

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

John W. Crawford  
Mining Engineer

Raymond T. Linville  
Coal Mine Inspection Supervisor

Originating Office - Bureau of Mines  
Norton, Virginia 24273  
J. S. Malesky, District Manager  
Coal Mine Safety District C

CONTENTS

PAGE

Summary.....	1
General Information.....	2
Mining Methods, Conditions, and Equipment.....	5
Mining Methods.....	5
Explosives.....	6
Ventilation and Gases.....	8
Dust.....	9
Transportation.....	10
Electricity.....	11
Illumination and Smoking.....	12
Mine Rescue.....	12
Pre-Explosion Conditions and Activities and Recovery Operations..	13
Assisting Organizations.....	13
Activities of Bureau of Mines Personnel.....	13
Mine Conditions Immediately Prior to Explosion.....	14
Evidence of Activities Prior to Explosion.....	15
Recovery Operations.....	17
Investigation of Cause of Explosion.....	18
Investigation Group.....	18
Methane and/or Dust as a Factor in the Explosion.....	20
Flame.....	22
Point of Origin.....	22
Forces.....	22
Factors Preventing Spread of Explosion..	23
Summary of Evidence.....	24
Cause of Explosion.....	25
Violations.....	26
Acknowledgment.....	28
Table 1 - Analyses of Air Samples	
Table 2 - Analyses of Dust Samples	
Appendix	
A - Victims of Explosion	
B - Map of Mine after Explosion	
C - Dust Survey Map	
D - No. 16 Mine, 1 left, No. 5 entry	
E - No. 15 Mine, 2 right, No. 6 entry	
F - Coal Mine Inspection Report, No. 15 Mine, June 19 and 22-23, 1970	
Report of Nonfatal Explosives Accident, No. 15 Mine	
August 12, 1970	
Spot Inspection, No. 15 Mine, August 14, 1970	
Report of Fatal Coal Mine Haulage Accident, No. 15 Mine,	
November 9, 1970	
Spot Inspection, No. 15 Mine, November 19, 1970	
Spot Inspection, No. 15 Mine, December 21, 1970	
Coal Mine Inspection Report, No. 16 Mine, October 19-20 and	
October 22, 1970	
Spot Inspection, No. 16 Mine, October 26, 1970	

- G - Memorandum, Composition of Mine Gases after an Explosion,  
January 15, 1971
- H - Memorandum, Tests on Explosives, January 18, 1971
- I - Memorandum, Effect of an Explosion on Dust in Mine Passageways,  
January 20, 1971
- J - Safety Research Center, Report No. S-4150, Analysis of Sample  
of Explosive, January 22, 1971
- K - Memorandum, Finley Coal Company, Hyden, Kentucky, January 26, 1971

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

and

J. S. Malesky  
District Manager

and

John W. Crawford  
Mining Engineer

and

Raymond T. Linville  
Coal Mine Inspection Supervisor

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:

	<u>Percent</u>
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, in by 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 deficiencies 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).

