

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

REPORT OF INVESTIGATION
UNDERGROUND MINE COAL DUST EXPLOSION

No. 11 Mine (ID No. 15-02290)
Adkins Coal Company
Kite, Knott County, Kentucky

December 7, 1981

by

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ABSTRACT

This report is the result of an investigation by the Mine Safety and Health Administration (MSHA) made pursuant to section 103(a) of the Federal Mine Safety and Health Act of 1977 (Mine Act), Public Law 91-173, as amended by Public Law 95-164, 30 U.S.C. 813(a) (Supp. IV, 1980).

On Monday, December 7, 1981, at approximately 2:50 p.m., a coal dust explosion occurred on the south main working section at the No. 11 mine, Adkins Coal Company, located at Kite, Knott County, Kentucky. The accident resulted in the death of all eight (8) miners who were underground at the time. The names, ages, occupations and mining experiences of the victims are contained in Appendix A.

The accident occurred while the face and right crosscut were being blasted simultaneously from the solid in the No. 1 entry of the active working section. The investigation revealed that a train of explosives, at least 74 inches in length, in the second hole from the right rib of the No. 1 entry face, failed to detonate. This failure provided too much burden for the rib hole to pull, causing the rib hole to blow out, igniting the coal dust which was in suspension from the blast of the other holes and the dust in suspension which had been previously deposited on the floor, roof and ribs from earlier mining operations. Evidence indicated that it was a practice not to use stemming in the blast holes and that each hole was loaded to or near the hole collar with explosives.

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PART I

GENERAL INFORMATION

General Information

The 007 section of the No. 11 mine is located on Potato Branch, off Right Beaver Creek, near Kite, Knott County, Kentucky, approximately 1 mile off State Highway 7. On September 10, 1979, the mine operator filed a legal identity form with the Mine Safety and Health Administration (MSHA) which listed the corporation name as the Adkins Coal Company. During the investigation, the operator maintained that the mine was operated by Incoal, Incorporated. An appropriate citation was issued during the investigation for failure to file a correct notification and every change thereof of legal identity with MSHA. During the investigation, the accountant for the company explained the relationship between Adkins Coal Company and Incoal, Incorporated, as follows:

Adkins Coal Company is a general partnership and the partners are Orville Adkins, Dixie Adkins, Adam Adkins and Sally Adkins. Adkins Coal Company subleases certain minerals consisting of approximately 360 acres of Elkhorn Seam No. 3 and 200 acres of Elkhorn Seam No. 1 from Island Creek Coal Company. These properties are located on Sly Branch, Knott County, Kentucky.

Incoal, Incorporated, is a Kentucky corporation and the stockholders are the same persons as the partners of the Adkins Coal Company. Incoal, Incorporated, also subleases certain minerals consisting of approximately 1,000 acres of Elkhorn Seam No. 1 from the Island Creek Coal Company, and this mineral is also located in Knott County.

Adkins Coal Company does not mine coal; the company contracts Incoal to mine the coal on its subleases. Incoal, Incorporated, was formed in August 1969 and Adkins Coal Company started in June 1974. The coal being mined at the time of the explosion was produced from the mineral subleased by Incoal, Incorporated.

In addition to leasing the mineral to Incoal, Incorporated, Island Creek Coal Company provided engineering services for the operator. These services consisted of underground surveys, providing a mine map showing the mine layout and a mining plan for the development of the active working places.

The mine management officials of the 007 section of the No. 11 mine at the time of the explosion were:

| | |
|------------------|---------------------|
| Harold Baldridge | Mine Superintendent |
| John Ellis Bates | Mine Foreman |
| Bobby Slone | Foreman |

The No. 11 mine had 2 active working sections, identified as the 006 and 007, and a preparation plant. The 2 working sections were not physically connected underground. The accident occurred on the 007 working section.

The 007 working section of the mine was opened in 1978 by 3 drifts into the Elkhorn No. 1 coalbed. At the third crosscut (250 feet in by the portal), 3 additional entries were developed and a 6-entry system was used throughout the mine. The Nos. 5 and 6 entries were used for main intake aircourses and the Nos. 1 and 2 entries were return aircourses. The Nos. 3 and 4 entries were separated from these aircourses by concrete block stoppings which isolated the travelway and the conveyor belt entry from the aircourses. The coalbed averaged about 31 inches in thickness and was relatively level.

A total of 23 persons, 20 working underground, were employed on 2 coal-producing shifts, 5 days a week. The average daily production reportedly was 450 tons of coal. The immediate roof overlying the coalbed was shale and sandstone, and the floor was fireclay.

During the investigation, a standard channel sample of coal was taken by MSHA in the working place of the No. 1 entry of the south main entries. The sample was analyzed by the Industrial Safety Division Laboratory, Bruceton Safety Technology Center, Pittsburgh, Pennsylvania. The proximate analysis of the channel sample was as follows:

| | <u>Percent</u> |
|-----------------|----------------|
| Moisture | 2.6 |
| Volatile matter | 34.2 |
| Fixed carbon | 54.7 |
| Ash | 8.5 |

Numerous tests by the Bureau of Mines have established that coal dust having a volatile ratio of 0.12 and higher is explosive. The volatile ratio of the coal in the face area of the 007 section from the analysis of the sample was 0.39. The coal dust is therefore highly explosive. The volatile ratio is the ratio of volatile matter to fixed carbon plus volatile matter:

$$VR = \frac{v}{fc + v}$$

The last MSHA inspection of the entire Adkins No. 11 mine was conducted October 7-22, 1981. This inspection covered both the 006 and 007 working sections. A total of 7 citations were issued, 4 in the underground workings of the 007 section.

Mining Methods, Conditions and Equipment

Mining Methods

The method of mining being followed in the section where the accident occurred consisted of 6 entries with a projected width of 22 feet on 60-foot centers and connecting crosscuts on 60-foot centers and 22 feet in width. The pillars established by this development were not recovered.

Generally, the immediate roof over the coalbed was 10 feet of shale and sandstone and the main roof was sandstone. Roof bolts, 30 inches in length, were the only means of roof support used in the immediate area of the accident and the roof bolting was done according to an MSHA-approved roof control plan. The mine roof in the accident area appeared to be adequately supported.

Ventilation and Examinations

Mine ventilation was induced by a 6-foot propeller-type exhaust fan installed on the surface in a fireproof housing constructed of sheet metal which connected it to the No. 3 entry. The fan was driven at 1760 rpm by a 20-horsepower electric motor and developed a pressure of 0.5 inches of water. During the last inspection of the entire mine conducted October 7-22, 1981, approximately 15,642 cubic feet of air per minute (cfm) was measured in the intake entries at the last permanent stopping. Approximately 9020 cfm of air was measured in the immediate return of the working section and 76,400 cfm was measured in the main return at the mine fan. The analyses of air samples taken at these locations did not reveal any methane in the mine.

The 007 section was being developed with 6 entries. Intake air entered the mine from the surface through the No. 5 east main entry and returned out the No. 3 entry. At the third crosscut underground, an additional intake entry (No. 6 entry) was developed. The south main entries were developed off the east main, the Nos. 5 and 6 entries were intake entries, and the Nos. 1 and 2 entries were return aircourses.

The belt conveyor entered the mine in the No. 4 entry of the east main entries. In the south main entries, the belt conveyor was installed in the No. 3 entry, and the air used to ventilate the belt entry was coursed directly into the return aircourse near the section loading point. The No. 4 entry was isolated in the same air current as the conveyor belt. Two escapeways were maintained, one of which was ventilated with intake air.

Permanent stoppings, constructed of concrete blocks, were used to provide the required separation between the various aircourses. According to the ventilation plan approved for the mine, line brattice and check curtains were required to direct the ventilating air currents in the working places.

A mine map showing air flow directions, air quantities, other information gathered from previous inspections, inspectors' notes, and during the investigation is in Appendix J.

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

A Ventilation System and Methane and Dust Control Plan for the mine was approved July 16, 1981.

Coal Dust

The primary means for rendering coal dust inert was by applying rock dust. While developing the working places, rock dust was applied by hand and periodically a portable rock dust machine was used to dust the entries again. Loose coal, including coal dust, was shoveled by hand into the roadways along the entries where scoops picked it up and loaded it onto the belt conveyor.

The approved Ventilation System and Methane and Dust Control Plan required that dust on the roadways be controlled by water and calcium chloride. The plan also required that dust be controlled at the transfer points, loading points, underground dumps, along the belt line and at belt drives, in the face areas and along the roadways by ventilation, water, calcium chloride, rock dust and a company clean-up program.

During the inspection of the entire mine made in October of 1981, a mine dust survey was not conducted because the survey area of the mine was too wet to collect samples. However, spot samples were taken during an inspection made in June 1981. These samples resulted in the issuance of a section 104(d)(1) unwarrantable citation because the analyses of the samples revealed that the incombustible content was less than that required by the regulations. The condition was subsequently corrected.

A waterline, 2-inches in diameter, paralleled the belt conveyor, and outlets were provided as required by the regulations. A water tank mounted on skids was located at the section loading point for use in sprinkling roadways. There were several areas in the mine where accumulations of water were present; these areas are shown on the mine map provided in Appendix K.

Explosives

Blasting supplies were delivered to the mine from a central storage magazine which was used to store explosive supplies for this and other mines operated by the company. The explosives were manufactured by Independent Explosives, Incorporated; the type used was a granular based Permissible E. Each of the original paper shipping cartons contained 50 pounds of 1-1/2- by 12-inch cartridges. The permissible electric blasting caps used to initiate the explosives were manufactured by the Du Pont Company. The caps had 12-foot iron leg wires and the mine utilized millisecond delay periods numbered 1 through 9. The No. 1 cap had a nominal delay time of 25 milliseconds and the No. 9 had a delay time of 700 milliseconds for a total delay period of 675 milliseconds. The explosives were detonated by a 20-shot permissible blasting unit. Reportedly, the explosives were transported underground in the original containers by being placed in the bare metal bucket of a battery-powered scoop. Two explosives storage magazines were located about 400 feet outby the face in a crosscut between Nos. 1 and 2 entries.

Coal was blasted from the solid face by certified shot firers using a method commonly called "slab shooting." When using this method, the breaker hole is drilled at an angle of about 45 degrees toward the rib from a point along the face to a depth that would cause the shot to pull the coal to develop a straight rib and a second free-face. The remaining holes are then drilled across the face while continually lessening the angle until the rib hole on the other side of the entry is drilled straight into the face so that a straight rib will be formed that will be flush with the existing rib. In preparing the places to be blasted, there were 7 to 9 blast holes drilled about 30 inches apart, ranging in depth from 4 to 10 feet in both the entries and crosscuts. See Appendix E for a typical sketch for hole placement for slab shooting off the solid.

Electricity

Ungrounded, 480-volt, 3-phase power was purchased from the Kentucky Power Company at a metering point near the mine portal. From the metering point, 480-volt, 3-phase power was furnished to the following electric equipment which was located on the surface: 5 battery chargers, the mine fan, the surface conveyor belt drive unit and a shop-made safety center.

The safety center was intended to provide the required protective features for the 480-volt, 3-phase underground distribution circuit. The safety center contained a zig-zag transformer to derive a neutral for the system. The derived neutral was properly grounded through a 15-ampere, current-limiting resistor. A grounding circuit, originating at the grounded side of the current-limiting resistor, was used to ground the frames of all underground electric equipment supplied from the system. However, the frames of the surface equipment receiving power from the system were not grounded to the grounded side of the current-limiting resistor.

A 225-ampere, molded-case circuit breaker in the safety center was equipped with a ground-check circuit and devices to provide short-circuit, grounded-phase and undervoltage protection for the underground distribution circuit. However, when tested during the investigation, the grounded-phase protective device was inoperative. Moreover, the safety center was installed in such a manner that the underground distribution circuit was not protected from the effects of a grounded-phase condition in any of the circuits supplying 480-volt, 3-phase power to the surface equipment. A 3-pole disconnect switch was provided in conjunction with the circuit breaker in the safety center to serve as a visual disconnecting device for the underground distribution circuit.

From the safety center, the underground distribution circuit entered the mine through the No. 4 (belt conveyor) entry and supplied 480-volt, 3-phase power to an underground belt conveyor drive unit located approximately 700 feet in by the portal and a portable power center located in the 007 section. The underground distribution circuit consisted of approximately 2,050 feet of No. 1/0 AWG, 3-conductor, type G-GC cable which was installed on the mine floor. A one-line diagram of the underground distribution circuit at the time of the explosion is contained in Appendix D.

The portable power center located in the 007 section was manufactured by Porter Industries, Incorporated, and contained a 150 kVA, 480 VAC to 240 VAC, 3-phase transformer, which was connected delta/delta. A neutral for the secondary system was derived by a zig-zag transformer. The neutral was properly grounded to the frame of the power center through a 15-ampere, current-limiting resistor. The frames of all equipment supplied from the power center were properly grounded to the grounded side of the current-limiting resistor.

The power center contained two 240-volt, 3-phase outlets; one was used to supply 240-volt, 3-phase power to the coal drilling machine on the section and the other was used to supply 240-volt, single-phase power to a water pump located in the worked-out rooms to the right of the south main entries. Each circuit was protected by a molded-case circuit breaker which was equipped with a ground-check circuit and devices to provide short-circuit, grounded-phase and undervoltage protection for the circuit. However, the ground-check circuit for the coal drilling machine had been rendered inoperative by shorting the ground-check pin to the grounding pin in the receptacle on the power center.

The power center also contained a 150 KW rectifier bridge and one 300-volt, direct-current outlet which was used to supply power to the roof bolting machine on the section. The roof bolting machine trailing cable was protected against short circuits by a molded-case circuit breaker.

Cable couplers were provided in conjunction with each of the 3 circuit breakers in the power center to provide visual evidence that the power was disconnected when the cable plug was withdrawn from the receptacle.

Single-phase, 240-volt power was conducted to the nonpermissible water pump by a No. 12 AWG, 3-conductor with ground cable. Three-phase, 240-volt power was conducted to the coal drilling machine by a No. 10 AWG, 5-conductor, trailing cable. Three hundred-volt, direct-current power was conducted to the roof bolting machine by a No. 4 AWG, 2-conductor, type G trailing cable.

The electric equipment used on the 007 section consisted of the following:

1. Three Elkhorn Industrial Products Model AR-4 battery-powered scoops, MSHA Approval No. 2G-2271;
2. One Galis Model 300 roof bolting machine, MSHA Approval No. 2F-2070-A;
3. One Click Welding Shop Model P3-27 coal drilling machine, MSHA Approval No. 2G-2436-1; and,
4. One spare Click Welding Shop Model P3-27 coal drilling machine (MSHA approval plate missing).

The electric equipment and circuits underground were examined and/or tested during the investigation. There were violations pertaining to the electric equipment and circuits; however, the results of tests and examinations conducted by MSHA investigators established that the electric equipment and circuits were not factors in the explosion.

Transportation

Coal was loaded and transported from the face by rubber-tired battery-powered scoops. The scoops discharged the coal onto a belt conveyor which transported the coal to the surface. When the coal reached the surface, it was trucked to a nearby tippie or to a preparation plant several miles away. Both of the loading facilities were served by the Chessie Railroad System. Scoops were also used to transport the miners and the mine supplies in and out of the mine.

Communication

The mine communication system consisted of permissible telephones installed on the surface in the shop near the portal and underground at the belt transfer point and at the belt dumping point. A commercial telephone was provided in the surface repair shop.

Training Program and Medical Assistance Program

On January 11, 1979, the operator submitted a training and retraining plan, which was approved on January 16, 1979, that met the requirements of 30 CFR 48. The operator had contracted the Industrial Education Corporation of Pikeville, Kentucky, to train the employees at this mine. Refresher training was provided for the employees on November 6 and 11, 1981, and the miners were instructed in the safe use and handling of explosives at that time.

The operator had made arrangements with the McDowell Appalachian Regional Hospital of McDowell, Kentucky, for emergency medical treatment for the employees and with the County Wide Ambulance Service of Hindman, Kentucky, for ambulance service.

Illumination and Smoking

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

Several of the victims had smoking articles in their possession, in pockets of jackets which were not being worn at the time of the explosion and in lunch buckets. There were several loose cigarettes, 1 empty cigarette package, and cigarette butts found in the last open crosscut from the No. 2 entry to the No. 5 entry. The pathologist's report stated 2 victims had smoking materials in their clothing pockets.

A plan for searching persons entering the underground area for smoking materials was submitted by the operator on January 19, 1979. Due to the quantity of smoking material found in the pockets and lunch buckets of the victims, and scattered across the last open crosscut, it was evident that the searches were inadequate. It was apparent that smoking underground was a practice; however, smoking was not considered a factor in the explosion.

Fire Protection

The operator's program of instruction for the miners, including the location and use of all firefighting equipment, location of escapeways, exits and routes of travel and evacuation procedures, was approved by the District Manager. According to mine records, all escapeways were examined on December 4, 1981, and the results were recorded in a book located on the surface. Mine records indicated that a fire drill, including an evacuation, was performed on October 1, 1981.

Dry chemical fire suppression systems were provided on all the mobile electric face equipment that used hydraulic oil. The tanks supplying the systems had a rated capacity of 20 pounds. Fire extinguishers of the proper rating were located at all electrical installations, and at oil storage areas and at surface areas where they were required. The belt conveyors were continuously monitored for fire by sensor systems utilizing point-type heat sensors. Belt conveyor drives were protected by water deluge systems.

A 2-inch waterline was installed along the conveyor belt entry. Outlets and fire hose of a sufficient length to reach between each outlet were provided.

Mine Rescue

The operator had made arrangements with the Kentucky Department of Mines and Minerals to provide mine rescue capability for the mine while miners were underground. The mine rescue station and the necessary equipment for serving the mine was located at Martin, Kentucky.

Each miner at the mine was provided with a 1-hour, filter-type self-rescuer and had been trained in the use of the device. A check-in and check-out system was maintained in the repair shop, which utilized a check board and tags corresponding to similar tags worn on the miners' belts.

PART II

EXPLOSION AND RECOVERY OPERATIONS

Participating Organizations

Officials of the organizations which assisted in directing the recovery operations included: Orville Adkins, Company President; Willard Stanley, Commissioner, Kentucky Department of Mines and Minerals; L. D. Phillips and Jerry L. Spicer, MSHA District Managers, Districts 6 and 7, respectively.

Four mine rescue teams participated in the underground recovery operations:

Kentucky Department of Mines and Minerals, two Martin Teams
Kentucky Department of Mines and Minerals, Hazard Team
Kentucky Department of Mines and Minerals, Pikeville Team

In addition to the 4 teams from the Kentucky Department of Mines and Minerals, a team from Island Creek Coal Company and one from National Mines Corporation were present; however, neither of these teams went underground during the recovery. The names of the mine rescue team members and the persons who participated in the recovery operations are listed in Appendix B.

Mining Conditions Immediately Prior to the Explosion

Records indicate that the day shift (6 a.m. to 2 p.m.) mine foreman made a preshift examination of the working section and reported no unsafe conditions.

The day shift drill crew drilled the face of a crosscut in the No. 1 entry. Due to malfunction of the drill, they did not drill the face of No. 1 entry. The drill crew removed the trailing cable from the drill and installed it on the extra drill that was present on the section. However, they did not have time to complete the splicing of the cable before the end of the shift. Other than this occurrence, the day shift foreman reported no unusual occurrence on the shift prior to the explosion.

Activities of MSHA Personnel

On the day of the accident, the Subdistrict inspectors and supervisors were attending a staff meeting at the Subdistrict office at Hazard, Kentucky. About 3 p.m., Adam Adkins, Vice President, informed Dwight Greenlee, Subdistrict Manager, that there had been an explosion at the No. 11 mine, Adkins Coal Company. Greenlee instructed Coal Mine Inspectors Stanley Allen, Jr., and Clarence Ritchie to go to the mine immediately. Greenlee made assignments to other inspectors and notified Jerry Spicer, District Manager, District 7, in Barbourville, Kentucky, of the explosion. After making the assignments, Greenlee and Acting Coal Mine Inspection Supervisor Jeff Ison, Jr., traveled to the mine. At 4 p.m. Spicer called Joseph A. Lamonica, Administrator for Coal Mine Safety and Health,

Arlington, Virginia, and informed him of the explosion.

The MSHA mine rescue teams in Morgantown, West Virginia, and Pittsburgh, Pennsylvania, were placed on standby for possible deployment to the mine. Later that day, it was determined that there were sufficient mine rescue teams available for the recovery operations and the MSHA rescue teams were removed from standby status.

Allen arrived at the mine about 4 p.m. and soon thereafter Ritchie arrived. They observed smoke emitting from the mine fan discharge. They removed and tagged out the electrical power circuit entering the underground area of the mine and began monitoring the fan discharge. At this time, the return air from the mine showed 1000 parts per million (ppm) of carbon monoxide (CO) and other varying amounts of combustible gases. Ritchie 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 to recover any person in the mine or to return the affected areas of the mine to normal.

About 4:10 p.m., Greenlee and Ison arrived at the mine and Greenlee assumed direction of MSHA personnel. Greenlee instructed Ison to monitor the mine return air and to guard the mine entrances and electrical power circuits entering the mine. A State mine rescue team from Martin was present under the supervision of Commissioner Willard Stanley. The rescue team was preparing to go underground. After the first mine rescue team entered the mine about 4:55 p.m., Greenlee called the District and reported the conditions that were present at the mine. The District personnel informed him to call the Arlington headquarters office to notify the Administrator of the developments and to report such information periodically as to the conditions and developments as they occurred.

At 5:18 p.m., Lamonica telephoned L. D. Phillips, District Manager, District 6, Pikeville, Kentucky, and instructed him to proceed to the mine to aid and assist in the rescue operations. At 8:30 p.m., Spicer arrived at the mine and assumed supervision of MSHA personnel. At 9:30 p.m., Coal Mine Inspector Ed Morgan and Coal Mine Inspection Supervisor Kenneth Howard of the District office arrived at the mine. All MSHA personnel remained at the mine and participated in the recovery.

At 4:15 p.m., on December 7, 1981, the Technical Support Mine Emergency Advisory Team was notified of the explosion at the mine. At the time, the team was on an assignment monitoring a mine fire at Vansant, Virginia. They were instructed to take the gas analysis van to the Adkins mine site. They arrived at the mine site at 11:30 p.m. where they were informed by Spicer that 7 of the 8 bodies had been located. The body of the eighth victim was found shortly thereafter. At 12:30 a.m., on December 8, 1981, Robert G. Peluso, Chief of the Pittsburgh Health Technology Center, directed the team to return to their previous assignment at Vansant, Virginia.

