UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

OFFICIAL REPORT OF MAJOR MINE EXPLOSION DISASTER
NOS. 15 and 16 MINES
FINLEY COAL COMPANY
HYDEN, LESLIE COUNTY, KENTUCKY

December 30, 1970

by

James Westfield
Assistant Director--Coal Mine Health and Safety

J. S. Malesky
District Manager

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SUMMARY

This report is based on an investigation made pursuant to the Federal Coal Mine Health and Safety Act of 1969 (83 Stat. 742).

A coal dust explosion occurred in the interconnected Nos. 15 and 16 mines of the Finley Coal Company, Hyden, Leslie County, Kentucky about 12:20 p.m., Wednesday, December 30, 1970. Thirty-eight of the 39 men who were underground at the time were killed. Observations made during the investigation of the disaster indicate that 14 men who were employed in No. 16 mine were apparently killed instantly by the explosion, and 3 others who may have moved a short distance after the explosion possibly died from asphyxiation or carbon monoxide poisoning. Nineteen men, who were employed in No. 15 mine were apparently killed instantly by the explosion, and 2 others who may have moved a short distance after the explosion presumably died from asphyxiation or carbon monoxide poisoning. The lone survivor was near the portal in the belt entry of No. 15 mine when the explosion occurred. He was injured slightly by the explosion force and the debris coming out of the mine.

The names of the victims, their social security numbers, ages, occupations, experience, and the number of their dependents are listed in Appendix A of this report.

The Bureau's investigation of the disaster included extensive examinations of the underground workings of the Finley Coal Company mines following the disaster, a public hearing held at Hyden on January 6, 1971, a study of all previous reports on inspections and accident investigations at the mines and interviews of all but 13 Finley Coal Company employees. On the basis of this investigation, the Bureau has concluded that the explosion occurred when coal dust was thrown into suspension and ignited by Primacord, by permissible explosives used in a nonpermissible manner, or by use of nonpermissible explosives during the blasting of roof rock for a loading point (boom hole). These practices are not permitted under the Act. Excessive accumulations of coal dust, and inadequate applications of rock dust in parts of Nos. 15 and 16 mines permitted propagation of the explosion throughout the mines.

GENERAL INFORMATION

The Nos. 15 and 16 mines are on Hurricane Creek off State Highway 80 about 4 miles east of Hyden, Kentucky. Coal from these mines is hauled by autotruck to a preparation plant on a siding of the Louisville and Nashville Railroad Company at Sibert, Kentucky.

The names and addresses of the operating officials of the company at the time of the explosion were:

Holt Finley, Co-owner	Sibert, Kentucky
Charles Finley, Co-owner	Manchester, Kentucky
Stanley Finley, Co-owner	Manchester, Kentucky
Walter Hibbard (Victim of explosion) Superintendent and Mine Foreman	Manchester, Kentucky

A total of 100 men was employed, of which 95 worked underground on 2 coal-producing shifts and 1 maintenance shift a day, 5 days a week. An average of 1,500 tons of coal a day was loaded by mobile loading machines into rubber-tired mine cars. These cars transported the coal to a belt conveyor system which carried it to the surface. The mines were opened by eight drift entries into the Hazard No. 4 coalbed, which ranged from 29 to 36 inches in thickness locally. They are classed nongassy by the Commonwealth of Kentucky, and are above drainage level. The immediate and main roof was generally firm shale, and the floor was also firm shale.

The analysis of a channel sample of coal, taken by Federal inspectors in No. 4 entry of No. 16 mine about 500 feet from the portal on January 15, 1971, is as follows:

	Percent
Moisture	3.10
Volatile Matter	38.60
Fixed Carbon	52.50
Ash	5.80

Numerous tests by the Bureau of Mines have shown that coal dust having a volatile ratio of 0.12 and higher is explosive. The volatile ratio of the coal in these mines is 0.42, indicating that the coal dust is highly explosive.

The following Federal inspections and investigations were made of Nos. 15 and 16 mines since they were opened in March and June 1970 respectively:

No. 15 mine

Partial but Representative Inspection	June 19 and 22-23, 1970
Investigation of Nonfatal Explosives Accident	August 14 and 19, 1970
Spot Inspection	August 14, 1970
Investigation of Fatal Haulage Accident	November 10 and 13, 1970
Spot Inspection	November 19, 1970
Spot Inspection (No underground visit)	December 21, 1970

No. 16 mine

Complete Inspection	October 19-20 and 22, 1970
Spot Inspection	October 26, 1970

The reports on each of these inspections and investigations are appended to this report. (Appendix F).

The Nos. 15 and 16 mines were not in production from December 22 through 27, 1970. Some maintenance work and blasting were done during this period. During a spot inspection of No. 15 mine on November 19, 1970, made because of a reported respirable dust violation, the Federal

inspector issued four Notices of Violation and gave the mine operator until 8 a.m. on December 22, 1970, to abate them.

On November 19, 1970, Federal Coal Mine Inspector Gordon Couch made a spot inspection of No. 15 mine. Five Notices of Violation were issued to the operator requiring abatement of these violations by 8 a.m. on December 22, 1970. Statements by experts indicate that none of these violations had anything to do with the December 30, 1970, disaster which resulted from an explosion in No. 16 mine.

Inspector Couch received a call from the operator, Charles Finley, prior to December 22, 1970, at which time Finley advised Couch that his mines would be closed December 22, 1970, through December 27, 1970. Federal Inspectors are required to return to a mine on the date set for abatement of violations, but they must inspect mines when they are operating.

On December 28, 1970, Inspector Couch was assigned priority duties for another Inspector who was taking his annual leave. On December 29, 1970, Inspector Couch made plans to visit three mines in an area other than the area of the Finley mines so that he could maximize the use of his time for mine inspection. He planned to return to the Finley mines on December 30. On the morning of December 30, he was assigned to investigate a fatality in another mine.

In the event Inspector Couch had gone to the Finley mines prior to the disaster to see if the five violations had been abated, he would have gone into only No. 15 mine to verify the abatements. If the operator had advised him that the violations had not been abated, he would not have gone underground, but would have issued Notices granting additional time to abate the violations, if such action was justified. His duties would not have taken him, in any event, into No. 16 mine, which was the point of origin of the explosion which led to the disaster.

On November 16, 1970, Inspector Couch issued to Finley Coal Company, for No. 16 mine, three Notices granting the operator additional time to (1) "obtain and install a ground check monitor" which was on order, (2) "obtain personnel to train and retrain qualified and certified persons," and (3) "train and certify persons to perform work on electric equipment." The operator was given until 8 a.m. on December 28, 1970, to abate these violations. None of these violations would have required an underground inspection by the inspector.

On November 16, 1970, Inspector Couch issued a Notice of Abatement or Extension on an Extension granting the operator additional time "to

complete work of installing water to abate dust created by mining operations."

It is to be noted that none of the items required to be abated on either December 22, 1970, or December 28, 1970, were violations contributing to the December 30, 1970, disaster.

The Bureau of Mines inspectors will continue to be required - except in higher priority cases - to return to a mine on the day set for a violation to be abated.

Some of the inspectors attached to the Barbourville, Kentucky Subdistrict office were on leave during the period December 14-30, 1970, since leave accumulated during the year had to be used prior to January 9, 1971, or lost; however, a force including a supervisory official remained on duty in the event an emergency should arise. The inspectors on leave were subject to instant recall if needed for an emergency.

The leave situation was aggravated during 1970 because of the new Act which required the time of all personnel on a virtual full-time basis to acquaint all mines as rapidly as possible with the requirements of the Act and enforce it to the utmost.

The new Act with far more mandatory provisions and increased requirements on mine inspections became operative with no time allowance for staffing, thus leave was virtually cancelled and most inspectors ended the year with leave to take or forfeit. The personnel at this station collectively lost 244 hours of leave for the year.

When the force of inspectors reaches the number the Bureau of Mines will require, annual leave of inspectors will be staggered throughout the entire year.

MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods

The Nos. 15 and 16 mines were opened by four drift entries each with a 190-foot coal barrier between the two mines (See Appendix B). When the entries in No. 16 mine were driven to a point about 260 feet underground, management decided to interconnect the two mines so that the one main belt conveyor which had been installed in No. 4 entry, No. 15 mine, could be used for transporting coal from both mines to the surface. Also, 2 additional entries were started in

each mine and the 12 entries were driven to a depth of 2,500 feet from the surface with several connections made through the barrier pillar at various intervals between the mines. After the first interconnection, the mines were developed as a single mine.

A block system of mining was employed. Sets of 6 to 7 entries were driven off the right and left main entries beginning 1,200 and 1,600 feet, respectively, inby the surface, and were driven to depths of from 110 feet to 800 feet depending on the mining conditions encountered. Entries were driven 20 to 30 feet wide, and crosscuts were about 60 feet apart. Pillars were not recovered.

Two working sections were producing coal on December 30, 1970. The 2 right section, No. 15 mine, consisted of a set of 6 entries, which had been driven to a depth of about 800 feet off No. 6 main entry, and coal was being loaded by a Jeffrey Model 81-C loading machine. The 1 left section, No. 16 mine, consisted of a set of 6 entries driven to a depth of about 150 feet off No. 1 main entry, and coal was being loaded by a WABCO Model 970 loading machine. Also, because additional coal acreage had been acquired adjacent to the left side of No. 16 mine, a new loading point (boom hole) was being made. Preparatory to blasting the roof to make room for this loading point, 30-inch holes were drilled on about 2-foot centers in the roof of No. 1 entry, 2 left, near the second crosscut, which was parallel and adjacent to No. 6 entry, 1 left. The portion of mine roof to be drilled and blasted was approximately 18 feet long and 28 feet wide. Drilling operations reportedly were completed on the day shift sometime during the morning of December 30, 1970.

The roof was supported by conventional timbering and roof bolts were installed in accordance with plans submitted by the operator and approved by the Bureau of Mines. Roof bolting was done with rotary-hydraulic drilling equipment.

Explosives

Supplies of permissible explosives and electric detonators were stored together in unlined metal magazines located on the surface. Two 50-pound cartons and part of a carton of nonpermissible Hercules 40 percent Extra strength dynamite, along with four 1000-foot rolls of Primacord and various other supplies were stored in a highway-type trailer of wood and metal construction about 105 feet from No. 15 mine portal. According to the mine operators, the dynamite and Primacord were for blasting highwalls during construction work and along the surface roadways. Explosives and detonators in specially constructed containers were transported into the mines in rubber-tired mine cars pulled by rubber-tired tractors.

Underground explosives-storage magazines were not used.

Coal was undercut to a depth of about 9 feet, and normally 3 holes were drilled for the placement of explosives. Hercules Red HL permissible explosives in 1-$\frac{1}{4}$ by 8-inch cartridges and Austin Red Diamond No. 9B permissible explosives in 1-$\frac{1}{4}$ by 8 inch cartridges were used for blasting coal. Austin Powder Company instantaneous electric detonators with 8-foot iron leg wires were used. Bags of water were used as stemming in holes drilled in coal and shots were fired singly and in multiple by designated shot firers using multiple permissible-type shot firing units. The two 10-shot permissible-type shot-firing units found on the working sections were examined in the Explosives Research Laboratory of the Bureau of Mines. The results are recorded in Appendix H. Although defects were found in both units, they did meet the electrical requirements of Schedule 16-B under which they were approved. The units were MSA, 10-shot units, Model No. 49408, Approval No. 1608. This particular design was approved in July 1950.

A shot firer had been hired by the company to prepare and blast holes. His experience had been principally with road construction work, involving the use of a variety of blasting materials.

It was revealed during the investigation and at the hearing that shot holes for blasting boom holes were drilled during the working shift, and that it was common practice to do the blasting during the 30-minute interval between the two coal-producing shifts or on an idle day, with a limited number of workmen in the mine. The number of shot holes required varied from 45 for a single loading point to more than 100 holes for a double loading point. The shot holes were drilled in the roof with a roof bolting machine. According to testimony, the holes were prepared for blasting by placing one or two cartridges of explosives in each hole; in these vertical holes, the explosives were held in place by wadded paper, pieces of brattice cloth, or similar material. This made them the equivalent of unstemmed or open shots. Testimony revealed that after the shots were prepared and when more than 10 shots were fired, a power source from the battery operated equipment or from a power cable was used. No evidence was found of any precautions being taken, such as cleaning up loose material and applying heavy layers of rock dust, immediately before boom holes were blasted. It was impossible to ascertain the precise quantity of explosives used in blasting the boom holes.

During the investigation of the mines following the explosion, evidence was found to indicate that dynamite was being used for blasting purposes. A small sample of explosive was found in a partially detonated shot hole in a boom hole in No. 15 mine which had been shot on December 22, 1970. The sample was analyzed by the U. S. Bureau

of Mines Explosives Research Laboratory and it was determined to be 40 percent strength dynamite. (See Appendix J). Samples of the permissible explosives found in the mines met the requirements for permissibility and passed explosion-gallery tests conducted by the Bureau of Mines. Nevertheless, explosives fired in the manner described, whether they are permissible explosives or dynamite, are capable of suspending and igniting coal dust. The Primacord found in the mines, on two separate spools, also was tested in the Bureau of Mines Laboratory and was found to be capable of suspending and igniting coal dust. (See Appendix H).

A number of witnesses including one that blasted a boom hole on December 22, 1970, stated that Primacord had been used to blast boom holes in the mines. Pieces of Primacord were found in the vicinity of the boom hole in No. 1 entry, 2 left of No. 16 mine, where the explosion originated.

It is to be noted that one witness stated in a post-hearing statement that he had been taught by the blaster killed in the December 30, 1970, explosion how to use Primacord to blast boom holes. This witness used Primacord in No. 15 mine on December 22, 1970, to blast a boom hole.

The Federal Coal Mine Health and Safety Act of 1969, requires that where it is necessary to do blasting in boom holes, and a permissible shot-firing unit of adequate capacity is not available, the mine operator must submit an acceptable blasting plan for consideration and approval. Such plan of blasting must be as safe or safer by firing a large number of shots than would be by firing small groups of shots. Safeguards are required before such permission is granted. Such request had not been received from the Finley Coal Company

Ventilation and Gases

Ventilation in Nos. 15 and 16 mines was induced by 2 propeller-type exhausting fans, operated continuously. The fan installed at No. 15 mine circulated approximately 55,000 cubic feet of air a minute, and No. 16 mine fan circulated approximately 45,000 cubic feet of air a minute.

During previous Federal inspections of these mines, the air currents were directed through the mines by means of incombustible stoppings, check curtains, and line brattices. Evidence of the use of line brattices to conduct the air from the last open crosscuts to the working faces was not found during the recovery operations or the underground investigation. During previous Federal inspections, between 15,000 and 18,000 cubic feet of air a minute was reaching the last open crosscuts, and over 3,000 cubic feet of air a minute was being delivered to the faces of the working places. At those times, preshift and suitable on-shift examinations were made by

certified officials and the results were recorded; however, weekly examinations for methane or other hazards were not made, and the operator was cited as being in violation of the law. (See Appendix F). According to company records, methane had not been detected by company officials. Methane was not detected during previous Federal inspections nor during the recovery operations using methane detectors. A sample of the main return air collected at No. 15 mine fan, about two hours after the disaster, contained 0.07 percent methane, 0.23 percent carbon monoxide, and 0.12 percent hydrogen. A sample of mine atmosphere collected near the face of No. 6 room off No. 1 main entry, No. 16 mine, during the investigation of the disaster contained 0.01 percent methane. The methane contained in these two samples could be combustion products of the explosion. There are no oil or gas wells on the property.

Dust

During the June 1970 Federal inspection, the surfaces of No. 15 mine ranged from damp to wet; however, dangerous accumulations of loose coal and coal dust and the absence of rock dust along the battery tractor roadways from the loading point to the faces of the working section where the floor was not wet was justification for issuance of an imminent danger Order. During subsequent Federal inspections of Nos. 15 and 16 mines on August 14, and on October 19-20 and 22, 1970, it was necessary to issue Notices for violations of the rock dusting provisions of Sections 304(a), 304(b), and 304(c) of the Federal Coal Mine Health and Safety Act of 1969. (See Appendix F). During the spot inspection made in No. 15 mine on November 19, 1970, the Federal inspector found the rock dusting to be adequate in the areas inspected. Dust samples were not taken during the Federal inspections of the mines. In accordance with Bureau procedures, the adequacy of rock dust applications was determined visually.

Although the 1 left section was supplied with water through a 2-inch pipeline, testimony at the hearing revealed that water was not being used to allay dust during cutting and loading operations. The operator was cited for being in violation of the law. (See Appendix F).

A third-shift, 9-man crew for each mine was responsible for the daily clean-up and application of rock dust, which involved turning out the loose coal and coal dust from the ribs by hand shovel and scraping it to the face with a blade attached to a battery tractor. Rock dust was then applied to the mine surfaces with a portable electric rock-dusting machine, of which two were available. Testimony

revealed, however, that the rock dusting machines were inoperable for a period of about two months prior to the explosion and rock dust had been applied by hand. Further, prior to the explosion, even though the machines had been repaired, rock dusting by hand was continued.

Transportation

Coal was transported from the face areas in Nos. 15 and 16 mines in rubber-tired mine cars pulled by rubber-tired battery-powered tractors, thence, to the surface by belt conveyors. The rolling stock was maintained in satisfactory condition, and beltmen were regularly employed to travel and inspect the belts for defective or stuck rollers, to clean the area of coal dust and loose coal, and to rock dust the belt entries. Men were transported to and from the working sections in the rubber-tired mine cars. A two-way Pagephone communication system was provided between the surface and loading points underground.

Electricity

Electric power at 7,200 volts alternating current was reduced to 440, 220, and 110 volts alternating current for use on the surface, and to 4,160, 440, and 220 volts alternating current and 275 volts direct current for use underground. The 4,160 volt alternating current was conducted underground in No. 4 (belt)entry of No. 15 mine by a three-conductor, No. 2 shielded-type, nonmetallic armored, high-voltage cable. The high-voltage circuit was protected against overloads by an oil circuit breaker, and the neutral circuit was provided with a fail-safe monitor system; however, a current-limiting resistor had not been installed in the circuit. Lightning arresters were installed in the circuit, but a suitable grounding medium was not provided for the arresters. A disconnecting switch was installed in the high-voltage circuit on the surface but a switch had not been provided for the branch line from No. 15 mine to No. 16 mine. Each of the noted deficiences was cited as a law violation (See Appendix F). The electrical power service equipment for No. 15 mine consisted of a portable 112-kva, 3-phase transformer, delta/delta connected, with a grounding transformer, and a 200-kw silicon diode rectifier, providing 275 volts direct current.

The electric face equipment for No. 15 mine consisted of two Jeffrey 81-C loading machines, a Joy 12-RB mining machine, a Long-Airdox TDF-20 coal drill, a Galis 300 roof drill, and four Kersey battery-powered tractors.

The electrical power service equipment for No. 16 mine consisted of a portable 300-kva, 3-phase transformer, delta/delta connected, and a 200-kw silicon diode rectifier providing 275 volts direct current. The electric face equipment for No. 16 mine consisted of a WABCO 970-L loading machine, two Joy 12-RB mining machines, two Long-Airdox coal drills, (TDF-10 and TDF-20), two Galis 300 roof drills, three S and S 160 battery-powered tractors, two Kersey 944 battery-powered tractors, and one Elkhorn Industrial Products Corporation battery-powered Load-a-Tram tractor. The electric face equipment was of both the permissible and nonpermissible type and was maintained in satisfactory mechanical condition, but the permissible-type equipment had not been maintained in permissible condition. The frames of the electric face equipment receiving power through trailing cables were not grounded, and the operator was cited as being in violation of the law (See Appendix F).

The trailing cables were of the flame-resistant type, and except for one of the roof drills in No. 16 mine, automatic circuit breakers were provided for the cables. The trailing cables for the loading machine, roof bolting machine, and coal drill in No. 15 mine contained 24, 21, and 8 temporary splices, respectively, and the trailing cables for the regular and spare roof bolting machines in No. 16 mine contained 3 and 44 temporary splices, respectively. For these deficiencies, the operator was cited as being in violation of the law (See Appendix F).

Illumination and Smoking

Permissible electric cap lamps were used for portable illumination in the mines. Evidence of smoking underground, such as burnt matches, cigarette butts, and empty cigarette packages were observed at many locations in the mines during the recovery operations and the underground investigation, and open packages of cigarettes were seen in the pockets of some of the victims. A suitable search program for smoking materials and flame making devices was not in effect at the mines as evidenced by these conditions and practices. The operator had been cited as being in violation of the law on this account and evidence of smoking was one of the reasons underlying issuance of an imminent danger Order on June 19, 1970 (See Appendix F). The operator subsequently (on November 14, 1970) filed an acceptable plan for a search program, but the plan apparently was not being followed at the time of the disaster.

Mine Rescue

The Finley Coal Company did not maintain a mine rescue team. After the explosion, trained and equipped mine rescue teams were made available on a standby basis by the following companies that operated coal mines nearby:

U. S. Steel Corporation, Lynch, Kentucky
International Harvester Company, Benham, Kentucky
Beth-Elkhorn Corporation, Jenkins, Kentucky
Westmoreland Coal Company, Big Stone Gap, Virginia
Clinchfield Coal Company, Dante, Virginia

The services of the mine rescue teams were not required during recovery operations.

Self-rescuers were not carried by the employees; however, twenty-one MSA one-hour self rescuers were stored in a metal container in No. 2 main entry of No. 16 mine about 400 feet from the faces of the working places and had not been disturbed by the explosion. There were no self rescuers stored in No. 15 mine, but 16 MSA one-hour self rescuers were stored in a trailer on the surface.

Adequate escapeways were available from the working sections to the surface. The check-in and check-out system was inadequate, as evidenced by the fact that about half the employees were not wearing identification tags, and identification could not be established until they were brought out of the mines.

Firefighting facilities were available but were not needed during the recovery operations.

PRE-EXPLOSION CONDITIONS AND ACTIVITIES AND RECOVERY OPERATIONS

Assisting Organizations

Employees of the Finley Coal Company and other local companies and representatives of the Kentucky Department of Mines and Minerals and United States Bureau of Mines assisted in the recovery operations and the underground investigation. During the recovery operations, the Frontier Nursing Service, Leslie County Sheriff's Department, State and local police, Red Cross, Leslie County Telephone Company, and several ambulance services provided invaluable assistance.

Activities of Bureau of Mines Personnel

The Barbourville, Kentucky, office of the Bureau of Mines was notified at 12:30 p.m. on December 30, 1970, by Charles Finley, co-owner, that an explosion had just occurred in Nos. 15 and 16 mines. The Barbourville office immediately notified J. S. Malesky, District Manager, Norton, Virginia who in turn, notified James Westfield, Assistant Director--Coal Mine Health and Safety, Washington, D. C.

Mining engineers Ralph Jones and Harold Dolan and Federal inspectors Hobart Jarvis, Gordon Couch, Kenneth Martin, and Elmer Smith were dispatched from the Barbourville office shortly thereafter, and they arrived at the mines at 2:30 p.m. After briefing by company officials and the assignment of personnel to handle check-in and check-out duties and to make frequent tests for gases at each fan, a party of State and Federal inspectors proceeded underground.

The following U. S. Bureau of Mines personnel arrived at various times and assisted in directing the recovery operations or entered the mines with rescue teams and assisted in the rescue work and recovery of the bodies, which was completed at 10:00 a.m. on December 31, 1970:

James Westfield	William Stewart
Joseph Malesky	Paul Bobrosky
Thomas Mark	James Ison
John Crawford	Jack Bartley
Clarence Hyde	James Rhea
Raymond Linville	Kenneth Fee
Charles Sample	James Begley
Dwight Greenlee	Monroe West
Hobart Jarvis	Frank Durbin

Harold Dolan	John Weekly
Gordon Couch	Ralph Jones
Kenneth Martin	Elmer Smith

Imminent danger Orders covering a mine explosion were issued December 30, 1970, under Section 104(a) of the Federal Coal Mine Health and Safety Act of 1969, requiring that all persons be withdrawn from, and prohibited from entering Nos. 15 and 16 mines, except those needed for rehabilitation, exploration, and recovery work.

Mine Conditions Immediately Prior to Explosion

Cold and cloudy weather prevailed in the vicinity of the mines on December 30, 1970. Barometric pressures recorded by the Federal Aviation Agency at the London, Kentucky airport on December 29 and 30, 1970, were as follows:

December 29, 1970	12:00 noon	29.97
December 30, 1970	12:00 noon	30.08

Bureau of Mines investigators believe that this slight variation in atmospheric pressure had no bearing on the explosion.

The report of the mine examiner (fire boss) for the 7:00 a.m. to 3:00 p.m. production shift on December 30, 1970, stated that all places in No. 15 mine were visited and all places were ready for the day shift. Investigators could not find any record of No. 16 mine being examined. The preshift record book indicates that only the working places in No. 15 mine were examined on December 30, 1970; however, further evidence obtained upon questioning the employee who made the examination revealed that the preshift examination listed in the record book for No. 15 mine was actually for the examination made in No. 16 mine and that someone else made the examination in No. 15 mine. It was learned upon questioning the man who made the examination of No. 15 mine that he made an examination of the working places in No. 15 mine and recorded the results in the record book on the surface; a record of this examination could not be located. The preshift examination record books were incomplete in that they did not indicate the time the examiner entered the mine and returned to the surface, the area or areas of the mines examined, whether methane or oxygen deficiency were detected, whether the air in the mine was traveling in its proper course and at normal volume, and the quantity of air reaching the last open crosscuts in the entries.

Evidence of Activities Prior to Explosion

The day-shift crews, consisting of 39 men, entered the mines about 6:45 a.m., December 30, 1970, and were transported in rubber-tired trailers to their respective sections. Apparently, routine coal-loading operations were in progress on each of the two conventional loading sections until shortly before the explosion.

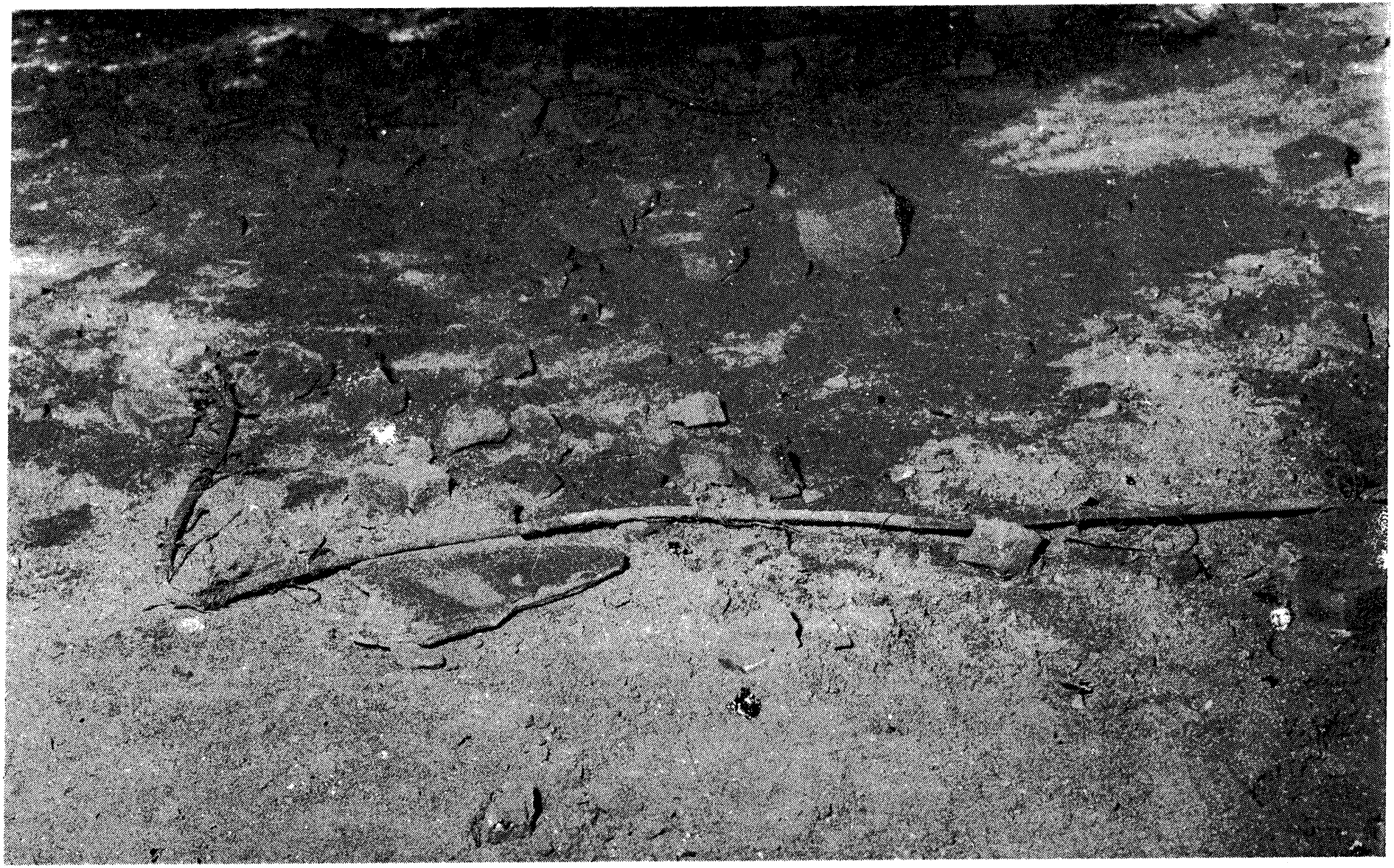
Work was in progress to prepare for installation of a belt conveyor from the active section in No. 16 mine to the main belt conveyor in No. 15 mine. On Tuesday night, December 22, 1970, a boom hole, about 54 feet long and 10 feet wide, had been blasted in the roof to accomdate the headpiece for the belt conveyor. On Wednesday, December 30, 1970, a boom hole 18 feet long, 28 feet wide, and 30 inches deep was being prepared for blasting to provide space for the tail section of the belt conveyor and two elevating conveyors (feeders). According to testimony, the shot holes in the roof for blasting boom holes were not stemmed properly; small pieces of wadded paper and brattice cloth materials were placed against the explosives charges to hold the cartridges in the 30-inch deep holes. According to testimony of persons responsible for or actually engaged in the preparation of boom holes, it was common practice to fire all the shots in a boom hole at the same time, from power cables or from the batteries of the tractors (48-64 volts).

Three pieces of Primacord were found about 300 feet outby a boom hole in No. 3 entry, No. 15 mine.

Two spools containing Primacord and three short pieces of Primacord were found near where a boom hole had been blasted on the second shift December 22, 1970, and four short pieces of Primacord were found in the vicinity of the boom hole that was blasted at the time of the explosion. Such evidence indicates that Primacord was used and had been used previously to detonate charges of explosives in blasting boom holes. The usual practice was to drill the 30-inch deep shot holes about 2 feet apart. Evidence found during the investigation indicated that some of the shot holes in the boom hole involved in the explosion were placed on less than the 24-inch standard pattern; therefore, it can be concluded that as many as 120 shot holes would have been required for this blasting operation.

During the official hearing at Hyden, A. T. Collins, utility man (beltman) testified that he entered No. 15 mine at 7:00 a.m., returned to the surface at 11:30 a.m., and observed no unusual conditions in the mine. Collins also stated that he saw Primacord in the mine some time before Christmas and was instructed by the superintendent to hide the Primacord. He stated that the superintendent told him at

PRIMACORD FOUND IN NO. 1 CROSSCUT BETWEEN NOS. 1 and 2 ENTRIES 2 LEFT,
NO. 16 MINE NEAR LOCATION OF BOOM HOLE IN NO. 1 ENTRY 2 LEFT



OUTBY END OF BOOM HOLE SHOT DOWN IN NO. 1 ENTRY 2 LEFT NO. 16 MINE

about 11:00 a.m. on December 30, 1970, that he had a man in the mine to shoot a couple of holes and that the blast would be light, but indicated by a wink and a nudge that the blast would be something unusual. Collins further stated that he saw no explosives transported underground on this date. Two other witnesses, both employees of the Finley Coal Company, testified that Primacord was used in conjunction with one electric detonator to detonate the explosives charges at the boom holes. Some of the testimony indicated that shots were fired from power cables and from battery connections of the battery-powered tractors, although permissible-type blasting units were provided in each active section of the mine.

According to former practices in blasting boom holes and evidence presented by various persons, and found during the investigation, it must be concluded that on the day of the explosion, 100 or more shot holes were drilled into the roof, each charged with one or two cartriges or explosives, connected by a trunk line of Primacord with short leaders of Primacord to each charge with one electric detonator, held in place with pieces of paper, and fired by means of a blasting cable attached either to a shot-firing unit, power cable, or to the battery connections of a nearby battery-powered tractor.

On January 14, 1971, an employee of the Finley Coal Company, using a Load-A-Tram scoop, moved the rock blasted from the boom hole in No. 1 entry, 2 left, No. 16 mine, and the operation was observed by representatives of the Department of Mines and Minerals and the U. S. Bureau of Mines. On the second scoop load, a detonator leg wire, 14 inches long, was found at the outby edge of the pile of rock. The thirtieth scoop load uncovered an 11-inch piece of Primacord near the center of the fall. On January 15, 1971, the remainder of the rock was moved, but Primacord, leg wires, or explosives were not found. The fact that one detonator leg wire and the Primacord were found substantiates the conclusion that illegal blasting practices were being followed. Primacord is detonated by one detonator. If the shots had been fired electrically with a detonator (each with two leg wires) in each shot hole, a large number of such leg wires would have been found. Furthermore, the location of the nearest power source and the location of the blasting cable after the explosion indicated that Primacord may have been used to extend the length of the blasting cable. The cable was 29 feet short of reaching the boom hole from its location after the explosion. On January 14, 1971, a 48-foot piece of Primacord was found near the belt entry in No. 26 crosscut in No. 15 mine.

Testimony indicated that the operator did not apply additional rock dust prior to blasting boom holes.

During the investigation, observations in the area of the boom hole in No. 1 entry, 2 left, No. 16 mine, revealed that small pieces of rock from the boom hole were scattered at the outby end of the boom hole for a distance of about 40 feet toward the mouth of the entry. This indicated that an open, unconfined shot or shots (explosives laid atop the piece of rock to be broken) may have been used to break rock that was too large for handling by the loading machine. However, after considering all the evidence, it is the opinion of the Bureau of Mines investigators that the scattered rock was the result of blasting the boom hole and not the result of an unconfined shot used to break the rock.

Recovery Operations

Shortly after being notified of the explosion, J. S. Malesky instructed Bureau of Mines personnel from the Barbourville office to proceed to the mines promptly with the necessary rescue equipment, to determine the condition of the ventilation system, and to start exploratory operations as soon as possible. They were also advised that additional Bureau personnel and rescue equipment were being dispatched to assist in the recovery operations.

At 3:00 p.m. on December 30, 1970, State and Federal inspectors entered the No. 3 portal of No. 15 mine and traveled without the aid of breathing apparatus to No. 24 crosscut between Nos. 3 and 4 main entries (Appendix B) before encountering any difficulty with carbon monoxide or smoke--although concrete block stoppings in 12 crosscuts outby the No. 24 crosscut were either partly or completely blown out. Travel between Nos. 24 and 30 crosscuts was accomplished with the use of gas masks, and three bodies were located in the vicinity of Nos. 29 and 30 crosscuts. Owing to high concentrations of carbon monoxide in the area, the recovery crew returned to the surface to obtain brattice material and other supplies. Then a party of State and Federal inspectors and company employees reentered No. 15 mine to repair the blown out stoppings and to continue toward the working places in 2 right section.

At 4:30 p.m., on December 30, State and Federal inspectors and a company employee entered No. 16 mine via No. 4 main entry, and were able to travel to No. 20 crosscut before encountering high concentrations of carbon monoxide between Nos. 3 and 4 main entries. Brattice cloth was used to replace blown out stoppings, and the crew continued its exploration into the mine. Additional stoppings were replaced in several crosscuts to remove the concentrations of carbon monoxide encountered enroute to the 1 left section. The crew reached the mouth of No. 3 entry, 1 left, about 7:00 p.m. There the first

body was found, and exploration of the 1 left section was continued. In all, 15 bodies were found before the crew encountered excessive carbon monoxide and decided to return to the surface with 3 of the bodies at 8:00 p.m. on December 30.

Additional recovery crews composed of State and Federal inspectors, company officials and employees, and volunteer officials and employees from other mines in eastern Kentucky, entered Nos. 15 and 16 mines at various times during the night of December 30 and the morning of December 31 to relieve or to assist crews in repairing or replacing damaged and blown out stoppings or to assist in recovery of bodies. The recovery work was completed, and the last body was brought to the surface at 10:00 a.m., December 31, 1970.

Evidence noted during the recovery operations, such as position and location of victims in addition to their physical appearance, is cause for Bureau of Mines investigators to conclude that all but 5 of the victims were apparently killed immediately by the explosion. Three of the victims, marked Nos. 3, 4, and 6 in Appendix B in No. 2 entry, 1 left, No. 16 mine may have moved a short distance -- less than 100 feet -- from their worksite after the explosion.

The tram controls of the loading machine in No. 6 entry, 2 right, No. 15 mine were found in the forward position indicating that the equipment may have been in operation at the time of the explosion. The bodies of the loading machine operator and the mechanic, indicated by R4 and R5, respectively, in Appendix B, were found 140 feet from the equipment and neither body showed evidence of being affected by forces of the explosion.

INVESTIGATION OF CAUSE OF EXPLOSION

Investigation Group

Finley Coal Company

Robert Combs	Crew Leader, 3rd shift
Arthur Lawson	Tractor Operator
Alson Collett	Tractor Operator
Eugene Barger	Tractor Operator
Bill Cornett	Mechanic

Underwriters Safety and Claims

Warren Mullins	Inspector
Earl Keene	Inspector

Kentucky Department of Mines and Minerals

H. N. Kirkpatrick	Commissioner
J. H. Mosgrove	Assistant to the Commissioner
Everett Bartlett	District Supervisor
Carl Smithers	District Supervisor
Albert Alexander, Jr.	Inspector
H. L. Payne	Engineering Trainee
B. E. Banks	Inspector
Grant Hall	Inspector
Clarence Powell	Inspector

United States Bureau of Mines

James Westfield	Assistant Director-- Coal Mine Health and Safety
William Park	District Manager
Joseph Malesky	District Manager
Thomas Mark	Subdistrict Manager
John Crawford	Mining Engineer
Clarence Hyde	Coal Mine Inspection Supervisor
Raymond Linville	Coal Mine Inspection Supervisor
Monroe West	Coal Mine Inspection Supervisor
Ralph Jones	Mining Engineer
Harold Dolan	Mining Engineer
Charles Sample	Coal Mine Inspector
Gordon Couch	Coal Mine Inspector

A detailed examination of the entire Nos. 15 and 16 mines was carefully made by the investigating group. To expedite the work, the group was divided into three teams, each composed of representatives of the respective agencies. Each team was provided with mine maps so that when the examinations were completed each agency would have a complete record of the findings for the final record.

Joint hearings were conducted by the Kentucky Department of Mines and Minerals and the United States Bureau of Mines, on January 6, 1971 at the Leslie County Court House at Hyden, Kentucky. The hearings were headed by Dr. Elburt Osborn, Director, U. S. Bureau of Mines, and H. N. Kirkpatrick, Commissioner, Kentucky Department of Mines and Minerals. J. H. Mosgrove, Kentucky Department of Mines and Minerals, and James Westfield, U. S. Bureau of Mines, questioned the officials and employees during the hearing. An invitation was extended to other persons desiring to provide information regarding the events prior to the explosion. The transcripts of the hearing and post hearing investigations are available for examination, by interested persons at those locations where this official report is being placed on open file.

Methane and/or Dust as a Factor in the Explosion

Mine records indicate that methane has not been detected in Nos. 15 and 16 mines by company officials. The analyses of two air samples collected in the immediate returns from the mines during previous Federal inspections indicated that methane was not present. The analyses of air samples collected during the investigation, and analyzed by the U. S. Bureau of Mines, are shown in Table 1, attached. The composite evidence of air samples collected during the regular inspections, and during this investigation, and numerous instrument tests made during recovery operations, establishes that methane was not a factor in the explosion. However, two air samples (bottle Nos. J7083 and K3118) did indicate the presence of methane. The concentrations of carbon dioxide, carbon monoxide, methane plus ethane, and hydrogen in the atmosphere after an explosion may range from traces to high percentages, depending on the quantity of coal dust, percentage of water in the dust, and the amount of dry inert present (See Appendix G).

During the underground investigation of the explosion, it was evident that coal dust propagated the explosion. Evidence of pressure and/or explosion forces was found at numerous locations, and evidence of burning coal dust, such as soot streamers and heavy deposits of coke, was found. The floor, roof, and ribs of the active 1 left section (explosion area) were dry, and excessive accumulations of loose coal and coal dust were present in the tractor roadway and in the area where the explosion originated. It was apparent that rock dust had been applied. The quantity, however, was inadequate. The floor of the active 2 right section ranged from wet to dry with standing water at several locations. The roof and ribs were dry. Rock dust had been applied to the floor but excessive accumulations of loose coal and coal dust were present throughout the section.

ANALYSES OF DUST SAMPLES

TABLE 2

COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
			EXPLOSION SAMPLES		
			sampling area = main entries No. 16 mine 0 + 00 = surface of main entries		
			No. 1 entry (return)		
	A1		0 + 350' wet, no sample		
	A2		0 + 530' same		
	AX2		0 + 560' same		
	A3		0 + 710' same		
344401	A4	band	0 + 890'	small	48.9
344402	AX4	"	0 + 920' crosscut between 1 and 2 entries	small	65.4
344403	A5	"	0 + 1,070'	large	51.0
344404	A6	"	0 + 1,250'	large	48.1
344405	AX6	"	0 + 1,280' crosscut between 1 and 2 entries	large	48.5
344406	A7	"	0 + 1,430'	large	38.1
344407	A8	"	0 + 1,610'	large	34.7
344408	AX8	"	0 + 1,640' crosscut between 1 and 2 entries	large	35.6
344409	A9	"	0 + 1,790'	large	37.4
344410	A10	"	0 + 1,970'	large	43.5
344411	AX10	"	0 + 2,000' crosscut between 1 and 2 entries	large	36.5
344412	A11	"	0 + 2,150'	large	29.6
344413	A12	"	0 + 2,330'	large	30.5
344414	AX12	"	0 + 2,360' crosscut between 1 and 2 entries	large	30.9
344415	A13	"	0 + 2,510'	large	40.1
			No. 2 entry (return)		
	B1		0 + 350' wet, no sample		
344416	B2	"	0 + 530'	large	40.3
344417	BX2	"	0 + 560' crosscut between 2 and 3 entries	small	40.0
344418	B3	"	0 + 710'	small	59.5
344419	B4	"	0 + 890'	small	48.4
	BX4		0 + 920' wet, no sample		
344420	B5	"	0 + 1,070'	small	44.7
344421	B6	"	0 + 1,250'	small	38.9
344422	BX6	"	0 + 1,280' crosscut between 2 and 3 entries	small	32.3

TABLE 2 COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344423	B7	band	0 + 1,430'	large	44.8
344424	B8	"	0 + 1,610'	large	35.6
344425	BX8	"	0 + 1,640' crosscut between 2 and 3 entries	large	31.7
344426	B9	"	0 + 1,790'	large	30.6
344427	B10	"	0 + 1,970'	small	28.4
344428	BX10	"	0 + 2,000' crosscut between 2 and 3 entries	small	29.8
344429	B11	"	0 + 2,150'	small	29.6
344430	B12	"	0 + 2,330'	small	27.4
344431	BX12	"	0 + 2,360' crosscut between 2 and 3 entries	small	30.0
344432	B13	"	0 + 2,510'	large	34.8
			No. 3 entry		
344433	C1	"	0 + 350'	small	39.1
344434	C2	"	0 + 530'	trace	54.0
344435	CX2	"	0 + 560' crosscut between 3 and 4 entries	trace	46.2
344436	C3	"	0 + 710'	small	47.1
344437	C4	"	0 + 890'	small	52.1
344438	CX4	"	0 + 920' crosscut between 3 and 4 entries	large	48.6
344439	C5	"	0 + 1,070'	large	39.7
344440	C6	"	0 + 1,250'	large	38.2
344441	CX6	"	0 + 1,280' crosscut between 3 and 4 entries	large	44.0
344442	C7	"	0 + 1,430'	large	37.7
344443	C8	"	0 + 1,610'	large	35.9
344444	CX8	"	0 + 1,640' crosscut between 3 and 4 entries	large	31.8
344445	C9	"	0 + 1,790'	large	35.2
344446	C10	"	0 + 1,970'	large	35.4
344447	CX10	"	0 + 2,000' crosscut between 3 and 4 entries	large	31.0
344448	C11	"	0 + 2,150'	large	38.8
344449	C12	"	0 + 2,330'	large	29.9
344450	CX12	"	0 + 2,360' crosscut between 3 and 4 entries	large	31.7
344451	C13	"	0 + 2,510'	large	33.7
			No. 4 entry		
344452	D1	"	0 + 350'	small	61.2
344453	D2	"	0 + 530'	small	60.8
344454	DX2	"	0 + 560' crosscut between 4 and 5 main entries	small	67.3

TABLE 2 COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344455	D3	band	0 + 710'	small	66.7
344456	D4	"	0 + 890'	small	64.4
344457	DX4	"	0 + 920' crosscut between 4 and 5 main entries	small	57.2
344458	D5	"	0 + 1,070'	small	60.0
344459	D6	"	0 + 1,250'	small	53.0
344460	Dx6	"	0 + 1,280' crosscut between 4 and 5 main entries	small	45.0
344461	D7	"	0 + 1,430'	large	46.3
344462	D8	"	0 + 1,610'	large	40.2
344463	DX8	"	0 + 1,690' crosscut between 4 and 5 main entries	large	44.9
344464	D9	"	0 + 1,790'	small	36.7
344465	D10	"	0 + 1,970'	small	32.6
344466	DX10	"	0 + 2,000' crosscut between 4 and 5 main entries	small	35.4
344467	D11	"	0 + 2,150'	large	39.3
344468	D12	"	0 + 2,330'	large	41.3
344469	DX12	"	0 + 2,360' crosscut between 4 and 5 main entries	large	49.8
344470	D13	"	0 + 2,510' No. 5 entry	large	48.4
344471	E1	"	0 + 350'	trace	71.0
344472	E2	"	0 + 530'	trace	78.5
344473	EX2	"	0 + 560' crosscut between 5 and 6 entries	trace	75.0
344474	E3	"	0 + 710'	small	55.5
344475	E4	"	0 + 890'	small	49.1
344476	EX4	"	0 + 920' crosscut between 5 and 6 entries	small	36.4
344477	E5	"	0 + 1,070'	small	48.6
344478	E6	"	0 + 1,250'	small	51.1
344479	EX6	"	0 + 1,280' crosscut between 5 and 6 entries	small	58.5
344480	E7	"	0 + 1,430'	large	41.9
344481	E8	"	0 + 1,610'	large	36.5
344482	EX8	"	0 + 1,640' crosscut between 5 and 6 entries	large	38.9
344483	E9	"	0 + 1,790'	small	33.5

ANALYSES OF DUST SAMPLES

TABLE 2 COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344484	E10	band	0 + 1,970'	small	32.1
344485	EX10	"	0 + 2,000' crosscut between 5 and 6 entries	small	32.3
344486	E11	"	0 + 2,150'	large	31.7
344487	E12	"	0 + 2,330'	large	38.0
344488	EX12	"	0 + 2,360' crosscut between 5 and 6 entries	large	35.6
344489	E13	"	0 + 2,510'	large	37.4
			No. 6 entry		
344490	F1	"	0 + 350'	small	33.6
344491	F2	"	0 + 530'	small	40.9
344492	F3	"	0 + 710'	small	42.1
344493	F4	"	0 + 840'	small	55.3
344494	F5	"	0 + 1,070'	small	62.4
344495	F6	"	0 + 1,250'	small	56.1
344496	F7	"	0 + 1,430'	small	56.3
344497	F8	"	0 + 1,610'	small	44.6
344498	F9	"	0 + 1,790'	small	37.7
344499	F10	"	0 + 1,970'	small	48.5
344500	F11	"	0 + 2,150'	large	47.8
344501	F12	"	0 + 2,330'	large	43.7
344502	F13	"	0 + 2,510'	large	42.7
			sampling area = 1 left entries No. 16 mine		
			0 + 00 = centerline No. 1 main entry		
344374	A1	"	0 + 30' No. 1 entry (return)	large	57.3
344375	B1	"	0 + 30' No. 2 entry (return)	large	54.2
344376	C1	"	0 + 30' No. 3 entry	large	50.9
344377	D1	"	0 + 30' No. 4 entry	large	47.5
344378	E1	"	0 + 30' No. 5 entry	large	50.2
344379	F1	"	0 + 30' No. 6 entry	large	46.0
			sampling area = 2 left entries No. 16 mine		
			0 + 00 = centerline No. 1 main entry		
			No. 1 entry		
344384	A1	"	0 + 30'	large	43.6
344385	A2	"	0 + 210'	large	46.9
344386	AX2	"	0 + 240' crosscut between 1 and 2 entries	large	45.8

The 3 right belt conveyor was empty and the main belt conveyor was loaded with coal for a distance of about 2,000 feet and it appeared that coal dust from the conveyor did enter into the explosion. Investigations of past explosions have proved conclusively that coal dust from loaded conveyor belts, mine cars, and chain conveyors does enter into and help propagate explosions.

Following the explosion, 308 samples of the mine dusts were collected systematically according to a predetermined pattern in areas affected by the explosion forces (See Table 2).. About 89 percent (277) of the samples collected contained less than 65 percent incombustibles, and 229 of the samples, or 74 percent, contained less than 50 percent incombustibles. Of the 6 samples collected in 1 left section all contained less than 65 percent incombustibles and 2 of these samples, or 33 percent, contained less than 50 percent incombustibles. Of the 29 samples collected in the 2 right section all contained less than 65 percent incombustibles and 25 of these samples or 89 percent, contained less than 50 percent incombustibles. Samples were collected in the vicinity of the point of origin and of the 14 samples collected all contained less than 65 percent incombustibles and 13 of those samples or 93 percent, contained less than 40 percent incombustibles (See Table 2A).

Dust samples collected after an explosion are not necessarily representative of mine dust conditions prior to an explosion, as coal dust thrown into suspension and deposited on rock dusted surfaces decreases the incombustible content. However, dust samples collected over extensive areas in a mine after an explosion will indicate the average incombustible content prior to the explosion (Appendix I). The samples collected determined the extent of flame and heat by the presence of coke. The presence of coke in the samples together with soot or coke on roof-bolt plates proves that coal dust propagated the explosion.

From visual observation during the investigation, and the reports of previous Federal inspections, rock dust definitely had been applied to the surfaces of the mines. Further, the 2 right section ranged from wet to dry and there was standing water in several locations. Although these conditions existed prior to the explosion, the surfaces of the major part of the mines were not rock dusted adequately as evidenced by extensive propagation of the explosion by coal dust, and the results of the analyses of the dust samples which indicated that 74 percent of the samples taken had less than 50 percent incombustibles. The Federal Coal Mine Health and Safety Act of 1969 provides that where rock dust is required, it shall be distributed upon the top, floor, and sides of all underground areas in such quantities that the incombustible content of the combined coal dust, rock dust, and other dust shall not be less than 65 percent, but the incombustible content in the return air courses shall be no less than 80 percent.

Flame

Evidence of heat or flame in the form of burned paper, shriveled remains of plastic stoppings, soot, coke deposits, and the presence of coke in dust samples taken as part of the investigation shows that the flame of the explosion extended over the major part of Nos. 15 and 16 mines. The extent of flame is shown on the map of the mines (Appendix C). Evidence indicated that the flame did not extend into the first right section of No. 15 mine, and traversed only a distance of about 500 feet outby the first right entry in Nos. 1, 2, and 3 main entries of No. 15 mine. The flame extended in all the main entries of No. 16 mine to within 500 feet of the portal. Evidence indicated that the flame did not extend to the portals of Nos. 15 and 16 mines. The survivor of the explosion who was about 20 feet inby the portal of the No. 4 entry, No. 15 mine, (belt entry), at the time of the explosion, did not suffer burns or observe flame.

Point of Origin

The explosion originated about 120 feet inby the mouth of No. 1 entry, 2 left, No. 16 mine, during blasting of roof rock for a loading point (boom hole).

Forces

During the investigation, evidence was conclusive that the forces were initiated at the boom hole in No. 1 entry, 2 left, No. 16 mine. The direction of travel of the forces radiated both inby and outby the boom hole in the No. 1 entry and through the adjacent crosscut between Nos. 1 and 2 entries. The forces then traversed throughout the mines as described on the map (Appendix B). The configuration of the mines allowed the forces to expand rapidly from the point of origin and to become less intense while traveling toward the surface. The rock-dust applications in the main entries assisted in dampening the explosion as it traveled toward the surface. Evidence disclosed that explosion forces extended into 1 left and 2 right sections, and along the main entries as substantiated by more than 60 concrete block stoppings being completely or partially blown out and by movement of equipment and damaged belt conveyor structures in the area of the loading point in No. 4 entry, No. 15 mine. There was no damage to the main fans; however, the explosion doors were blown open and required minor repairs before they could be reclosed, and one concrete block stopping in the mouth of No. 2 entry, No. 16 mine

was damaged and required repairs.

Factors Preventing Spread of Explosion

The forces of the explosion reached the surface. However, from observations made during the investigation and the diminishing amounts of coke in dust samples collected from areas about 900 and 1,100 feet outby the working sections in Nos. 15 and 16 mines, respectively, it was evident that rock-dust applications and the absence of excessive coal-dust accumulations in the main entries as well as rapid expansion of the forces from the point of origin were the factors that prevented the spread of the flame to the surface.

Summary of Evidence

Conditions observed in the mines during the investigation following the explosion, together with information available from Federal coal-mine inspection and investigation reports and from company officials, workmen, and mine records, provided evidence as to the cause and origin of the explosion. The evidence from which the conclusions of the Federal investigators are drawn is summarized below. Those paragraphs marked with an asterisk indicate conditions or practices that contributed to the explosion:

1. This was a dust explosion, and there was no evidence indicating that methane entered into the explosion.

2. Most of the victims were burned in some degree, which proves there was flame and intensive heat.

**3. Coal dust, including float coal dust, was deposited on rock-dusted surfaces, and loose coal and accumulations of coal dust were observed in parts of Nos. 15 and 16 mines. Rock dusting was substandard preceding the explosion. Testimony revealed that water was not being used to allay dust during cutting and loading operations, although the 1 left section was supplied with water through a 2-inch pipeline.

4. Permissible explosives, electric detonators, permissible blasting units, and blasting cables were provided for underground blasting.

5. Two full cartons, 5 pounds each, and about one-half of an additional carton of 40 percent strength dynamite (about 125 pounds) were stored in a truck-type trailer about 105 feet from the nearest mine portal. Two full cartons of Primacord (4,000 feet) were also stored in this trailer.

**6. Two spools containing Primacord were found in the mines following the explosion, and short pieces of Primacord were found near the boom hole that was blasted on the day of the explosion. While moving the rock blasted from the boom hole, additional Primacord and one detonator leg wire were found.

**7. While moving the rock blasted from the boom hole, additional Primacord and one detonator leg wire were found. Primacord is detonated by one detonator. If the shots had been fired electrically with a detonator (each with two leg wires) in each shot hole, a large number of such leg wires would have been found.

8. Explosives were generally stored underground in the original cardboard shipping containers.

**9. According to evidence given by various persons during the investigation, boom holes had been blasted with Primacord, and the charges were improperly secured with paper or brattice cloth.

**10. According to testimony of some of the persons responsible for or actually engaged in the blasting of boom holes, all shots in a boom hole, 45 to more than 100, were fired at the same time from power cables or from the battery connections of battery-powered tractors (48-64 volts).

11. Unsafe practices in handling explosives in these mines were discovered during the investigation of a nonfatal explosives accident that occurred in No. 15 mine on August 12, 1970, (See Appendix F).

**12. Additional rock dust was not applied in the vicinity of boom holes before blasting.

13. Boom holes customarily were blasted when production employees were underground.

14. Evidence of smoking underground, such as burnt matches, cigarette butts, and empty cigarette packages was observed at numerous locations in the mines during the recovery operations and ensuing investigation, and opened packages of cigarettes were observed in the pockets on the bodies of some of the victims. A suitable search program for smoking materials and flame-making devices was not in effect at the mines as evidenced by these conditions and practices.

15. Samples of explosives taken during the investigation from storage areas and lying scattered on the mine floor in 1 left section were tested by the Bureau of Mines. The tests and analyses indicated that the explosives conformed to specifications for permissible explosives.

**16. A sample of explosive found in a shot hole for a boom hole that was blasted earlier was determined to be 40 percent strength dynamite.

Cause of Explosion

It is the conclusion of the Bureau of Mines that the explosion occurred when coal dust was thrown into suspension and ignited by Primacord or by permissible explosives used in a nonpermissible manner or by use of nonpermissible explosives during the blasting of roof rock for a loading point (boom hole). Excessive accumulations of coal dust, and inadequate applications of rock dust in parts of Nos. 15 and 16 mines permitted propagation of the explosion throughout the mines.

Violations

During the investigation of this disaster, the Bureau of Mines found that there had been violations of the Mandatory Safety Standards of the Federal Coal Mine Health and Safety Act of 1969. For each of these violations a Notice of Violation has been issued pursuant to said Act. In addition, all these violations must be abated before the imminent danger orders of December 30, 1970, on Nos. 15 and 16 mines will be terminated and before the mines will be permitted to resume production. Numbers in parentheses identify sections of Part 75-Mandatory Safety Standards, Underground Coal Mines, Title 30 Code of Federal Regulations.

1. Coal dust, including float coal dust deposited on rock-dusted surfaces, loose coal, and other combustible materials, shall be cleaned up and not be permitted to accumulate in active workings. (75.400)

2. Where rock dust is required to be applied, it shall be distributed upon the top, floor, and sides of all underground areas of a coal mine and maintained in such quantities that the incombustible content of the combined coal dust, rock dust, and other dust shall be not less than 65 percent, but the incombustible content in the return air courses shall be no less than 80 percent. (75.403)

3. Only permissible explosives and electric detonators of proper strength shall be used in all underground areas of a coal mine, and shall be used in a permissible manner. (75.1303)

4. Permissible explosives shall be fired only with permissible shot firing units. (75.1303)

5. Unconfined shots shall not be fired underground. (75.1300)

6. Only incombustible material shall be used for stemming boreholes. (75.1303)

7. Supplies of explosives and detonators for use in one or more underground working sections shall be stored in section boxes or magazines of substantial construction with no metal exposed on the inside, located at least 25 feet from the roadways and power wires, and in a dry, well rock-dusted location protected from falls of roof. (75.1306)

8. In working places, particularly in distances less than forty feet from the face, water, with or without a wetting agent, shall be applied to coal dust on the ribs, roof, and floor to reduce dispersibility and to minimize the explosion hazard. (75.401)

9. A self-rescue device approved by the Secretary shall be made available to each underground miner by the operator. (75.1714)

10. A suitable check-in and check-out system which will provide positive identification of every person underground shall be established. (75.1715)

11. The minimum quantity of air reaching each working face shall not be less than 3,000 cubic feet a minute. (75.301)

12. Properly installed and adequately maintained line brattices or other approved devices shall be continuously used from the last open crosscut of an entry or room of each working section to provide adequate ventilation to the working faces. (75.302)

13. The search program shall be enforced to insure that persons entering the underground area of the mine do not carry smoking materials, matches, or lighters. (75.1702)

14. Temporary splices shall not be permitted in trailing cables except that one temporary splice may be used for the following 24-hour period. (75.603)

15. Devices shall be installed on all conveyor belts which will give a warning automatically when a fire occurs on or near the belts. (75.1103)

16. A waterline, equipped with firehose outlets and valves at 300-foot intervals and 500 feet of firehose at a strategic location, shall be provided along the 3 right belt conveyor. (75.1100)

17. Deluge-type water sprays, automatically activated by a rise in temperature, shall be installed at the belt conveyor drives. (75.1101)

18. The ground wires for the lightning arresters shall be separated from neutral ground for a distance of at least 25 feet. (75.521)

19. A circuit breaker shall be provided to protect the trailing cable to the spare roof drill in No. 16 mine against short circuits. (75.601)

20. The frames of the electric face equipment receiving power through trailing cables shall be grounded adequately. (75.703)

21. A current-limiting resistor shall be installed in the grounding circuit for the 4,160-volt alternating current circuit. (75.802)

22. A visible disconnecting device shall be installed in the 4,160-volt alternating current branch line from No. 15 mine to No. 16 mine. (75.808) (75.808)

23. Suitable records shall be kept of the preshift examinations (75.303)

ACKNOWLEDGMENT

The writers gratefully acknowledge the courtesies, cooperation, and assistance rendered in the recovery work and the investigation following the explosion.

Respectfully submitted,

/s/ James Westfield

Assistant Director--Coal Mine Health and Safety

/s/ J. S. Malesky

District Manager

/s/ John W. Crawford

Mining Engineer

/s/ Raymond T. Linville

Coal Mine Inspection Supervisor

Approved by:

/s/ Henry P. Wheeler, Jr.

Deputy Director--Health and Safety

/s/ Elburt F. Osborn

Director

ANALYSES OF AIR SAMPLES

TABLE 1

DATE COLLECTED December 30-31, 1970, and January 2-3, 1971

MINE Nos. 15 and 16 COMPANY Finley Coal Company COLLECTED BY R. B. Jones, K. Martin, G. Couch, E. Smith, M. L. West, H. A. Jarvis, J. Begley, and C. H. Sample

BOTTLE NO.	LABORATORY NO.	LOCATION IN MINE	PERCENT IN VOLUME						CUBIC FEET AIR PER MINUTE
			CARBON DIOXIDE	OXYGEN	METHANE	CARBON MONOXIDE	NITROGEN	HYDROGEN	
		EXPLOSION SAMPLES							
K5209	114290	face No. 6 entry No. 2 right (No. 15 mine)	0.12	20.74	0.00	0.000	79.14	0.00	
K3118	291	main return main fan outside (No. 15 mine)	0.54	20.18	0.07	0.23	78.86	0.12	66,000
L1131	292	face No. 2 main entry 5' left 20 - R (No. 15 mine)	0.09	20.69	0.00	0.000	79.22	0.00	
B1247	293	main return at fan (No. 16 mine)	0.05	20.84	0.00	0.000	79.11	0.00	48,000
I9238	294	face No. 1 entry, 2 left (No. 16 mine)	0.04	20.73	0.00	0.000	79.23	0.00	
I9239	295	face No. 6 entry, 3 left (No. 16 mine)	0.07	20.80	0.00	0.000	79.13	0.00	
K3153	296	main return at fan (No. 15 mine)	0.06	20.81	0.00	0.007	79.13	0.00	66,000
K1406	297	40 feet outby No. 5 entry 1 right (No. 15 mine)	0.12	20.69	0.00	0.005	79.19	0.00	
K7716	298	face No. 2 entry 3 right (No. 15 mine)	0.07	20.81	0.00	0.000	79.12	0.00	
K2606	299	main return at fan (No. 16 mine)	0.04	20.86	0.00	0.000	79.10	0.00	48,000
L943	300	face No. 3 main entry (No. 15 mine)	0.10	20.81	0.00	0.000	79.09	0.00	
K7715	301	face 3 way place No. 2 room right off No. 6 room 2 right entries (No. 15 mine)	0.05	20.79	0.00	0.000	79.16	0.00	

ANALYSES OF AIR SAMPLES

TABLE 1 DATE COLLECTED December 31, 1970, and January 2, 1971

MINE No. 16 COMPANY Finley Coal Company COLLECTED BY R. T. Linville

BOTTLE NO.	LABORATORY NO.	LOCATION IN MINE	PERCENT IN VOLUME					CUBIC FEET AIR PER MINUTE
			CARBON DIOXIDE	OXYGEN	METHANE	CARBON MONOXIDE	NITROGEN	
		EXPLOSION SAMPLES						
K667	114340	special on top of shot rock at loading point	0.15	20.75	0.00	0.000	79.10	
J7083	341	face No. 6 room off No. 1 main entry	0.16	20.67	0.01	0.000	79.16	
J7082	342	face No. 2 room off No. 1 main entry following mine explosion	0.08	20.79	0.00	0.000	79.13	

ANALYSES OF DUST SAMPLES

TABLE 2A — COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
			EXPLOSION SAMPLES		
			sampling area = 2 left entries (abandoned) No. 16 mine		
344723	1	band	No. 1 entry 5 feet outby blasted boom hole	large	40.8
344724	2	"	No. 1 entry 25 feet outby blasted boom hole	large	32.2
344725	3	"	No. 1 entry 60 feet outby blasted boom hole	large	29.8
344726	4	"	No. 2 entry 100 feet inby mouth	large	30.3
344727	5	"	No. 2 entry 130 feet inby mouth	extra large	28.9
344728	6	"	No. 1 entry 5 feet inby blasted boom hole	extra large	28.8
344729	7	"	No. 1 entry 30 feet inby blasted boom hole	large	34.3
344730	8	"	No. 1 entry 10 feet inby No. 3 crosscut	extra large	30.5
344731	1X	"	mouth of crosscut left 40 feet outby blasted boom hole	large	33.4
344732	2X	"	mouth of crosscut right 40 feet outby blasted boom hole	large	27.0
344733	3X	"	5 feet to right of blasted boom hole in No. 2 crosscut	large	28.0
344734	4X	"	30 feet to right of blasted boom hole in No. 2 crosscut	large	26.0
344735	5X	"	mouth of No. 2 crosscut right No. 2 entry	large	27.1
344736	6X	"	mouth of No. 3 crosscut right No. 1 entry	extra large	33.8

APPENDIX A

Victims of Mine Explosion Nos. 15 and 16 Mines

FINLEY COAL COMPANY

December 30, 1970

Name and Social Security number	Identification number	Age	Dependents	Occupation	Mining experience
Kermit Hubbard 402-40-6700	R-5	39	Wife 3 Children	Repairman	23 years
James C. Minton 547-68-0303	R-10	27	Wife 1 Child	Tractor Operator	4 years
Walter Hibbard 722-03-7190	R-17	41	Wife 5 Children	Superintendent and Mine Foreman	25 years
Carl Ghent 402-48-6250	R-6	31	Wife 3 Children	Loading Machine Operator	17 years
George Holland 404-28-5760	R-16	41	Wife 3 Children	Mining Machine Operator	23 years
Albert Wagers 402-56-9894	R-4	28	Wife 3 Children	Loading Machine Operator	10 years
Fred Collins 403-76-5969	R-2	18	Single	Tractor Operator	3½ years
Kenople Collins 406-60-7752	R-11	26	Wife 2 Children	Tractor Operator	10 years
Ben Hoskins 403-60-9698	12	24	Wife 1 Child	Tractor Operator	6 years
Frank Hoskins 400-78-5964	R-14	19	Wife 1 Child	Tractor Operator	6 months
Russell Morgan 404-48-0615	2	33	Wife 2 Children	Repairman	11 years

Victims (Continued)

Name and Social Security number	Identification number	Age	Dependents	Occupation	Mining experience
Wilbert Smith 403-46-0456	15	33	Wife	Mining Machine Operator	18 years
Lee Mitchell 403-74-4095	R-21	18	Single	Beltman	6 months
Holt Couch 403-46-2370	16	34	Wife 3 Children	Tractor Operator	15 years
Lester Harris 403-46-1052	9	35	Wife 3 Children	Mining Machine Operator	18 years
Andrew D. Whitehead 407-20-7710	6	46	Wife 5 Children	Section Foreman	31 years
Jeffie Spurlock 407-36-1185	3	41	Wife 4 Children	Loading Machine Operator	24 years
Theo Griffin 405-56-5446	1	28	Wife 1 Child	Tractor Operator	4 months
Stanley Roberts 407-30-2247	10	44	Wife 4 Children	Shot Firer	26 years
Arnold Sizemore 400-48-1530	8	34	Wife 3 Children	Utilityman	18 years
Billy J. Bowling 406-60-8380	R-15	25	Wife 3 Children	Tractor Operator	8 years
Grover Bowling, Jr. 402-48-6871	R-3	33	Wife 1 Child	Tractor Operator	17 years
Teddy Bush 406-72-8140	R-7	21	Single	Timberman	6 months
Lonnie Collins 405-56-7891	14	28	Wife 1 Child	Roof Drill Operator	5 years
Alonzo Couch 403-46-4143	R-18	34	Wife 2 Children	Tractor Operator	17 years

Victims (Continued)

Name and Social Security number	Identification number	Age	Dependents	Occupation	Mining experience
Lawrence Gray 402-52-8583	R-13	30	Wife 2 Children	Coal Drill Operator	10 years
Delbert Henson 406-72-8584	R-1	19	Single	Loading Point Operator	6 months
Elmer White 402-72-5368	R-20	23	Wife 1 Child	Loading Point Operator	1 month
Price Henson 403-46-0440	R-12	38	Wife 7 Children	Roof Drill Operator	15 years
Earl Phillips 406-24-3950	R-8	45	Wife 9 Children	Shot Firer	25 years
Armond Wagers 405-34-6360	R-19	40	Wife 11 Children	Tractor Operator	24 years
Arnold Wagers 400-42-9929	17	35	Wife 4 Children	Tractor Operator	16 years
Jim Jones 402-46-3947	13	36	Wife 3 Children	Coal Drill Operator	15 years
Denver Young 402-56-4880	R-9	29	Wife 1 Child	Mining Machine Operator	7 years
Rufus Jones 401-14-0525	5	53	Wife	Timberman	20 years
Walter Bentley 406-05-4150	7	60	Wife 6 Children	Shot Firer Utilityman	8 years
Alfred Gibson 404-28-5977	11	44	Wife 2 Children	Bratticeman	23 years
Howard Couch 403-46-2467	4	34	Wife 3 Children	Loading Machine Operator	15 years

TABLE 2 COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
			No. 2 entry		
344387	B1	band	0 + 30'	large	45.1
344388	B2	"	0 + 210'	large	43.4
344389	BX2	"	0 + 240' crosscut between 2 and 3 entries	large	48.3
			No. 3 entry		
344390	C1	"	0 + 30'	large	41.1
344391	C2	"	0 + 210'	large	42.6
344392	CX2	"	0 + 240' crosscut between 3 and 4 entries	large	39.9
			No. 4 entry		
344393	D1	"	0 + 30'	large	39.4
344394	D2	"	0 + 210'	large	42.3
344395	DX2	"	0 + 240' crosscut between 4 and 5 entries	large	45.9
			No. 5 entry		
344396	E1	"	0 + 30'	large	43.6
344397	E2	"	0 + 210'	large	48.9
344398	EX2	"	0 + 240' crosscut between 5 and 6 entries	large	48.8
			No. 6 entry		
344399	F1	"	0 + 30'	large	44.8
344400	F2	"	0 + 210'	large	45.2
			connecting crosscuts between Nos. 15 and 16 mines		
344380	CC4	"	No. 4 crosscut between Nos. 15 and 16 mines	small	54.2
344381	CC7	"	No. 7 crosscut between Nos. 15 and 16 mines	large	47.5
344382	CC10	"	No. 10 crosscut between Nos. 15 and 16 mines	large	46.0
344383	CC13	"	No. 13 crosscut between Nos. 15 and 16 mines	large	45.1

TABLE 2 COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
			EXPLOSION SAMPLES		
			sampling area = main entries No. 15 mine		
			0 + 00 = surface main entries		
			No. 1 main entry		
344575	A1	band	0 + 200'	small	44.6
344576	A2	"	0 + 380'	small	51.5
344577	AX2	"	0 + 410' crosscut between 1 and 2 main entries	small	39.4
	A3		0 + 560' no sample received		
	A4		0 + 740' same		
344578	AX4	"	0 + 770' crosscut between 1 and 2 main entries	trace	45.0
344579	A5	"	0 + 920'	trace	50.0
344580	A6	"	0 + 1,100'	trace	26.0
344581	AX6	"	0 + 1,130' crosscut between 1 and 2 main entries	small	39.4
344582	A7	"	0 + 1,280'	small	38.6
344583	A8	"	0 + 1,460'	small	40.8
344584	AX8	"	0 + 1,490' crosscut between 1 and 2 main entries	small	42.2
344585	A9	"	0 + 1,640'	large	36.5
344586	A10	"	0 + 1,820'	small	37.2
344587	AX10	"	0 + 1,850' crosscut between 1 and 2 main entries	small	34.9
344588	A11	"	0 + 2,000'	small	36.1
344589	A12	"	0 + 2,180'	large	38.0
344590	AX12	"	0 + 2,210' crosscut between 1 and 2 main entries	large	35.6
344591	A13	"	0 + 2,360'	extra large	32.1
344592	AX14	"	0 + 2,510' crosscut between 1 and 2 main entries	extra large	35.2
			No. 2 main entry		
	B1		0 + 200' roof fall, no sample		
344593	B2	"	0 + 380'	small	37.7

TABLE 2 COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344594	BX2	band	0 + 410' crosscut between 2 and 3 main entries	trace	69.5
344595	B3	"	0 + 560'	trace	22.0
344596	B4	"	0 + 740'	none	32.0
344597	BX4	"	0 + 770' crosscut between 2 and 3 main entries	trace	54.0
344598	B5	"	0 + 920'	small	37.1
344599	B6	"	0 + 1,100'	large	44.8
344600	BX6	"	0 + 1,130' crosscut between 2 and 3 main entries	small	49.3
344601	B7	"	0 + 1,280'	small	43.9
344602	B8	"	0 + 1,460'	large	44.5
344603	BX8	"	0 + 1,490' crosscut between 2 and 3 main entries	large	42.6
344604	B9	"	0 + 1,640'	large	55.9
344605	B10	"	0 + 1,820'	small	38.3
344606	BX10	"	0 + 1,850' crosscut between 2 and 3 main entries	small	35.2
344607	B11	"	0 + 2,000'	small	36.9
344608	B12	"	0 + 2,180'	large	37.7
344609	BX12	"	0 + 2,210' crosscut between 2 and 3 main entries	large	39.0
344610	B13	"	0 + 2,360'	large	35.2
344611	BX14	"	0 + 2,510' crosscut between 2 and 3 main entries	large	32.2
			No. 3 main entry		
344612	C1	"	0 + 200'	trace	80.5
344613	C2	"	0 + 380'	trace	74.0
344614	CX2	"	0 + 410' crosscut between 3 and 4 main entries	none	46.5
344615	C3	"	0 + 560'	trace	73.0
344616	C4	"	0 + 740'	trace	71.0
344617	CX4	"	0 + 770' crosscut between 3 and 4 main entries	trace	48.0

TABLE 2

COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344618	C5	band	0 + 920'	trace	53.5
344619	C6	"	0 + 1,100'	trace	75.5
344620	CX6	"	0 + 1,130' crosscut between 3 and 4 main entries	small	54.9
344621	C7	"	0 + 1,280'	small	59.7
344622	C8	"	0 + 1,460'	small	51.8
344623	CX8	"	0 + 1,490' crosscut between 3 and 4 main entries	small	51.0
344624	C9	"	0 + 1,640'	small	47.1
344625	C10	"	0 + 1,820'	small	39.3
344626	CX10	"	0 + 1,850' crosscut between 3 and 4 main entries	small	35.3
344627	C11	"	0 + 2,000'	small	44.0
344628	C12	"	0 + 2,180'	small	44.9
344629	CX12	"	0 + 2,210' crosscut between 3 and 4 main entries	small	36.4
344630	C13	"	0 + 2,360'	large	49.4
344631	CX14	"	0 + 2,510' crosscut between 3 and 4 main entries	large	45.8
			No. 4 main entry		
344632	D1	"	0 + 200'	trace	88.0
344633	D2	"	0 + 380'	none	87.0
344634	DX2	"	0 + 410' crosscut between 4 and 5 main entries	none	96.0
344635	D3	"	0 + 560'	none	91.5
344636	D4	"	0 + 740'	none	91.0
344637	DX4	"	0 + 770' crosscut between 4 and 5 main entries	none	76.5
344638	D5	"	0 + 920'	none	92.0
344639	D6	"	0 + 1,100'	none	88.0
344640	DX6	"	0 + 1,130' crosscut between 4 and 5 main entries	trace	70.5
344641	D7	"	0 + 1,280'	trace	85.5
344642	D8	"	0 + 1,460'	trace	72.5
344643	DX8	"	0 + 1,490' crosscut between 4 and 5 main entries	trace	46.0

TABLE 2 COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344644	D9	band	0 + 1,640'	small	44.2
344645	D10	"	0 + 1,820'	small	43.1
344646	DX10	"	0 + 1,850' crosscut between 4 and 5 main entries	small	33.5
344647	D11	"	0 + 2,000'	small	61.4
344648	D12	"	0 + 2,180'	small	45.3
344649	DX12	"	0 + 2,210' crosscut between 4 and 5 main entries	small	33.1
344650	D13	"	0 + 2,360'	small	35.6
344651	DX14	"	0 + 2,510' crosscut between 4 and 5 main entries	small	33.8
			No. 5 main entry (return)		
344652	E1	"	0 + 200'	small	60.4
344653	E2	"	0 + 380'	trace	77.5
344654	EX2	"	0 + 410' crosscut between 5 and 6 main entries	none	85.0
344655	E3	"	0 + 560'	none	78.0
344656	E4	"	0 + 740'	none	42.0
344657	EX4	"	0 + 770' crosscut between 5 and 6 main entries	none	87.0
344658	E5	"	0 + 920'	none	90.0
344659	E6	"	0 + 1,100'	none	90.0
	EX6		0 + 1,130' crosscut between 5 and 6 main entries - roof fall and gob, no sample		
344660	E7	"	0 + 1,280'	none	65.0
344661	E8	"	0 + 1,460'	none	50.5
344662	EX8	"	0 + 1,490' crosscut between 5 and 6 main entries	trace	45.5
344663	E9	"	0 + 1,640'	trace	44.5
344664	E10	"	0 + 1,820'	trace	61.5
344665	EX10	"	0 + 1,910' crosscut between 5 and 6 main entries	small	36.6
344666	E11	"	0 + 2,000'	small	42.2
344667	E12	"	0 + 2,180'	small	38.5

TABLE 2 COLLECTED AFTER EXPLOSION

LAB NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344668	EX12	band	0 + 2,210' crosscut between 5 and 6 main entries	large	33.8
344669	E13	"	0 + 2,360'	large	37.1
344670	EX14	"	0 + 2,510' crosscut between 5 and 6 main entries	large	30.3
			No. 6 main entry (return)		
	F1	"	0 + 200' no sample, not developed		
344671	F2	"	0 + 380'	trace	87.0
344672	F3	"	0 + 560'	none	32.0
344673	F4	"	0 + 740'	none	59.0
344674	F5	"	0 + 920'	none	59.0
344675	F6	"	0 + 1,100'	none	33.0
	F7	"	0 + 1,280' roof fall, no sample		
344676	F8	"	0 + 1,460'	none	36.0
344677	F9	"	0 + 1,640'	small	30.3
344678	F10	"	0 + 1,820'	small	33.6
344679	F11	"	0 + 2,000'	extra large	40.3
344680	F12	"	0 + 2,180'	large	36.3
344681	F13	"	0 + 2,360'	large	37.4
			sampling area = 1 right off main entries No. 15 mine		
			0 + 00 = centerline No. 6 main entry		
			No. 1 entry		
	A1		0 + 30' wet, no sample		
344503	A2	"	0 + 210'	small	40.3
344504	AX2	"	0 + 240' crosscut between 1 and 2 entries	small	39.7
	A3		0 + 390' wet, no sample		
			No. 2 entry		
344505	B1	"	0 + 30'	small	42.3
344506	B2	"	0 + 210'	none	31.0
344507	BX2	"	0 + 240' crosscut between 2 and 3 entries	none	25.5
344508	B3	"	0 + 390'	none	21.5
			No. 3 entry		
344509	C1	"	0 + 30'	none	31.0
344510	C2	"	0 + 210'	none	43.0

ANALYSES OF DUST SAMPLES

TABLE 2

COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344511	CX2	band	0 + 240' crosscut between 3 and 4 entries	none	44.5
344512	C3	"	0 + 390'	none	21.5
			No. 4 entry		
344513	D1	"	0 + 30'	none	45.0
344514	D2	"	0 + 210'	none	29.5
	DX2		0 + 240' crosscut between 4 and 5 entries - wet, no sample		
	D3		0 + 390' wet, no sample		
			No. 5 entry (return)		
344515	E1	"	0 + 30'	none	66.5
	E2		0 + 210' wet, no sample		
344516	EX2	"	0 + 240' crosscut between 5 and 6 entries	none	46.0
344517	E3	"	0 + 390'	none	27.5
			No. 6 entry (return)		
344518	F1	"	0 + 30'	none	54.5
344519	F2	"	0 + 210'	none	67.0
344520	F3	"	0 + 390'	none	33.5
			sampling area = 2 right entries No. 15 mine		
			0 + 00 = centerline No. 6 main entry		
			No. 1 entry		
344521	A1	band	0 + 30'	large	44.1
344522	A2	"	0 + 210'	large	43.1
344523	AX2	"	0 + 240' crosscut between 1 and 2 entries	small	40.5
344524	A3	"	0 + 390'	large	39.7
344525	A4	"	0 + 570'	large	42.5
344526	AX4	"	0 + 600' crosscut between 1 and 2 entries	large	45.1
			No. 2 entry		
344527	B1	"	0 + 30'	large	42.6
344528	B2	"	0 + 210'	large	47.1
344529	BX2	"	0 + 240' crosscut between 2 and 3 entries	large	42.2
344530	B3	"	0 + 390'	extra large	43.6
344531	B4	"	0 + 570'	extra large	46.2
344532	BX4	"	0 + 600' crosscut between 2 and 3 entries	extra large	49.5

ANALYSES OF DUST SAMPLES

TABLE 2

COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
			No. 3 entry		
344533	C1	hand	0 + 30'	small	44.4
344534	C2	"	0 + 210'	large	45.2
344535	CX2	"	0 + 240' crosscut between 3 and 4 entries	large	41.8
344536	C3	"	0 + 390'	extra large	40.4
344537	C4	"	0 + 570'	extra large	45.5
344538	CX4	"	0 + 600' crosscut between 3 and 4 entries	extra large	50.1
			No. 4 entry		
344539	D1	"	0 + 30'	large	41.6
344540	D2	"	0 + 210'	large	42.3
344541	DX2	"	0 + 240' crosscut between 4 and 5 entries	large	42.4
344542	D3	"	0 + 390'	large	41.4
344543	D4	"	0 + 570'	large	44.9
	DX4		0 + 600' crosscut between 4 and 5 entries - wet, no sample		
			No. 5 entry (return)		
344544	E1	"	0 + 30'	large	42.0
344545	E2	"	0 + 210'	large	45.8
344546	EX2	"	0 + 240' crosscut between 5 and 6 entries	large	52.5
344547	E3	"	0 + 390'	large	55.7
	E4		0 + 570' wet, no sample		
	EX4		0 + 600' crosscut between 5 and 6 entries - wet, no sample		
			No. 6 entry (return)		
344548	F1	"	0 + 30'	small	45.5
	F2		0 + 210' wet, no sample		
	F3		0 + 390' same		
344549	F4	"	0 + 570'	extra large	56.8
			sampling area = 3 right entries off No. 15 mine		
			0 + 00 = centerline of No. 6 main entry		
			No. 1 entry		
344550	A1	"	0 + 30'	extra large	45.5
344551	A2	"	0 + 210'	extra large	42.2

TABLE 2

COLLECTED AFTER EXPLOSION

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
344552	AX2	band	0 + 240' crosscut between 1 and 2 entries	extra large	41.0
344553	A3	"	0 + 390'	small	42.2
			No. 2 entry		
344554	B1	"	0 + 30'	large	42.3
344555	B2	"	0 + 210'	large	40.6
344556	BX2	"	0 + 240' crosscut between 2 and 3 entries	large	43.8
344557	B3	"	0 + 390'	large	40.8
			No. 3 entry		
344558	C1	"	0 + 30'	large	42.5
344559	C2	"	0 + 210'	large	38.2
344560	CX2	"	0 + 240' crosscut between 3 and 4 entries	large	41.9
344561	C3	"	0 + 390'	large	49.0
			No. 4 entry (return)		
344562	D1	"	0 + 30'	large	44.1
344563	D2	"	0 + 210'	large	42.8
344564	DX2	"	0 + 240' crosscut between 4 and 5 entries	large	47.0
	D3		0 + 390' wet, no sample		
			No. 5 entry (return)		
344565	E1	"	0 + 30'	large	43.1
344566	E2	"	0 + 210'	large	43.1
344567	EX2	"	0 + 240' crosscut between 5 and 6 entries	large	45.1
	E3		0 + 390' no sample received		
			No. 6 entry (return)		
344568	F1	"	0 + 30'	large	43.3
344569	F2	"	0 + 210'	large	43.0
344570	FX2	"	0 + 240' crosscut between 6 and 7 entries	large	44.2
	F3	"	0 + 390' wet, no sample		
			No. 7 entry (return)		
344571	G1	"	0 + 30'	large	46.9
344572	G2	"	0 + 210'	large	52.5
344573	GX2	"	0 + 240' crosscut between 3 right and 2 right	large	42.4
344574	G3	"	0 + 390'	large	47.0