, mine rescue and recovery personnel, and MSHA personnel who could supply information pertinent to the events occurring before and after the explosion were scheduled and conducted by members of the investigation team.

PERSONS WHO PARTICIPATED IN THE INVESTIGATION

The underground investigation of the explosion was begun on April 22, 1981, and continued until May 8, 1981. The following persons participated in the investigation:

Mid-Continent Resources, Inc.

John A. Reeves, Sr.	President
John Turner	Vice President
M. J. Turnipseed	Manager of Mines
John A. Reeves, Jr.	Assistant Manager of Mines
William R. Martin	Superintendent
Bradley J. Bourquin	Chief Engineer
Jesus Meraz	Master Mechanic
Ronald L. Henderson	Safety Director
William Turnipseed	Engineer
Donald E. Ford	Health and Safety Instructor

Redstone Workers Association

Charles Corey	President
John Charlesworth	Vice President
Richard Lane	Chairman, Safety Committee
Mike Jerome	Safety Committeeman

Colorado Division of Mines

Boyd Emmons	State Coal Mine Inspector
McLain O'Connor	State Coal Mine Inspector

Mine Safety and Health Administration

Robert A. Elam	Mining Engineer, Coordinator
Cecil E. Lester	Coal Mine Specialist, Electrical Investigation
Alex O'Rourke	Supervisory Mining Engineer, Plotting of Evidence and Ventilation
Timothy J. Thompson	Mining Engineer, Rescue and Recovery
Raymond A. Strahin	Coal Mine Inspector, Dust Sampling Survey
Edward M. Kawenski	Supervisory Mining Engineer, Evaluation of Flame and Forces
Cloyd Blankenship	Mining Engineer, Bumps and Coal Outbursts
J. Lamar Bishop	Subdistrict Manager
Alan H. Yamamoto	Attorney, Office of the Solicitor
James M. Smith	Supervisory Coal Mine Specialist (Electrical)
Clarence J. Daniels	Coal Mine Inspector (Electrical)
William G. Denning	Supervisory Civil Engineer
William P. Knepp	Supervisory Mining Engineer (Ventilation)
Earl F. Mazzeo	Audio Visual Production Specialist
Charles R. Brady	Coal Mine Inspector
Calvert Browning	Coal Mine Inspector
Theodore L. Caughman	Coal Mine Inspector
Lawrence J. Ganzer	Coal Mine Inspector
Jerry O. D. Lemon	Coal Mine Inspector
George C. Moore, Jr.	Coal Mine Inspector
James R. Thompson	Coal Mine Inspector

FACTORS AFFECTING THE EXPLOSION

Methane, Outbursts and Ventilation

The 102 Section had been developed approximately 1,100 feet by two entries into virgin coal. The No. 1 entry, which contained the belt conveyor, was a return aircourse. The No. 2 entry was an intake aircourse, its split of air isolated from the main returns in the slope entries by prefabricated metal overcasts.

"Kennedy" (metal) stoppings were used in the crosscuts to separate the intake and return aircourses, leaving one open crosscut outby the faces. The ventilating air current for this section was controlled by a metal regulator across the No. 7 slope entry just inby No. 58 crosscut.

Methane was released into the Dutch Creek No. 1 Mine from the roof, ribs and floor feeders. The daily mine methane liberation rate as determined by analysis of vacuum bottles and air measurements taken in the main return air courses immediately inby the main fans by Lee Smith, Federal Coal Mine Inspector, during an inspection of the entire mine in January, 1981, was 1,612,000 cubic feet. On the day shift, April 15, 1981, the daily methane liberation rate from the 102 Section, as calculated from an inspector's air and methane reading, was approximately 1,000,000 cubic feet. There had been no production of coal from the mine faces during this shift when the measurements were made. Normally, additional methane is released from newly exposed ribs, faces and the coal bottom during mining operations. Entries in the mine examiner's record book, kept on the surface of the mine, showed that methane concentrations in the 102 Section return exceeded 1.0 percent at least once a day from April 6-10, 1981. Methane concentrations for this location on April 13 and 14, 1981, were less than 1.0 percent.

This coalbed was also subject to outbursts locally called "pushes" or "pushouts" and these occurrences could release additional methane into the mine quickly. Data was not available to indicate the range of the methane quantities released by these outbursts. It was known from statements of mine officials and miners during the investigation that outbursts of coal and methane from the face had been a serious problem at this mine in the past; occurring frequently during the mining of coal. These outbursts had released varying amounts of methane, coal and coal dust into the face areas and, according to statements, hazardous methane concentrations had been found in the intake airways, at times more than 100 feet outby the face area. The time to dilute the methane released to concentrations less than 1.0 percent had varied from a few minutes to more than a shift.

According to the statements of Danny Anderson, the "A" Shift continuous mining machine operator on the 102 Section, and Nepo Loya, the "A" Shift tailpiece operator on the 102 Section, a large pushout had occurred in the No. 2 entry a few days prior to April 15. Dust and methane from this pushout had extended about 100 feet outby the faces in the intake air course.

During the investigation, it was evident from the amount of loose coal in the face in front of the continuous mining machine, that a coal outburst had occurred in the face of the No. 1 entry. Because the line brattice had been blown down and melted, it was impossible to determine its condition prior to the explosion;

however, it was observed that the furthest inby line post on which line brattice was normally attached remained intact and was approximately 12 feet outby the cutter head of the continuous mining machine.

When outbursts occurred, it was not uncommon to damage the line curtain or to partially block the face return behind the line curtain with coal. This would restrict airflow in the face and, depending on the tightness of the line curtain, could even restrict the section airflow, possibly allowing methane to back out of the face area against the intake airflow. From the position of the six victims in the face area of the No. 1 entry of the 102 Section, the investigators believe these miners were attempting to remove methane from the face area by "winging" the line curtain across the face.

The approved Ventilation System and Methane and Dust Control Plan for the mine required 40,000 cfm in the last open crosscut, 20,000 cfm in the working faces and required the line curtain to be maintained within 12 feet of the working face in development sections. The 102 Section was ventilated with a single air split and airflow was controlled by a regulator. The ventilation system in use on the 102 Section at the time of Villegos' inspection was operating normally and the airflow exceeded the requirements of the ventilation plan. There was no indication the system changed before the explosion.

From the available evidence, MSHA investigators concluded that sometime after the "B" shift started loading coal and prior to the explosion, an outburst occurred in the face of the No. 1 entry on the 102 Section releasing a large quantity of methane that could not be diluted by the available intake air to less than explosive concentrations. In addition to releasing a large methane quantity, the outburst released fine coal dust and could have knocked the line curtain down or blocked the return area behind the line curtain, further restricting both section and face airflow.

Coal Dust

During an MSHA inspection of the entire mine conducted from September 5-30, 1980, 18 mine dust samples were taken in the slope entries. The analyses of these samples showed that 10 of the 18 had less than the required incombustible content. The condition was corrected on October 9, 1980. During the MSHA inspection of the entire mine which started on March 30, 1981, a citation was issued on April 1, for inadequate rock dust in the last open crosscut of the No. 3 entry in the Slope Section. The condition was corrected and the citation was terminated on April 2.

During the investigation, MSHA conducted a mine dust survey of the mine. Band samples were taken in the main slope entries, the 102 Section, the 7th South, the 101 Longwall Section, and

the 6th South. A total of 516 samp taken, 200 feet apart in areas outby No. 40 crosscu slope entries, and 100 feet apart inby this cross samples were analyzed for incombustible content and the p of coke. Coke was present in 94% of the samples inby crosscut. A map showing the location of these sampl e analyses are in Appendices H-1 and H-2.

The incombustible content of the 158 s collected in the intake entries outby No. 50 crosscut in the main slopes averaged 71.5 perce he incombustible content of the 97 samples taken in t urn entries outby the No. 50 crosscut averaged 71.6 perce hirty-three percent of the intake samples were below the required 65 percent incombustible content and 52 percent of the return samples were below the required 80 percent incombustible content.

Twenty-nine dust samples were taken in the 102 Section after the explosion. The average incombustible content of the 18 samples taken in the No. 1 belt return entry was 26.7 percent. The average incombustible content of the 11 samples taken in the No. 2 intake entry was 24.4 percent. The average incombustible content of 138 samples taken inby No. 50 crosscut in the slope entries was 38.0 percent. A breakdown of the incombustible content of the samples in the slope entries is as follows:

No. 2 Entry (Return)	No. Samples	Average Incombustible Content	No. Samples Exceeding 80%
Crosscut Nos. 50-63	13	55.9	2
Crosscut Nos. 63-69	7	45.2	0
Crosscut Nos. 50-69	20	52.2	2

No. 3 Entry (Intake)	No. Samples	Average Incombustible Content	No. Samples Exceeding 65%
Crosscut Nos. 50-63	25	46.7	5
Crosscut Nos. 63-68	12	34.7	0
Crosscut Nos. 50-68	37	42.8	5
No. 4 Entry (Belt Intake)			
Crosscut Nos. 50-63	26	55.8	9
Crosscut Nos. 63-69	14	38.7	1
Crosscut Nos. 50-69	40	49.8	10

No. 5 Entry (Intake)			
Crosscut Nos. 50-63	26	32.0	0
Crosscut Nos. 63-69	7	28.6	0
Crosscut Nos. 50-69	33	31.3	0
No. 6 Entry (Intake)			
Crosscut Nos. 50-63	26	30.4	2
No. 7 Entry (Return)		Average Incombustible Content	No. Samples Exceeding 80%
Crosscut Nos. 50-63	23	46.7	0

Coal dust produced by the pushout, along with coal and dust present in the shuttle car, feeder, belt conveyor, and mine entries was thrown into suspension and provided ample fuel to propagate the explosion. The incombustible content of the above samples cannot be taken as representative of conditions prior to the explosion because mine dust was dispersed and transported during the explosion. The investigators were unable to determine whether or not the required incombustible content was maintained throughout the mine immediately prior to the explosion.

Smoking

There was no indication that smoking articles were taken into or used in the mine.

The Explosion and Propagation

Based on observations and the evidence, the investigation team concluded that the explosion originated in the face area of the No. 1 entry of the 102 Section where the Joy 12CM continuous mining machine was located. Soot and coke deposits confirmed that methane and coal dust entered into the explosion. Flame and major forces of the explosion propagated from the face area of the 102 Section, and split in the main slope entries at the mouth of the section. Flame and forces traveled inby in the slope entries to the No. 69 crosscut of the Slope Section and outby in the slopes as far as No. 56 crosscut for flame and No. 48 crosscut for forces. The explosion developed enough pressure and velocity to destroy, damage, or otherwise disrupt ventilation in the 102 entries and in the slope entries from the face areas as far as No. 48 crosscut.

Research has shown that there are five major factors that limit flame propagation in a mine explosion, namely: (1) dispersed inert material; (2) oxygen deficiency; (3) excess of fuel; (4) lack of fuel; and (5) pressure relief. With respect to the first factor, dispersed inert material, band mine dust samples collected in all areas traversed by flame and also in many areas outby the flame terminus indicates the rock dust present in the explosion area did not render inert the coal dust released by the pushout and the coal dust that was thrown into suspension by the forces of the explosion. The second factor, oxygen deficiency, as a possible deterrent to flame propagation must be discounted since the four entries where the flame traveled the furthest were in intake air and all would have had ample oxygen. The third and fourth factors were eliminated as possibilities because the mine dust samples showed neither an excess nor lack of fuel. The fifth factor, pressure relief, was considered as the major mechanism for arresting the flame propagation. As shown on the map in Appendix D, the forces near and outby the flame terminus converge upon each other, which would result in a reduction of the magnitude of the leading pressure wave. A dissipation of forces into the 7th South, along with the converging forces, may have provided sufficient pressure relief to contain flame in Nos. 2, 3 and 4 entries. Similarly, pressure relief into the mined-out 101 Longwall Section, reinforced by converging forces, probably affected flame travel in Nos. 5 and 6 entries. A possible explanation for the lack of flame in the No. 7 entry may be attributed to the speed of the leading pressure wave moving out of the 102 Section. This speed may have caused a reduction in pressure in the No. 7 entry. The reduced pressure in this area would have prevented flame propagation.

Extent of Flame and Forces

The extent of the flame and forces of the explosion has been primarily determined from the underground observations of the investigation team. Statements from the persons in the mine and on the surface at the time of the explosion were also influential in these determinations.

Flame: Partly burned paper, melted plastic brattice material, soot deposits and coke on the roof, on one or both sides of posts, on mining equipment, and in other places was visibly evident in the 102 Section and in the slope entries from the faces as far outby as No. 56 crosscut in No. 6 entry. Severely charred posts were found in the Slope Section. In the 102 Section, soot and some coking was evident throughout the length of the No. 2 entry, but only sporadically in the No. 1 entry. The slower moving flame in the No. 2 entry lent itself to coke formations while higher flame speeds in the belt entry inhibited coke formation. Inby the last open crosscut of No. 1 entry, coke was observed as if splattered on the mine roof above the continuous mining machine and on the only post in the face area remaining intact, 12 feet outby the cutting head of the continuous mining machine.

There was no evidence of flame inby the No. 65 crosscut in the Nos. 6 and 7 slope entries which were flooded and no evidence outby the No. 63 crosscut in the No. 7 return slope. Flame also bypassed areas inby the No. 69 crosscut in Nos. 2, 3, and 4 slope entries. Research has shown that the flame of an explosion will not propagate into a dead end area of an entry unless methane is present, and the above areas were essentially like dead ends.

The heaviest coke deposits observed appeared to be concentrated in No. 5 slope entry inby No. 67 crosscut and in the last line of open crosscuts between Nos. 5, 4, and 3 slope entries. This coke concentration may have occurred because of a decrease in flame velocity possibly caused by a change in direction of flame travel when the flame reached the dead end. The evidence indicates that flame split in the main slope entries at the mouth of the 102 Section and traveled down slope in the Nos. 7, 6, and 5 entries to the last crosscut between Nos. 5 and 4 slopes and then moved outby in the slope entries to reinforce the original divided flame up the main slope entries. These conclusions as to the direction of the flame are confirmed by the location of the coke formed on posts and cap blocks, which generally was on the outby sides going down slope and on the inby sides moving up slope.

Light and thin soot deposits were observed in the No. 1 return entry of the 102 Section in an area 150 to 600 feet outby the face. Some soot streamers, less than 1/4-inch in length, were suspended from the roof at different locations, and intermittently on pipelines near the roof which were not destroyed by the explosion.

Some of the mine dust samples collected for analysis of incombustibility were also analyzed for coke. Chemical analysis for coke is more sensitive than visual observation, and coking was found by chemical analysis beyond the areas where coke was visually observed. However, the investigators believe that the coke in areas where it could not be visually observed was placed there by the air movements during the explosion. Data on the coke in the dust samples are in Appendix H-2.

The extent of the flame was determined from visible coking, from burned paper and melted brattice that did not appear to be transported from another location, or from charred posts. The extent of the flame is shown on a map in Appendix D.

Forces: Major forces of the explosion propagated from the face area of the No. 1 entry of the 102 Section and traveled outby in both entries. The direction of forces was towards the No. 2 entry. All permanent stoppings were destroyed in the 102 Section. The power center in the third crosscut outby the face of No. 2 intake entry was blown into the rib of the intake entry and almost totally destroyed. Power cables were

torn apart. Cap lamps and self-rescuers were torn away from the victims. Posts were dislodged and scattered, and the shuttle car canopy was lifted off the car parked at the belt feeder, and moved 50 feet outby in the No. 1 conveyor belt entry. The conveyor belt was blown completely out of the belt tailpiece, and the conveyor belt and belt structure and pipelines were extensively damaged and blown into a pile along the rib. A section of the conveyor belt and belt structure starting 650 feet from the belt tailpiece and running 275 feet outby remained intact. Three prefabricated metal overcasts at the mouth of the 102 Section were dislodged and destroyed. Figures 7-11 in Appendix L are photographs of this damage.

The forces split in the main slope entries at the mouth of the 102 entries, traveled down the slope entries to No. 69 crosscut in the Slope Section, and then moved outby in the slope entries to reinforce original divided forces moving up the main slope entries.

Stoppings, overcasts, and regulators inby No. 55 crosscut were destroyed. Damage to ventilating devices as far outby as No. 48 crosscut was observed. According to eyewitnesses underground and on the surface, dust from the forces traveled through the mine and was expelled out the surface openings. The forces of the explosion in the slope entries inby and outby the 102 Section were not as violent as they were in the 102 Section entries. The victims in the slope entries suffered from flash burns but only minimal other external physical injuries.

Tests by researchers on the physiological effects of blast pressures have shown that a peak overpressure of one (1) psi will knock a person down, 5 psi will rupture eardrums, 15 psi causes lung damage, and 35 psi is the threshold for fatalities.

Following the ignition of methane and its development into a propagating coal dust explosion, the major forces moved outby in the No. 1 entry of the 102 Section. Four of the five metal stoppings separating the Nos. 1 and 2 entries were blown into the No. 2 entry, as was the power center located in the third crosscut outby the face. Stoppings of the metal type are assumed to be similar in flexural strength to concrete block stoppings, where failure would normally occur at overpressures of about 3 psi. Flame speeds in excess of 800 ft/sec. are not uncommon in a coal dust explosion. This flame speed corresponds to a static pressure of about 15 psig and dynamic pressure of about 30 psig. These pressure values correspond to the overpressure of about 35 psi threshold for fatalities. A static overpressure of 15 psi would readily demolish metal stoppings and move and destroy an estimated 2-ton power center.

Methane ignitions in dead ends, such as the face area of the No. 1 return entry, are usually accompanied by short-life static pressures that vary in magnitude with the concentration, quantity,

homogeniety, and confinement of the gas-air mixture. Once the methane ignition progresses into a propagating coal dust explosion, then the static pressures become secondary to the more violent dynamic pressures.

Details of the extent and direction of the forces are shown on the map in Appendix D.

On April 18 and 19, 1981 autopsies were performed on all the victims by Dr. Robert L. Deters and Dr. Patrick C. Allen at the Farnum Mortuary, Glenwood Springs, Colorado. According to the autopsy report, three of the six victims in the immediate face area of the 102 Section died as a result of concussive blast injuries, two as a result of carbon monoxide poisoning, and one as the result of a combination of concussive blast injuries and carbon monoxide poisoning. The two victims near the shuttle car in the 102 Section died as a result of concussive blast injuries caused by the explosion. Their clothing and bodies had been burned and damaged during the blast. The victim in the face of the No. 2 entry of the 102 Section, and all six men in the Slope Section died as a result of carbon monoxide poisoning.

Electric Circuits and Equipment

All energized electric circuits and equipment located in the area of the mine in which evidence of heat or flame was found, or which supplied power to electric equipment in this area, were carefully examined or tested to determine the adequacy of short-circuit, overload, and grounded-phase protective devices and to determine if the ignition source for the explosion was of electrical origin.

The surface substation, where the underground 7200-volt distribution circuit originated, was carefully examined. The grounding resistor, and high-voltage circuit breaker and associated relaying, and underground high-voltage cable were examined and tested by MSHA electrical personnel. An examination of high-voltage circuit breaker protective relays revealed the relays were adjusted as follows:

1. inverse time overcurrent, 320 amperes;

2. instantaneous overcurrent, 2240 amperes; and

3. inverse time grounded-phase, 7.5 amperes.

The grounding resistor limited grounded-phase current to 25 amperes. The smallest high-voltage cable in the underground distribution circuit was No. 1/0 AWG, type SHD G-GC cable.

The high-voltage circuit breaker protecting the underground circuit did not activate during the explosion. The 63-ampere current-limiting fuses in the Y-box supplying power to the 102 Section opened, activating the associated three-pole switch, which deenergized the branch line supplying 7200 volts to the 102 Section. One 63-ampere fuse also opened in the Y-box installed in the main high-voltage circuit at No. 53 crosscut, which in turn caused the associated three-pole switch to open, removing electric power from both coal-producing sections. The outby circuits remained energized, and all belt conveyors except No. 7 and the 102 Section continued to run.

Bill Martin, Superintendent, stated he removed electric power from the mine at approximately 4:37 p.m. on April 15, by manually activating the high-voltage circuit breaker on the surface.

Tests conducted by MSHA electrical personnel ascertained that the high-voltage circuit was free from a grounded-phase condition from the surface substation to the Y-box at No. 53 crosscut. During recovery operations, the damaged high-voltage cable was replaced between this location and the power center at No. 61 crosscut to provide power for the 125-horsepower water drainage pump at No. 64 crosscut, so that water could be pumped from the Slope Section of the mine. Damaged high-voltage cable was later replaced between No. 53 crosscut and each of the two section power centers so that power could be restored to the coal-producing sections for the purpose of testing the face equipment during the investigation.

The Y-box, the high-voltage cable from No. 53 crosscut to the two section power centers and the section power centers had been moved or damaged by the explosion. A new power center was installed on the 102 Section to allow testing of the face equipment, and then transported to the Slope Section to also provide power for the testing of the face equipment there.

The 102 Section power center was almost completely destroyed in the explosion; however, the panel supporting the molded-case circuit breakers and relays appeared to receive only minimal damage. All circuit breakers were in the tripped position. The movable contact in each of the Struthers Dunn grounded-phase relays was bent in a manner that could prevent the relays from activating in a normal manner. The investigators concluded that these contacts were bent by the forces of the explosion.

The examination of the high voltage system revealed that the system was not the source of the ignition.

An examination was made of the electric face equipment and other equipment in the slopes from No. 56 crosscut to the faces of the Slope Section to determine if they could have been the source of the ignition. It was determined that they were not. The results of these examinations are found in Appendices N-1 and N-2.

The investigators determined that a definite written maintenance program for keeping methane monitors operative had not been established and adopted. Mid-Continent maintenance foremen stated that they did not know of the existence of a written maintenance program for methane monitors.

Discussion of Potential Ignition Sources in the 102 Section

All permissible-type electric face equipment and other potential ignition sources in the 102 Section were examined. Explosion-proof compartments containing arcing components were disassembled and examined for evidence of a methane ignition. The results of these examinations are set out below.

Continuous Mining Machine

The continuous mining machine in the 102 Section was a Joy Model 12CM-5-8BKK, Approval No. 2G-2833A-43, Serial No. JM2228. The voltage rating of the machine was 550 volts, phase-to-phase. The machine was of a permissible type but had not been safely maintained or maintained in a permissible condition. An examination of the machine disclosed the following:

The continuous mining machine was operated by intrinsically safe radio remote controls. All controls on the mining machine were in position for remote operation. All levers on the remote control units were in the "off" position. The power circuit breakers on the machine were in the "on" position. The trailing cable and control unit were damaged in the explosion, and were replaced so that the machine could be energized and tests could be performed. After power was supplied to the continuous mining machine and a new remote control unit provided, the mining machine operated normally.

Tests revealed that all three phases of the continuous mining machine trailing cable had been grounded to the grounding conductor due to the explosion. Examination of the trailing cable revealed no evidence of arcing.

The grounding conductor in the continuous mining machine trailing cable was separated from the ground terminal. The investigators concluded that the conductor had been pulled loose by the force of the explosion.

The emergency stop switch located on the left side of the continuous mining machine was wedged in the "run" position with a piece of wood lath, preventing rapid operation of the switch in the event of an emergency.

Loose coal, coal dust, and spilled hydraulic oil had been permitted to accumulate on the electric components and inside the cab of the continuous mining machine. These accumulations were packed around the electric motors and the methane monitor control compartment.

After the new power center was installed, the continuous mining machine was energized and the no-load voltage was measured and found to be 660 volts phase-to-phase. The continuous mining machine was equipped with a Bacharach Model 23-7167 methane monitor, Certification No. 32A-7/MS. When the machine was first energized, the "trouble light" (blue) came on in the readout assembly of the methane monitor. Continuity tests revealed that the sensor cable had been pulled loose inside the connecting plugs by the explosion. After necessary repairs were made, the meter indicated 0.6 percent methane. Tests made by hand-held methanometers, indicated 0.2 percent methane at the sensor location. After the meter was adjusted to 0.2 percent, to correspond with the methane content in the face, the methane monitor performed properly when tested with a known 2.3 percent methane-air mixture. Both the test switch and application of the 2.3 percent methane-air mixture caused activation of the methane monitor.

The methane monitor sensor was located on the right side of the machine approximately 10 feet from the coal face. The readout assembly was located on the machine in a location that made it impossible for the operator, while operating remotely, to see at all times the light designed to give warning automatically when the concentration of methane exceeded 1.0 percent. A bolt was missing from the dust cover over the zero adjust control in the methane monitor control compartment.

The methane monitor was connected into the continuous mining machine circuitry in such a manner that activation of the methane monitor caused deenergization of all electric equipment and circuits on board the machine except the methane monitor itself, the incoming trailing cable, and the McJunkin Corporation lighting system installed on the machine.

The McJunkin Corporation lighting system, consisting of a lighting transformer, light control switch, four 150-watt sodium vapor lights and ballasts, and two 70-watt sodium vapor headlights with ballasts, remained energized after activation of the methane monitor to deenergize the machine. The investigators found that Mid-Continent officials had discussed the lighting and methane monitor systems with MSHA inspectors, who had not advised them that the methane monitor was improperly connected in that the lighting system remained energized when the methane monitor deenergized the machine.

On June 9, 1978, Mid-Continent had made application to the MSHA subdistrict office in Price, Utah, for permission to install a McJunkin Corporation lighting system, Statement of Test and Evaluation No. 5000952, on this continuous mining machine. At that time, the machine was being operated in Mid-Continent's Bear Creek No. 4 Mine. In a letter dated June 23, 1978, to Mr. M. J. Turnipseed, Fred W. Tatton, Jr., Acting Subdistrict Manager, granted permission to install the lighting system,

and, according to company officials, the work was done in July or August of 1978. However, the lighting system was not installed in accordance with the approval granted by MSHA and as required by Section 18.48(c) of Part 18, 30 CFR in that a two-pole switch to turn the lights on and off was not included in the secondary circuit of the lighting transformer. Furthermore, the methane monitor contacts were not wired into the primary circuit of the lighting transformer in such a manner as to cause deenergization of the lighting system when the sensor for the methane monitor detected methane concentrations exceeding 2.0 percent. The two-pole switch and the proper monitor connections had been plainly illustrated on the wiring diagram submitted by Mid-Continent with their request to install the lighting system. See Appendix M.

The installation of the lighting system constituted a field modification of permissible equipment, which, by MSHA policy, required MSHA to inspect the field modification during the next MSHA electrical inspection at the mine; however the investigators could not ascertain from the available information whether the inspection was made, since records of the inspections do not normally detail all the activities of the inspectors during their inspections.

The continuous mining machine, with its improperly installed lighting system, was transferred to the Dutch Creek No. 1 Mine in May 1980, and was intermittently used in that mine until the day of the explosion. According to company officials, no change was made to the lighting system until a light switch and cover were installed on April 6, 1981.

The original installation did not include a switch for turning the lights on and off. According to John Cerise, third shift maintenance foreman, the old cover plate on the explosion-proof compartment was replaced on April 6, 1981, with a cover plate containing a light switch. The light switch was wired into the circuit so that the lights could be turned off and on.

The explosion-proof compartment's new cover was manufactured by Service Machine Company, Serial No. PTO-1523, XP 1665-21, and installed by Mid-Continent on the compartment housing the lighting transformer and the light switch. It was installed as part of the McJunkin Corporation lighting system. An examination of the explosion-proof compartment revealed that the cover plate had been bolted down onto a No. 14 AWG insulated wire in the plane flange joint, leaving openings in the flame path in excess of 0.015 inch. Federal standards allow a maximum opening of 0.004 inch. The six lights of the lighting system were controlled by the light switch in the explosion-proof compartment that had the opening under the cover in the plane flange joint caused by the presence of the wire in the flame path. Statements made by miners and mine officials indicated that the lights were to be kept on whenever the continuous

mining machine was in operation, however, the light switch was found in the "off" position.

The investigation revealed that the work was neither performed by a qualified person within the meaning of Section 75.153, 30 CFR, nor done under the direct supervision of a qualified person. Statements from mine officials and each person that was qualified to perform electrical work as required by Section 75.153 indicated that the compartment had not been entered since the new cover had been installed. The investigators found no evidence that the compartment had been entered for any purpose other than installation of the light switch. An MSHA inspector examined the continuous mining machine on two occasions after the new cover was installed, April 9 and April 13, to determine if the machine was in permissible condition. He did not detect the permissibility deficiencies during these examinations.

All explosion-proof compartments that contained electric components that arc during normal operation were examined for evidence of methane ignition. None of the compartments contained visible evidence of methane ignition except the explosion-proof enclosure housing the light switch controlling the McJunkin Corporation lighting system. The flame paths and the interior of this enclosure contained coal dust and evidence of a methane ignition. See Figures 3, 4, 5 and 6 in Appendix L for photographs of this enclosure. The enclosure was removed from the machine and sent to MSHA laboratories in Pittsburgh, Pennsylvania, for further testing. Laboratory tests of dust taken from the top of the transformer and the bottom of the enclosure revealed the presence of burned coal, indicating the presence of flame within the enclosure. The results of these tests are set out in Appendices N-3 and N-4.

Stamler Belt Feeder

The Stamler belt feeder, Model No. BF-14-0-10, apparently was of a permissible type but the permissibility approval plate was missing. The belt feeder had not been maintained in permissible condition, in that a nonpermissible switch was wired into the control circuitry to start and stop the conveyor chain. The main power circuit breaker on the belt feeder was found in the "off" position during the investigation. The position of the main circuit breaker control indicated that the main circuit breaker had been placed in the "off" position by hand prior to the explosion. Therefore, the trailing cable and the circuit breaker were the only electric components of the feeder that were energized at the time of the explosion but there was no indication that these components were the source of the ignition.

The total length of the No. 1 AWG trailing cable supplying power to the Stamler feeder was 645 feet. The cable was blown apart in four places and damaged in other places as a result

of the explosion forces. An examination of the cable revealed no evidence of arcing.

Standard Shuttle Car

The standard drive, Joy 10SC shuttle car, Approval No. 2F-1974-28, Serial No. ET 10000, on the 102 Section, was of a permissible type but was not used in permissible manner. A trailing cable had been attached in excess of the maximum allowable length specified in Table 4 of Schedule 2F, which was the permissiblity schedule under which the shuttle car was approved. The trailing cable consisted of 605 feet of new No. 1 AWG three-conductor, type G-GC cable, and 435 feet of No. 2 AWG three-conductor, type G-GC cable, making a total of approximately 1,040 feet.

In the section power center the circuit breaker which provided short-circuit protection for the shuttle car trailing cable was improperly adjusted to 1,750 amperes. Also, the control circuit breaker lever on the shuttle car was stuck and could not be moved by hand.

An explosion-proof switch and 30 feet of control cable had been installed on the shuttle car to allow remote operation of the conveyor chain. The control cable contained three permanent splices. A new trailing cable and rebuilt reel had been installed on the shuttle car shortly before the explosion. Explosion forces pulled the trailing cable apart approximately three feet from the machine.

Each explosion-proof compartment on the shuttle car containing electric components that could arc was examined; no evidence of a methane ignition was found.

The main circuit breaker on the shuttle car was found to be in the "off" position at the time of the investigation. Therefore, the trailing cable, reel, and circuit breaker were the only electric components that were energized at the time of the explosion and an examination revealed they were not the source of ignition. The main lever controlling the circuit breaker, located on top of the explosion-proof compartment housing the circuit breaker, was in the "off" position, indicating that the circuit breaker had been manually placed in the "off" position prior to the explosion. The brake mechanism on the shuttle car was disassembled and examined for metal to metal contact. The brake discs and pads were found to be in proper operating condition. Therefore, the shuttle car could not have been a source of the ignition.

After the trailing cable was repaired and power restored, the shuttle car, all motors, and the cable reel operated normally.

Telephone Circuit

According to miners on the previous shifts of April 15, 1981, the permissible Gaitronics Corporation telephone, Approval 9B-29, was installed at the belt feeder in the No. 1 entry, on the roof support posts on which line curtain was hung. The telephone was completely destroyed in the explosion.

As originally approved, it contained only intrinsically safe circuits that were incapable of releasing sufficient energy to ignite methane. There was no evidence to indicate that the telephone had not been maintained as approved.

Belt Conveyor Control and Feeder Control Switches

A General Electric control switch, GE No. J201C, was installed in the No. 2 entry, approximately 20 feet outby the last open crosscut, to start and stop the belt conveyor. An identical switch was also installed beside the Stamler belt feeder for the purpose of starting and stopping the conveyor chain of the feeder. These two switches were nonpermissible; however, they had been approved by Underwriter Laboratories for use in Class I, Divisions E, F, and G type locations, which includes locations in which methane may accumulate. The control cables entered the control switch housing through dust-proof entrance glands. The belt feeder control switch housing was moved outby approximately 50 feet by the force of the explosion. The cable was pulled from the entrance gland and the interior of the switch housing was coated with coal dust and smelled of burned material. The investigators found several open enclosures which looked and smelled the same and concluded this resulted from the explosion. The design and construction of the switch boxes, their locations, and the manner of cable entrance make it highly improbable that either of these switches was the source of the ignition.

Portable Power Center

The 750-kVA portable power center was located in intake air, in the third crosscut from the face, approximately 450 feet outby the face of the No. 2 entry in the 102 Section. The power center contained several open-type switches, relays, and circuit breakers that in normal operation would create arcing containing sufficient energy to readily ignite methane. During previous pushouts, methane had reportedly accumulated in the intake entries as far back as the location of the power center. The direction of the explosion forces and the manner in which the explosion moved the power center itself, indicated that the explosion could not have initiated at the power center.

Torch Igniter

A torch igniter was found, attached to the section mechanic's belt, lying beside the shuttle car in the No. 1 entry of the 102 Section. Electrical tape had been placed over the flint holder, but the striker could easily be moved beneath the tape to create an incentive spark. The igniter was sent to the MSHA Approval and Certification Center in Triadelphia, West Virginia, where tests showed that the striker was capable of igniting a methane-air mixture. See Appendix N-2. There has been at least one instance documented by MSHA in which a torch igniter was operated and accidentally ignited methane in a coal mine. However, because the igniter was found still attached to the mechanic's belt 25 feet outby the mechanic's body, and the evidence indicated the explosion originated inby, the torch igniter could not have been the source of the ignition.

Flame Safety Lamp

A permissible Koehler flame safety lamp was found in the No. 1 entry of the 102 Section approximately 210 feet outby the face. The flame safety lamp was sent to MSHA Industrial Safety Division Laboratory, Pittsburgh, Pennsylvania for testing. The lamp had been properly assembled. The lower asbestos washer was broken, with a large portion of it crumbled on the top surface of the fount. The glass globe was coated on the inner surface with a heavy layer of black soot. The upper ring and the upper washer were undamaged. The inner and outer gauzes were not damaged, except for a small dent in the upper edge of the outer gauze. The laboratory's examination revealed that the damage was caused by forces acting from the outside toward the inside of the lamp, indicating that the explosion was not originated by the flame safety lamp. See Appendix N-5. MSHA investigators concluded that the damage to the flame safety lamp was caused by the forces of the explosion which originated inby the probable location of the lamp.

The following other equipment found in the 102 Section during the investigation was sent for testing to the MSHA Approval and Certification Center in Triadelphia, West Virginia.

1. A Mine Safety Appliances Company, Model N "Spotter" methane detector was found undamaged on the body of Terry Lucero.

2. An MSA Model M-402 methane detector was found broken in pieces within its case on the body of Ronald Patch.

3. A Dupont Model 101 Blaster's Multimeter was found in the No. 2 intake entry on the upper rib approximately 400 feet outby the face. Extensive physical damage had occurred to the instrument.

4. A Lodestar Laser Alignment Inc., Model 2500, laser alignment cylinder was found in the inby end of the Stamler feeder. The cylinder remained sealed, but pieces of the case and battery plates were found approximately 200 feet outby ''e face of the No. 1 entry.

5. A VIZ Manufacturing Company, Model WV-5478 voltohmmeter s found in the middle of the No. 1 entry, ten feet inby the uttle car. The meter case was broken and the internal parts d the distinctive odor of burned electrical parts.

e tests conducted on the above items revealed no energy storage mponent or combination of electrical components which under rmal or fault conditions could store sufficient electrical ergy to render the instrument capable of being a source of nition of a methane-air atmosphere. See Appendix N-2.

scussion of Point of Origin

Based on the evidence of flame, forces of the explosion, and condition of the bodies of the victims, the investigators concluded that the ignition originated at the continuous mining machine located in the No. 1 entry of the 102 Section. The most likely ignition source found on or reasonably near the continuous mining machine was the two-pole light switch that was part of the lighting system. The light switch was housed in the improperly maintained explosion-proof compartment that also housed the lighting transformer. A No. 14 AWG insulated wire was found in the flame path of the plane flange joint under the compartment cover. The cover had been bolted tightly on the wire, leaving an opening in the flame path in excess of 0.015 inch.

The explosion-proof compartment housing the light switch was removed from the machine and sent to the Technical Support Center in Pittsburgh for testing. These tests show conclusively that, under certain conditions, a methane explosion inside the compartment with the No. 14 wire present in the flame path will expel flame and burning material through the opening and ignite an explosive atmosphere outside the compartment. The results of these tests are contained in Appendix N-4. See Figures 1-6 in Appendix L for photographs of the explosion-proof compartment.

A test of the dust taken from the top of the transformer and the bottom of the explosion-proof compartment by the Bureau of Mines, revealed the presence of burned coal within the compartment.

The location of the victims, the mining practices normally followed, and other evidence indicated that after the outburst at the face of the No. 1 entry had occurred and methane had accumulated in the working place, the methane monitor activated

and removed power from all the motor circuits and control circuits except the lighting system. The location of the victims' bodies indicated that part of the crew in the 102 Section was standing at or on the front of the continuous mining machine at the time of the explosion, installing the line curtain to remove the methane from the working face. The lights were installed and directed in such a manner as to c
top of or in front of the continuous

The investigators believe that one of
near the light switch turned the ligh
found in the "off" position. Turning
break the circuit to the light fixtur
have created an intense arc inside th
housing the light switch. By the tim
been turned off, methane would have m
in an explosive concentration.

Research has shown that a one-thousan
spark can readily ignite mixtures rang
percent methane. The calculated energy of an inductance spark in the two-pole light switch for the lighting system could be as high as 2.0 joules, indicating that the available spark energy was possibly 2,000 times greater than the energy required to ignite the methane.

PART IV

FINDINGS OF FACT

1. The average volatile ratio of the coal in the face area of the 102 Section at the time of the explosion from analysis of two samples was 0.25, indicating that the coal dust is explosive.

2. Federal inspection reports in January show that the total mine airflow was 528,552 cfm from two surface fans and the mine liberated 1,612,000 cubic feet of methane in 24 hours. The mine fans continued to operate after the explosion.

3. A Federal inspection of the entire mine was started on March 30, 1981, and was still in progress at the time of the explosion. On the 7:00 a.m. to 3:00 p.m. "A" shift of April 15, 1981 the mine operated normally. Federal Inspector Louis Villegos was continuing an inspection of the entire mine.

4. Villegos took an intake air reading on the 102 Section about 11:15 a.m., at a location approximately 300 feet outby the last open crosscut. The air quantity was 116,622 cfm. He observed that the line canvas in the No. 1 entry was installed over the belt feeder and along the right rib to within 6 feet of the working face in No. 1 entry. Before leaving the section at 11:30 a.m., he checked for methane, finding 0.7 percent at the face of No. 1 entry and 0.6 percent in the section return.

5. The overburden of the coal basin "B" coalbed ranged up to 2,700 feet. This overburden, along with other geological conditions, in and adjacent to the coalbed, had resulted in extreme stresses being exerted on the coal faces, floor, and ribs, causing numerous "outbursts" and "bumps" while mining. These conditions have historically presented problems in this coalbed.

6. The outbursts often release large quantities of methane resulting in explosive methane-air mixtures over large areas. Dense clouds of fine coal dust may also be released by the outbursts.

7. Two entries were being mined in the 102 Section to develop headgate entries for a retreating longwall, with the entries on 40-foot centers and a 20-foot pillar between the entries, and crosscuts at 200-foot intervals. The belt conveyor was located in the return aircourse.

8. The mine was operating pursuant to a Ventilation System and Methane and Dust Control Plan, approved on September 3, 1980. An updated plan was being reviewed by MSHA at the time of the explosion.

9. According to Danny Anderson, the continuous mining machine operator in the 102 Section, there had been a small push of about forty to eighty tons of coal near the end of the shift. Anderson further stated that the top right side of the face was very "tight" at the end of the shift and this "tightness" normally occurs prior to a push.

10. A recording ammeter located on the surface was connected so as to record the current of the No. 1 belt conveyor motor. By counting the current surges, company officials could estimate the number of shuttle cars of material loaded on the belt conveyor. There were 6 or 7 surges recorded on the chart between 3:55 and 4:10 p.m. According to statements, one or two cars of rock had been loaded from the Slope Section. The remaining shuttle cars were apparently coal loaded out of the 102 Section before the explosion occurred.

11. A methane and coal dust explosion originated in the face area of the No. 1 entry, 102 Section at approximately 4:08 p.m. April 15, 1981, resulting in the death of nine men working in the 102 Section and six men working in the Slope Section. Six other men in the mine at the time of the explosion escaped.

12. Mine rescue teams explored and ventilated the mine and located the fifteen victims between approximately 7:30 p.m. April 15, and 6:00 a.m. April 17, 1981.

13. According to the autopsy report, three of the six victims in the immediate face area of the 102 Section died as a result of concussive blast injuries, two as a result of carbon monoxide poisoning, and one as the result of a combination of concussive blast injuries and carbon monoxide poisoning. The two victims near the shuttle car in the 102 Section died as a result of concussive blast injuries caused by the explosion. Their clothing and bodies had been burned and damaged during the blast. The victim in the face of the No. 2 entry of the 102 Section, and all six men in the Slope Section died as a result of carbon monoxide poisoning.

14. Flame evidenced by partly burned paper, melted plastic brattice material, soot deposits and coke on the roof, on one or both sides of posts, on mining equipment, and in other places was visible in the 102 Section and in the slope entries from the faces as far outby as No. 56 crosscut in No. 6 entry. Severely charred posts were found in the Slope Section. In the 102 Section, soot and some coking was evident throughout the length of the No. 2 entry, but only sporadically in the No. 1 entry. Inby the last open crosscut of No. 1 entry, coke was observe as if splattered on the mine roof above the continuous

mining machine and on the only post in the face area remaining intact, 12 feet outby the cutting head of the continuous mining machine.

15. The major forces of the explosion propagated from the face area of the No. 1 entry of the 102 Section and traveled outby in both entries to the mouth of the 102 Section, where the forces split. Forces traveled inby in the right entries of the slope entries to No. 69 crosscut of the Slope Section, and then moved outby in the slope entries to reinforce the original divided forces that moved up the main slope. The major forces traveled outby to the No. 48 crosscut and dissipated. Dust from the forces traveled through the mine and was expelled out the surface openings.

16. The 102 Section had been developed approximately 1,100 feet by two entries into virgin coal. The No. 1 entry, which contained the belt conveyor, was a return aircourse. The No. 2 entry was an intake aircourse, its split of air isolated from the main returns in the slope entries by prefabricated metal overcasts. The No. 2 entry was also the travelway to the working section. "Kennedy" (metal) stoppings were used in the crosscuts to separate the intake and return aircourses, leaving one open crosscut outby the faces. The ventilating air current for this section was controlled by a metal regulator across the No. 7 slope entry just inby No. 58 crosscut.

17. The approved Ventilation System and Methane and Dust Control Plan for the mine required 40,000 cfm in the last open crosscut, 20,000 cfm in the working faces, and required the line curtain to be installed within 12 feet of the working face in development sections. The ventilation system in use on the 102 Section at the time of Villegos' inspection was operating normally and exceeded the requirements of the ventilation plan. There is no indication the system changed before the explosion.

18. During the investigation, it was evident from the amount of loose coal in the face in front of the continuous mining machine, that a coal outburst had occurred in the face of No. 1 entry. Because the line brattice had been blown down and melted, it was impossible to determine its condition prior to the explosion; however, the furthest inby line post on which line brattice is normally attached remained intact and was approximately 12 feet outby the cutter bits.

19. Sometime after the "B" shift started loading coal and prior to the explosion, an outburst occurred in the face of the No. 1 entry on the 102 Section releasing a large

quantity of methane that could not be diluted by the available intake air to less than explosive concentrations.

20. Coal dust produced by the pushout, along with coal and dust present in the shuttle car, feeder, belt conveyor, and mine entries, provided ample fuel to propagate the explosion. The rock dust present in the explosion area did not render inert the coal dust released by the pushout and the coal dust that was thrown into suspension by the forces of the explosion.

21. A lighting system was installed on the continuous mining machine in the 102 Section. The lighting system was not installed in accordance with the permit granted by MSHA: A two-pole switch to turn the lights on and off was not included in the secondary circuit of the lighting transformer; and the methane monitor contacts were not wired into the primary circuit of the lighting transformer in such a manner as to cause deenergization of the lighting system when the sensor for the methane monitor detected methane concentrations exceeding 2.0 percent.

22. The installation of the lighting system constituted a field modification of permissible equipment, which, by MSHA policy, required MSHA to inspect the field modification during the next MSHA electrical inspection at the mine, however, the investigators could not ascertain whether the inspection was made since records of the inspections do not detail all the inspectors activities.

23. The original installation did not include a switch for turning the lights on and off. According to John Cerise, Third Shift Maintenance Foreman, the old cover plate on the explosion-proof compartment was replaced on April 6, 1981, with a cover plate containing a light switch and wired into the lighting circuit.

24. The investigation revealed that the cover plate had been bolted down onto a No. 14 insulated wire in the plane flange joint, leaving openings in the flame path in excess of 0.015 inch. Statements from mine officials and each qualified person performing electrical work indicated that the compartment had not been entered since the new cover had been installed. The investigators found no evidence that the compartment had been entered for any purpose other than installation of the light switch. An MSHA inspector examined the continuous mining machine on two occasions after the new cover was installed, on April 9 and April 13, to determine if the machine was in permissible condition. He did not detect the permissibility deficiencies.

25. The investigation revealed that the work of installing the new cover plate on the continuous mining machine explosion-proof compartment was neither performed by a qualified person within the meaning of Section 75.153, 30 CFR, nor done under the direct supervision of a qualified person.

26. The methane monitor was connected into the continuous mining machine circuitry in such a manner that activation of the methane monitor caused deenergization of all electric equipment and circuits on board the machine except the methane monitor itself, the incoming trailing cable, and the lighting system's six lights which were controlled by the light switch in the explosion-proof compartment. Statements made by miners and mine officials indicated that the lights were to be kept on whenever the continuous mining machine was in operation; however, the light switch was found in the "off" position. The investigators determined that Mid-Continent officials had discussed this methane monitor system with MSHA inspectors, who had not advised them that the methane monitor was improperly connected.

27. None of the explosion-proof compartments contained visible evidence of methane ignition except the explosion-proof compartment housing the light switch controlling the lighting system. The flame paths and the interior of this compartment contained coal dust and evidence of a methane ignition. Laboratory tests of dust taken from the top of the transformer and the bottom of the enclosure revealed the presence of burned coal, indicating the presence of flame within the enclosure.

28. The investigators determined that a definite written maintenance program for keeping methane monitors operative had not been established and adopted. Mid-Continent maintenance foremen stated that they did not know of the existence of a written maintenance program for methane monitors.

Four of the conditions and practices in the Findings of Fact contributed to the explosion and constituted violations of the Federal Mine Safety and Health Act of 1977 and the mandatory standards contained in 30 CFR. These are listed below:

§75.313	The methane monitor on the continuous mining machine in the 102 Section deenergized the continuous mining machine when the methane concentration reached 2.0 percent; however, it did not deenergize the lighting system.

§75.503	The continuous mining machine in the 102 Section was not maintained in permissible condition in that an opening in excess of 0.004 inch existed in the plane flange joint under the cover of the explosion-proof compartment housing the lightin transformer and switch.
§75.511	Electrical work consisting of the installation of a cover on an explosi proof compartment and the wiring of a two-pole light switch on the continuous mining machine in the 102 Section was not performed by a qualified person or under the direct supervision of a qualified person.
§75.313-1	A definite maintenance program for keeping methane monitors operative was not established and adopted.

A copy of these citations is in Appendix O.

Other violations were found during the investigation which did not contribute either to the cause or severity of the explosi Appropriate citations were issued to Mid-Continent, Inc., for all violations.

PART V - CONCLUSION

nclusion

e investigators concluded that an outburst of coal and methane curred at the face of the No. 1 entry on the 102 Section, leasing large amounts of methane and coal dust, creating explosive methane-air and coal dust mixture. The outburst s caused by extensive stresses exerted on the coalbed and ce by the massive overburden and other geological conditions the mine. The explosion occurred when methane had accumulated ound the continuous mining machine and migrated into the mpartment housing the light switch and the light switch control- ng the lighting system on the continuous mining machine was rned off. The electric components of the switch were housed an explosion-proof compartment which, while designed to explosion-proof, had not been maintained in permissible ndition. The cover of the compartment had not been properly stalled because it had been closed upon a No. 14 AWG insulated re inadvertently left in the plane flange joint of the compart- nt causing an opening exceeding 0.015 inch. The opening rmitted methane to migrate into the compartment and flame ...d burning material to escape the compartment when the methane inside was ignited by an arc caused by the operation of the switch. The escaping flame and burning material ignited the explosive methane-air mixture in the face area of the No. 1 entry.

The following conditions and practices contributed to the cause of the explosion:

- The lighting system was not installed in accordance with the wiring diagram that was submitted by Mid-Continent with their request to install the lighting system and approved by MSHA. The lighting system on the continuous mining machine was not deenergized when the methane monitor activated as the methane content exceeded 2.0 percent.

- The installation and wiring of the two-pole light system control switch and the installation of the cover of the explosion-proof compartment was not performed by a person who was qualified within the meaning of Section 75.153 30 CFR or under the direct supervision of a qualified person.

- The flame path under the cover of the explosion-proof compartment was not properly tested to ascertain that the compartment was in permissible condition after the cover was installed.

Mining Engineer

Cecil E. Lester

Cecil E. Lester
Coal Mine Specialist

Alex O'Rourke

Alex O'Rourke
Supervisory Mining Engineer

Raymond A. Strahin

Raymond A. Strahin
Coal Mine Inspector

Timothy J. Thompson

Timothy J. Thompson
Mining Engineer

Edward M. Kawenski

Edward M. Kawenski
Supervisory Mining Engineer

Approved by:

J. Lamonica

Joseph A. Lamonica
Administrator--Coal Mine Safety and Health

APPENDIX A

VICTIMS OF EXPLOSION, DUTCH CREEK
NO. 1 MINE, MID-CONTINENT RESOURCES, INC.

April 15, 1981

Name and Social Security Number	Age	Sex	Job Classification	Experience At That Job	Total Experience
John Ayala 522-80-9281	40	M	Continuous Mining Machine Operator	Not Available	7 years 10 months
Kyle Delano Cook 234-56-7109	43	M	Shuttle Car Operator	1 week	15 years
Kelly Bert Greene 524-84-4466	25	M	Foreman	1 year 4 months	5 years 10 months
William Eugene Guthrie 422-64-9282	32	M	Underground Mechanic Electrician	7 years 4 months	2 years 3 months
Richard Allen Lincoln 523-98-9158	22	M	Experienced Miner	4 months	2 years 7 months
Daniel Bryan Litwiller 522-78-0569	21	M	Apprentice Miner	1 month	1 month
Terry E. Lucero 521-82-5904	28	M	Continuous Mining Machine Operator Helper	7 months	3 years 1 month
Loren Herbert Mead 523-62-5625	35	M	Continuous Mining Machine Operator Helper	7 months	6 years 1 month
Ronald Westley Patch 521-60-5544	34	M	Crew Foreman	3 years 2 months	5 years 2 months
Hugh William Pierce Jr. 457-98-0089	19	M	Apprentice Miner	1 month	1 month

APPENDIX A

VICTIMS OF EXPLOSION, DUTCH CREEK
NO. 1 MINE, MID-CONTINENT RESOURCES, INC.

April 15, 1981

Name and Social Security Number	Age	Sex	Job Classification	Experience At That Job	Total Experience
Robert Harold Ragle 521-80-4603	29	M	Foreman	4 years 5 months	8 years 4 months
John Arthur Rhodes 522-74-5975	29	M	Crew Foreman	3 years 3 months	8 years
Glen William Sharp 522-72-5435	31	M	Continuous Mining Machine Operator	3 years 3 months	4 years 10 months
Brett James Tucker 523-70-0243	30	M	Experienced Miner	1 month	7 years 11 months
Thomas N. Vetter 521-88-4452	24	M	Experienced Miner	Not Available	4 years 4 months

APPENDIX B

MINE RESCUE TEAMS

Mid-Continent Resources, Inc.
Redstone, Colorado

Team No. 1	Team No. 2
Grant Brady, Jr., Captain	Duane Mortenson, Captain
Lee McBride	Moses LaCome
Pat Gwyn	John K. Wood
Gene Shilling	George Prewitt
Tim Cole	Larry Roebke
Donald Ford, Trainer	

Colorado-Westmoreland, Inc.
Paonia, Colorado

Team No. 1	Team No. 2
Don Emmons, Captain	Harry Galer, Captain
Mark Branson	Leroy Martin
Pat Peck	Fred Davenport
Ray Melins	Kay Hallows
Link Derrick, Trainer	Matt Winey
	Dwayne Schearer

U.S. Steel Mining Co., Inc.
Somerset, Colorado

Donovan Story, Captain
Joe Voorhees
Rusty Tullio
Andy Pavlisick
Melvin McFarlane
John Weldon, Trainer

Price River Coal Co.
Helper, Utah

John Grako, Captain
Laine Adair
Randy Tatton
Steve Cowan
Ron Gracolletto
John O'Green, Trainer

Emery Mining Corp.
Huntington, Utah

Curtis Steel, Captain
Kevin Tuttle
Roger Tuttle
Tony Koss
Eric Bunderson
Bryan Clements
Ray Guymon, Trainer

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 23, 1981 and April 26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		(A) No. 1 return entry, main slope, about 60 feet inby No. 2 crosscut from main portal, No. 2 fan, left side fan		
		No. 1 - A entry, return		
1-A-1	rib, floor	0 + 00'		97
1-A-2	do	0 + 200'		86
1-A-3	do	0 + 400'		95.5
1-A-4	do	0 + 600'		100
1-A-5	do	0 + 800'		95
1-A-6	do	0 + 1,000'		90
1-A-7	do	0 + 1,200'		99
1-A-8	do	0 + 1,400'		86
1-A-9	do	0 + 1,600'		60
1-A-10		0 + 1,800' - caved - no sample		
1-A-11		0 + 2,000' - caved - no sample		
1-A-12		0 + 2,200' - caved - no sample		
1-A-13		0 + 2,400' - not accessable - no sample		
1-A-14	rib, floor	0 + 2,600' - no sample received		
1-A-15		0 + 2,800' - full of water, pump sump, no sample		
1-A-16		0 + 3,000' - floor heaved to roof - no sample		
1-A-17	rib, floor	0 + 3,200'		90
1-A-18	do	0 + 3,400'		71
1-A-18X		0 + 3,450' - no crosscut at this spot, no sample		
1-A-19	rib, floor	0 + 3,600'		81.5
1-A-19X		0 + 3,650' - no crosscut - no sample		
1-A-20	rib, floor	0 + 3,700'	none	91
1-A-20X		0 + 3,750' - no crosscut - no sample		

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 23, 1981 and April 26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		(B) No. 2, intake and return entry, main slope		
		B (No. 2 entry), intake, return		
1-B-1	rib, floor	intake, 0 + 00'		65
1-B-2	do	intake, 0 + 200'		48 ✓
1-B-3	do	intake, 0 + 400'		84.5
1-B-3X	do	intake, 0 + 450'		84.5
1-B-4	do	intake, 0 + 600'		90
1-B-5	do	intake, 0 + 800'		62.5 ✓
1-B-6	do	intake, 0 + 1,000'		82
1-B-6X	do	intake, 0 + 1,050'		81
1-B-7	do	return, 0 + 1,200'		99
1-B-8	do	return, 0 + 1,400'		90.5
1-B-9	do	return, 0 + 1,600'		51.5 ✓
1-B-9X		sample received in lab		69.5 ✓
1-B-10	do	return, 0 + 1,800'		85.5
1-B-11	do	return, 0 + 2,000'		78
1-B-12	do	return, 0 + 2,200'		88
1-B-12X		crosscut crushed in - no sample		
1-B-13	rib, floor	return, 0 + 2,400'		88.5
1-B-14	do	return, 0 + 2,600'		95.5
1-B-15	do	return, 0 + 2,800'		75.5 ✓
1-B-15X	do	return, 0 + 2,850'		81
1-B-16	do	return, 0 + 3,000'		73.5 ✓
1-B-17	do	return, 0 + 3,200'		65 ✓
1-B-18	do	return, 0 + 3,400'		51.5 ✓
1-B-18X		crosscut floor uplifted to roof, 0 + 3,400', no sample		

EXHIBIT D-76

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 23, 1981 and April 26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-B-19	floor, rib	return, 0 + 3,600'		61 ✓
1-B-19X		crosscut floor uplifted to roof, 0 + 3,650', no sample		
1-B-20	floor, rib	return, 0 + 3,800'		73 ✓
1-B-20X	do	return, 0 + 3,850'	none	81.5
1-B-21	do	return, 0 + 3,900'	none	45
1-B-21X		crosscut floor uplifted to roof, 0 + 3,950', no sample		
1-B-22	floor, rib	return, 0 + 4,000'	none	71
1-B-22X		crosscut floor uplifted to roof, 0 + 4,050', no sample		
1-B-23	floor, rib	return, 0 + 4,100'	none	37.5
1-B-23X		crosscut floor uplifted to roof, 0 + 4,150', no sample		
1-B-24	floor, rib	return, 0 + 4,200'	none	62
1-B-25	do	return, 0 + 4,300'	none	45.5
1-B-26	do	return, 0 + 4,400'	none	46
1-B-27	do	return, 0 + 4,500'	none	42.5
1-B-28	do	return, 0 + 4,600'	none	52.5
1-B-29	do	return, 0 + 4,700'	none	21.5
1-B-30	do	return, 0 + 4,800'	trace	89
1-B-31	do	return, 0 + 4,900'	trace	59
1-B-32	do	return, 0 + 5,000'	trace	48.5
1-B-33	do	return, 0 + 5,100'	small	76.5
1-B-34	do	return, 0 + 5,200'	small	43.5
1-B-35	do	return, 0 + 5,300'	large	46.5
1-B-36	do	return, 0 + 5,400'	large	45.1
1-B-37	do	return, 0 + 5,500'	large	45.8

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 23, 1981 and April 26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-B-38	floor, rib	return, 0 + 5,600'	extra large	52.3
1-B-39	do	return, 0 + 5,700'	extra large	24.8
1-B-40	do	return, 0 + 5,800'	extra large	85.3
1-B-41	do	return, 0 + 5,900'	extra large	60.1
1-B-42	do	return, 0 + 6,000'	extra large	50.5
1-B-43	do	return, 0 + 6,100'	extra large	66.5
1-B-44	do	return, 0 + 6,200'	extra large	64.3
1-B-45	do	return, 0 + 6,300'	extra large	27.8
1-B-46	do	return, 0 + 6,400'	extra large	55.1
1-B-47	do	return, 0 + 6,500'	extra large	58.8
1-B-48	do	return, 0 + 6,600'	extra large	23.1
1-B-49	do	return, 0 + 6,700'	extra large	20.5
1-B-50		filled with water, 0 + 6,800', no sample		

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 22, 1981 and April 25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		slope entry, C entry, intake and return, No. 3 entry, about 35 feet inby the first crosscut inby the intake portal C - No. 3, intake entry		
1-C-1	rib, floor	0 + 00'		38.5
1-C-2	do	0 + 200'		54
1-C-3	do	0 + 400'		65
1-C-3X	do	0 + 450'		91
1-C-4	do	0 + 600'		74
1-C-5	do	0 + 800'		80
1-C-6	do	0 + 1,000'		86
1-C-6X	do	0 + 1,050'		63
1-C-7	do	0 + 1,200'		75.5
1-C-8	do	0 + 1,400'		59.5
1-C-9	do	0 + 1,600'		92.5
1-C-9X	do	0 + 1,680'		68
1-C-10	do	0 + 1,800'		85
1-C-11	do	0 + 2,000'		81
1-C-12	do	0 + 2,200'		72
1-C-12X	do	0 + 2,250'		100
1-C-13	do	0 + 2,400'		80
1-C-14	do	0 + 2,600'		80
1-C-15	do	0 + 2,800'		93
1-C-15X	do	0 + 2,850'		93
1-C-16	do	0 + 3,000'		76
1-C-17	do	0 + 3,200'		82

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 22, 1981 and April 25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-C-18	rib, floor	0 + 3,400'		79.5
1-C-18X	do	0 + 3,450'		80.5
1-C-19	do	0 + 3,600'		87
1-C-19X	do	0 + 3,650'		93
1-C-20	do	0 + 3,800'	none	100
1-C-20X	do	0 + 3,850'	none	78
		Return entry		
1-C-21	do	0 + 3,900'	none	63
1-C-21X	do	0 + 3,950'	none	65
1-C-22	do	0 + 4,000'	none	81
1-C-22X	do	0 + 4,050'	none	87.5
1-C-23	do	0 + 4,100'	none	88
1-C-23X	do	0 + 4,150'	none	92
1-C 24	do	0 + 4,200'	none	92
1-C-24X	do	0 + 4,250'	none	83.5
1-C-25	do	0 + 4,300'	none	92.5
1-C-25X	do	0 + 4,350'	none	100
1-C-26	do	0 + 4,400'	none	79
1-C-26X	do	0 + 4,450'	none	84.5
1-C-27	do	0 + 4,500'	none	79.5
1-C-27X	do	0 + 4,550'	none	55
		Intake entry		
1-C-28	do	0 + 4,600'	none	84
1-C-28X	do	0 + 4,650'	none	66
1-C-29	do	0 + 4,700'	none	70
1-C-29X	do	0 + 4,750'	none	67.5

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 22, 1981 and April 25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-C-30	rib, floor	0 + 4,800'	none	81
1-C-30X	do	0 + 4,850'	trace	59
1-C-31	do	0 + 4,900'	trace	35
1-C-31X	do	0 + 4,950'	trace	35
1-C-32	do	0 + 5,000'	none	32
1-C-32X	do	0 + 5,050'	none	32
1-C-33	do	0 + 5,100'	none	49
1-C-33X	do	0 + 5,150'	trace	81.5
1-C-34	do	0 + 5,200'	trace	52.5
1-C-34X	do	0 + 5,250'	trace	93
1-C-35	do	0 + 5,300'	trace	31
1-C-35X	do	0 + 5,350'	trace	69.5
1-C-36	do	0 + 5,400'	trace	65.5
1-C-36X	do	0 + 5,450'	small	47.5
1-C-37	do	0 + 5,500'	small	25
1-C-37X	do	0 + 5,550'	large	45.2
1-C-38	do	0 + 5,600'	small	24
1-C-38X	do	0 + 5,650'	large	62.9
1-C-39	do	0 + 5,700'	large	55.4
1-C-39X	do	0 + 5,750'	large	34.4
1-C-40	do	0 + 5,800'	large	36.5
1-C-40X	do	0 + 5,850'	small	19
1-C-41	do	0 + 5,900'	small	37.5
1-C-41X		crosscut pushed up into roof, 0 + 5,950'		
1-C-42	rib, floor	0 + 6,000'	small	28
1-C-42X	do	0 + 6,050'	extra large	35.7
1-C-43	do	0 + 6,100'	extra large	29.2
1-C-43X	do	0 + 6,150'	extra large	49.7

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED April 22, 1981 and April 25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-C-44	rib, floor	0 + 6,200'	extra large	25.3
1-C-44X	do	0 + 6,250'	extra large	26.3
1-C-45	do	0 + 6,300'		27.6
1-C-45X	do	0 + 6,350'	extra large	27.8
1-C-46	do	0 + 6,400'	extra large	22.3
1-C-46X	do	0 + 6,450'	extra large	36.5
1-C-47	do	0 + 6,500'	extra large	32.7
1-C-48	do	0 + 6,600'	extra large	32.6
1-C-48X	do	0 + 6,650'	extra large	62.5
1-C-49	do	0 + 6,700'	extra large	44.2
1-C-50		entry filled with water, 0 + 6,800', no sample		
		Return entry		
1-C-50X		entry filled with water, 0 + 6,850', no sample		

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED April 22, 1981 and April 24, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		main slope entries, about 32 feet inby the No. 2 stopping in the No. 4 (D) belt entry, intake		
1-D-1	rib, floor	0 + 00'		78.5
1-D-2	do	0 + 200'		68.5
1-D-3	do	0 + 400'		91
1-D-3X	do	0 + 450'		100
1-D-4	do	0 + 600'		89.5
1-D-5	do	0 + 800'		98
1-D-6	do	0 + 1,000'		79
1-D-6X	do	0 + 1,050'		73.5
1-D-7	do	0 + 1,200'		90
1-D-8	do	0 + 1,400'		89.5
1-D-9	do	0 + 1,600'		99
1-D-9X	do	0 + 1,620'		85.5
1-D-10	do	0 + 1,800'		96
1-D-11	do	0 + 2,000'		95
1-D-12	do	0 + 2,200'		100
1-D-12X	do	0 + 2,250'		97.5
1-D-13	do	0 + 2,400'		100
1-D-14	do	0 + 2,600'		100
1-D-15	do	0 + 2,800'		81.5
1-D-15X	do	0 + 2,850'		89
1-D-16	do	0 + 3,000'		94
1-D-17	do	0 + 3,200'		92
1-D-18	do	0 + 3,400'		100
1-D-18X	do	0 + 3,450'		100
1-D-19	do	0 + 3,600'		84
1-D-19X	do	0 + 3,650'		93.5

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 22, 1981 and April 24, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-D-20	rib, floor	0 + 3,800'	none	89
1-D-20X	do	0 + 3,850'	none	78.5
1-D-21	do	0 + 3,900'	none	76
1-D-21X	do	0 + 3,950'	none	92.5
1-D-22	do	0 + 4,000'	none	89.5
1-D-22X	do	0 + 4,050'	none	90
1-D-23	do	0 + 4,100'	none	95.5
1-D-23X	do	0 + 4,150'	none	98
1-D-24	do	0 + 4,200'	none	91
1-D-24X	do	0 + 4,250'	none	77
1-D-25	do	0 + 4,300'	none	68.5
1-D-25X	do	0 + 4,350'	none	99.5
1-D-26	do	0 + 4,400'	none	92
1-D-26X	do	0 + 4,450'	none	81.5
1-D-27	do	0 + 4,500'	none	71
1-D-27X	do	0 + 4,550'	none	43.5
1-D-28	do	0 + 4,600'	none	78
1-D-28X	do	0 + 4,650'	none	68.5
1-D-29	do	0 + 4,700'	none	54.5
1-D-29X	do	0 + 4,750'	none	83.5
1-D-30	do	0 + 4,800'	none	67
1-D-30X	do	0 + 4,850'	none	60
1-D-31	do	0 + 4,900'	trace	52
1-D-31X	do	0 + 4,950'	none	46.5
1-D-32	do	0 + 5,000'	none	64.5
1-D-32X	do	0 + 5,050'	trace	87.5
1-D-33	do	0 + 5,100'	trace	43.5
1-D-33X	do	0 + 5,150'	trace	58.5
1-D-34	do	0 + 5,200'	trace	76
1-D-34X	do	0 + 5,250'	trace	86

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED April 22, 1981 and April 24, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-D-35	rib, floor	0 + 5,300'	trace	72
1-D-35X	do	0 + 5,350'	trace	74
1-D-36	do	0 + 5,400'	trace	54
1-D-36X	do	0 + 5,450'	trace	37
1-D-37	do	0 + 5,500'	trace	79.5
1-D-37X	do	0 + 5,550'	trace	64
1-D-38	do	0 + 5,600'	trace	73
1-D-38X	do	0 + 5,650'	small	60
1-D-39	do	0 + 5,700'	small	39
1-D-39X	do	0 + 5,750'	large	35.5
1-D-40	do	0 + 5,800'	small	67.5
1-D-40X	do	0 + 5,850'	small	22
1-D-41	do	0 + 5,900'	large	32.4
1-D-41X	do	0 + 5,950'	large	29.5
1-D-42	do	0 + 6,000'	large	34.0
1-D-42X	do	0 + 6,050'	large	35
1-D-43	do	0 + 6,100'	large	19.7
1-D-43X	do	0 + 6,150'	large	25.6
1-D-44	do	0 + 6,200'	trace	40
1-D-44X	do	0 + 6,250'	small	45
1-D-45	do	0 + 6,300'	large	25.5
1-D-45X	do	0 + 6,350'	extra large	48.6
1-D-46	do	0 + 6,400'	extra large	48.9
1-D-46X	do	0 + 6,450'	extra large	61.8
1-D-47	do	0 + 6,500'	extra large	28.1
1-D-48	do	0 + 6,600'	extra large	27.6
1-D-48X	do	0 + 6,650'	extra large	39.7
1-D-49	do	0 + 6,700'	extra large	12.2
1-D-49X	do	0 + 6,750'	extra large	20.5
1-D-50		) + 6,800'	trace	98

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		No. 5, 6, and 7 main slopes, 23 feet inby the equalizing overcast located in the No. 6 slope entry Samples No. 1-E-1 through and including No. 1-E-5X was not taken due to the fact that the No. 5 main slope was not developed to where sample No. 1-E-6 was taken No. 5 slope, intake		
1-E-6	band	0 + 1,043'		100
1-E-6X	ribs, floor	0 + 1,106'		67
1-E-7	do	0 + 1,243'		77
1-E-8	do	0 + 1,443'		69
1-E-9	do	0 + 1,643'		80
1-E-9X	do	0 + 1,763'		68.5
1-E-10	do	0 + 1,843'		65
1-E-11	band	0 + 2,043'		40
1-E-12	ribs, floor	0 + 2,243'		76
1-E-12X		0 + 2,303', crosscut heaved closed, no sample		
1-E-13	band	0 + 2,443'		33
1-E-14	do	0 + 2,643'		51
1-E-15	ribs, floor	0 + 2,843', (roof too high)		77
1-E-15X	band	0 + 2,903'		57
1-E-16	ribs, floor	0 + 2,943', (roof too high)		61
1-E-17	do	0 + 3,143', (roof too high)		49.5
1-E-17X		0 + 3,193', crosscut heaved closed, no sample		
1-E-18	band	0 + 3,243'		58.5
1-E-18X	ribs, floor	0 + 3,293',(roof too high)		45

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-E-19	band	0 + 3,343'		60.5
1-E-19X	ribs, floor	0 + 3,393', (roof too high)		60
1-E-20	band	0 + 3,443'	none	55
1-E-20X	do	0 + 3,493'	none	23
1-E-21	do	0 + 3,543'	none	43
1-E-21X	ribs, floor	0 + 3,593', (roof too high)	none	39
1-E-22	do	0 + 3,643', (roof too high)	none	33
1-E-22X	do	0 + 3,693', (roof too high)	none	26.5
1-E-23	do	0 + 3,743', (roof too high)	none	50
1-E-23X	do	0 + 3,793', (roof too high)	none	45
1-E-24	do	0 + 3,843', (roof too high)	trace	51.5
1-E-24X	do	0 + 3,893', (roof too high)	none	27
1-E-25	do	0 + 3,943', (roof too high)	none	28
1-E-25X		0 + 3,993', (overcast), no sample		
1-E-26	ribs, floor	0 + 4,043', (roof too high)	trace	30.5
1-E-26X	do	0 + 4,093', (roof too high)	none	38
1-E-27	band	0 + 4,143'	none	26.5
1-E-27X	ribs, floor	0 + 4,193', (roof too high)	none	30
1-E-28	band	0 + 4,243'	none	29.5
1-E-28X	ribs, floor	0 + 4,293', (roof too high)	none	36
1-E-29	do	0 + 4,343', (roof too high)	none	38
1-E-29X	do	0 + 4,393', (roof too high)	none	61
1-E-30	do	0 + 4,443', (roof too high)	trace	58
1-E-30X	do	0 + 4,493', (roof too high)	trace	59
1-E-31	floor	0 + 4,543', (roof too high and ribs fenced off)	trace	30
1-E-31X	ribs, floor	0 + 4,593', (roof too high)	trace	36
1-E-32	do	0 + 4,643', (roof too high)	small	29
1-E-32X	do	0 + 4,693', (roof too high)	large	28.6
1-E-33		0 + 4,743', (roof too high and floor wet)	large	26.7

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-E-33X	ribs, floor	0 + 4,793', (roof too high)	large	47.9
1-E-34	floor	0 + 4,843', (roof too high and floor wet)	small	28
1-E-34X	ribs, floor	0 + 4,893', (roof too high)	extra large	59
1-E-35	do	0 + 4,943', (roof too high)	small	27
1-E-35X	band	0 + 4,993'	large	35.1
1-E-36	do	0 + 5,043'	small	26
1-E-36X	do	0 + 5,093'	large	32.5
1-E-37	do	0 + 5,143'	small	35
1-E-37X	do	0 + 5,193'	small	21.5
1-E-38	ribs, floor	0 + 5,243', (roof too high)	large	30
1-E-38X	band	0 + 5,293'	small	28
1-E-39	ribs, floor	0 + 5,343', (roof too high)	small	24
1-E-39X	band	0 + 5,393'	large	25
1-E-40	ribs, floor	0 + 5,443', (roof too high)	large	30.5
1-E-40X	do	0 + 5,493', (roof too high)	large	18.2
1-E-41	do	0 + 5,543', (roof too high)	large	20.9
1-E-41X	do	0 + 5,593', (roof too high)	extra large	30.7
1-E-42	do	0 + 5,643', (roof too high)	extra large	14
1-E-42X	do	0 + 5,693', (roof too high)	large	30.8
1-E-43	do	0 + 5,743', (roof too high)	extra large	28.1
1-E-43X	do	0 + 5,793', (roof too high)	extra large	27.5
1-E-44	do	0 + 5,843', (roof too high)	extra large	18.4
1-E-44X	do	0 + 5,893', (roof too high)	extra large	29.3
1-E-45	do	0 + 5,943', (roof too high)	large	42.2
1-E-46	do	0 + 6,043', (roof too high)	extra large	40.2
1-E-46X	do	0 + 6,093', (roof too high)	extra large	14.2

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		No. 5, 6, and 7 main slopes, 23 feet inby the equalizing overcast located in the No. 6 slope entry		
		No. 6 slope, rope slope intake		
1-F-1	band	0 + 23'	none	89
1-F-2	do	0 + 223'	none	97
1-F-3	do	0 + 423'	none	95
1-F-3X	do	0 + 498'	none	91
1-F-4	do	0 + 623'	none	81.5
1-F-5	ribs, floor	0 + 823', (roof too high)	none	82
1-F-6	roof, ribs	0 + 1,103', (floor wet)		93
1-F-6X	band	0 + 1,163'	none	77
1-F-7	do	0 + 1,303'	none	98
1-F-8	do	0 + 1,503'	none	62
1-F-9	do	0 + 1,703'	none	88.5
1-F-9X	ribs, floor	0 + 1,723', (roof too high)	none	81.5
1-F-10	do	0 + 1,903', (roof too high)	none	91
1-F-11	do	0 + 2,103', (roof too high)	none	90.5
1-F-12	band	0 + 2,303'	none	85
1-F-12X		0 + 2,353', (crosscut heaved closed, no sample)		
1-F-13	band	0 + 2,503'	none	62
1-F-14	do	0 + 2,703'	none	92
1-F-15	ribs, floor	0 + 2,903', (roof too high)	none	87
1-F-15X		0 + 2,953', (crosscut heaved closed, no sample)		
1-F-16	band	0 + 3,103'		78.5
1-F-17	do	0 + 3,303'		75.5
1-F-17X	do	0 + 3,353'		74.5
1-F-18	do	0 + 3,453'		84.5

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-F-18X	band	0 + 3,493'		47
1-F-19	do	0 + 3,553'		62.5
1-F-19X	do	0 + 3,593'		67.5
1-F-20	do	0 + 3,653'	none	61
1-F-20X	do	0 + 3,693'	none	65
1-F-21	do	0 + 3,753'	none	82.5
1-F-21X	rib, floor	0 + 3,793', (roof too high)	none	74
1-F-22	band	0 + 3,853'	none	65
1-F-22X	ribs, floor	(roof too high)	none	35
1-F-23	do	0 + 3,953', (roof too high)	none	77
1-F-23X	do	0 + 3,993', (roof too high)	none	42
1-F-24	band	0 + 4,053'	none	70.5
1-F-24X	ribs, floor	0 + 4,093', (roof too high)	none	36
1-F-25	band	0 + 4,153'	none	50
1-F-25X		0 + 4,193', (overcast)		
1-F-26	ribs, floor	0 + 4,253', (roof too high)	none	51
1-F-26X	do	0 + 4,293', (roof too high)	none	46
1-F-27	do	0 + 4,353', (roof too high)	none	53
1-F-27X	band	0 + 4,403'	none	36
1-F-28	ribs, floor	0 + 4,453', (roof too high)	none	49
1-F-28X	band	0 + 4,493'	none	52.5
1-F-29	do	0 + 4,553'	trace	55
1-F-29X	ribs, floor	0 + 4,603', (roof too high)	trace	22
1-F-30	band	0 + 4,653'	trace	67
1-F-30X	ribs, floor	0 + 4,703', (roof too high)	none	45
1-F-31	ribs, floor	0 + 4,753', (roof too high)	trace	67.5
1-F-31X	do	0 + 4,803', (roof too high)	extra large	30.8
1-F-32	do	0 + 4,853', (roof too high)	small	42
1-F-32X	do	0 + 4,903', (roof too high)	extra large	30.4

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-25, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-F-33	ribs, floor	0 + 4,953', (roof too high)	trace	24
1-F-33X	do	0 + 5,003', (roof too high)	extra large	31.2
1-F-34	do	0 + 5,053', (roof too high)	small	27
1-F-34X	do	0 + 5,103', (roof too high)	extra large	34.4
1-F-35	do	0 + 5,153', (roof too high)	small	46
		No. 6 slope, track entry, intake		
1-F-35X	band	0 + 5,203'	large	26
1-F-36	ribs, floor	0 + 5,253', (roof too high)	small	33
1-F-36X	band	0 + 5,303'	large	26
1-F-37	ribs, floor	0 + 5,353', (roof too high)	small	35
1-F-37X	band	0 + 5,403'	extra large	27.6
1-F-38	ribs, floor	0 + 5,453', (roof too high)	large	25.4
1-F-38X	ribs, floor	0 + 5,503', (roof too high)	large	18.6
1-F-39	do	0 + 5,553', (roof too high)	small	22
1-F-39X	do	0 + 5,603', (roof too high)	small	20
1-F-40	do	0 + 5,653', (roof too high)	large	20.2
1-F-40X	do	0 + 5,703', (roof too high)	small	17
1-F-41	do	0 + 5,753', (roof too high)	extra large	18
1-F-41X	do	0 + 5,803', (roof too high)	small	14
1-F-42	do	0 + 5,853', (roof too high)	small	25
1-F-42X	do	0 + 5,903', (roof too high)	large	17.7

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-23 and 25-26, 1981

MINE Dutch Creek No. 1 COMPANY Mid Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		No. 5, 6, and 7 main slope, 23 feet inby the equalizing overcast located in the No. 6 slope entry		
		No. 7 slope, return		
1-G-1	band	0 + 23'		98.5
1-G-2	do	0 + 223'		95
1-G-3	ribs, floor	0 + 423', (roof too high)		82
1-G-3X		0 + 498', (roof bad)		
1-G-4	band	0 + 623'		88
1-G-5	do	0 + 823'		79.5
1-G-6	ribs, floor	0 + 1,023', (roof too high)		65
1-G-6X		0 + 1,063', (bad roof)		
1-G-7	ribs, floor	0 + 1,223', (roof too high)		65.5
1-G-8	do	0 + 1,473', (roof too high)		60.5
1-G-9	do	0 + 1,693', (roof too high)		80
1-G-9X	do	0 + 1,773', (roof too high)		86
1-G-10	do	0 + 1,873', (roof too high)		79
1-G-11	band	0 + 2,073'		88
1-G-12	do	0 + 2,273'		65
1-G-12X		0 + 2,360', (crosscut heaved closed)		
1-G-13	ribs, floor	0 + 2,473', (roof too high)		89
1-G-14	band	0 + 2,673'		95
1-G-15	do	0 + 2,873'		64
1-G-15X	do	0 + 2,923'		76.5
1-G-16	do	0 + 3,073'		89.5
1-G-17	do	0 + 3,273'		69
1-G-17X		0 + 3,323', (crosscut heaved)		

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-23 and 25-26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-G-18	band	0 + 3,373'		46
1-G-18X	do	0 + 3,423'		52
1-G-19	ribs, floor	0 + 3,473', (roof too high)		19
1-G-19X	band	0 + 3,523'		83
1-G-20	ribs, floor	0 + 3,573', (roof too high)	none	27
1-G-20X		0 + 3,623', (crosscut heaved)		
1-G-21	ribs, floor	0 + 3,673', (roof too high)	none	36
1-G-21X	band	0 + 3,723'	none	86
1-G-22	ribs, floor	0 + 3,773', (roof too high)	none	33
1-G-22X		0 + 3,823', (crosscut heaved)		
1-G-23	ribs, floor	0 + 3,873', (roof too high)	none	39
1-G-23X	band	0 + 3,923'	none	81.5
1-G-24	ribs, floor	0 + 3,973', (roof too high)	none	35
1-G-24X	band	0 + 4,023'	none	83.5
1-G-25	ribs, floor	0 + 4,073', (roof too high)	none	41
1-G-25X	do	0 + 4,123', (roof too high)	none	41
1-G-26	do	0 + 4,173', (roof too high)	none	51
1-G-26X		0 + 4,223', (crosscut heaved)		
1-G-27	band	0 + 4,273'	none	35.5
1-G-27X	ribs, floor	0 + 4,323', (roof too high)	none	66
1-G-28	do	0 + 4,373', (roof too high)	trace	36
1-G-28X	band	0 + 4,423'	none	66
1-G-29	ribs, floor	0 + 4,473', (roof too high)	trace	50
1-G-29X	do	0 + 4,523', (roof too high)	trace	42.5
1-G-30	band	0 + 4,573'	trace	63
1-G-30X	do	0 + 4,623'	none	74
1-G-31	do	0 + 4,673'	trace	53
1-G-31X		0 + 4,723' (overcast)		
1-G-32	ribs, floor	0 + 4,773', (roof too high)	small	52.5
1-G-32X		+ 4,823', (overcast)		
1-G-33		+ 4,873', (roof too high)		

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED April 22-23 and 25-26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1-G-33X	band	0 + 5,023'	extra large	47.3
1-G-34	do	0 + 5,073'	small	50
1-G-34X	do	0 + 5,123'	large	51
1-G-35	do	0 + 5,173'	small	52.5
1-G-35X	do	0 + 5,223'	extra large	59.9
1-G-36	do	0 + 5,273'	small	41
1-G-36X	do	0 + 5,323'	large	42.5
1-G-37	do	0 + 5,373'	small	47.5
1-G-37X	do	0 + 5,423'	small	69.5
1-G-38	ribs, floor	0 + 5,473', (roof too high)	large	29.7
1-G-38X	band	0 + 5,523'	large	54.5
1-G-39	do	0 + 5,573'	small	51
1-G-39X	ribs, floor	0 + 5,623', (roof too high)	extra large	36.7
1-G-40	band	0 + 5,673'	small	58
1-G-40X	ribs, floor	0 + 5,723', (roof too high)	small	23.5
1-G-41	do	0 + 5,773', (roof too high)	extra large	19.1
1-G-41X	do	0 + 5,823', (roof too high)	trace	19.5
1-G-42	do	0 + 5,873', (roof too high)	trace	20

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR

MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		102 section (2 entries), survey station No. 7219 in the return entry of the 102 section		
		No. 1 entry, intake		
2-A-1	ribs, floor	0 - 50', (roof too high)	trace	38
2-A-2	do	0 + 50', (roof too high)	trace	30
2-A-3	do	0 + 150', (roof too high)	small	20.5
2-A-4	do	0 + 250', (roof too high)	small	33.5
2-A-5	do	0 + 350', (roof too high)	small	23.5
2-A-6	do	0 + 450', (roof too high)	small	17
2-A-7	do	0 + 550', (roof too high)	large	28.4
2-A-8	do	0 + 650', (roof too high)	large	21.4
2-A-9	do	0 + 750', (roof too high)	extra large	21.9
2-A-10	ribs	0 + 850', (floor wet and roof too high)	extra large	16.2
2-A-11	do	0 + 950', (floor wet and roof too high)	extra large	18.2
		No. 2 entry, belt and return		
2-B-1	band	0 - 50'	trace	28
2-B-1X	do	0 + 0'	large	30
2-B-2	do	0 + 50'	trace	37
2-B-3	ribs, floor	0 + 150', (roof too high)	trace	32
2-B-3X	do	0 + 200', (roof too high)	large	38.3
2-B-4	do	0 + 250', (roof too high)	trace	53.5
2-B-5	do	0 + 350', (roof too high)	trace	40
2-B-5X	do	0 + 400', (roof too high)	small	33
2-B-6	do	0 + 450', (roof too high)	trace	25

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
2-B-7	ribs, floor	0 + 550', (roof too high)	small	19
2-B-7X	do	0 + 600', (roof too high)	large	24.6
2-B-8	do	0 + 650', (roof too high)	large	22.2
2-B-9	do	0 + 750', (roof too high)	large	17.1
2-B-9X	do	0 + 800', (roof too high)	large	17.9
2-B-10	do	0 + 850', (roof too high)	extra large	16.8
2-B-11	do	0 + 950', (roof too high)	extra large	14.2
2-B-11X	band	0 + 1,000', return entry on the intake side	extra large	15.3
2-B-12	do	0 + 1,050', return entry at the face	large	16.5

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 27, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		6th south section, No. 3 (c) entry, sixth south, 120 feet inby the No. 2 slope, return air overcast		
		No. 1 return entry		
3-A-1	rib, floor	No samples taken in this entire entry as it is unaccessable due to the entry floor heaving against the roof. Closed tight.		
3-A-1X	do			
3-A-2	do			
3-A-3	do			
3-A-4	do			
3-A-5	do			
3-A-6	do			
3-A-7	do			
		No. 2 return entry		
3-B-1	do	0 + 00'		85.5
3-B-1X		0 + 50', floor heaved to top		
3-B-2	rib, floor	0 + 100'		64
3-B-2X		0 + 150', floor heaved to top		
3-B-3	rib, floor	0 + 200'		94
3-B-3X		0 + 250', floor heaved to top		
3-B-4	rib, floor	0 + 300'		86
3-B-4X		0 + 350', floor heaved to top		
3-B-5	rib, floor	0 + 400'		51
3-B-5X		0 + 450', floor heaved to top		
3-B-6	rib, floor	0 + 500'		74
3-B-6X		0 + 550', floor heaved to top		
3-B-7		0 + 600', floor heaved to top		

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED April 27, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		No. 3 belt intake entry		
3-C-1	rib, floor	0 + 00'		81
3-C-1X	do	0 + 50'		73
3-C-2	do	0 + 100'		83.5
3-C-2X	do	0 + 150'		54.5
3-C-3	do	0 + 200'		100
3-C-3X	do	0 + 250'		67
3-C-4	do	0 + 300'		71
3-C-4X	do	0 + 350'		66
3-C-5		0 + 400', no sample, caved entry, bad top		
		No. 4 intake entry		
3-D-1	rib, floor	0 + 00'		43
3-D-1X	do	0 + 50'		42
3-D-2	do	0 + 100'		63
3-D-2X	do	0 + 150'		66
3-D-3	do	0 + 200'		26
3-D-3X	do	0 + 250'		65
3-D-4	do	0 + 300'		68
3-D-4X	do	0 + 350'		93
3-D-5	do	0 + 400'		78
3-D-5X	do	0 + 450'		66
3-D-6	do	0 + 500'		94
3-D-6X	do	0 + 550'		91
3-D-7		roof fall, bad top, 0 + 600'		

MSHA [illegible] [illegible]A

TABLE_____ - ANALYSES OF DUST [illegible]

MINE Dutch Creek No. 1 [illegible] Incorporated

COLLECTED BY Jerry O. D. Lemon, George [illegible] arry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM		ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
3-E-1		entry filled with water, pump sump, no samples		
3-E-2				
3-E-3				
3-E-4				
3-E-4X				
3-E-5				
3-E-5X				
3-E-6				
3-E-6X				
3-E-7				

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 26, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		7th south section, No. 1 entry, 7 south, 50 feet inby centerline of No. 2 slope		
		Return		
4-A-1	floor, rib	0 + 00'		88
4-A-2	do	0 + 100'		84
4-B-1	do	0 + 00'		21
4-B-1X	do	0 + 50'		46.5
4-B-2	do	0 + 100'		73.5
4-B-2X	do	0 + 150'		71
4-C-1	do	0 + 00'		39
4-C-1X	do	0 + 50'		57.5
4-C-2	do	0 + 100'		20
4-C-2X	do	0 + 150'		50.5

APPENDIX H-2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

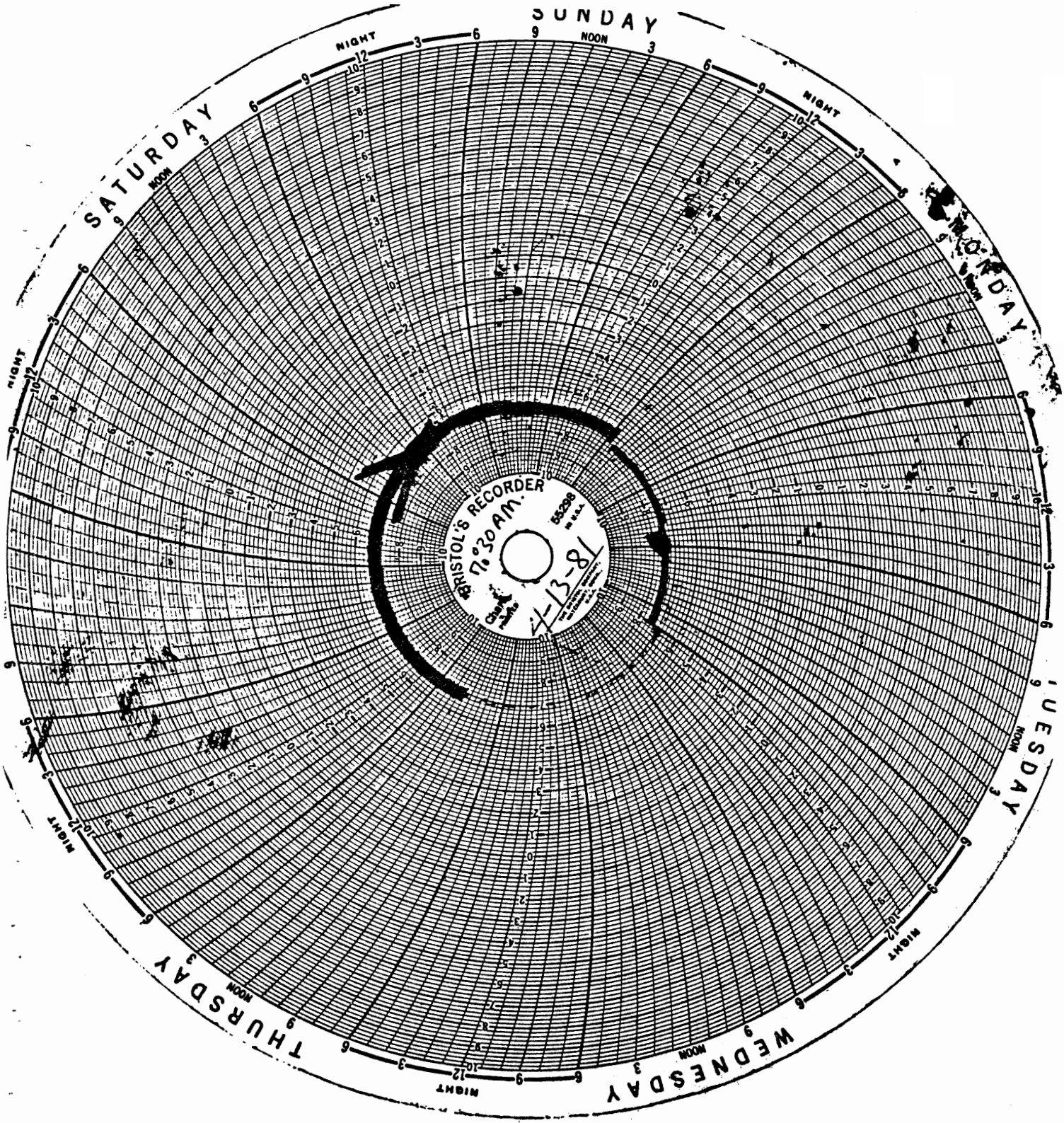
TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED April 27, 1981

MINE Dutch Creek No. 1 COMPANY Mid-Continent Resources, Incorporated

COLLECTED BY Jerry O. D. Lemon, George Moore, Calvert Browning, Jim Thompson, Larry Ganzer, and Charles Brady

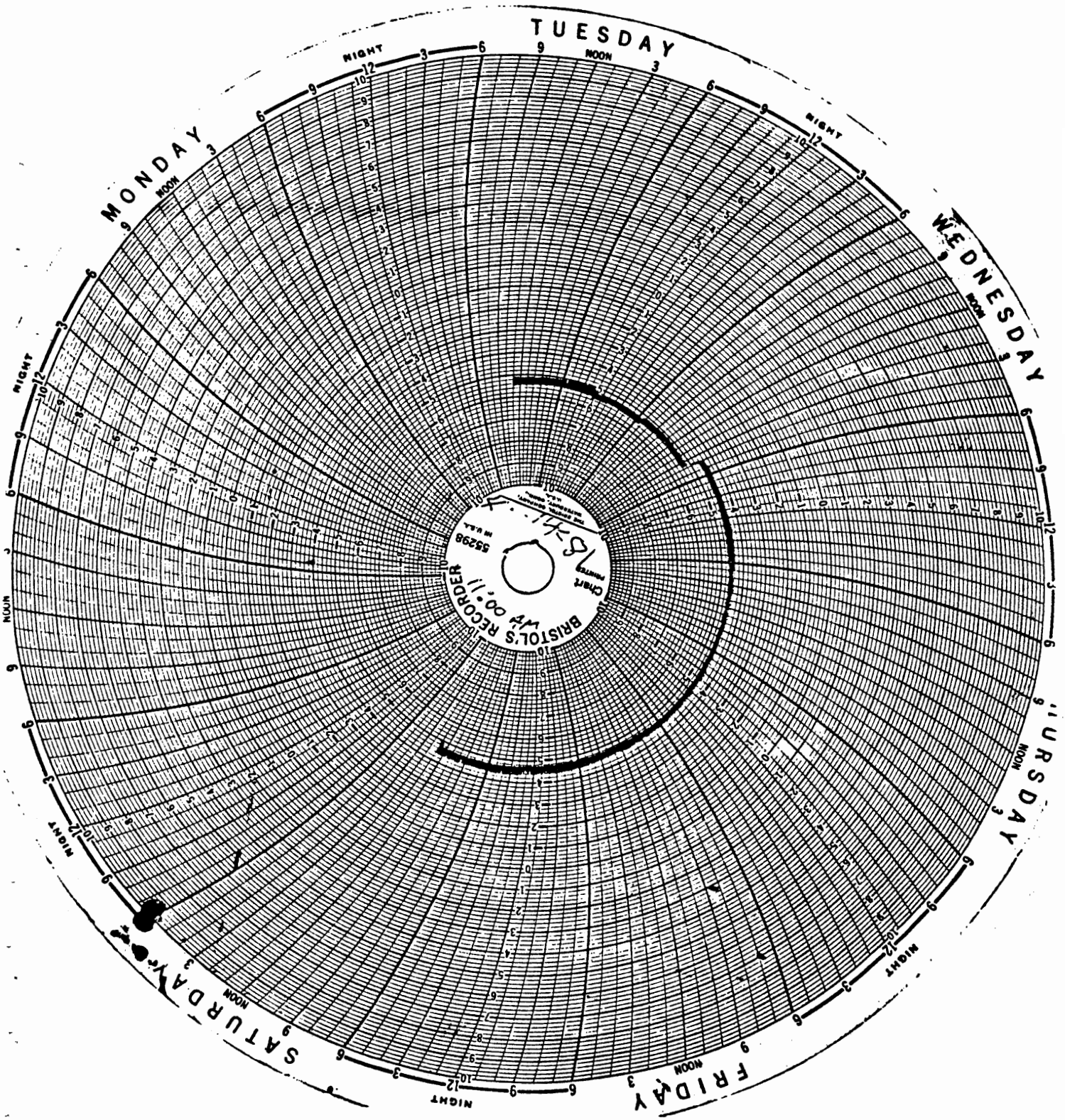
CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		101 longwall section (abandoned), survey station No. 1004 in the No. 4 entry		
		No. 1 entry, intake		
5-A-1	band	0 + 100'		91
5-A-1X	ribs, floor	0 + 150', (roof too high)		71.5
5-A-2		0 + 200'		37.5
		No. 2 entry, intake		
5-B-1	band	0 + 100'		50.5
5-B-2	ribs, roof	0 + 200', (floor wet) - no sample received		
		No. 3 entry, return		
5-C-1	band	0 + 100'		100
5-C-1X		0 + 150', (bad roof)		
5-C-2	band	0 + 200'		99
5-C-2X		0 + 250', (heaved closed)		
5-C-3	band	0 + 300'		97
5-C-3X	do	0 + 350'		93
		No. 4 entry, return		
5-D-1	do	0 + 100'		62
5-D-2	do	0 + 200'		44.5
5-D-3	do	0 + 300'		67

APPENDIX I

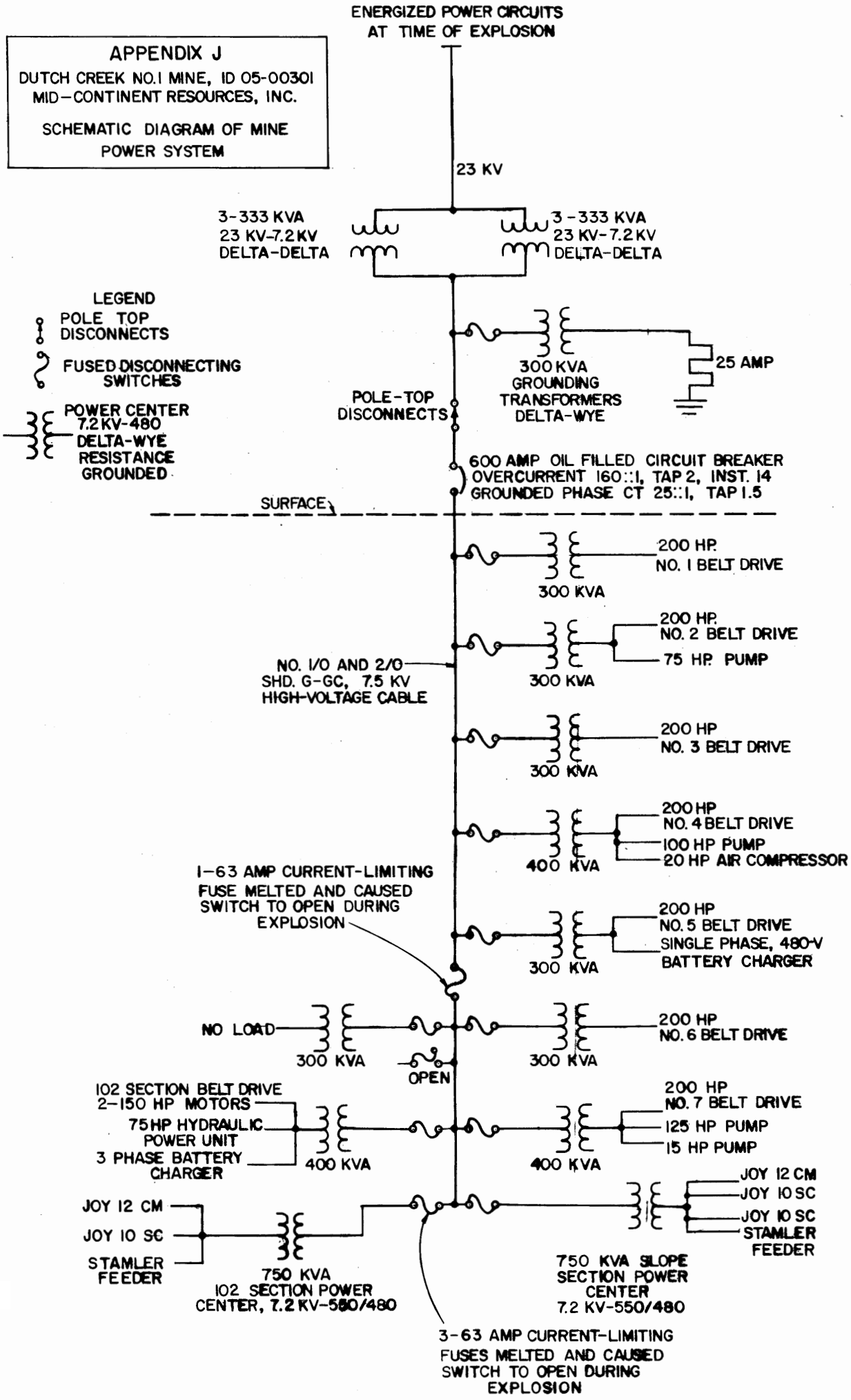


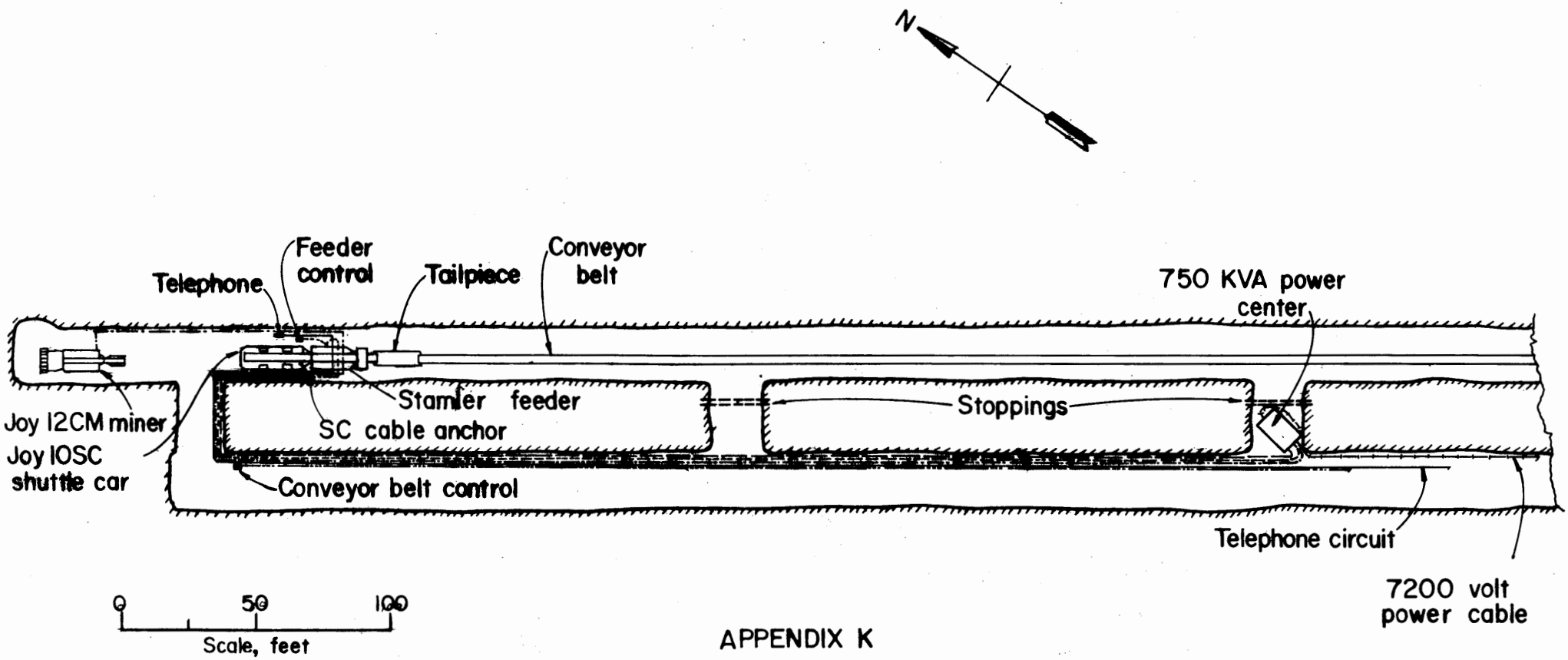
NO. 1 FAN

APPENDIX I



NO. 2 FAN


APPENDIX J
DUTCH CREEK NO.1 MINE, ID 05-00301
MID-CONTINENT RESOURCES, INC.
SCHEMATIC DIAGRAM OF MINE POWER SYSTEM
ENERGIZED POWER CIRCUITS AT TIME OF EXPLOSION
23 KV
3-333 KVA 23 KV-7.2 KV DELTA-DELTA
3-333 KVA 23 KV-7.2 KV DELTA-DELTA
LEGEND
POLE TOP DISCONNECTS
FUSED DISCONNECTING SWITCHES
POWER CENTER 7.2 KV-480 DELTA-WYE RESISTANCE GROUNDED
300 KVA GROUNDING TRANSFORMERS DELTA-WYE
25 AMP
POLE-TOP DISCONNECTS
600 AMP OIL FILLED CIRCUIT BREAKER OVERCURRENT 160::1, TAP 2, INST. 14 GROUNDED PHASE CT 25::1, TAP 1.5
SURFACE
200 HP NO. 1 BELT DRIVE
300 KVA
200 HP NO. 2 BELT DRIVE
75 HP PUMP
300 KVA
NO. 1/0 AND 2/0 SHD. G-GC, 7.5 KV HIGH-VOLTAGE CABLE
200 HP NO. 3 BELT DRIVE
300 KVA
200 HP NO. 4 BELT DRIVE
100 HP PUMP
20 HP AIR COMPRESSOR
400 KVA
1-63 AMP CURRENT-LIMITING FUSE MELTED AND CAUSED SWITCH TO OPEN DURING EXPLOSION
200 HP NO. 5 BELT DRIVE
SINGLE PHASE, 480-V BATTERY CHARGER
300 KVA
NO LOAD
300 KVA
OPEN
300 KVA
200 HP NO. 6 BELT DRIVE
102 SECTION BELT DRIVE
2-150 HP MOTORS
75 HP HYDRAULIC POWER UNIT
3 PHASE BATTERY CHARGER
400 KVA
400 KVA
200 HP NO. 7 BELT DRIVE
125 HP PUMP
15 HP PUMP
JOY 12 CM
JOY 10 SC
STAMLER FEEDER
JOY 12 CM
JOY 10 SC
JOY 10 SC
STAMLER FEEDER
750 KVA 102 SECTION POWER CENTER, 7.2 KV-550/480
750 KVA SLOPE SECTION POWER CENTER 7.2 KV-550/480
3-63 AMP CURRENT-LIMITING FUSES MELTED AND CAUSED SWITCH TO OPEN DURING EXPLOSION



APPENDIX K

DUTCH CREEK NO. 1 MINE, ID 05-00301

MID-CONTINE CES, INC.

ENERGIZED POWER 102 SECTION

AT TIME ION

FIGURE 1. - Lighting system box on left side of Joy 12 CM continuous mining machine in face of No. 1 entry 102 section.

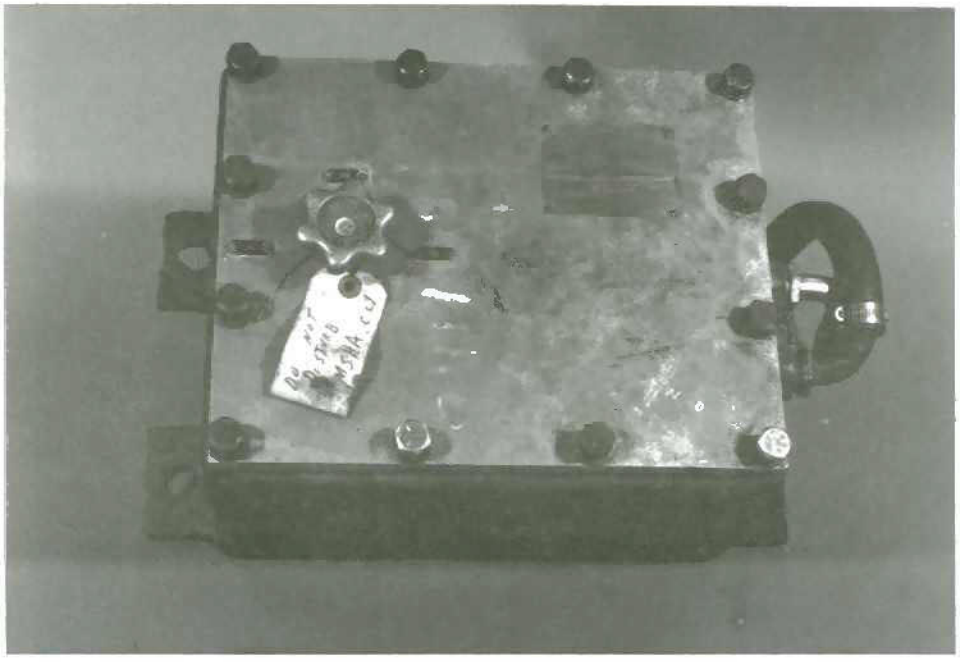


FIGURE 2. - McJunkin Corp. lighting system box.

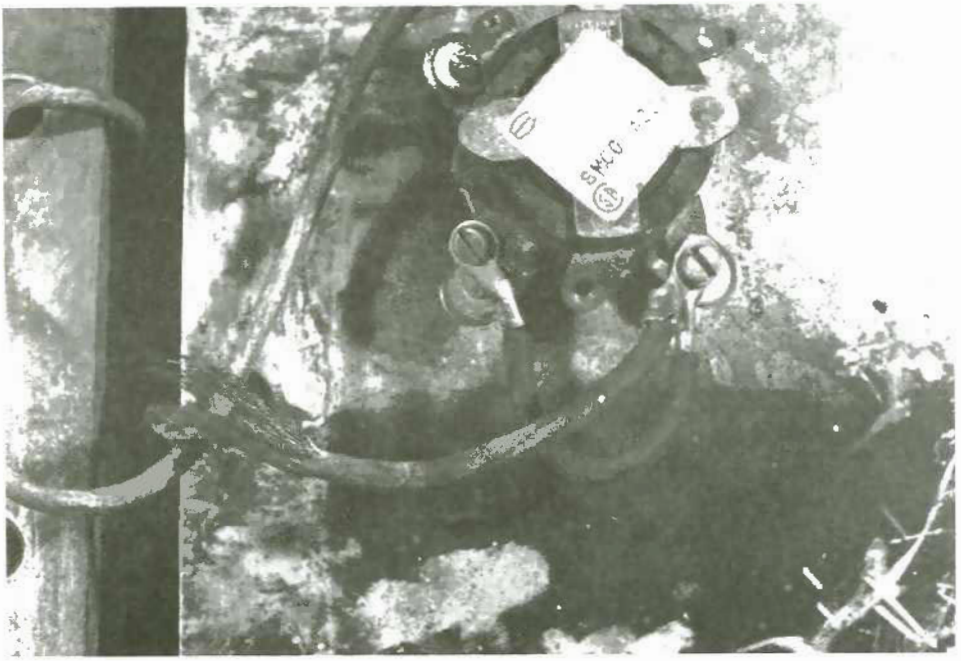


FIGURE 3. - Light switch and No. 14 wire inside McJunkin Corp. lighting system box.

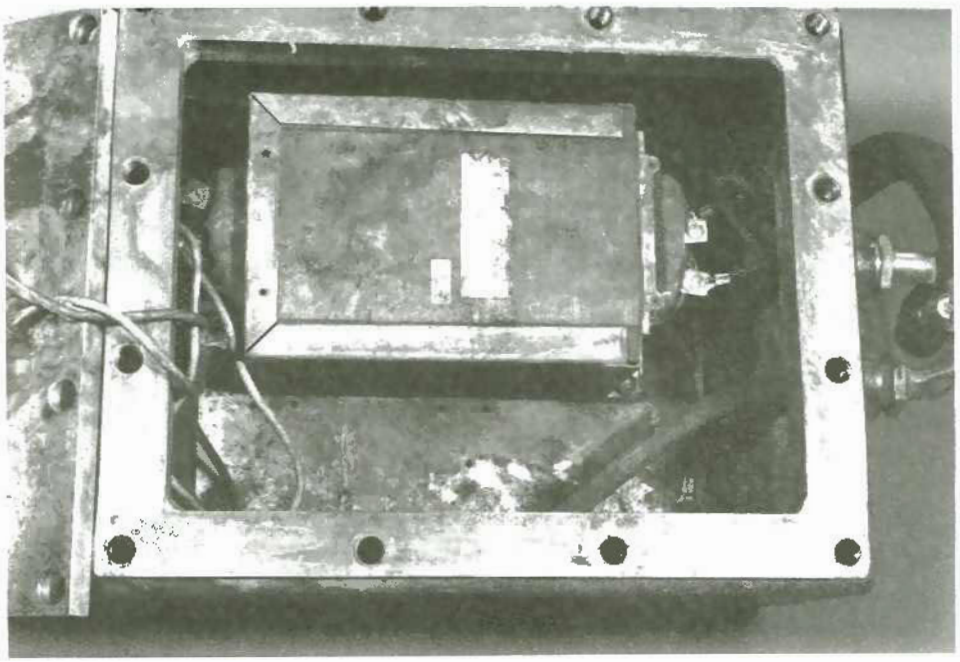


FIGURE 4. - Transformer inside the McJunkin Corp. lighting system box.

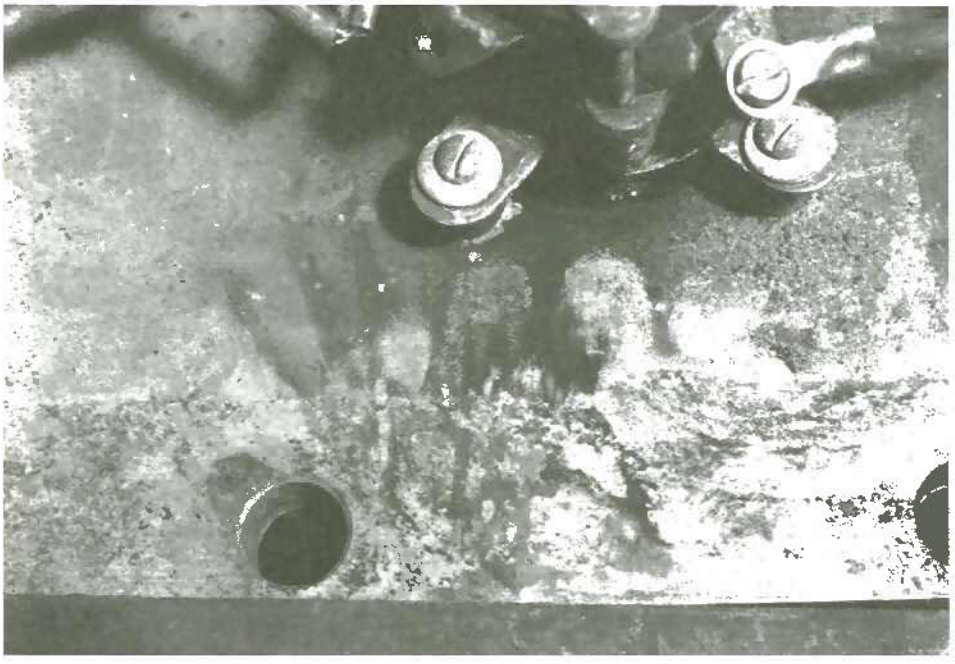


FIGURE 5. - Dust inside the McJunkin Corp. lighting system box.

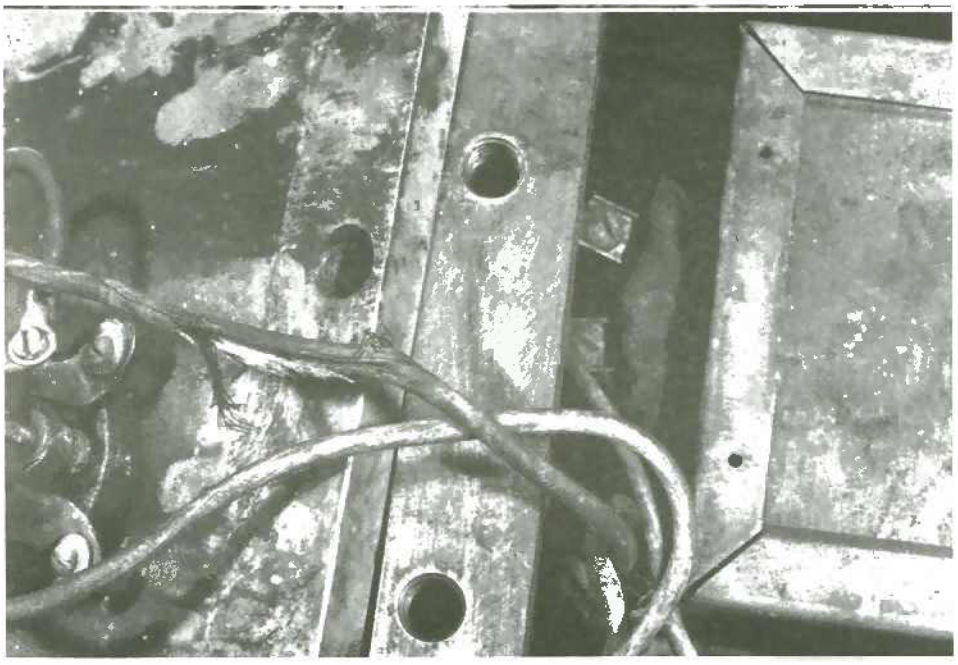


FIGURE 6. - No. 14 wire inside the McJunkin Corp. lighting system box.

APPENDIX L

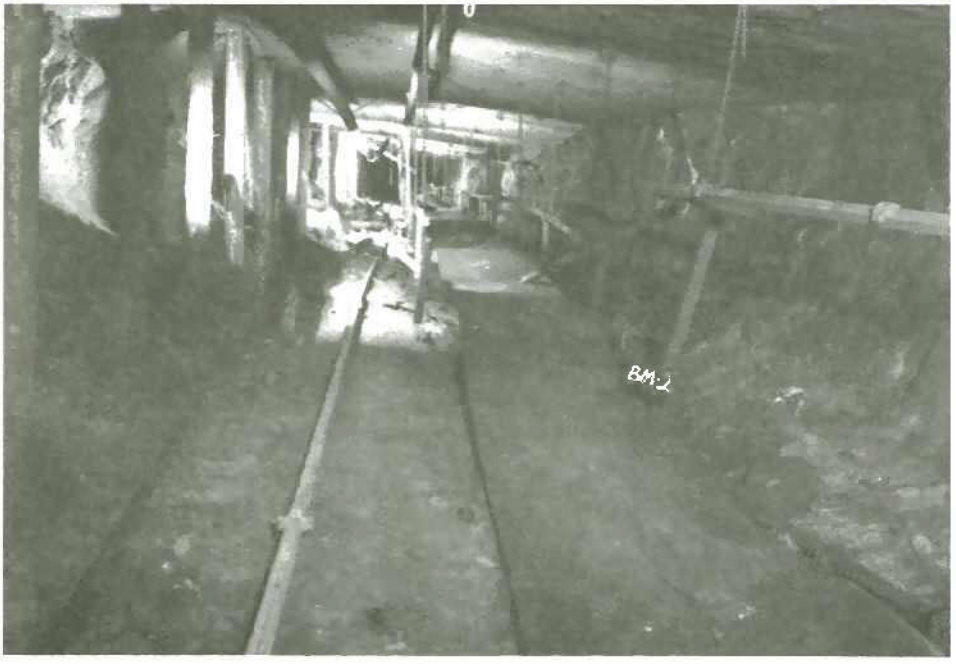


FIGURE 7. - Belt destruction 102 section.

FIGURE 8. - Belt air lock 63rd x cut No. 7 slope.

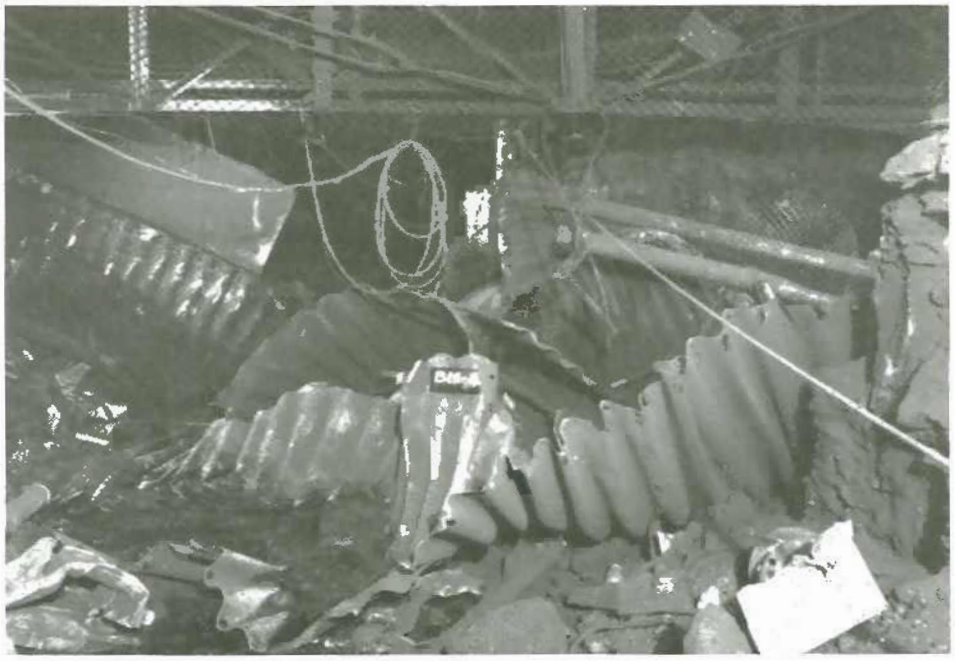


FIGURE 9. - Overcast destruction No. 6 slope 63 x cut.

FIGURE 10. - Overcast destruction No. 5 slope No. 63 x cut.

APPENDIX L

FIGURE 11. - Overcast destruction No. 64 x cut No. 7 slope.

FIGURE 12. - Heavy coke on post about 20 ft outby last open x cut No. 2 entry 102 section.

FILE

APPENDIX M

U.S. DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Coal Mine Health and Safety
Drawer J
Price, Utah 84501

DISTRICT 9
Price, Utah Subdistrict

June 23, 1978

Mr. M. J. Turnipseed
Manager of Mines
Mid-Continent Coal & Coke Co.
P.O. Box 158
Carbondale, Colorado 81623

Dear Mr. Turnipseed:

SUBJECT: Install Illumination Systems on Permissible Machines
(See Attached Field Modification Requests)
Mine: Bear Creek No. 4

Your application to install illumination systems on the subject machines has been approved.

Permission to install the illumination systems on these machines is granted provided installation of the electrical components is in conformity with the manufacturer's instructions, Statement of Test Evaluation, and applicable requirements of Part 18 (Schedule 2G).

When the installation is completed in accordance with the aforementioned requirements, the machines can be placed in service.

Sincerely,

Fred W. Tatton, Jr.
Acting Subdistrict Manager

Attachments

APPENDIX M

June 23, 1978

SUBJECT: Install Illumination systems on Permissible Machines
Mine: Bear Creek No. 4

Machine	Joy Coninuous Mining Machine
Model No.	12CM-5
Serial No.	2228
Approval No.	2G-2833A-43
Project No.	5000952

Machine	Joy Loading Machine
Model No.	14BU10-11DH
Serial No.	10274
Approval No.	2G-2384A-10
Project No.	STE 5001099

Machine	Joy Loading Machine
Model No.	14BU10-11DH
Serial No.	10116
Approval No.	2G-2384A-10
Project No.	STE 50001099

Machine	Joy Loading Machine
Model No.	14BU10-11DH
Serial No.	8971
Approval No.	2F-1712A-18
Project No.	STE 5001099

APPENDIX M

INFORMATION FOR LIGHTING OF FACE EQUIPMENT WITH STE NUMBER

Date: June 9, 1978 Sheet No.: 1

Company: Mid-Continent Coal and Coke Company

Mine: Bear Creek No. 4 I.D. No.: 0500351-0

Equipment Type: Continuous Mining Machine Manufacturer: Joy Mfg Co.

Approval No.: 2G-2833A-43 Model No.: 12CM-5 Voltage: 550V - AC

Number of machines changed: 1 Serial No.: 2228

Complete Description of Modified and/or Additional Packing Glands and Cable Runs

CABLE--Type: SO Conductors: 3 Size: 14 O.D.: .560

Acceptance No.: USBM 1611 Overcurrent Protection: 20 AMP IN LINE

HOSE CONDUIT--I.D.: .750 Acceptance No.:

Cable Length: 10' Hose Conduit Length: 6'

From: JOY MFG GLAND # 10870-1 To: McJUNKIN # 975S
Item---Mfg.---P/N Item---Mfg.---P/N

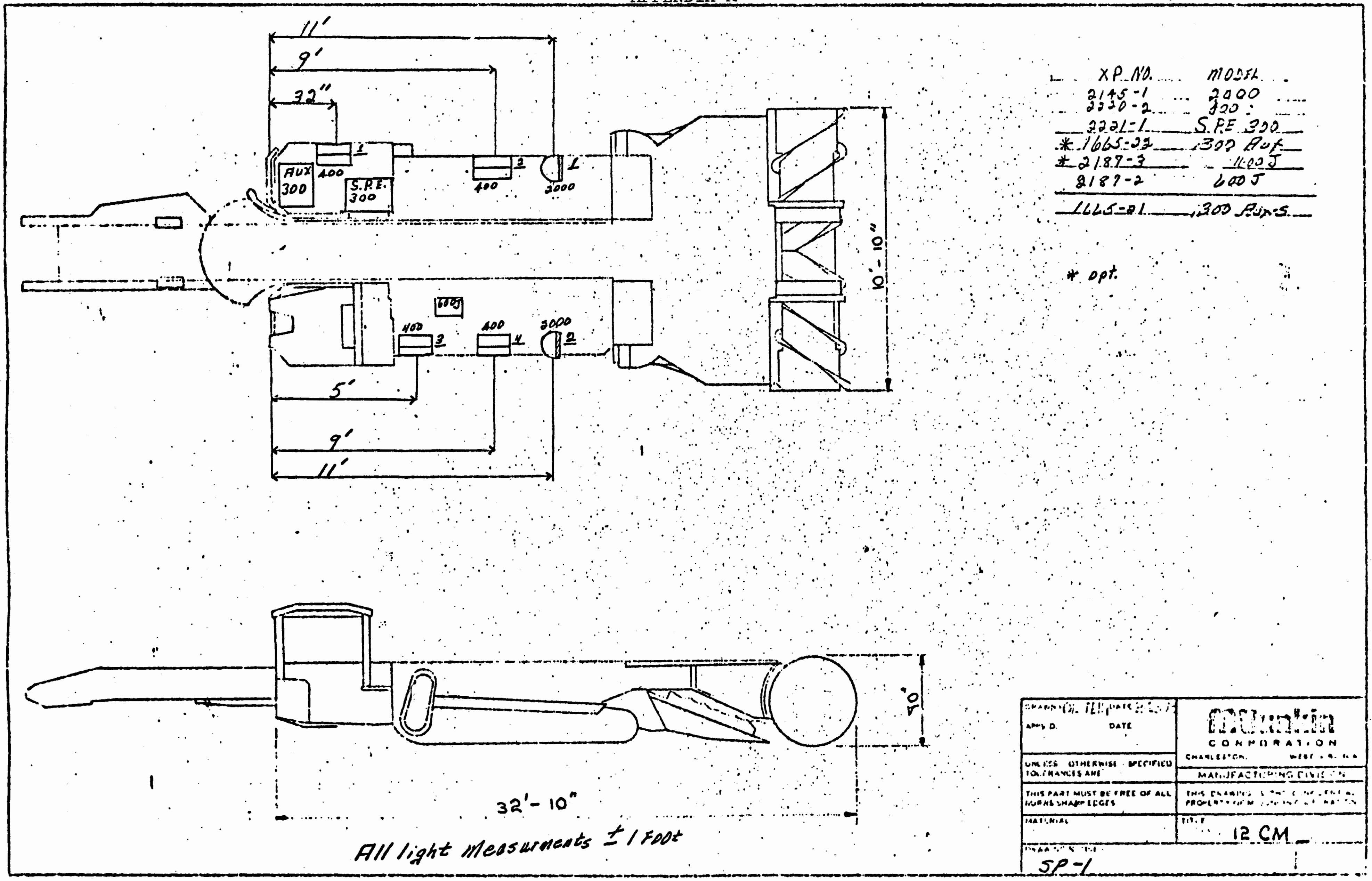
Packing Gland Components	I.D.	Component Mfg. and Part No.	I.D.	Component Mfg. and Part No.
Stuffing Box Thru. Hole	.625	12545- 11	.781	SERVICE MACHINE 300 AUX-S
Inner Bushing			.625	SERVICE MACHINE A11A
Outer Bushing			.625	SERVICE MACHINE A12A
Gland or Gland Nut	.625	10870-1		
Hose Tube				
Stuffing Area	.938		1.125	SERVICE MACHINE 300 AUX-S
Packing Size	.250	15 inches	.250	

Remarks:

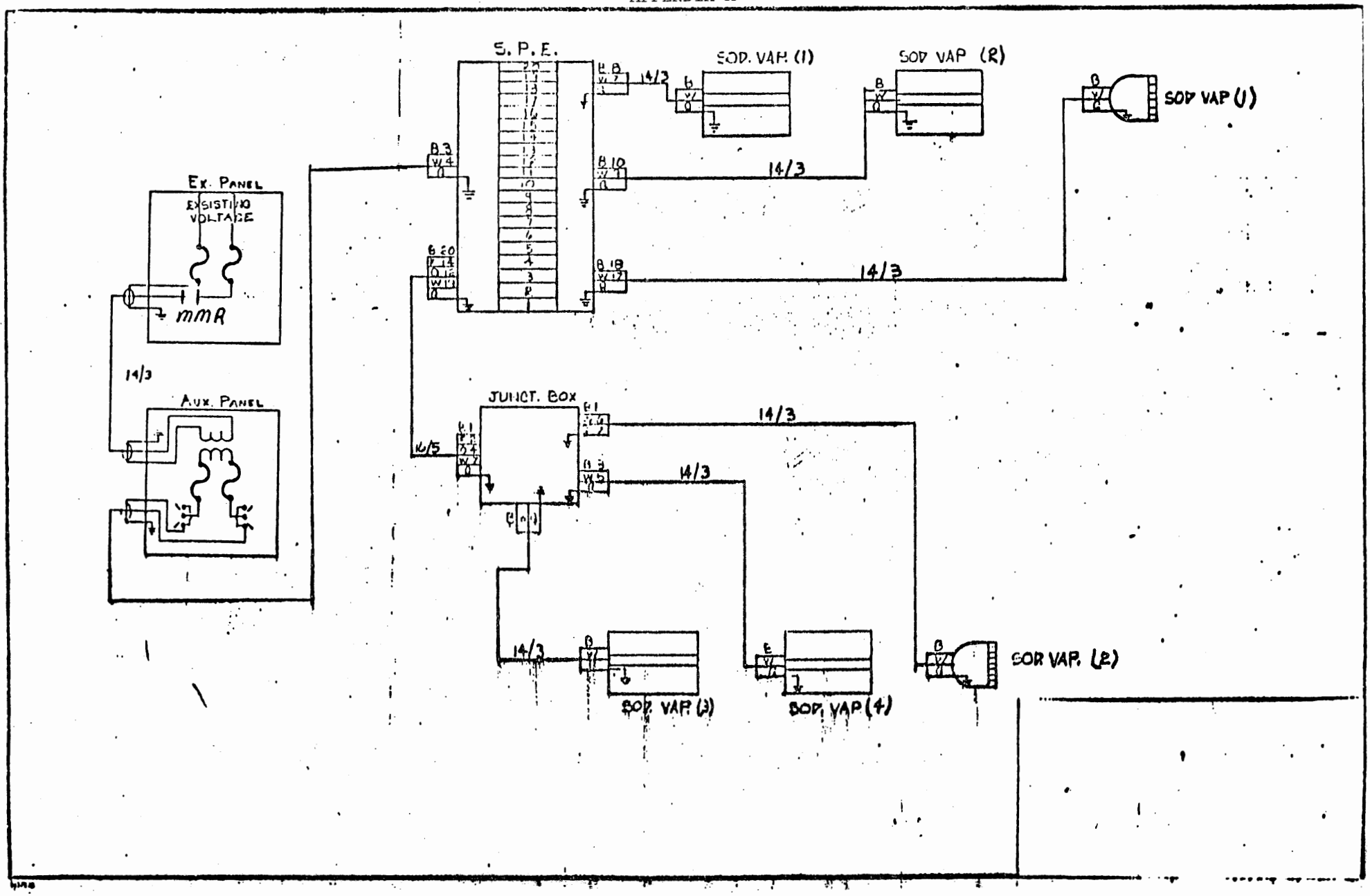
SIZE OF ENTRY 12'X 32' MAXIMUM

STE NUMBER 5000952

APPENDIX M



11'
9'
32"
AUX 300
400
1
S.P.E. 300
400
3
2000
1
10'-10"
6005
400
3
400
4
2000
2
5'
9'
11'
10'
32'-10"
XP NO. MODEL
2145-1 2000
2330-2 300
2221-1 S.P.E 300
*1665-23 1300 Aux
*2187-3 1100 J
2187-2 600 J
1665-21 1300 Aux-S
* opt.
All light Measurments ± 1 Foot
CORPORATION
CHARLESTON
MANUFACTURING DIVISION
DATE
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
THIS PART MUST BE FREE OF ALL BURRS SHARP EDGES
MATERIAL
12 CM
SP-1


S. P. E.
SOD. VAP. (1)
SOD VAP (2)
SOD VAP (1)
EX. PANEL
EXISTING VOLTAGE
mmR
14/3
AUX. PANEL
JUNCT. BOX
16/5
14/3
SOD. VAP. (3)
SOD. VAP. (4)
SOD VAP. (2)

506214-19
600361-45
JCM713-9

506230-10
506205-657
506205-620
570553-2
506205-657
506205-660
506205-661
506205-657
506205-663
506205-665
506205-363

506205-445
JCM714-5
JCM764-1
500112-248
500140-367
500140-1306

PD2570 PD2570-2
532520

A32579 #1
534613-3

PD2619 PD2619-2
A28379
A34072

LD812 LD812-2
A32765

PD2440 PD2440-2

APPENDIX M

Serial No. JM 2228

SHIP TO

MID-CONTINENT COAL AND COKE COMPANY
#1 MINE ABOVE
REDSTONE, COLORADO

SHOP ORDER NO. 2-18-77

SHIPPING INSTRUCTIONS
MOTOR FREIGHT - COLLECT

TERMS & SHIPPING POINT
F.O.B. FRANKLIN, PENNSYLVANIA

MACHINE DESCRIPTION
ONE (1) 12CM5-8BKK JOY CONTINUOUS MINER - 40"HIGH - 8'-6" WIDE X 38" DIA. FLAT DRUM HEAD -U40 (45°) PIN-ON BIT BLOCKS - 24" WIDE CONVEYOR - WATER COOLED MOTORS - JIC REUSABLE FITTINGS - STABILIZER JACK - FIRE PROTECTION SPRAY EQUIPMENT -OPERATOR'S CAB (FLOATING) - PANIC BAR - BACHARACH METHANE MONITOR - REMOTE CONTROL - TRACTION BRAKES

PAINT SPECIFICATIONS
JOY ORANGE

DATE SHIPPED

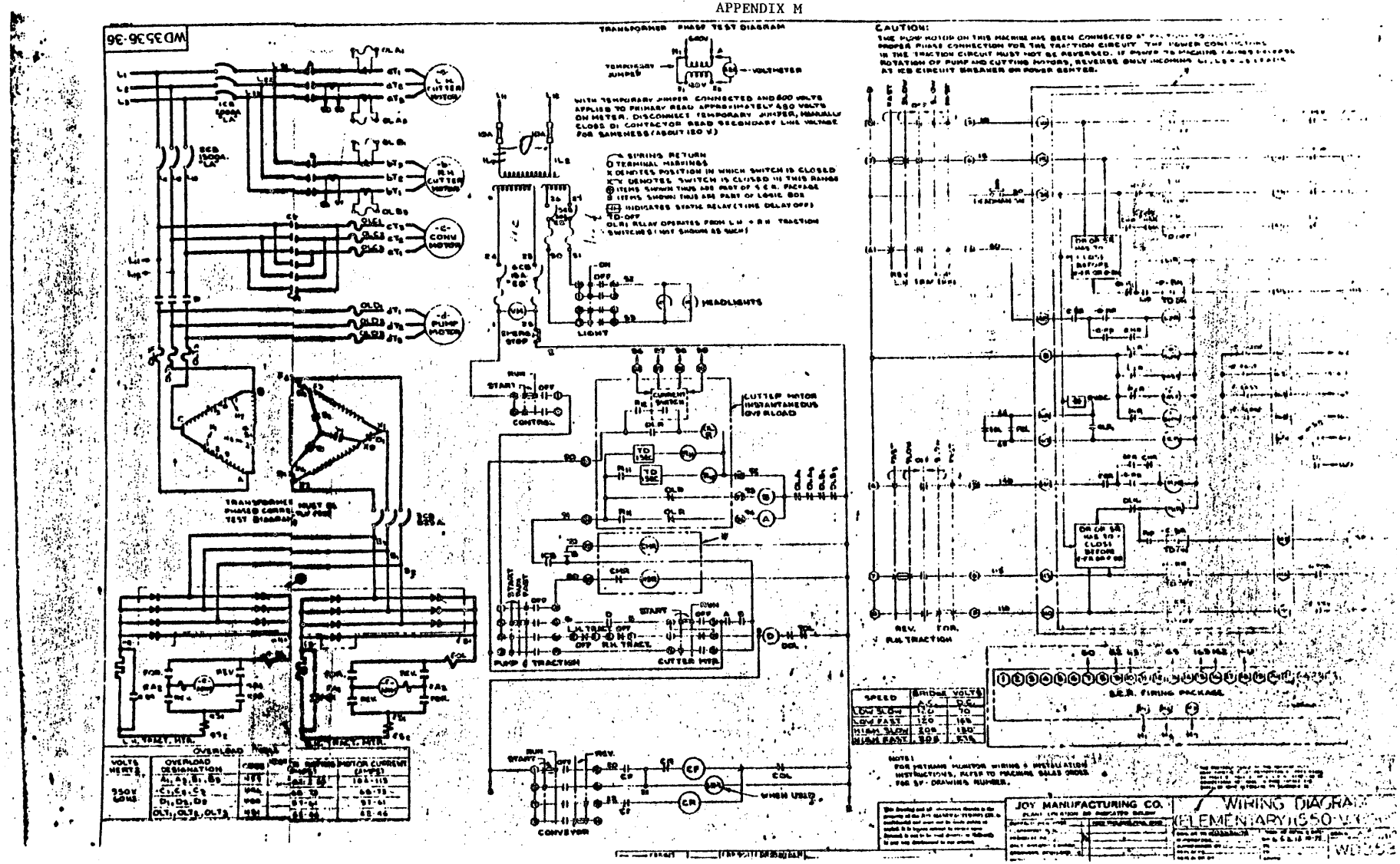
DATE ENG. SPECS. FINAL
6-9-75

VOLTAGE
550 VOLT A.C.

APPROVAL REQ.
YES

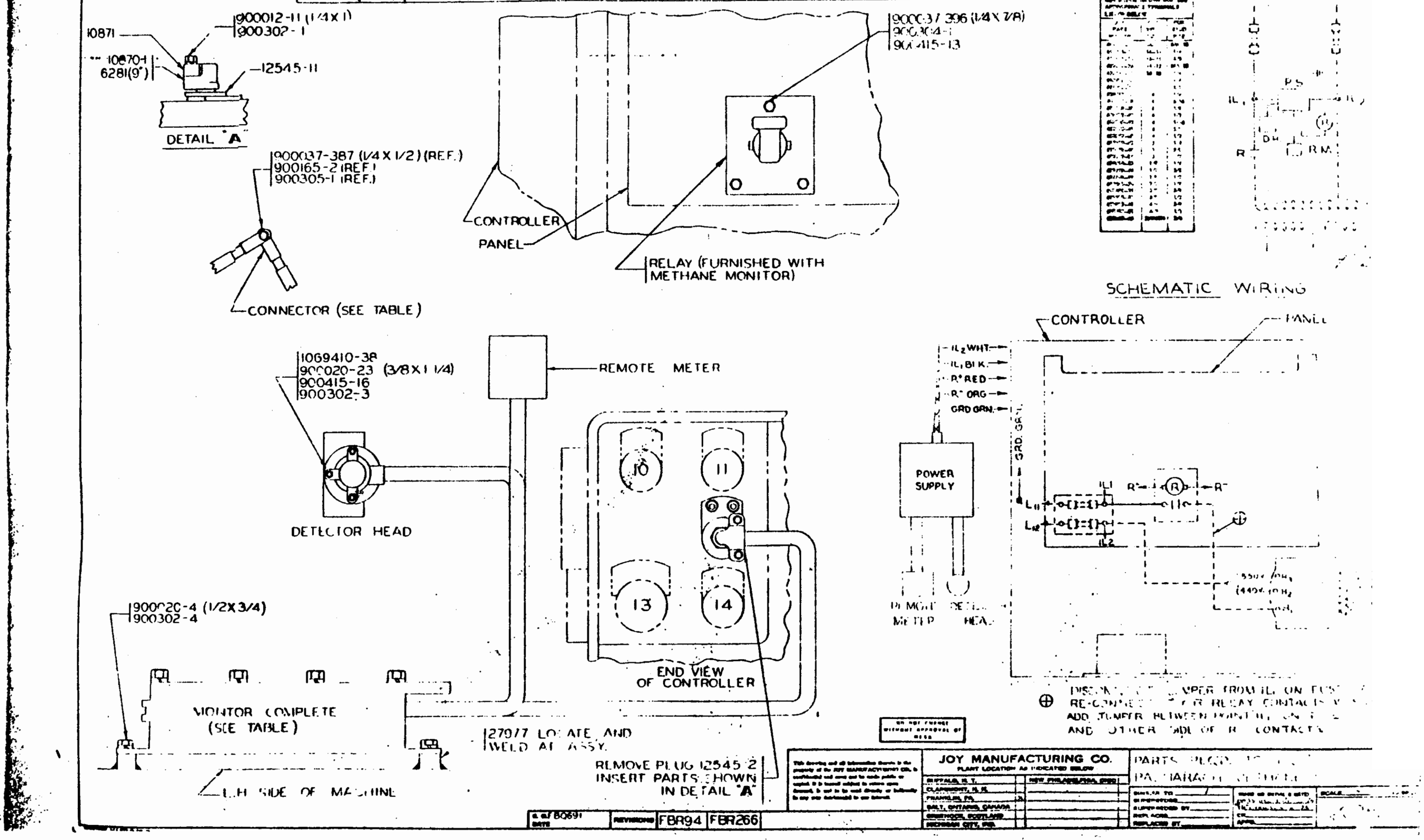
LESS: CABLE SOLID HEAD 1-1/2" BIT SPACING

CHANGE NO.	QTY.	JOY PART NO. OR DM	DESCRIPTION	REFERENCE DRAWINGS
D			GENERAL ARRANGEMENT	JCM706-10
			GEAR DIAGRAM	JCM711-14
			LUBRICATION DIAGRAM	LD785-3
		IL233	FINAL INSPECTION LIST	
			PRECAUTION INSTRUCTIONS FOR CHAINS	SK64073
			CAP SCREW TORQUE VALUES	SK24122
			ELECTRICAL GROUP: JCM 713A	WD3536-36
	1	700016-761	ELECTRIC EQUIPMENT	WD3536-37
				CL3536-37 JCM773
			2- X131-23 HEADLIGHT ASSY.	X131-23
			TROUBLE SHOOTING CHARTS	SK24299/-1/-2
	1	500184-2639	CONTROLLER	500184-2629
			1- 500523-1430 CONTROL PANEL	500523-1429
			4- 601542-27 CONTACTOR	601542-
			2- 601543-4 CONTACTOR	601543-
			1- 601544-4 CONTACTOR	601544-
			1- 601848-4 S.C.R. PACKAGE	601848-1
B			1- 500523-1453 CONTROL PANEL	500523-1447
			2- 601542-27 CONTACTOR	601542-
			2- 601543-4 CONTACTOR	601543-
		500183-260	MASTER SWITCH	500183-266


WD3536-36
TRANSFORMER PHASE TEST DIAGRAM
CAUTION:
WIRING DIAGRAM
ELEMENTARY 550 V
JOY MANUFACTURING CO.
L.H. TRACT. MTR.
R.H. TRACT. MTR.
CONVEYOR
CONTROL
HEADLIGHTS
LIGHT
CUTTER MOTOR INSTANTANEOUS OVR LOAD
S.C.R. FIRING PACKAGE
REV. FOR. R.H. TRACTION
PUMP & TRACTION
CUTTER MTR.
WHEN USED

APPENDIX M

703500-3003	440 / 60	601577-21	
703500-3023	550 / 60	601577-22	
703500-3099	440/60; 550/60	——	MONITOR FURNISHED BY CUSTOMER



EQUIPMENT IN THE SLOPE SECTION INCLUDING ELECTRIC CIRCUITS

All permissible-type electric equipment in the Slope Section was examined. Explosion-proof compartments containing arcing components were disassembled and examined for evidence of a methane ignition. The results of these examinations are set out below.

Continuous Mining Machine

The continuous mining machine, Joy Model No. 12CM-5-8BKK, Approval No. 2G-2833A-51, Serial No. JM2613, was of a permissible type but had not been maintained in a permissible manner, in that an opening exceeding 0.004 inch existed in the plane flange joint under the cover of the explosion-proof compartment housing the remote control equipment.

All explosion-proof compartments housing electric components that could arc were disassembled and carefully examined. No evidence of a methane ignition was present in any of the compartments.

The continuous mining machine was equipped with a Bacharach Model 23-7167 methane monitor, Certification No. 32A-7/MS. The sensor head was installed on the top of the left side of the machine, at a point placing it 11 feet, 10 inches from the face. The readout assembly was located on the machine in a location that made it impossible for the operator, while operating remotely, to see at all times the warning light designed to give a warning automatically when the methane content exceeded 1.0 percent. Also, the dust cover was missing from the zero-adjust control in the side of the methane monitor control compartment.

The investigators received statements during the interviews that the methane monitor on the continuous mining machine in the Slope Section was regularly defeated by adjusting the zero control so that the monitor would not deenergize the machine when the methane concentration exceeded 2.0 percent.

When the machine was first energized, the pilot light operated properly in the methane monitor readout assembly, but the meter needle rested against the stop peg in the downscale (reverse) direction instead of pointing to a proper zero reading. The position of the zero-adjust control was carefully noted by M. J. Turnipseed, Mid-Continent Manager of Mines, and Cecil Lester, MSHA Coal Mine Specialist. While Jack Smith, MSHA Supervisory Coal Mine Specialist (Electrical), observed the meter in the readout assembly, Lester slowly turned the zero-adjust control approximately 90 degrees, until the needle pointed to zero.

The zero-adjust control was returned to its original downscale position, and a 2.3 percent methane-air mixture was applied

to the sensor element. The methane monitor did not deenergize any part of the machine, and the meter needle remained against the downscale stop peg.

The zero-adjust control was again properly adjusted to place the needle on 0.1 percent methane, which was the percentage indicated by a handheld methane detector in the face area near the sensor. A 2.3 percent methane-air mixture was applied to the sensor element. Although the meter indicated about 2.1 percent, the monitor did not activate. Jesus Meraz, Mid-Continent Master Mechanic, then applied a 2.3 percent methane-air mixture from the test tank that he used to calibrate methane monitors. The tank apparently provided a greater flow rate, and the methane monitor performed properly and deenergized the entire machine, including the McJunkin Corporation lighting system, except for the methane monitor itself.

The no-load voltage at the machine was approximately 600 volts, phase-to-phase during the tests.

Tests were conducted in the MSHA Electrical Testing Laboratory in Beckley, West Virginia, on a similar methane monitor, Model No. 23-7167, Certification No. 32A-7/MS, with a new sensor element. These tests revealed that, with the zero-adjustment control turned 90 degrees counterclockwise from zero, a methane-air mixture containing 4.2 percent methane was required to cause the meter on the methane monitor to indicate 2.0 percent and activate the monitor relay.

The sensor element was removed from the methane monitor on the Joy 12CM continuous mining machine in the Slope Section and sent to the MSHA Electrical Testing Laboratory in Beckley, West Virginia, where it was installed in the test monitor. These tests indicated that the sensor element was in an operative condition at the time of the explosion. The results of these laboratory tests are set out in Appendix N-7.

The test monitor from the Beckley Electrical Testing Laboratory and sensor element taken from the methane monitor on the continuous mining machine in the Slope Section were taken to the Bruceton Safety Technology Center in Pittsburgh, Pennsylvania, for further testing. A series of tests were performed to determine the effect of a methane ignition on the performance of sensor elements. The results of these tests are contained in Appendix N-6 and indicate that ignition of the test mixture surrounding the sensor element taken from the Slope Section of Dutch Creek No. 1 Mine reduced the sensitivity of the methane sensor but did not affect the electrical zero. New sensor elements, however, showed no change in electrical characteristics after repeated ignitions of methane in their presence.

The explosion did no apparent damage to the continuous mining machine. Loose coal had been permitted to accumulate on and around the electric traction motors and the methane monitor control compartment in the cab of the continuous mining machine. The trailing cable was tested and was found to be free from defects. After a new section power center was installed, the machine was energized and operated normally, both with the original remote control unit that survived the explosion and with a new remote control unit.

Standard Shuttle Car

The Joy 10SC standard drive shuttle car, Approval No. 2G-2585A-8, Serial No. ET10863, was of a permissible type but had not been maintained in permissible condition in that the following conditions existed:

1. The cable entrance stuffing box located on the shuttle car coal conveyor switch, which was remotely controlled, was improperly packed.

2. The unused cable entrance cover located on the bottom of the left traction motor was worn off, as were the heads of three of the four bolts holding the cover in place.

3. The end bell of the traction motor on the left side was damaged and one bolt was broken off.

4. The No. 1 AWG trailing cable exceeded the 750-foot maximum length specified in Table 9 of Part 18, 30 CFR, Schedule 2G; the trailing cable was approximately 886 feet long. The shuttle car was not damaged by the explosion. The trailing cable was examined and tested, and found to be free from defects. The explosion-proof compartments on the shuttle car housing electric components that could arc were disassembled and examined for evidence of a methane ignition; no evidence was detected.

Opposite Standard Shuttle Car

The Joy 10SC opposite standard drive shuttle car, Approval No. 2G-2585A-8, Serial No. ET10864, was of a permissible type but had not been maintained in a permissible condition in that the following conditions existed:

1. The cable entrance gland located on the shuttle car coal conveyor switch, which was remotely controlled, was improperly packed.

2. The packing gland for the power cable entrance on the left traction motor was damaged and the cable entrance stuffing box was improperly packed.

3. The unused cable entrance cover located on the bottom of the left traction motor was worn off, as were the heads of two of the four bolts holding the cover in place.

4. The No. 1 AWG trailing cable exceeded the 750-foot maximum length specified in Table 9 of Part 18, 30 CFR, Schedule 2G; the trailing cable was approximately 920 feet long.

The shuttle car was not damaged during the explosion. The trailing cable was examined and tested, and found to be free from defects. The explosion-proof compartments housing electric components that could arc were disassembled and examined for evidence of a methane ignition; no evidence was detected.

Stamler Belt Feeder

The Stamler belt feeder, Model No. BF-14-0-10, Approval No. 2G-2851A, Serial No. 10643, was of a permissible type but had not been maintained in permissible condition: a nonpermissible Ensign Hubbell centrifugal switch was connected into the feeder control circuitry, for the purpose of interlocking the feeder with the belt conveyor. The feeder was not damaged, except that the forces of the explosion had pulled the feeder trailing cable from the control panel. The trailing cable was examined and tested, and found to be free from defects. The explosion-proof compartments housing electric components that could arc were disassembled and examined for evidence of a methane ignition; no evidence was detected.

Loading Machine

The Joy 14BU10-11DH loading machine, Approval No. 2G-2384A-10, Serial No. 10274, apparently was not energized at the time of the explosion. Although the trailing cable was plugged into the power center, it was piled in the conveyor boom, indicating the machine was not in use at that time. Nevertheless, the explosion-proof compartments housing electric components that could arc were disassembled and examined for evidence of a methane ignition; no evidence was detected. The loading machine was not equipped with a methane monitor. According to company officials, the loading machine had not been used in the working place to load coal.

Methane Detectors

Two permissible MSHA "Spotter" methane detectors were present in the Slope Section at the time of the explosion. One was found near the rear of the continuous mining machine in the No. 4 slope entry. It was identified on the case as belonging to "RHODES." The other detector was in its case and on the body of Robert Ragle. Neither methane detector was damaged.

Flame Safety Lamps

Two permissible Koehler flame safety lamps were present in the Slope Section. One was found sitting upright on the right side of the belt tailpiece. The name "H. MORTEISEN" was printed on tape stuck on the fount. The other lamp was located nea the power center located in No. 66 crosscut between Nos. 4 and 5 entries. The name "GARY FOGG" was printed on tape st on the fount. Neither lamp was damaged.

MOBILE HAULAGE EQUIPMENT OUTBY THE COAL-PRODUCING SECTIONS

The following mobile haulage equipment was present in the n at locations outby the coal-producing sections. None was i use at the time of the explosion:

Crosscut Location	Manufacturer	Power	Type	Approval No.	Serial No.
57	Elkhorn	Battery	Truck	2G-2641-4	4759542
57	Elkhorn	Battery	Truck	2G-2641-1	4739505
56	Eimco	Diesel	LHD	Plate Missing	913257
54	Eimco	Diesel	Loader	31-56	9130346
54	Eimco	Diesel	Loader	31-45	9350027

Each of the above units was originally approved as permissible; however, none had been maintained in permissible condition. Various permissibility deficiencies existed on each machine, however, they were not required to be maintained in permissible condition unless they were used in areas requiring permissible equipment.

U. S. Department of Labor

Mine Safety and Health Administration
Industrial Park Boulevard
RR 1, Box 201B
Triadelphia, West Virginia 26059

October 28, 1981

MEMORANDUM FOR: ROBERT A. ELAM
Mining Engineer, Coal Mine Safety and Health

THROUGH: RICHARD W. METZLER
Acting Chief, Division of Electrical Safety
Approval and Certification Center

FROM: KENNETH A. SPROUL
Chief, Intrinsic Safety and Instrumentation Branch
Approval and Certification Center

SUBJECT: Evaluation of equipment recovered from the Dutch Creek Mine Disaster; forwarding of final report.

Forwarded, per your request, is a copy of the report which documents the findings of the Intrinsic Safety and Instrumentation Branch relative to the evaluation of equipment recovered from the Dutch Creek Mine Disaster. The report, together with back-up data and photographs, is filed under Special Investigation X-154 at the Approval and Certification Center.

A brief summary of the findings is given herein for your convenience. Nine individual pieces of equipment were evaluated resulting in the following findings:

a. Four hand held methane detectors were evaluated. All were determined not to be a source of ignition of a methane-air atmosphere. One instrument was too badly damaged to conduct performance tests. Performance testing of the other three revealed that each instrument indicated methane concentrations lower than actual concentrations of known test samples.

b. A blaster's multimeter was evaluated and was determined analytically to be intrinsically safe. Actual testing was not possible due to the condition of the instrument.

c. A laser alignment cylinder was determined to be intrinsically safe from review of approval records. However, a detailed technical evaluation of the actual instrument was not possible because essential parts of the instrument were either not available or not accessable.

d. The other three devices submitted for evaluation were determined to be non-permissible. One was a welder's striker which quite obviously is intended to ignite gas-fueled welding torches. The second was a ground fault relay which is likely to have been used on a mine power center which should be located in fresh air. The third was a volt-ohm-meter which has never been issued an approval. However, the instrument is intrinsically safe and would not be considered a possible source of ignition of methane-air.

If you require any further information or have questions concerning the attached report, please contact me or Arthur E. Page on FTS 923-1039.

APPENDIX N-2

SPECIAL INVESTIGATION X-154

Evaluation of Equipment Recovered from the Dutch Creek Mine Disaster

Pursuant to a letter from Robert W. Dalzell, Chief, Approval and Certification Center dated June 6, 1981; Robert A. Bradburn, Arthur E. Page, John C. Petrus, and Ronald T. Miller of the Intrinsic Safety and Instrumentation Branch of the MSHA, Approval and Certification Center (Division of Electrical Safety) were assigned the task of evaluating the equipment described as follows;

1. Exhibit #P-43a "Welder's striker with tape around flint end of striker".

2. Exhibit #P-14d "MSA Spotter" methane detector, Serial No. 01351.

3. Exhibit #P-70 "Ground fault relay from power center in 102LW section, for the shuttle car".

4. Exhibit #P-12b "MSA Spotter" methane detector, Serial No. 02614.

5. Exhibit #P-11a "Methane detector, M402 model, which is broken in pieces and remains in case".

6. Exhibit #P-53 "Methane detector and case MSA Spotter Serial No. 01356 identified by tape on case as Rhodes".

7. Exhibit #P-71 "Dupont Blasters Multimeter Model 101, No. on face -08271".

8. Exhibit #P-68 "Laser Alignment Cylinder, Part No. 31900, Model No. 2500 Laser Construction Tools, Laser Alignment Inc."

9. Exhibit #P-15 "VIZ Tech - VOM; Volt-Ohm Meter, Serial No. 108609, Model No. WV-5478.

June 3, 1981: Richard W. Metzler, Technical Coordinator, Division of Electrical Safety, transferred custody to Arthur E. Page III, electrical engineer, IS&I Branch, the subject described equipment as well as the additional equipment described as follows:

1. Exhibit #P-7c "Used self rescuer which was found with J. Rhodes' body".

2. Exhibit #P-54 "Bottom half of MSA W-65 self rescuer case, Serial No. AR8800".

Identification photographs of each piece of equipment were taken by Mr. Earl Mazzeo, photographer, MSHA Audio-Visual Services (PTSC). Mr. Mazzeo was assisted by Mr. Gerald Shaw, electrical engineering technician, IS&I Branch. Each piece of equipment was photographed in the condition that it was received at the MSHA, Approval and Certification Center.

June 5-9, 1981: The subject equipment was inspected and evaluated by the following IS&I Branch personnel; Ronald Miller, electrical engineering technician, John Petrus, electrical engineering technician, and Arthur Page, electrical engineer.

APPENDIX N-2

June 10, 1981: Photographs that show the detail of all components of each piece of the subject equipment were taken by Earl Mazzeo, assisted by Ron Miller and Jerry Shaw.

June 11, 1981: A memorandum from Arthur Page, through Robert E. Marshall, Chief, Division of Electrical Safety, for Robert W. Dalzell, Chief, Approval and Certification Center, was written to summarize the preliminary findings of this special investigation (reference correspondence file X-154).

Examination and Evaluation of:

Exhibit #P-43a "Welder's striker with tape around flint end of striker".

Visual Inspection;

1. The subject item had no MSHA, MESA, or Bureau of Mines approval plate.

2. The flint end of the striker was wrapped with electrical tape.

3. The electrical tape appears to have been partially melted as well as frayed and torn.

4. The item will produce sparks when operated due to mechanical friction. The purpose of the striker is, in fact, to ignite gas torches.

Safety Evaluation;

The electrical tape was removed from the flint end of the striker and the striker was operated over a bunsen burner fueled by methane gas. It was demonstrated that the striker will ignite methane gas.

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Examination and Evaluation of:

Exhibit #P-14d "MSA "Spotter" Methane Detector, Serial No. 01351".

Visual Inspection;

1. The item is a MSA (Mine Safety Appliances Co.) Model N "Spotter" portable methane detector (MSA Part No. 465005).

2. Serial No. 01351 is stamped on the front of the instrument case.

3. The instrument has an MSHA approval plate with approval number 8C-45 stamped on it. MSA was granted MSHA-approval for this instrument in a letter from the MSHA, Approval and Certification Center on May 24, 1978 (reference MSHA:A&CC:Investigation No. GD-51.8).

4. The visual inspection revealed no apparent physical damage to the instrument.

5. The battery test gives a visual indication of 3.2 on the digital display. A fully charged battery should give an indication of 2.2 - 2.8 on the display. A battery check circuit malfunction is suspected.

6. The calibration record affixed to the inside of the back cover of the instrument case indicates that the last calibration of this instrument was performed on 7-30-80. The calibration record label has the statement, "A calibration check is required after 5 days use to assure the most accurate response" printed on it.

7. A detailed comparison of this instrument with the drawings and specifications on file at the MSHA, Approval and Certification Center under Investigation No. GD-51.8 revealed that this instrument was built according to those drawings and was not modified in any manner.

Intrinsic Safety Evaluation:

1. After this instrument was found to have been built in accordance with the drawings and specifications on file at the MSHA, Approval and Certification Center, a review was made of the intrinsic safety evaluation contained in the final report of MSHA, Investigation No. GD-51.8. The final report concluded that the subject instrument would not be a potential source of ignition of a methane-air atmosphere.

2. A technical evaluation of the actual circuit used in this instrument revealed no energy storage component, or combination of components under normal or fault conditions, that could store sufficient electrical energy that would render the instrument capable of being a source of ignition of a methane-air atmosphere.

3. A catalytic-type sensor used in instruments of this type are a possible source of a thermal (hot-wire) ignition of a methane-air atmosphere. To ascertain if this sensor could have been such a hazard, the instrument was placed in an explosive methane-air atmosphere with the sensor operating. No ignition of the 7.75% methane-in-air gas mixture occurred during the thirty (30) minute test.

APPENDIX N-2

Performance Evaluation;

A performance test of this methane detector was performed in order to determine the response of this instrument to various concentrations of methane gas.

1. The batteries used in this instrument were prior to the performance testing using an MSA charging unit for the Model N "Spotter" methane detector.

2. Known methane concentrations of between 1.0% and 5.0% were used to determine the response of the instrument. The methane and air were mixed in the appropriate proportions by means of a Matheson Model SP-795 "Dyna-Blender". The gas concentrations were verified by gas chromatography (reference IS&I test procedure IS&I-4, Rev. B).

3. Results of performance testing:

Actual methane concentration	Methane concentration indicated
0.0	0.3
1.0	0.5
2.0	0.8*
3.0	1.8
4.0	2.7
5.0	3.4

*Reading rose to 2.1%, remained at that reading several seconds, then fell to 0.8 and stabilized at that reading.

4. Calibration of the instrument was attempted using the specified MSA calibration kit and the procedures found in the operator's manual of the Model N "Spotter" methane detector. The instrument could be "zeroed" in fresh air using the "zero" potentiometer located on the circuit board of the instrument. The instrument could not be "spanned" (upper calibration adjusted). The display indicates a reading of 0.9% methane in a known 2.0% methane gas concentration when the "span" potentiometer was at its maximum (fully clockwise) position.

The subject MSA Model N "Spotter" methane detector, Serial No. 01351, displays indications of methane concentrations significantly lower than the actual concentrations of that gas. The instrument could not be calibrated using the procedures set forth in the operator's manual.

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Examination and Evaluation of:

Exhibit #P-70 "Ground fault relay from power center in 120LW section, for the shuttle car".

Visual Inspection;

1. The ground-fault relay is identified by the following markings on the unit; Struthers and Dunn (manufacturer) type 112XAX26, 1.3 volt, 60-hz coil, 115 volt 2 amp, contact rating.

2. The unit appears to be undamaged, physically. No assessment of the operational capabilities was made.

3. A film of coal dust covers the inside of the glass enclosure.

4. All of the terminals are intact. The wires have been cut away leaving only the connectors on the unit.

5. A wing nut is missing from the top of the glass enclosure.

6. The unit has no MSHA, MESA, or Bureau of Mines approval or certification plate.

Safety Evaluation;

No intrinsic safety evaluation of this unit was made. No reference of this item to any intrinsic safety evaluation has been found after a review of all I.S. Evaluations completed by the Intrinsic Safety and Instrumentation Branch. The unit is likely to have been used on a mine power center which should be located in a fresh-air (intake) section of a mine where "permissible" equipment is not required.

APPENDIX N-2

Examination and Evaluation of:

Exhibit #12b "MSA "Spotter" methane detector, Serial No. 02614".

Visual Inspection;

1. The item is a Mine Safety Appliances Co. (MSA) Model N "Spotter" Portable Methane Detector (MSA part No. 465005).

2. Serial No. 02614 is stamped on the front of the instrument case.

3. The instrument has an MSHA approval plate with approval number 8C-45 stamped on it. MSA was granted MSHA-approval for this instrument in a letter from the MSHA, Approval and Certification Center on May 24, 1978 (reference MSHA:A&CC:Investigation No. GD-51.8).

4. Physical damage to the instrument was limited to a small gash in the back side of the instrument case.

5. The instrument appears to be in operational condition although the case is heavily soiled with coal dust.

6. The battery test indicates the unit needs to be recharged.

7. The display is slightly askewed in the instrument case.

8. The potentiometer located on the circuit board used for calibrating the battery test display was broken off the circuit board. The potentiometer was loose in the instrument case.

9. The display board mounting pins are bent.

10. The charging jack is broken.

11. The calibration record affixed to the inside back cover of the instrument case indicates that the last calibration of this instrument to have been performed on 2-19-81. The calibration record label has the statement "A calibration check is required after 5 days use to assure the most accurate response" printed on it.

12. The calibration record references serial number 00671; however, the subject instrument has manufacturer's serial number 02614 stamped on the front of the case. The back of the instrument is removeable and may be interchanged with any other MSA Model N "Spotter" methane detector.

13. A detailed comparison of this instrument with the drawings and specifications on file at the MSHA, Approval and Certification Center under Investigation No. GD-51.8 revealed that the instrument was built according to those drawings and specifications.

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Intrinsic Safety Evaluation:

1. After this instrument was found to have been built in accordance with the drawings and specifications on file at the MSHA, Approval and Certification Center, a review was made of the intrinsic safety evaluation contained in the final report of MSHA Investigation No. GD-51.8. The final report concluded that the subject instrument would not be a potential source of ignition of a methane-air atmosphere.

2. A technical evaluation of the actual circuit used in this instrument revealed no energy storage component, or combination of components under normal or fault conditions, that could store sufficient electrical energy that would render the instrument capable of being a source of ignition of a methane-air atmosphere.

3. The catalytic-type sensor used in instruments of this type are a possible source of a thermal (hot-wire) ignition of a methane-air atmosphere. To ascertain if this sensor could have been such a hazard, the instrument was placed in an explosive methane-air atmosphere with the sensor operating. No ignitions of the 7.75% methane-in-air gas mixture occurred during the thirty (30) minute test.

Performance Evaluation:

A performance test of this methane detector was performed in order to determine the response of this instrument to various concentrations of methane gas.

1. The batteries used in this instrument were recharged prior to the performance testing using an MSA charging unit specified for the Model N "Spotter" Methane Detector.

2. Known methane concentrations of between 1.0% and 5.0% were used to determine the response of the instrument. The methane and air were mixed in the appropriate proportions by means of a Matheson Model SP-795 "Dyna-Blender". The gas concentrations were verified by gas chromatography (reference IS&I test procedure IS&I-4, rev. B).

3. Results:

Actual methane concentration	Methane concentration indicated
0.0	0.0
1.0	0.4
2.0	0.9
3.0	1.7
4.0	2.2
5.0	3.0

The instrument is not within the accuracy requirements specified by 30 CFR Section 22.7 (d)(2) for methane-indicating detectors.

4. Calibration of the instrument was attempted using the specified MSA calibration kit and the procedures found in the operators manual of the Model N "Spotter" Methane Detector. The instrument could be "zeroed" in fresh air using the "zero" potentiometer located on the circuit board of the instrument. The instrument could not be "spanned" (upper calibration point). The display indicates a methane concentration of 1.8% in a
the "span" potentiometer at its ma

The subject MSA Model N "Spotter" M
indications of methane concentratic
concentrations of that gas. The ir
the procedures set forth in the op

APPENDIX N-2

Examination and Evaluation of:

Exhibit #P-11a "Methane Detector, M402 Model, which is broken in pieces and remains in case".

Visual Inspection;

1. The item is identified as the Model M-402 portable methane detector manufactured by the Auer Gesellshaft Company of Germany.

2. The instrument has a U.S. Bureau of Mines approval plate affixed to it with Approval No. 8C-18 printed on it.

3. The Mine Safety Appliances Company was granted U.S. Bureau of Mines Approval No. 8C-18 for this methane detector in a letter dated March 22, 1967 (reference MSHA, A&CC Investigation No. GD-23.8).

4. The final report of Investigation No. GD-23.8 states that the units are manufactured in Germany by Auergessellschaft GMBH, a wholly-owned subsidiary of Mine Safety Appliances Company.

5. Extensive physical damage has occurred to the instrument. The instrument has been broken into numerous pieces in its leather carrying case. The leather case is ripped and is covered with coal dust.

6. A detailed comparison of the instrument with the drawings and specifications on file at the MSHA, Approval and Certification Center under Investigation No. GD-23.8 revealed that this instrument was built according to those drawings and was not modified.

Intrinsic Safety Evaluation;

1. After this instrument was found to have been built in accordance with the drawings and specifications on file at the MSHA, Approval and Certification Center, a review was made of the intrinsic safety evaluation contained in the final report of Investigation No. GD-23.8. The final report concluded that the instrument would not be a potential source of ignition of a methane-air atmosphere.

2. Intrinsic safety testing of the actual instrument was not possible because of the condition of the instrument.

3. Since this instrument was in its carrying case and, therefore, was not in use at the time of the explosion, it could not have been the source of ignition of the explosion.

Performance Evaluation;

A performance evaluation of this instrument was not possible because the instrument has been destroyed and could not be made operational.

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Examination and Evaluation of:

Exhibit #P-53 "Methane detector and case Mine Safety Appliances Spotter, Serial No. 01356 identified by tape on case as Rhode's".

Visual Inspection;

1. The item is identified as a Mine Safety Appliances Company Model N "Spotter" portable methane detector (MSA part No. 465005).

2. Serial No. 01356 is stamped on the front of the instrument case.

3. The instrument has an MSHA approval plate with Approval No. 8C-45 stamped on it. Mine Safety Appliances Company was granted MSHA-approval for this instrument in a letter from the MSHA Approval and Certification Center on May 24, 1978 (reference MSHA:A&CC:Investigation No. GD-51.8).

4. The visual inspection revealed no physical damage to the unit.

5. The instrument appears to be in operational condition.

6. The battery test indicates the unit needs to be recharged.

7. The calibration record affixed to the inside of the back cover of the instrument case indicates that the last calibration of the instrument was performed on 6-11-80. The calibration record label has the statement "A calibration check is required after 5 days use to assure the most accurate response" printed on it.

8. A detailed comparison of this instrument with the drawings and specifications on file at the MSHA, Approval and Certification Center under Investigation No. GD-51.8 revealed that this instrument was built according to those drawings and was not modified in any manner.

Intrinsic Safety Evaluation:

1. After this instrument was found to have been built as described by the drawings and specifications on file at the MSHA, Approval and Certification Center, a review was made of the intrinsic safety evaluation contained in the final report of MSHA Investigation No. GD-51.8. The final report concluded that the subject instrument would not be a potential source of ignition of a methane-air atmosphere.

2. A technical evaluation of the actual circuit used in this instrument revealed no energy storage component, or combination of components under normal or fault conditions, that could store sufficient electrical energy that would render the instrument capable of being a source of ignition of a methane-air atmosphere.

3. The catalytic-type sensor used in instruments of this type are a possible source of a thermal (hot-wire) ignition of a methane-air atmosphere. To ascertain if this sensor could have been such a hazard, the instrument was placed in an explosive methane-air atmosphere with the sensor operating. No ignition of the 7.75% methane-in-air gas mixture occurred during the thirty (30) minute test.

APPENDIX N-2

Performance Evaluation:

A performance test of this methane detector was performed in order to determine the response of this instrument to various concentrations of methane gas.

1. The batteries used in this instrument were recharged prior to the performance testing using an MSA charging unit specified for the model N "Spotter" methane detector.

2. Methane concentrations of between 1.0% and 5.0% were used to determine the response of the instrument. The methane and air were mixed in the appropriate proportions by means of a Matheson Model SP-795 "Dyna-Blender". The gas concentrations were verified by gas chromatography (reference IS&I test procedure IS&I-4, rev. B).

3. Results:

Actual methane concentration	Methane concentration indicated
0.0	0.2
1.0	0.2
2.0	0.2
3.0	0.2
4.0	0.2
5.0	0.2

4. Calibration of the instrument was attempted using the specified MSA calibration kit and the procedures found in the operator's manual of the Model N "Spotter" methane detector. The instrument was "zeroed" in fresh air using the "zero" potentiometer located on the circuit board of the instrument. The instrument could not be "spanned" (upper calibration point). The display indicates a reading of 0.0% methane in a known 2.0% methane-air gas concentration when the "span" potentiometer was at its maximum (fully clockwise) position.

The subject MSA Model N "Spotter" portable methane detector, Serial No. 01356, does not respond to any concentrations of methane gas. The instrument could not be calibrated using the procedures set forth in the operator's manual.

Exam

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Visu

1. ster's Multimeter.

2. roval No. 2G-2344 printe
on it.

3. The E.I. DuPont de Nemours Company (DuPont) was granted U.S. Bureau of Mines approval for the Model 101 Blaster's Multimeter in a letter dated November 17, 1970. (reference MSHA, A&CC Investigation No. MR-4060.2).

4. The final report of Investigation No. MR-4060.2 states that the instrumen is assembled for DuPont by the Simpson Electric Co., but the manufacturing is controlled by DuPont.

5. Extensive physical damage has occurred to the instrument. The instrument has been broken into numerous pieces in its leather carrying case. The leather carrying case is ripped and covered with coal dust.

6. A detailed comparison of the instrument with the drawings and specifications on file at the MSHA, Approval and Certification Center under Investigation No. MR-4060.2 revealed, to the extent possible, that this instrument was built according to those drawings and did not appear modified in any manner.

Intrinsic Safety Evaluation;

1. After this instrument was found to have been built according to the drawings and specifications on file at the MSHA, Approval and Certification Center, a review was made of the intrinsic safety evaluation contained in the final report of Investigation No. MR-4060.2. The final report concluded that the subject instrument would not be a potential source of ignition of a methane-air atmosphere.

2. A technical evaluation of the actual circuit used in this instrument revealed no energy storage component, or combination of components under normal or fault conditions, that could store sufficient electrical energy that would render the instrument capable of being a source of ignition of a methane-air atmosphere.

Exa

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Las

ıe instrument is identified as a Model 2500 Laser Alignment Cylinder
No. 31900) manufactured by the Laser Alignment Inc.

ıe unit has an MSHA approval plate with Approval No. 2G-2711 stamped
Laser Alignment Inc. received MESA-approval for this instrument in
:er from MESA dated August 21, 1973 (reference MSHA:A&CC:Investigation
ł-4805.2).

ıe electrical cable entering the end of the unit has been cut and frayed
ıng the copper wire conductors.

4. The unit has sustained limited external physical damage to the metal enclosure.

5. There are loose parts inside the enclosure.

6. A comparison of the actual instrument with the drawings and specifications on file at the MSHA, Approval and Certification Center under Investigation No. MR-4805.2 revealed that the subject instrument as approved includes a separate battery and assembly which was not received with the unit.

7. Inspection of the instrument was not possible because the unit was unable to be disassembled. A potting compound prevented the end caps from disengaging the cylinder.

Intrinsic Safety Evaluation;

1. A review was made of the intrinsic safety evaluation contained in the final reports of MSHA investigation No. MR-4805.2. The final reports concluded that the subject instrument would not be a potential source of ignition of a methane-air atmosphere.

A technical evaluation of the actual instrument was not able to be
e because the essential parts of the instrument were not available or
accessable.

APPENDIX N-2

Evaluation of:

1Z Tech

n;

1. The instrument is i

2. Serial No. 108609 i

3. No MSHA, MESA, or B
instrument.

4. No record of this i
V1Z Tech, was located i
Center.

5. The instrument sust
operative.

Intrinsic Safety Evaluation:

1. The instrument is powered by a 1.5-volt, "AA" size, carbon-zinc battery. Batteries of this type have been evaluated by the Intrinsic Safety and Instrumentation Branch of the MSHA, Approval and Certification Center and have been determined not to be source of ignition of a methane-air atmosphere if a short should occur across the output of the battery.

2. There are no other electrical components, or combination of electrical components under normal or fault conditions, used in this instrument that could store sufficient electrical energy that would render the instrument capable of being a source of ignition of a methane-air atmosphere.

APPENDIX N-3

United States Department of the Interior

BUREAU OF MINES

PITTSBURGH RESEARCH CENTER
COCHRANS MILL ROAD
POST OFFICE BOX 18070
PITTSBURGH, PENNSYLVANIA 15236

September 3, 1981

Mr. Edward Kawenski
U.S. D.O.L., MSHA
Bruceton Technology Center
4800 Forbes Avenue
Pittsburgh, PA 15213

Dear Mr. Kawenski:

On May 15, 1981, dust samples were collected in the MSHA laboratory from an explosionproof box which houses a transformer and from another explosionproof box which houses the start switch of a conveyor belt loader.

The samples were collected as follows: A small speck of dust was sampled using a microspatula for transfer onto one side of a double sticking tape; the other side of this tape was attached to a metallic disc. The dusts collected were from the inside surface of the cover of the first box, the transformer it houses and from the bottom of both boxes. The samples so prepared were later metal-coated for examination in the Scanning Electron Microscope.

The following is the results of the SEM study of these samples: No burned dust was found in the samples collected from the box's cover. Burned dusts are dust particles that showed rounded features, blow-holes and xenospheres in contrast to unburned dusts which show characteristic angular edges and angular features. Some burned dust particles were observed in the samples collected from the top of the transformer and the bottom of both boxes, but these burned particles were not plentiful. The majority of the dust particles retained their unburned characteristics.

Sincerely yours,

Dan Ng
Research Physicist
Fires and Explosions

U. S. Department of Labor

Mine Safety and Health Administration
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213

Bruceton Safety Technology Center

July 15, 1981

MEMORANDUM FOR: EDWARD M. KAWENSKI

FROM: STEVEN J. LUZIK
Supv. Chemical Engineer
Industrial Safety Division

SUBJECT: Dutch Creek No. 1 Mine Explosion Investigation: Test Resul of Explosibility Studies on Light Switch Box Enclosures and Proximate Analysis of Coal and Coke Dust Samples

LIGHT SWITCH BOX EXPLOSIBILITY TEST STUDY

Test Procedures and Results

Two explosion-proof light switch box enclosures, used to control power to headlamps on a continuous mining machine, were received by our laboratory from Coal Mine Safety and Health personnel. They were identified as follows:

Enclosure No. 1: Taken from Joy 12CM continuous mining machine located on the 102 Longwall Section of the Dutch Creek No. 1 Mine at the time of the post-explosion investigation. Manufactured by Service Machine Company, Huntington, West Virginia - Bulletin SM-500, Serial No. PTO-1523, Certification No. X/P 1665-21.

Enclosure No. 2: A duplicate box provided through the manufacturer not yet put into service. Serial No. PTO-2233, Certification No. identical to Enclosure No. 1.

Explosibility tests were divided into two regimes. Regime 1 was designed to determine if an electrical wire (No. 14 gauge, stranded insulated), pinched between the lip of the enclosure and the cover plate, would permit an internal methane/air ignition to pass flames through the flanges and ignite an external flammable body of gas. Regime 2 was undertaken to determine the minimum uniform gap required to consistently effect external ignitions from an ignition within the enclosure.

A small partition was assembled in the Division's Gas Gallery and used for both regimes. Details of the partition are shown in Figure 1. The height of the

enclosure was 78 inches. Thin polyethylene sheeting served as a diaphragm on the north and west walls. A 3-foot by 4-foot opening in the east wall was also covered with polyethylene. Cylinder gas was admitted to the partition through the feed line and mixed with a totally enclosed motor fan. A centrifugal pump and valving system enabled partition mixutres to be drawn into the switch box. Enriched mixtures could be achieved by admitting pure methane directly into the box (not shown). Sampling lines were installed to determine methane concentrations both inside the box and within the partition. An infrared analyzer was used to sample gaseous mixtures.

Regime 1: Ignition of the mixture within the box was achieved remotely by either an electric squib or capacitively discharged high-energy spark. Tests were conducted with both original and duplicate boxes. A section of No. 14 stranded wire was placed on the box between the cover plate and box lip. The wire location can be seen in Figure 1 on the south side of the box between the second and third bolts. Gap sizes, ignition source, energy and location, percent methane, and coal dust on flange were all varied in an attempt to propagate an external ignition from an ignition inside the box. Test results are detailed in Table 1.

Regime 2: Ignitions were initiated by capacitively discharged high-energy sparks. Various size washers were used as shims and placed next to the threaded bolt holes on the lip of the box. The cover plate was then placed on the box and tightened down. A feeler gauge was inserted in the gaps to insure that the desired spacing was achieved. These tests were carried out in total darkness so that appearance of flame out of the flanges could be detected, if present. Test results are listed in Table 2.

Conclusions

Regime 1: Forty-two tests were conducted. External ignitions were achieved in four tests, one of which involved the original enclosure. The minimum gap through which flame propagated and ignited the partition mixture was 0.040 inch (between the first and second bolts on the south side of the box in Test 9). The gap width (0.040-0.050), created by the pinched wire, appears to be a marginal parameter for flame propagation to the outside and subsequent external ignition. Four external ignitions were observed, however, so that the potential exists for creation of an external explosion from an internal one under the conditions established by the experiment.

Two important observations are also noted as a result of these tests:

1. Examination of the box after selected tests and at the end of the program revealed no evidence of internal combustion. Neoprene insulation on the three conductor cables, as well as coal particulates, showed no evidence of heating or flame. This is primarily due to the fact that the methane/air ignition is of rapid duration and the mass of the box acts as a heat sink to dissipate the heat before appreciable combustion can take place.

2. Both the original and duplicate boxes were examined after internal ignitions had taken place. Striations, or paths, were visible in the coal dust layer on the box on either side of the pinched wire and are presumably made by high-pressure combustion gases escaping from the box (see Figure 2).

Regime 2: No flames or external ignitions were observed for the constan sizes up to 0.050 inch. At 0.062 inch, six out of six external ignition achieved. Flame was observed emanating from the gaps in each instance.

PROXIMATE ANALYSIS OF COKE AND COAL SAMPLES

A proximate analysis was performed on 15 samples of coal and coke taken the Dutch Creek Mine after the explosion of April 15, 1981. Test proced were in accordance with ASTM D-3172, "Standard Methods for Proximate Ana of Coal and Coke." Sampling locations and test results are listed in Ta and 4. Samples ISB 172 and 173 were channel samples and were taken as a basis for comparison with the other 11 samples, all of which had undergone some degree of heating. Samples ISB 166 and 167 seem to have experienced the highest degree of coking of 11 samples tested based on their high ash and low volatile matter content.

Attachments
Figures 1 and 2
Tables 1, 2, 3, and 4

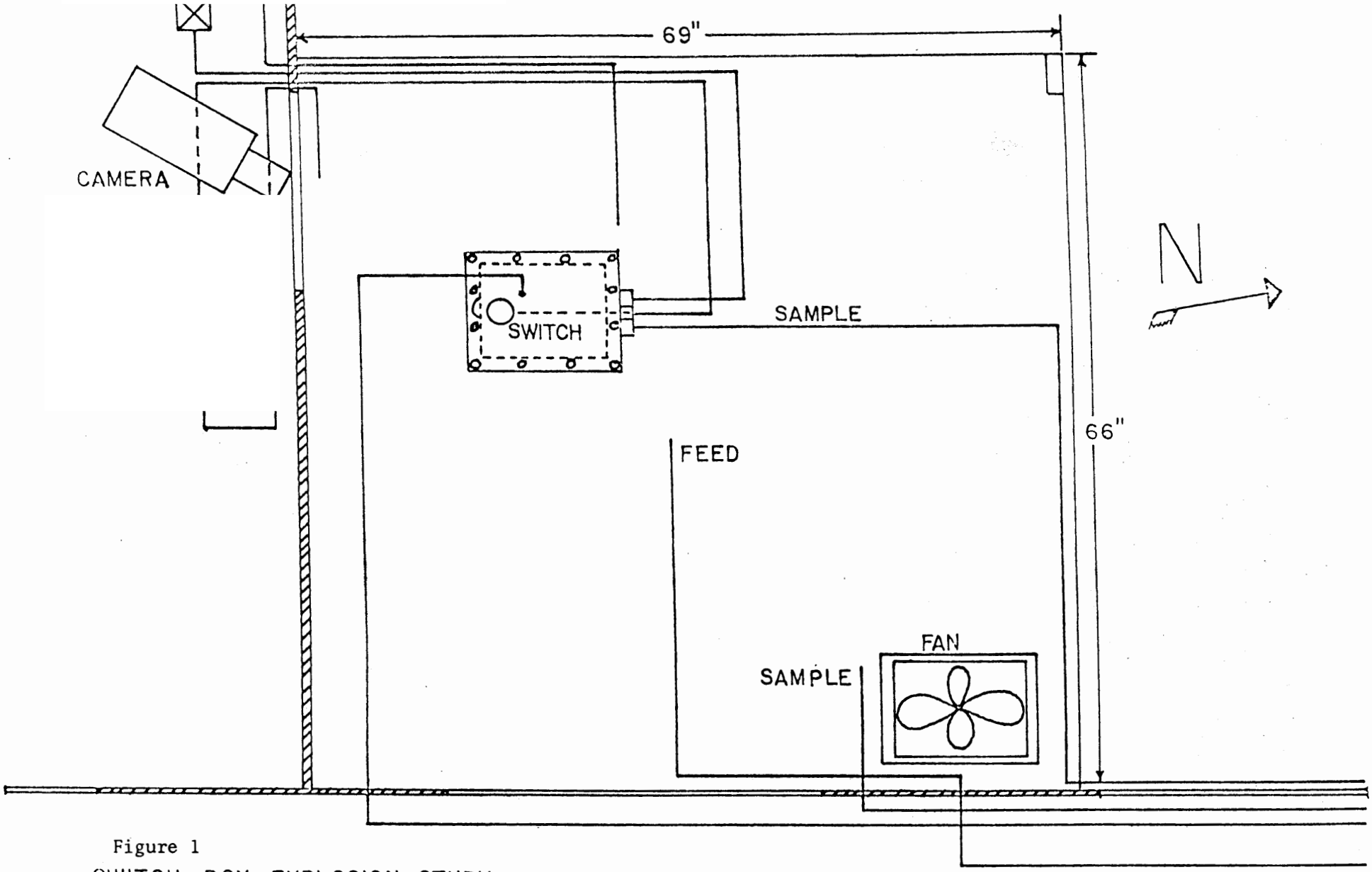


Figure 1

SWITCH BOX EXPLOSION STUDY
TEST SET-UP
SCALE: 1"=1'
6-2-81 TMF

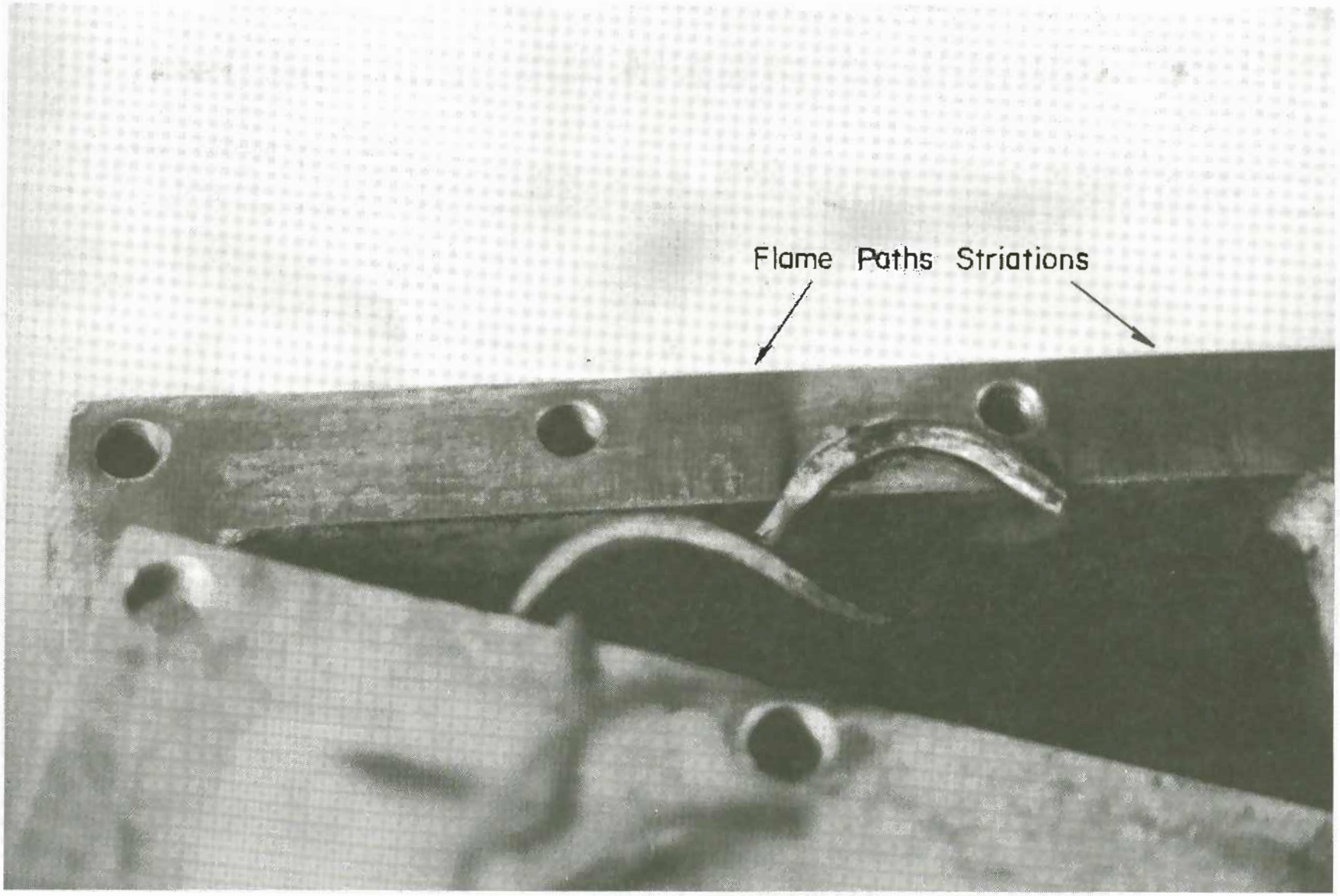


FIGURE 2 - Original Box showing fingers in dust on both sides of pinched wire.

APPENDIX N-4

DUTCH CREEK MINE
Explosion Investigation Test Results

Date	Series	Temp.	RH	Test	Box	Coal Dust Added	Ignition Source	Location	Energy (j)	Max. Gap (inches)	% CH_4 (box)	% CH_4 (gallery)	OBSERVATIONS	External Ignition
6/1/81	I	70	55	37	Duplicate	X	Electrode	C	4.800	0.050	7.4	7.4	Pressure observed.	-
6/1/81	I	70	55	38	Duplicate	-	Electrode	C	4.800	0.050	7.4	7.4	Pressure observed.	-
6/1/81	I	70	55	39	Duplicate	-	Electrode	C	4.800	0.050	9.0	9.0	Pressure observed.	-
6/1/81	J	70	55	40	Duplicate	-	Electrode	C	4.800	0.052	7.7	7.7	Pressure observed.	-
6/1/81	J	70	55	41	Duplicate	-	Electrode	C	4.800	0.052	7.7	7.7	Pressure observed.	-
6/1/81	J	70	55	42	Duplicate	-	Electrode	C	4.800	0.052	6.8	6.8	Flames observed.	X

Series J - In this series, the lower left bolt was loosened resulting in a gap of 0.030 inch around the southwest corner of the box.

NOTES:

EM = Electric match

Locations:

A = Located on the righthand side of the switch about 1-inch from the inside surface of the cover plate. (Tungsten electrodes used; 1/8-inch spacing.)
B = Located on the lefthand side of the switch, 1-inch from the surface of the cover plate and 1.5 inches from the left edge of the plate.
C = Located within 1/2-inch of the gap between the wire and the third bolt from the left on the inside of the box. One-eighth inch from the surface of the cover plate. Electrode gap = 1/4-inch.

Footnotes:

[1] Two bent bolts taken off the original box were utilized and placed in the threaded holes on either side of the pinched wire.
[2] In order to achieve this gap, the bolt in the lower lefthand corner of the box had to be loosened. This resulted in an extension of the gap around the lower left corner of the box.

APPENDIX N-4

DUTCH CREEK MINE
Explosion Investigation Test Results

Date	Series	Temp.	RH	Test	Box	Coal Dust Added	Ignition Source	Location	Energy (j)	Max. Gap (inches)	% CH_4 (box)	% CH_4 (gallery)	OBSERVATIONS	External Ignition
5/28/81	E	65	75	23	Duplicate	-	Electrode	B	0.486	0.050	10+	7.0	Pressure observed.	-
5/28/81	E	65	75	24	Duplicate	-	Electrode	B	0.486	0.050	10+	7.0	Pressure observed.	-
5/28/81	E	65	75	25	Duplicate	-	Electrode	B	0.486	0.050	10+	6.0	Pressure observed	-
5/28/81	E	65	75	26	Duplicate	-	Electrode	B	0.486	0.050	10+	5.0		-
5/29/81	F	65	75	27	Duplicate	X	Electrode	C	0.486	0.050	9.0	9.0	Pressure observed.	-
5/29/81	F	65	75	28	Duplicate	-	Electrode	C	2.400	0.050	7.8	7.8	Pressure observed.	-
5/29/81	F	65	75	29	Duplicate	-	Electrode	C	2.400	0.050	9.5	9.5	Pressure observed.	-
5/29/81	F	65	75	30	Duplicate	-	Electrode	C	2.400	0.050	12.0	9.5	Pressure observed.	-
5/29/81	G	65	75	31	Duplicate	X	Electrode	C	2.400	0.070[2]	9.5	9.5	Pressure observed.	-
5/29/81	G	65	75	32	Duplicate	-	Electrode	C	2.400	0.070[2]	7.5	7.5	Flames observed both sides of pinched wire as well as near lower left bolt. First flame appeared between 2nd and 3rd bolts. Gap remeasured here; found to be 0.050 inches.	X
5/29/81	G	65	75	33	Duplicate	-	Electrode	C	2.400	0.070[2]	7.5	7.5	Flames observed both sides of pinched wire.	X
5/29/81	H	65	75	34	Duplicate	-	Electrode	C	2.400	0.050	7.5	7.5	Lower left bolt tightened down closing gap on left side and decreasing area of opening resulting in no external ignitions.	-
5/29/81	H	65	75	35	Duplicate	-	Electrode	C	2.400	0.050	7.5	7.5		-
5/29/81	H	65	75	36	Duplicate	-	Electrode	C	2.400	0.050	7.5	7.5		-

APPENDIX N-4

DUTCH CREEK MINE
Explosion Investigation Test Results

Date	Series	Temp.	RH	Test	Box	Coal Dust Added	Ignition Source	Location	Energy (j)	Max. Gap (inches)	% CH_4 (box)	% CH_4 (gallery)	OBSERVATIONS	External Ignition
5/26/81	C	80	61	13	Duplicate	X	Electrode	A	0.486	0.050	10.0	7.7	Dust observed flying from gaps.	-
5/26/81	C	80	61	14	Duplicate	-	Electrode	A	0.486	0.050	9.5	6.6	Small flame observed on both sides of wires.	-
5/26/81	C	80	61	15	Duplicate	-	Electrode	A	0.486	0.050	9.5	8.0	Pressure escapes at gaps, some dust too.	-
5/26/81	C	80	61	16	Duplicate	-	Electrode	A	0.486	0.050	8.4	8.4	Pressure escapes at gaps, some dust too.	-
5/27/81	D	70	70	17	Duplicate	X	Electrode	B	0.486	0.050	8.0	8.0	Pressure and flying dust observed.	-
5/27/81	D	70	70	18	Duplicate	-	Electrode	B	0.486	0.050	13.0	13.0	Slight pressure.	-
5/27/81	D	70	70	19	Duplicate	-	Electrode	B	0.486	0.050	9.0	9.0	Pressure observed.	-
5/27/81	D	70	70	20	Duplicate	-	Electrode	B	0.486	0.050	7.7	7.7	Pressure observed.	-
5/27/81	D	70	70	21	Duplicate	-	Electrode	B	0.486	0.050	7.0	7.0	Slight pressure observed.	-
5/27/81	D	70	70	22	Duplicate	X				0.050	9.2	9.2		-

Test 22 - Electric match placed inside box. Box and gallery contained 9.2% methane. An electric match ignited the mixture in the gallery. The cover of the box was removed after this ignition. The electric match inside the box had not ignited. There was no evidence of fingers or ripples in the dust layer between the box and cover plate near the pinched wire. No evidence of external flame getting into or creating any disturbance with the box.

APPENDIX N-4
TABLE I
DUTCH CREEK MINE
Explosion Investigation Test Results
Regime 1

Date	Series	Temp.	RH	Test	Box	Coal Dust Added	Ignition Source	Location	Energy (j)	Max. Gap (inches)	% CH_4 (box)	% CH_4 (gallery)	OBSERVATIONS	External Ignition
5/18/81	A	-	-	1	Duplicate	-	EM	NW Corner	-	0.050	8.6	8.7		
5/18/81	A	-	-	2	Duplicate	-	EM	Near Lid	-	0.100	7.5	7.7	No observable phenomenon.	-
5/18/81	A	-	-	3	Duplicate	-	EM	Near Lid	-	0.050	10.0	10.0	Slight ping heard.	-
5/19/81	A	-	-	4	Duplicate	X	EM	Near Lid	-	0.056	8.4	8.4	Small flame observed around cover.	-
5/19/81	A	-	-	5	Duplicate[1]	X	EM	Near Lid	-	0.047	9.1	9.1	Pressure observed at flange near bent bolt.	-
5/19/81	A	-	-	6	Duplicate[1]	X	EM	Near Lid	-	0.035	8.8	8.8	Pressure observed through openings.	-
					Switch Box opened and examined after each test in Series A. No evidence of combustion inside of box. Fingers or paths observed in coal dust layer on box between bolt holes. Presumably the path that the pressure took in escaping out of the box.									
5/21/81	B	63	43	7	Original	-	EM	Near Lid	-	0.060	8.2	8.2	No evidence of combustion inside box.	-
5/21/81	B	63	43	8	Original	X	EM	Near Lid	-	0.050	8.5	8.5	Wires appear normal; pressure observed at gaps.	-
5/21/81	B	75	40	9	Original	X	EM		-	0.050	8.6	8.0	String of flame emanated from left side of box followed by flame thru gaps. Gap rechecked after ignition. 0.040 inch on left side of wire. 0.050 inch on right side.	X
5/21/81	B	80	40	10	Original	X	EM	Near Lid	-	0.050	8.2	7.8	Small flame observed on both sides of wire.	-
5/21/81	B	80	40	11	Original	X	EM	Near Lid	-	0.050	9.5	7.8	Small flame observed on both sides of wire.	-
5/21/81	B	80	40	12	Original	Thru 20 mesh	EM	Near Lid	-	0.050	9.5	7.2	Small flame observed on both sides of wire, fingers observed in dust layer between cover plate and box after box was disassembled.	-
					In Test Series C through I, the cover was not removed after the first test in the series. The box was brought back up to the desired concentration automatically with a valve and pump system.									

Date	Series	Temp.	R.H.	Test	Gap	%CH_4	Observations	External Ignition
6/11/81	5	65	70	1	.050"	7.1	Pressure heard; no flames	
6/11/81	5	65	70	2	.050"	7.0	do.	
6/11/81	5	65	70	3	.050"	7.1	do.	
6/11/81	5	65	70	4	.050"	7.9	do.	
6/11/81	5	65	70	5	.050"	9.0	do.	
6/11/81	5	65	70	6	.050"	8.9	do.	
6/11/81	5	65	70	7	.050"	9.1	do.	
6/11/81	5	65	70	8	.050"	8.0	do.	
6/11/81	5	65	70	9	.050"	9.0	do.	
6/11/81	6	65	70	1**	.060"	8.0	Flame 1st appear between 2nd & 3rd bolts on southside of box	X
6/11/81	6	65	70	2	.062"	7.9	do. (flames later observed out eastside of box	X
6/11/81	6	65	70	3	.062"	7.0	Flames 1st visible between 2nd & 3rd bolts; southside of box	X
6/11/81	6	65	70	4	.062"	9.0	do.	X
6/11/81	6	65	70	5	.062"	6.9	First evidence of flame on eastside & northside of box	X
6/11/81	6	65	70	6	.062"	9.0	Flames first visible between 2nd & 3rd bolts	X

*Gap remeasured after ignition found to be .065 inch. Lid tightened down to .040 inch for Tests 2 through 9.

**Gap remeasured after ignition. Found to be .062 inch. Box left "as is" for Tests 2 through 6.

APPENDIX N-4

TABLE 2 - Supplementary Explosion Investigation
Test Results - Regime 2

Date	Series	Temp.	R.H.	Test	Gap	%CH_4	Observations	External Ignition
6/10/81	1	64	100	1	.010"	7.0	Small pressure heard; no flame observed.	
6/10/81	1	64	100	2	.010"	7.0	do.	
6/10/81	1	64	100	3	.010"	8.0	do.	
6/10/81	1	64	100	4	.010"	7.0	do.	
6/10/81	1	64	100	5	.010"	8.0	do.	
6/10/81	1	64	100	6	.010"	8.0	do.	
6/10/81	1	64	100	7	.010"	9.0	do.	
6/10/81	1	64	100	8	.010"	9.0	do.	
6/10/81	1	64	100	9	.010"	9.0	do.	
6/10/81	2	64	100	1	.020"	7.0	Soft pressure heard; no flame	
6/10/81	2	64	100	2	.020"	7.0	do.	
6/10/81	2	64	100	3	.020"	7.0	do.	
6/10/81	2	64	100	4	.020"	8.0	Medium pressure heard; no flame	
6/10/81	2	64	100	5	.020"	8.0	do.	
6/10/81	2	64	100	6	.020"	8.0	do.	
6/10/81	2	64	100	7	.020"	9.0	High pressure heard; no flame	
6/10/81	2	64	100	8	.020"	9.0	do.	
6/10/81	2	64	100	9	.020"	9.0	do.	
6/10/81	3	64	100	1	.030"	7.0	Slight pressure; no flame	
6/10/81	3	64	100	2	.030"	7.1	do.	
6/10/81	3	64	100	3	.030"	7.0	do.	
6/10/81	3	64	100	4	.030"	8.0	do.	
6/10/81	3	64	100	5	.030"	8.0	do.	
6/10/81	3	64	100	6	.030"	7.9	do.	
6/10/81	3	64	100	7	.030"	9.0	Higher pressure; no flame	
6/10/81	3	64	100	8	.030"	9.0	do.	
6/10/81	3	64	100	9	.030"	9.0	do.	
6/10/81	4	64	100	1*	.040"	7.1	Flames 1st appear thru 2nd & 3rd bolts	X
6/10/81	4	64	100	2	.040"	7.4	Pressure; no flame	
6/10/81	4	64	100	3	.040"	7.0	do.	
6/10/81	4	64	100	4	.040"	8.0	do.	
6/10/81	4	64	100	5	.040"	8.0	do.	
6/10/81	4	64	100	6	.040"	8.0	do.	
6/10/81	4	64	100	7	.040"	9.1	do.	
6/10/81	4	64	100	8	.040"	8.9	do.	
6/10/81	4	64	100	9	.040"	8.9	do.	

APPENDIX N-4

TABLE 3 - Sampling Locations of Coal and Coke Specimens

ISB 157, No. 1, Coke Sample, 4/24/81: Collected from flat surface on left side of tail conveyor on 12 CM miner, face of return entry, 120 longwall section. Collected by Jack Matekovic.

ISB 158, No. 1E, Spot Sample, 9:15 am, 4/24/81: Off top of circuit breaker on outby end of power center in lower entry (intake) at 3rd outby crosscut, Section 102. Collected by J. M. Smith and witnessed by E. J. Daniels and C. Corey. Dust was 1.5 inches deep on top of circuit breakers.

ISB 159, No. 2, Coke Sample, 4/24/81: Collected on right side of the 12 CM miner at the head hinge pin, face of belt entry, 102 longwall. Collected by Jack Matekovic.

ISB 160, No. 3, Coke Sample, 4/24/81: Collected around cab on shuttle car just outby last open crosscut in belt entry off 102 longwall section. Collected by Jack Matekovic.

ISB 161, No. 4, 4/24/81: Collected from flat surface inby end of shuttle car belt entry, 102 longwall section. Collected by Jack Matekovic.

ISB 162, No. 5, 4/24/81: Collected from flat surfaces on feeder breaker on right side above motor belt entry, 102 longwall. Collected by Jack Matekovic.

ISB 163, No. 6, 4/24/81: Collected on outby end of feeder breaker belt entry, 102 longwall section. Collected by Jack Matekovic.

ISB 164, No. 7, Coke Sample, 4/24/81: Collected from inby side of last set timber and cap piece in intake entry just outby last open crosscut, 102 longwall section. Collected by Jack Matekovic.

ISB 165, No. 8, 4/24/81: Collected on inby and outby side of timber in face of belt entry, 102 longwall section (only timber in fall).

ISB 166, Coke Sample: Crosscut 65 between Nos. 3 and 4 slope entries.

ISB 167, Possible Coke Sample: Crosscut 64 and No. 4 belt entry.

ISB 168: Crosscut 64 and No. 4 belt entry.

ISB 169: No. 4 belt at right rib, post at south timber. Large coke sample from top inby side post.

ISB 172, Coal Dust Sample: 102 Section, No. 1 entry intake, 35-feet outby face in explosion area. Channel sample.

ISB 173, Coal Dust Sample: 102 Section, No. 2 entry return, 50-feet outby face in explosion area. Channel sample.

TABLE 4 - Proximate Analysis Test Results

ASTM D-3172-73 - Proximate Analysis (standard method of proximate analysis of coal and coke)

Sample No.	Moisture (%)	Volatile Matter (%)	Ash (%)	Fixed Carbon (%)
ISB 157	0.4		12.6	63.8
ISB 158	1.1		12.4	64.2
ISB 159	1.0	22.8	13.6	62.6
ISB 160	2.1	21.5	15.2	61.2
ISB 161	0.4	21.7	12.1	65.8
ISB 162	1.0	19.9	14.2	64.9
ISB 163	0.5	22.7	14.7	62.1
ISB 164	1.0	16.6	17.7	64.7
ISB 165	1.4	15.7	17.0	65.9
ISB 166	1.1	17.1	20.0	61.8
ISB 167	0.3	16.5	30.0	53.2
ISB 168	0.9	22.2	19.2	57.7
ISB 169	1.6	16.3	16.1	66.0
ISB 172	0.4	23.5	7.1	69.0
ISB 173	0.5	22.7	6.7	70.1

U. S. Department of Labor

Mine Safety and Health Administration
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213

Bruceton Safety Technology Center

August 6, 1981

MEMORANDUM FOR: ROBERT A. ELAM

FROM: GEORGE C. PRICE
Mining Engineer
Industrial Safety Division

SUBJECT: Examination of damaged flame safety lamp (Exhibit P-42) Dutch Creek No. 1 Mine explosion; addendum to memorandu dated 7/21/81

Two other flame safety lamps (Exhibits P-52 and P-75) were recovered from the mine. An examination of these lamps did not show evidence that they had contributed to the explosion.

Attachment
Memo dated 7/21/81

APPENDIX N-5

U. S. Department of Labor

Mine Safety and Health Administration
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213

Bruceton Safety Technology Center

July 21, 1981

MEMORANDUM FOR: ROBERT A. ELAM

FROM: GEORGE C. PRICE
Acting Chief, Industrial Safety Division

SUBJECT: Examination of damaged flame safety lamp (Exhibit P-42) from Dutch Creek No. 1 Mine explosion

The flame safety lamp (Exhibit P-42) was found in the belt (return) entry of 102 Longwall Section approximately 175-feet outby the face. The bail and swivel eye were missing and the hood, bonnet, top stiffening ring, and fuel fount were bent or dented. The outer surface was coated with a layer of soot. The igniter sparked but would not light the wick and the relighter would not retract.

Following the examination of the external surfaces, the lamp was disassembled. The fount did not contain naptha and the wick was dry. The wick was at normal flame height. The lower ring was not damaged, but the lower asbestos washer was broken with the larger portion of it crumbled into a pile on the top surface of the fount. (This could indicate forces acting from the outside toward the inside of the lamp.) The glass globe was coated on the inner surface with a heavy layer of black soot. The upper ring and upper washer were undamaged. The inner and outer gauzes were not broken and, except for a small dent in the upper edge of the outer gauze, were in good shape although coated with a layer of soot and/or coal dust. The flame safety lamp had been properly assembled. The glass globe could be turned easily by fingers due to the damaged lower asbestos ring.

From the location where the lamp was found and the examinations of the lamp, it was concluded that the lamp would not have initiated the mine explosion.

Attachments

bcc: E. M. Kawenski
G. C. Price
ISD Files

MT:GCPRICE:cjf:7/21/81
Bldg.38:Rm.203:BRTN:X6935

U. S. Department of Labor

Mine Safety and Health Administration
4800 Forbes Avenue
Pittsburgh Pennsylvania 15213

Bruceton Safety Technology Center

August 12, 1981

MEMORANDUM FOR: ROBERT A. ELAM

THROUGH: EDWARD M. KAWENSKI E.M. Kawenski
Chief, Industrial Safety Division

FROM: STEVEN J. LUZIK S.J. Luzik
Supv. Chemical Engineer

SUBJECT: Explosibility studies on methanometer sensing elements

As requested, explosibility studies were conducted on five sensing heads received from Mr. Cecil Lester, Coal Mine Specialist, CMS&H, Beckley, West Virginia. The purpose of the study was to determine if repeated exposure of the heads to near stoichiometric methane/air ignitions would result in degradation in sensitivity and/or failure of the sensing element. A Bacharach methane monitoring system was also provided by Mr. Lester to supply the electronics for this test study. The following identification numbers appeared on the meter and AC power supply chassis:

1. Analog current meter with dial scale readout 0-4.0% methane; Bacharach Model 23-7157; Serial No. 2462.

2. AC Power Supply Chassis; Bacharach Model No. 23-7167; Serial No. 142.

Five sensing elements were utilized in the test program. They were identified by small numbers taped onto the side of the element. Four of the elements were silver in color with the number "23 1414" stamped on them. One of these was taken from the continuous mining machine in the Slope Section of the Dutch Creek No. 1 Mine, Mid-Continent Resources, Inc., Carbondale, Colorado, at th time of the post-explosion investigation. The other three were assumed to b new and not yet put into service. The fifth head was bronze in color with t number "800 072" stamped on it. This head had previously been used in labor tory tests by Mr. Lester's staff and will be referred to as the "Beckley" sensing head in the discussions that follow.

Test Set-Up and Procedures

A 64 cubic-foot gallery (4-foot x 4-foot x 4-foot) was used in the test prog The detector head assembly was placed on a cinder block so that it was cente within the gallery. Methane sampling and feed lines were installed and a 2-

plastic diaphragm was placed over the open end of the gallery to confine the flammable methane mixture. This diaphragm was 16 square feet in area and provided adequate venting so that maximum explosion pressures were reduced to below 2.0 inches water gage. Ignition was achieved by remotely igniting an electric match placed in the gallery. Figure 1 shows the test configuration.

The test procedure employed was as follows: Normal calibration was performed on a particular sensor head using certified cylinder gas (2.5% methane). This calibration involved adjustment of zero and span controls so that the analog meter would read zero when the sensor head was exposed to fresh air and 2.5% when exposed to the calibration gas. The gallery, containing the sensor head, was filled with near stoichiometric mixtures of methane/air and ignited. Following ignition, the indicating needle on the meter was observed to insure that it returned to zero followed by a calibration re-check to determine if this had been altered as a result of the ignition. This procedure was repeated a number of times to determine the cumulative effect of instantaneous heating on the sensor heads. Calibration procedures and checks were performed by Mr. Terry Miller of the Mine Electrical Systems Division.

Test Results

The following test results were observed:

1. The three new sensor heads were repeatedly exposed to near stoichiometric methane/air ignitions without any noticeable effect on calibration. The meter returned to zero after each ignition and no adjustments were necessary when calibration gas check was performed after each ignition.

-Sensor #15 - 8 tests performed - Average methane = 9.6%
-Sensor #13 - 5 tests performed - Average methane = 9.6%
-Sensor #11 - 5 tests performed - Average methane = 9.6%

2. Three tests were performed on the Beckley sensor head. Degradation in the sensor head was observed after the second ignition. Calibration at 2.5% methane could not be achieved after the third ignition. The span calibration control was turned fully clockwise and the unit would only read approximately 0.5% methane.

3. The sensor head taken from the continuous mining machine at the Dutch Creek No. 1 Mine was calibrated and exposed to one ignition at 9.7% methane. The needle on the analog meter returned to zero following the ignition, but a pronounced degradation in the span calibration check was observed. The 2.5% methane calibration mixture was passed by the sensor head and the span calibration control was adjusted to its maximum. The gage would read only 1.7% methane and slowly dropped to 0.8% methane. Further attempts to re-calibrate this head proved futile.

4. In all of the tests performed on the five sensor heads, the indicating meter needle returned to* zero after ignition of the flammable gas mixture. The degradation and loss of sensitivity observed in the Beckley and Colorado sensor heads affected only the span or 2.5% methane calibration point.

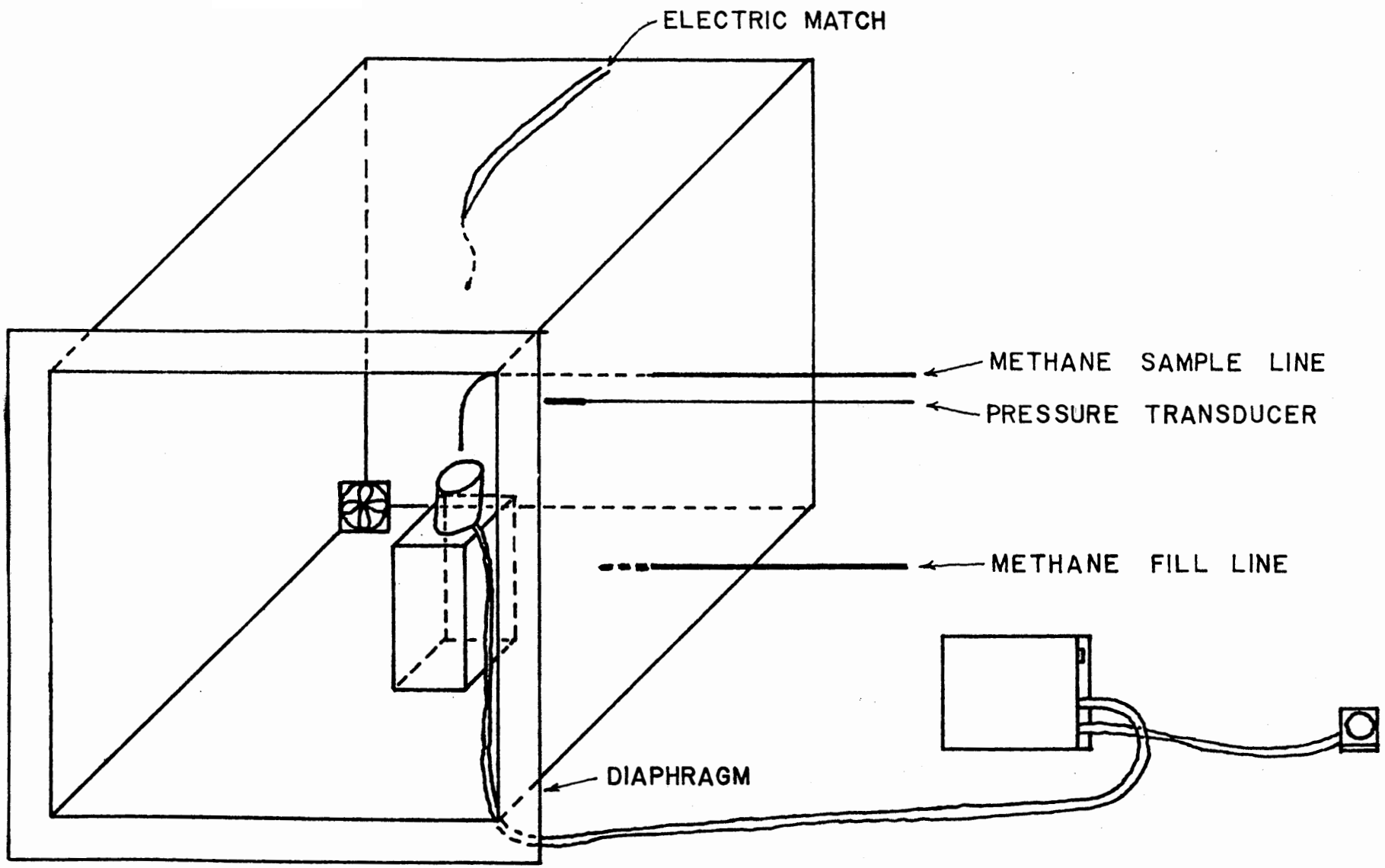
*Within plus or minus one-needle width of the zero mark on the meter.

Conclusions

It appears as though repeated exposure of the sensor element to near stoichi metric methane/air ignitions can cause degradation in sensor head performan This is not surprising since adiabatic flame temperature of stoichiometric methane/air ignitions, although present for only fractions of a second, may approach 2000°C. Repeated short-term exposure to these kinds of temperatur are likely to have adverse effects on the delicate bridge wires present ins the sensing head itself.

Further testing would be necessary to determine the actual number of exposu and conditions necessary to initiate degradation. Physical wear, temperature, and humidity are also factors which may play an important part in this determination.

Attachment



METHANE MONITOR SENSING HEAD EXPLOSIBILITY STUDY

TEST SET-UP

SCALE: 3/4"=1'

8-6-81

FIG. 1

TMF

CHAMBER INSIDE DIMENSIONS: 4'X4'X4'

U. S. Department of Labor

Mine Safety and Health Administration
P O Box 1166, Building F
Beckley, West Virginia 25801

July 21, 1981

MEMORANDUM FOR: THE RECORD

FROM: JAMES PIFER James Pifer
Electrical Engineer
A&CC, Beckley Electrical Testing Laboratory

SUBJECT: Tests conducted at Beckley Technical Support on June 24 and 25, 1981, and June 29 through July 2, 1981, on a Bacharach methane monitor, Model No. 23-7157, Serial No. 2834, as per request from Coal Mine Safety and Health

Prior to conducting the tests, a new sensing element was installed in the subject methane monitor. The methane monitor was then carefully examined, tested, adjusted and calibrated to assure proper operating condition by Andrew W. Price, Service Supervisor, Bacharach Instrument Company.

Test No. 1

Object of test: To determine if turning the zero adjuster control 90 degrees counterclockwise would desensitize the methane monitor to the extent that the meter needle would rest on the downscale meter needle stop and if application of a 2.2 percent methane in air mixture would fail to cause the meter needle to rise off the meter stop. This test was performed by Andrew W. Price and witnessed by Cecil Lester and the writer.

The zero adjuster control was slowly turned 90 degrees counterclockwise by Cecil Lester and witnessed by Andrew W. Price. The meter needle rested against the left (downscale) stop. Andrew W. Price then applied a known 2.2 percent methane in air mixture to the sensing element while observing the meter needle. The meter needle remained stationary against the downscale stop.

Test No. 2

Object of test: To determine the percentage of methane required to cause activation of the methane monitor with the zero adjuster rotated counterclockwise 90 degrees.

The methane monitor sensing element was placed in a gas chamber and the methane content was slowly increased until the red alarm light burned. The methane

monitor meter indicated 2 percent and [illegible] monitor activated the alarm and the control relay. The methane content was then measured by the writer, using a Riken gas indicator, Type 18, Serial No. 23787. The methane content was measured and found to be 4.2 percent.

Test No. 3

Object of test: To determine the condition of the sensing element taken from the methane monitor on the Joy 12CM continuous mining machine in use in the Dutch Creek No. 1 Mine, Mid-Continent Resources, Incorporated, Redstone, Colorado, at the time of the April 15, 1981, mine explosion.

After a proper warm up period, the zero adjuster was carefully adjusted so that the meter needle indicated zero. The sensing element was removed from the methane monitor and the sensing element taken from the Dutch Creek No. 1 Mine, Mid-Continent Resources, Incorporated, Redstone, Colorado, was installed. The results were as follows:

1. The meter needle rested against the left (downscale) stop.

2. The zero adjuster was rotated 60 degrees clockwise and the meter needle rested on zero.

3. A 2.2 percent methane in air mixture was applied to the sensor element. The meter indicated 1.3 percent and the methane monitor did not activate. The methane monitor was then recalibrated in accordance with the manufacturer's instructions. A 2.2 percent methane in air mixture was again applied to the sensor element. The methane monitor functioned normally, giving a visual warning when the methane content increased to 1 percent and another warning when the methane content exceeded 2 percent. The methane monitor also activated the cut-off relay when the methane content increased to 2 percent.

The methane monitor with the Dutch Creek sensor was tested daily during the period of June 29 through July 2. Each morning the monitor was allowed to warm up for a 15 minute period and a 2.2 percent methane in air mixture was applied to the sensing element. During each of these daily tests, the methane monitor and sensing element functioned normally. These tests were conducted by the writer.

cc: R. Dalzell
R. Rinehart
A. Massey

MSHA:BETL:JRPifer

APPENDIX O

U.S. DEPARTMENT OF LABOR—MINE SAFETY AND HEALTH ADMINISTRATION
MSHA FORM 7000-3 [Jun 78]

1128142

☐ CITATION (SEE REVERSE) ☒ ORDER OF WITHDRAWAL (SEE REVERSE) DATE 04/15/81 (MO/DA/YR) TIME 1755 (24 HR CLOCK)

SERVED TO William Martin - Supt. OPERATOR Mid-Continent Resources, Inc.

MINE Dutch Creek No.1 MINE I.D. 05-00301-____ (CONTRACTOR)

TYPE OF ACTION 103-k-_____ VIOLATION OF SECTION _____ OF THE ACT OR

PART AND SECTION _____ OF TITLE 30 CODE OF FEDERAL REGULATIONS: OFFICE USE ONLY DATE

TYPE OF INSPECTION AFA ☐ S AND S (SEE REVERSE) ☐ W N CODES __/__P__L__ATD__/__/__

CONDITION OR PRACTICE The mine has experienced a fatal mine explosion accident in the mine. This order is issued to assure the safety of any person in the coal mine until an examination or investigation is made to determine that the entire mine is safe. The following persons are permitted to enter the mine; only company

AREA OR EQUIPMENT Entire Mine

INITIAL ACTION ☐ NOTICE ☐ CITATION ☐ ORDER NO. _____ DATED __/__/__ (MO/DA/YR)

TERMINATION DUE DATE __/__/__ (MO/DA/YR) TIME _____ (24 HR CLOCK) SIGNATURE ▶ Louis Dillegno 21654 AR

ACTION TO TERMINATE

DATE __/__/__ (MO/DA/YR) TIME _____ (24 HR CLOCK) SIGNATURE ▶ ____ AR ☒ SEE CONTINUATION FORM

U.S. DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
MSHA FORM 7000-3a (Jun 78)

(original issue) DATED 04/15/81 No 1128142

☐ SUBSEQUENT ACTION ☒ CONTINUATION ☐ CITATION ☒ ORDER DATE 04/1[illegible]

SERVED TO William Martin - Supt. OPERATOR Mid-Con[illegible]

MINE Dutch Creek No.1 MINE I.D. 05-00301-____ (CONTRACTOR)

JUSTIFICATION FOR ACTION CHECKED BELOW

officials necessary to conduct investigation, representatives of the miners necessary to conduct investigation state officials necessary to conduct investigation, mine apparatus rescue crew necessary to explore and restore ventilation into the mine, and other related duties.

☐ EXTENDED TO: DATE __/__/__ (MO/DA/YR) TIME _____ (24 HR CLOCK) ☐ VACATED

☐ TERMINATED ☐ MODIFIED ☐ SEE CONTINUATION FORM

OFFICE USE ONLY CODES __/__P__L__ATD__/__/__ DATE

TYPE OF INSPECTION AFA

SIGNATURE ▶ [illegible]

APPENDIX O

U.S. DEPARTMENT OF LABOR—MINE SAFETY AND HEALTH ADMINISTRATION
MSHA FORM 7000-3 [Jun 78]

[X] CITATION (SEE REVERSE) [ ] ORDER OF WITHDRAWAL (SEE REVERSE) DATE 10/06/81 TIME 1430 0802484

SERVED TO M J Dunigrad V.P. OPERATOR Mid-Continent Resources, Inc.

MINE Dutch Creek #1 UG MINE I.D. 05-00301-___ (CONTRACTOR)

TYPE OF ACTION 104-a-__,____-__-__ VIOLATION OF SECTION ____-__-__ OF THE ACT OR

PART AND SECTION 75 313 ____ OF TITLE 30 CODE OF FEDERAL REGULATIONS. OFFICE USE ONLY DATE

TYPE OF INSPECTION AFA [X] S AND S (SEE REVERSE) [ ] WN CODES __/__ P__L__ ATD__/__/__

CONDITION OR PRACTICE The methane monitor installed on the 12CM continuous-mining machine, Serial No. JM2228, located in the 102 Section was not installed in a manner to deenergize automatically the continuous miner in that the lighting system of the machine remained energized when the concentration of methane reached 2.0 percent. The methane monitor also was not installed so as to give a warning automatically at all times when the concentration of methane reached 1.0 percent while the machine was being operated by remote control. Th

AREA OR EQUIPMENT

INITIAL ACTION [ ] NOTICE [ ] CITATION [ ] ORDER NO. _____ DATED __/__/__ MO DA YR

TERMINATION DUE DATE 11/06/81 TIME 0800 (24 HR CLOCK) SIGNATURE ▶ Clarence J Daniels 2-1621 AR

ACTION TO TERMINATE

DATE __/__/__ MO DA YR TIME ____ (24 HR CLOCK) SIGNATURE ▶ ____ AR [X] SEE CONTINUATION FORM

U.S. DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
MSHA FORM 7000-3a (Jun 78)

(original issue) DATED 10/06/81 No 0802484-1

[ ] SUBSEQUENT ACTION [X] CONTINUATION [X] CITATION [ ] ORDER DATE 10/06/81 TIME 1430 (24 HR CLOCK)

SERVED TO M J Dunigrad V.P. OPERATOR Mid-Continent Resources, Inc.

MINE Dutch Creek #1 UG MINE I.D. 05-00301-___ (CONTRACT

JUSTIFICATION FOR ACTION CHECKED BELOW warning light is located in a position that cannot be see at all times. These conditions were observed on April 25, 1981, during an inspection as part of the accident investigation of the April 15, 1981, explosion.

[ ] EXTENDED TO: DATE __/__/__ MO DA YR TIME ____ (24 HR CLOCK) [ ] VACATED OFFICE USE ONLY CODES __/__ P__L__ ATD__/__/__

[ ] TERMINATED [ ] MODIFIED [ ] SEE CONTINUATION FORM DATE

TYPE OF INSPECTION AFA

SIGNATURE ▶ Clarence Daniels 2-1621 AR

APPENDIX O

U.S. DEPARTMENT OF LABOR—MINE SAFETY AND HEALTH ADMINISTRATION
MSHA FORM 7000-3 [Jun 78]

[X] CITATION (SEE REVERSE) [ ] ORDER OF WITHDRAWAL (SEE REVERSE) DATE 10/06/81 TIME 1435 08

SERVED TO M. J. Turnipseed OPERATOR Mid-Continent Resources, In

MINE Dutch Creek #1 UG MINE I.D. 05-00301-___ (CONTR

TYPE OF ACTION 104-a-__,___-__-__ VIOLATION OF SECTION ___-__-__ OF THE A

PART AND SECTION 75.503-_____ OF TITLE 30 CODE OF FEDERAL REGULATIONS: OFFICE USE DATE

TYPE OF INSPECTION AFA [X] S AND S (SEE REVERSE) [ ] WN CODES __/__P__L__ATD__

CONDITION OR PRACTICE The 12CM continuous-mining machine, Serial No. JM2228, located 102 Sectior was not maintained in permissible condition in that an opening in exce 0.004-inch existed in the plane flange joint under the cover of the explosion-proof compar housing the lighting transformer and switch. A 0.015-inch fecler gauge could easily be inserted into the opening. This condition was observed on April 25, 1981, during an inspection as part of the accident investigation of the April 15, 1981, explosion.

AREA OR EQUIPMENT

INITIAL ACTION [ ] NOTICE [ ] CITATION [ ] ORDER NO. _____ DATED __/__/__ (MO/DA/YR)

TERMINATION DUE DATE 11/06/81 (MO/DA/YR) TIME 0800 (24 HR CLOCK) SIGNATURE ▶ J M Smith 2-1691 (AR)

ACTION TO TERMINATE The explosion-proof compartment was removed from the miner during the investigation for testing.

DATE __/__/__ (MO/DA/YR) TIME ____ (24 HR CLOCK) SIGNATURE ▶ ___ (AR) [ ] SEE CONTINUATION FORM

APPENDIX-O

U.S. DEPARTMENT OF LABOR—MINE SAFETY AND HEALTH ADMINISTRATION
MSHA FORM 7000-3 [Jun 78]

[X] CITATION (SEE REVERSE) [ ] ORDER OF WITHDRAWAL (SEE REVERSE) DATE 10/06/81 (MO/DA/YR) TIME 1435 (24 HR CLOCK) 0802486

SERVED TO M J Sunnstead V.P. OPERATOR Mid-Continent Resources, Inc.

MINE Dutch Creek #1 UG MINE I.D. 05-00301-___ (CONTRACTOR)

TYPE OF ACTION 104-d-1,_____ VIOLATION OF SECTION ___-___-___ OF THE ACT OR

PART AND SECTION 75.511-_____ OF TITLE 30 CODE OF FEDERAL REGULATIONS: OFFICE USE ONLY DATE

TYPE OF INSPECTION AFA [X] S AND S (SEE REVERSE) [ ] W N CODES __/__ P L ATD __/__/__

CONDITION OR PRACTICE Electric work performed on April 6, 1981, consisting of installation of a cover on an explosion-proof compartment and the wiring of a two-pole light switch on the Joy 12CM continuous-mining machine, Serial No. JM2228, in the 102 Section, was not performed by a qualified person nor under the direct supervision of a qualified person. This violation was determined during an inspection as part of the accident investigation of the April 15, 1981, explosion.

AREA OR EQUIPMENT

INITIAL ACTION [ ] NOTICE [ ] CITATION [ ] ORDER NO. _____ DATED __/__/__ (MO/DA/YR)

TERMINATION DUE DATE 11/06/81 (MO/DA/YR) TIME 0900 (24 HR CLOCK) SIGNATURE ▶ Clarence J Daniels 216 (AR)

ACTION TO TERMINATE

DATE __/__/__ (MO/DA/YR) TIME ____ (24 HR CLOCK) SIGNATURE ▶ ___ (AR) [ ] SEE CONTINUATION FORM

APPENDIX O

U.S. DEPARTMENT OF LABOR—MINE SAFETY AND HEALTH ADMINISTRATION
MSHA FORM 7000-3 [Jun 78]

[X] CITATION (SEE REVERSE) [ ] ORDER OF WITHDRAWAL (SEE REVERSE) DATE 10/26/81 (MO/DA/YR) TIME 1 (24 HR C

SERVED TO M J Tunnessed V. P. OPERATOR Mid-Continent E

MINE Dutch Creek #1 UG MINE I.D. 05-00301-

TYPE OF ACTION 104-a-,---- VIOLATION OF SECTION ---

PART AND SECTION 75 313 -1 ---- OF TITLE 30 CODE OF FEDERAL REGULA

TYPE OF INSPECTION AFA [X] S AND S (SEE REVERSE) [ ] W N CODES --/--

CONDITION OR PRACTICE A definite maintenance program for keeping methar was not established and adopted. A written description of such progr for inspection and had not been made available to the qualified persc maintenance of the methane monitors. This violation was determined during an inspection as part of the accident investigation of the April 15, 1981, explosion.

AREA OR EQUIPMENT

INITIAL ACTION [ ] NOTICE [ ] CITATION [ ] ORDER NO. ---------- DATED --/--/-- (MO/DA/YR)

TERMINATION DUE DATE 11/06/81 (MO/DA/YR) TIME 0800 (24 HR CLOCK) SIGNATURE Clarence J Daniels 2 1 6 1 S

ACTION TO TERMINATE

DATE --/--/-- (MO/DA/YR) TIME ---- (24 HR CLOCK) SIGNATURE ▶ ---AR [ ] SEE CONTINUATION FORM