UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DISTRICT C

FINAL REPORT OF COAL-MINE EXPLOSION

NO. 1 MINE
PRINCESS COALS, INCORPORATED, PRINCESS EIKHORN DIVISION
DAVID, FLOYD COUNTY, KENTUCKY

July 28, 1967

by

Raymond Linville
Federal Coal Mine Inspection Supervisor

and

James P. Begley
Federal Coal Mine Inspector

Originating Office - Bureau of Mines
Barbourville, Kentucky 40906
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Barbourville, Kentucky, Subdistrict, Health and Safety District C

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INTRODUCTION

This report is based on an investigation made in accordance with provisions of the Federal Coal Mine Safety Act (66 Stat. 692; 30 U.S.C. Secs. 451-483) as amended.

A gas explosion occurred about 3:45 a.m., Friday, July 28, 1967, along No. 2 entry of the abandoned 8 right section, approximately 1,000 feet off south mains in the No. 1 Mine, Princess Coals, Incorporated, Princess Elkhorn Division, David, Floyd County, Kentucky. The four men in the area were killed almost instantly. Twenty-three men working in other parts of the mine were not affected by the explosion, and some of them assisted company officials in recovery operations. The names of the victims, their ages, occupations, experience, and the number of their dependents are listed in Appendix A of this report.

Bureau of Mines investigators are of the opinion that the explosion originated in the general vicinity of the hoist and the end of the hoist rope along the No. 2 entry, 8 right, where an explosive mixture of methane and air was ignited either when a workman attempted to light a cigarette with a cigarette lighter or from an electric arc or spark, since the hoist, with an open-type motor, was energized by touching the end of the negative power conductor to a track rail. The hoist was moved by its own power and hoist rope. The positive power conductor to the hoist was connected to the trolley wire, and, when it became necessary to move the hoist on July 28, 1967, it was accomplished by contacting (nipping) the negative power conductor to one of the rails of the haulage track. The hoist was being taken into the area to recover a coal drill. It is also believed by the investigators that the methane liberation originated in the No. 1 coalbed

and traveled up the slopes to 8 right entries in No. 3 coalbed where it accumulated to an explosive mixture. Forces of the explosion started from the vicinity of the hoist and the end of the hoist rope, extended throughout 8 right entries, and dissipated in the worked-out abandoned areas in 8 right. Some brattice-cloth stoppings and man doors in the concrete-block stoppings between Nos. 5 and 6 entries in 8 right were blown out as was part of the overcast at the mouth of 8 right.

GENERAL INFORMATION

The No. 1 Mine is off State Highway Route No. 404, at David, Kentucky, and it is served by the Chesapeake and Ohio Railroad.

The operating officials of the company are:

David Francis	Chairman of the Board	Huntington, West Virginia
Ralph Huffman	President	Huntington, West Virginia
C. D. Todd	General Manager	David, Kentucky
Ray Spears	Safety Director	David, Kentucky
Jesse Webb	General Mine Foreman	David, Kentucky
Rudell Wicker	Chief Engineer	David, Kentucky

A total of 133 men, 111 underground and 22 on the surface, was employed on 2 coal-producing shifts and 1 maintenance and supply shift a day, 5 days a week. An average of 1,080 tons of coal a day was loaded by loading machines.

The mine was opened in March 1941 by drifts in the Elkhorn No. 3 coalbed. During July 1961, two underground slopes were driven from the Elkhorn No. 3 coalbed near the faces of Nos. 4 and 6 entries in 8 right to the Elkhorn No. 1 coalbed, a vertical distance of about 75 feet below the Elkhorn No. 3 coalbed. One of the slopes was on a 14° pitch, approximately 300 feet long, and was utilized as an intake airway and as a belt conveyor and track haulageway. The other slope was on a 45° pitch, approximately 105 feet long, and was used as a return airway and second escapeway. Mining in the Elkhorn No. 1 coalbed, including both slopes, was abandoned in January 1965. Both coalbeds ranged from 26 to 36 inches in thickness.

The immediate roof ranged from fragile to firm shale, and the main roof was firm shale. The floor was hard fire clay.

The analyses of the coal from the Elkhorn Nos. 1 and 3 coalbeds in this mine, as provided by the company, are as follows:

Elkhorn No. 1	Percent	Elkhorn No. 3	Percent
Moisture	2.50	Moisture	3.00
Volatile Matter	37.50	Volatile Matter	37.00
Fixed Carbon	57.00	Fixed Carbon	57.00
Ash	3.00	Ash	3.00
	100.00		100.00

Numerous tests by the Bureau of Mines have shown that coal dust having a volatile-combustible ratio of 0.12 is explosive and that the explosibility increases with an increase in the volatile ratio. The volatile-incombustible ratio of the Elkhorn Nos. 1 and 3 coalbeds in this mine is 0.39, indicating that the coal dust is explosive. The last regular Federal inspection was completed May 31, 1967.

MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods: The No. 1 Mine was opened by drifts into the Elkhorn No. 3 coalbed in March 1941, and by two underground slopes from Elkhorn No. 3 coalbed to the Elkhorn No. 1 coalbed in July 1961. The mine was developed by a room-and-pillar method. Main, cross, and room entries were driven in sets of four to seven in each of the coalbeds. Entries were driven 20 to 28 feet wide, and rooms were about 30 feet wide. Crosscuts were about 60 feet apart.

Mining in the Elkhorn No. 1 coalbed was discontinued in January 1965. Shortly thereafter, work in 8 right entries in the Elkhorn No. 3 coalbed was resumed and mining was continued until January 1967, when the section was considered by company officials to be worked out. None of the 8 right entry pillars outby the slopes to No. 1 coalbed was removed, and, although the section was abandoned, some of the equipment, haulage tracks, and trolley wire were left on the section to be recovered as needed. The 8 right haulageway was used as a loaded car-storage track for a distance of about 500 feet inby the mouth of the entry.

Roof-support plans had been adopted, and they were followed. Where roof bolts were used, they were installed in compliance with recommendations of a Bureau of Mines roof-control representative.

Coal was loaded by mobile loading machines into shuttle cars.

Where pillars were mined, only a partial-split method was used.

Explosives: Permissible explosives and detonators were used for blasting, and they were stored properly on the surface. The blasting supplies were transported into the mine in a satisfactory manner, but underground storage was unsatisfactory at the time of the May 1967 Federal inspection. Coal was undercut and blasted on shift; tests for gas were made before and after blasting. During the investigation, explosives and detonators were found stored in crosscuts in their original shipping containers at three locations along No. 2 entry, 8 right.

Ventilation and Mine Gases: Ventilation was induced by a propeller fan, installed properly on the surface and equipped with the necessary safety devices; however, the pressure-recording gage was inoperative at the time of the explosion. The fan was operated continuously and was exhausting about 90,000 cubic feet of air a minute.

A split system of ventilation was used, and permanent stoppings and overcasts were constructed with concrete blocks; doors were not used.

Regulators in return airways were used to control the quantity of air circulated in the active sections. While mining was in progress and after mining was discontinued in the Elkhorn No. 1 coalbed, ventilation in that area was accomplished by using five of the seven 8 right entries and one of the slopes as intake airways, and the other slope and the two remaining 8 right entries as return airways. Soon after the 8 right section in the Elkhorn No. 3 coalbed was abandoned in January 1967, concrete-block stoppings were erected across the two return airways at a point about 450 feet inby the mouth of the entries in order to increase the amount of air to the active sections. Reportedly, a small opening was left in one of the stoppings to serve as a regulator-bleeder for the section. During final mining in 8 right section, it was necessary to replace six concrete-block stoppings with brattice-cloth stoppings. As a result, very little, if any, ventilation had been coursed through the 8 right section or through the slopes after the two stoppings were built in the return airways.

The mine is classed gassy in accordance with the laws of the State and the Bureau of Mines. Preshift examinations were made by certified persons before the first coal-producing shift each day, and preshift examinations for succeeding shifts were made by on shift section foreman as part of their regular duties. Examinations were not made regularly in abandoned areas. Several gas wells penetrated the coalbed on this property, but adequate protection has been provided for the wells.

Air measurements and methane contents recorded in the May 1967 Federal inspection report are as follows:

Location in Mine	Volume of Air, c.f.m.	Methane Percent	Cubic Feet of Methane in 24 Hours
Immediate return No. 3 section	6,200	0.10	8,900
Immediate return No. 15 section	9,750	0.05	7,000
Immediate return No. 9 section	6,500	0.14	13,000
Main return 50 feet inby fan	76,000	0.00	

The analytical results of the air samples collected during the December 1966 Federal inspection when coal was being produced in 8 right off south mains indicated that methane was being liberated in the explosion area. The air measurements and analyses of the air samples are as follows:

Location in Mine	Volume of Air, c.f.m.	Methane Percent	Cubic Feet of Methane in 24 Hours
Immediate return No. 9 section	7,200	0.19	20,000
Immediate return No. 3 section	12,300	0.02	2,400
Immediate return No. 15 section - 8 right off south mains	14,200	0.05	10,000
Main return 50 feet inby fan	85,000	0.07	86,000

Dust: At the time of the May 1967 Federal inspection, the mine surfaces ranged from wet to dry. Coal dust and loose coal were not present in dangerous quantities in the active underground workings, and excessive dust was not raised into suspension during mining operations. Rock salt was used to allay dust on shuttle-car roadways. Where necessary, rock dust was applied to within 20 feet of the faces, including back and parallel entries, and the applications were adequate at the close of the inspection.

During the March 1966 Federal inspection, a dust survey was made in 8 right entries. The survey at that time was started at a location 250 feet inby the point where the ignition occurred. The samples were collected on a pattern at 200-foot intervals beginning near No. 1 belt drive and extending for a distance of 700 feet inby the belt drive to within 100 feet of the active faces. The incombustible content in 12 of the 19 samples collected during the survey ranged from 66 to 91 per centum. The remaining 7 samples ranged from 26.5 to 60.0 per centum. Additional rock dust was applied in the deficient areas promptly during the inspection.

Transportation: Coal was transported from the faces in shuttle cars to belt conveyors and mine-car loading points, thence, to the surface in mine cars by trolley locomotives. Repairmen, foremen, and other general laborers traveled into and out of the mine on "jitterbugs," local name for personnel conveyance, receiving power through nips. Regular section workmen were transported underground in solid-bottom mine cars under the supervision of certified officials. All track haulageways were installed in intake air. Either the top rock or bottom was taken to provide height along track haulageways.

Electricity: Electric power, at 7,200 volts alternating current, was used to operate rectifiers and a rotary converter, to supply 275 volts direct-current power for use underground, and 110, 220, and 440 volts alternating-current power was used on the surface. Two rectifiers and a rotary converter were used underground, and one rectifier was located on the surface. Electric power wires entered the mine through the drift portal and boreholes.

Disconnecting switches and lightning arresters were provided in the power circuits near the points where the circuits entered the mine. Trolley and feeder wires were installed on insulated hangers, and cutout switches were provided at necessary locations. The electric face equipment was of the permissible and nonpermissible types, and the permissible equipment used in the face areas was in permissible condition at the close of the May 1967 Federal inspection. Trailing cables were of the fire-resistant type and provided with short-circuit protection. Tests for methane were made with permissible flame safety lamps before the electrically-driven equipment was taken into or operated in the face regions and at frequent intervals while such equipment was operated at the faces.

Illumination and Smoking: Permissible electric cap lamps were used for portable illumination underground. Smoking was prohibited underground; however, a cigarette and cigarette lighter (closed) were found alongside the body of the inby victim. Part of a package of cigarettes (5) was found in the middle of the track near the end of the hoist rope, and a half-full can of Prince Albert smoking tobacco was found in the same area. Smokers' articles were not listed by the mortician among the personal effects of the victims. A search program for smokers' articles was in effect at the mine, but searches were infrequent and were obviously ineffective.

Mine Rescue: A mine rescue team was not maintained at the mine. Some of the officials had received mine rescue training. Six Chemox breathing apparatus and five All-Service gas masks were available at the mine. Some of the employees carried self-rescuers underground, and some of the self-rescuers were used during the recovery work. Six trained mine rescue teams are available at mines within 50 miles of the operation.

Escapeways were provided and maintained in good condition. A positive check-in-and-out system was not used.

Firefighting equipment was adequate and consisted of portable chemical tanks of 40-gallon capacity equipped with suitable hose and nozzle; high pressure rock-dust machines with sufficient hose and ample supplies of rock dust; fire extinguishers in each section, along belt conveyors, at stationary electrical equipment, and on locomotives. Also, supplies of lumber, brattice cloth, nails, tools, and other equipment were available.

STORY OF EXPLOSION AND RECOVERY OPERATIONS

Participating Organizations: Officials and employees of Princess Coals, Incorporated, representatives of United Mine Workers of America, Kentucky Department of Mines and Minerals, Underwriters Safety and Claims, and United States Bureau of Mines participated in the investigation. Recovery operations and removal of the bodies to the surface were done by officials and employees of Princess Coals, Incorporated. The company officials and employees who participated in the recovery of the victims under hazardous and difficult conditions are to be commended.

Activities of Bureau of Mines Personnel: Raymond Linville, Federal Coal Mine Inspection Supervisor, was notified about 5:15 a.m., July 28, 1967, by a telephone call from William B. Wright, Principal Inspector, Kentucky Department of Mines and Minerals, that an explosion had occurred in the No. 1 Mine and that men were known to be trapped therein. After reporting the incident to G. W. Parry, Subdistrict Manager, Linville and Federal inspectors Adams and Begley proceeded to the mine promptly. J. S. Malesky, District Manager, and James Westfield, Assistant Director, Coal Mine Safety, were also notified of the occurrence. Linville, Adams, and Begley arrived at the mine about 7:15 a.m. At about 8 a.m., before State and Federal inspectors entered the mine, the bodies were brought to the surface.

J. S. Malesky, G. W. Parry, and James Westfield arrived at the mine at 10:30 a.m., 11:30 a.m., and 3 p.m., respectively, on the day of occurrence, and participated in the underground investigation and the official hearing. Ray G. Ross, W. E. Duke, and R. B. Jones, Bureau personnel, arrived at the mine the same day and assisted in the investigation.

A withdrawal Order, explosion danger, was issued under Section 203(a)(1) of the Federal Coal Mine Safety Act on July 28, 1967, debarring all persons from the mine except those needed for exploratory and investigative work. Before the Order was issued, all persons except those mentioned above, had been kept from entering the mine.

Mine Conditions Immediately Prior to Explosion: Normal mining operations were started on the day shift on Thursday, July 27, 1967, and continued without incident until the explosion occurred on the third shift at about 3:45 a.m., July 28, 1967. The weather was mostly cloudy on the evening of July 27 and continued mostly cloudy during July 28. The barometric pressure and temperature readings for July 27 and 28 recorded at the U. S. Weather Bureau, Huntington, West Virginia, were as follows:

Date	Time	Barometric Pressure	Temperature
7-27-67	6 a.m.	29.10	68°
7-27-67	12 m	29.11	84°
7-27-67	6 p.m.	29.04	80°
7-28-67	12:01 a.m.	29.03	76°
7-28-67	6 a.m.	29.01	69°

The normal pressure for this area is 29.04. It is believed that the slight change in atmospheric pressure had no bearing on the explosion.

Evidence of Activities and Story of Explosion: Mining in the Elkhorn No. 1 coalbed was discontinued in January 1965, and mining in the

Elkhorn No. 3 coalbed in 8 right section was completed in January 1967. Some of the mining equipment, haulage tracks, and trolley wires were not removed from the section.

A large rock fall, 225 feet long, 20 feet wide, and from 10 to 36 inches in thickness, occurred on 8 right haulageway (No. 5 entry) about 500 feet inby the mouth of the entry sometime between January 13 and 18, 1967. No effort had been made since the fall occurred to recover any of the equipment until July 20, 1967.

In March 1967, company officials decided to reopen the Open Fork Mine which had been abandoned in April 1965; however, work to reactivate the mine was not started until about 3 weeks before the explosion occurred. The Open Fork Mine is located near but is not interconnected with the No. 1 Mine. A decision was made to recover a shop-made portable coal drill from 8 right for use in the Open Fork Mine. The drill was located in a crosscut between Nos. 2 and 3 entries, about 1,200 feet from the mouth of the 8 right entries and about 100 feet outby one of the slopes to the Elkhorn No. 1 coalbed.

An enclosed-type motor was used on the drill, and it was hydraulically-operated; however, the controller had been removed, and the drill was inoperative.

Because of the rock fall on 8 right haulageway, locomotive power could not be used to recover the drill from the section. As a result, on July 20, 1967, Jesse Webb, general mine foreman, went into 8 right to determine the best and most practical way to recover the drill. Webb decided that a Brownie hoist could be taken into the section, and the drill pulled along No. 2 entry and through the crosscuts to the haulage tracks outby the rock fall in No. 5 entry; the drill could then be transported to the surface by a locomotive and an equipment carrier. Webb stated that he made tests for gas with a permissible flame safety lamp while in 8 right section, and that he did not detect any gas.

Webb instructed William B. Titlow, general third-shift mine foreman, to get a Brownie hoist from the surface shop and take it to 8 right to recover the coal drill. The hoist, a Brown-Fayro car-spotting type, Model HKL, equipped with a 5 hp. open-type motor, was equipped with a choke coil. The hoist was 70 inches long, 34 inches wide, and 24 inches high.

On the third shift of July 25, Titlow and James Risner, motorman, used a locomotive and an equipment carrier to transport the hoist from the shop to a point about 75 feet inby the end of the trolley wire in 8 right. A piece of Simplex single conductor cable (P-101-BM) was connected to the trolley wire and extended about 75 feet to a crosscut between Nos. 5 and 4 entries. One conductor of a 2-conductor twisted plastic cable, No. 14 wire, usually used for telephone cable, was connected to the Simplex cable; the remaining conductor was connected to the track. The other end of the plastic cable was connected to the 24-foot, 2-conductor, No. 10 trailing cable on the hoist. After making the power connections, the hoist was moved by its own power and hoist rope from No. 5 entry and through the

crosscuts to No. 2 entry where it was left to be moved to the drill at a later date. Since the hoist was not equipped with a power-control switch, power to the hoist on July 25, 1967, was controlled by connecting and disconnecting (nipping) one of the power wires to the trolley wire. Risner stated that Titlow made tests for gas with a permissible flame safety lamp while they were moving the hoist to No. 2 entry. No work was done in 8 right on July 26.

Webb stated that during a telephone conversation with Titlow at 9:30 p.m., July 27, concerning moving the hoist toward the drill in 8 right, he instructed Titlow to take three rolls of brattice cloth with him to establish ventilation in No. 2 entry by erecting brattice-cloth stoppings across Nos. 5, 4, and 3 entries and in the crosscuts between Nos. 2 and 3 entries to the point where the drill was located; he also stated that he instructed Titlow to be sure to make tests for gas while he was in 8 right section.

Usual starting time for third shift employees was 11 p.m., except for maintenance men, who started at midnight. At 11 p.m., July 27, the third-shift employees started their usual duties of supply, maintenance, and other related tasks. After completing the necessary work on the surface, William Titlow, general third-shift mine foreman, with Ancil Turner, Shannon Turner, and George Cavins, general laborers, entered the mine at 12:15 a.m., to continue moving the hoist for use in the recovery of the coal drill. Titlow used a tram locomotive and mine car to transport the men to 8 right. The locomotive was then used by James Risner, motorman, to take a trip of loaded cars from the mouth of 8 right to the surface. William Osborne, third-shift maintenance foreman, arrived at 8 right from the surface on a "jitterbug," and, after Risner started to the surface with the trip of loaded cars, Titlow instructed Osborne to take him and the three workmen to the end of the trolley wire in 8 right. After transporting the men into 8 right, Osborne left the section at about 1:30 a.m., and proceeded to the 10 right section. At 2 a.m., Risner returned from the surface and entered 8 left section to recover rails.

At about 3:45 a.m., Risner heard a loud blast followed by a second blast. He got on the locomotive and started toward the mouth of 8 left to determine the cause of the blasts. When he arrived at the mouth of 8 left, Risner discovered smoke on the main haulageway at 8 right. He traveled only a short distance to get through the smoke; however, in doing so the trolley pole on the locomotive came off the wire and was broken against the roof. Risner left the locomotive and continued toward the surface on foot. When he reached the intersection of Open Fork Mains, a distance of about two miles outby 8 right, he tried by telephone to contact someone on the surface. William Whitaker, third-shift mine foreman at the company's nearby No. 4 Mine, was contacted in the No. 4 Mine and was informed of the occurrence by Risner. Whitaker then called Stewart Conley, shop repairman, and instructed him to call Ray Spears, safety director, and Jesse Webb, general mine foreman, to tell them of the occurrence. Spears and Webb arrived at the mine at 5 a.m. After Whitaker arrived at the No. 1 Mine office, he called C. D. Todd, general manager.

Osborne, who was at the 10 right loading point, heard the conversation between Risner and Whitaker on an amplified telephone. He left 10 right on a "jitterbug" and started toward 8 right. Except for encountering some light smoke for a distance of about 150 feet along 10 right haulageway, Osborne did not have any difficulty in traveling to the mouth of 8 right. William Reynolds and Leonard Pack, repairmen, and Vonnie Chaffin and Mermon Penix, general laborers, were in 8 left section when they heard the explosion, and they came to the mouth of 8 left to see what had happened. When Osborne reached the mouth of 8 right, an effort was made by him and other employees in the area to enter the 8 right haulageway; however, they found the 8 right overcast partially blown out, and, due to dense smoke, they traveled only a short distance before returning to the main haulageway. Osborne notified officials on the surface that an explosion had definitely occurred and asked for assistance before continuing the recovery work.

Recovery Operations: After arriving at the mine, Spears checked the main fan and made tests for methane and carbon monoxide with P-2 and Colorimetric detectors, respectively. The fan was operating normally, no smoke was visible, and carbon monoxide and methane were not detected. Shortly after 5 a.m., Spears, Webb, and Whitaker entered the mine on "jitterbugs," and, when they arrived at 8 right, took charge of the recovery operations. All men who had been working inby 8 right were accounted for, and it was decided to erect brattice-cloth stoppings across the main intake entries inby 8 right and outby the damaged overcast in order to provide sufficient ventilation for the recovery work. Spears and a crew of workmen traveled 8 right haulageway (No. 5 entry), and, where necessary, replaced man doors in the concrete-block stoppings between Nos. 5 and 6 entries and erected brattice-cloth stoppings in some of the crosscuts.

Webb and a crew of workmen followed the power wires to the hoist and erected brattice-cloth stoppings across Nos. 5, 4, and 3 entries as they progressed toward No. 2 entry. When Webb got to No. 2 entry shortly after 6 a.m., he saw a light in No. 2 entry about 100 feet inby the crosscut. Although dense smoke was present in the area, Webb used a self-rescuer and crawled to the light where he found the body of Titlow lying on the mine floor facing toward the mouth of the entry. Titlow's cap was found later about 130 feet outby his body. Webb returned to fresh air and notified other rescue workers that he had found Titlow. He instructed one of the crew to notify someone on the surface of the finding. Webb then put on a new self-rescuer and reentered No. 2 entry where he found the bodies of Ancil Turner, George Cavins, and Shannon Turner at points approximately 215, 250, and 315 feet, respectively, inby the body of Titlow. The victims were facing toward the mouth of the entry and had traveled (crawled) a few feet after the explosion occurred, as evidenced by the imprints of knee pads in the settled dust on the mine floor. Recovery of the victims was made shortly after they were found, and the bodies were transported to the surface in mine cars by 8 a.m. Location of the bodies in the explosion area is shown in Appendix B.

No fires were found, and except for the use of self-rescuers, breathing apparatus was not used during recovery operations. Continuous tests for methane and carbon monoxide were made with permissible flame safety lamps, P-2 methane detectors, and Colorimetric carbon monoxide detectors during the recovery work. Traces of carbon monoxide were present in most of the area, particularly in the area where the bodies were found. Very little methane was detected during recovery operations; however, while the bodies were being removed from No. 2 entry, Spears traveled inby the ventilated area for a distance of about 150 feet, and 2 per centum of methane and 0.01 per centum of carbon monoxide were detected in the vicinity.

According to statements by William Whitaker and James Risner, Titlow was carrying a permissible flame safety lamp when he entered the mine. William Osborne also stated that when Titlow and the three workmen got off the "jitterbug" at the end of the wire in 8 right that he (Titlow) took the flame safety lamp, a tool box, knee pads, and a sack containing a lunch off the "jitterbug" and set them on a wooden platform near the end of the wire. The flame safety lamp was not found in the explosion area when the bodies were recovered. Also, searches for the lamp during and following the investigation in all accessible areas in 8 right were to no avail. To date, the flame safety lamp has not been located.

When the investigation was completed, ventilation had been restored in 8 right section and into the Elkhorn No. 1 coalbed; methane or carbon monoxide were not present in detectable amounts; regular examinations of abandoned areas were made and records of the examinations were kept, and a more positive and regular search program was initiated by the company to prevent smokers' articles from being taken underground. A special inspection of the mine was made August 1, 1967. The danger described in the withdrawal Order of July 28, 1967, was found to be totally abated, and the Order was annulled by the Director on August 1, 1967.

INVESTIGATION OF CAUSE OF EXPLOSION

Investigation Committee: The underground investigation of the explosion was started on the day of the occurrence and continued through July 31, 1967. Members of the official investigating committee were:

Princess Coals, Incorporated

Ralph Huffman	President
C. D. Todd	General Manager
Jesse Webb	General Mine Foreman
Ray Spears	Safety Director
William Osborne	Third-Shift Maintenance Foreman
William Whitaker	Third-Shift Mine Foreman, No. 4 Mine
Woodrow Chaffins	Section Foreman

United Mine Workers of America

Noble Hobbs	Field Worker, District 30
Howard Hamilton	Chairman, Safety Committee
Orville Ousley	Member, Safety Committee
Richard Shepherd	Member, Safety Committee

Underwriters Safety and Claims

Warren Mullins	Inspector

Kentucky Department of Mines and Minerals

J. H. Mosgrove	Director, Mining Division
William B. Wright	Principal Inspector
Willard Stanley	District Supervisor
James Sammons	Inspector
James Blevins	Inspector
Clabe Mosley	Inspector
Arnold Turner	Inspector

United States Bureau of Mines

James Westfield	Assistant Director, Coal Mine Safety
J. S. Malesky	District Manager, District C
G. W. Parry	Subdistrict Manager
Ray Ross	Technical Assistant
Raymond Linville	Federal Coal Mine Inspection Supervisor
James P. Begley	Federal Coal Mine Inspector

The Kentucky Department of Mines and Minerals conducted an official hearing in the company's conference room on July 29, 1967. The hearing was headed by J. H. Mosgrove, Director, Mining Division, who was assisted by other State personnel. Mr. Mosgrove invited representatives of Princess Coals, Incorporated, the United Mine Workers of America, Underwriters Safety and Claims, and the Bureau of Mines to participate in the interrogation of any person who might have information concerning events prior to and at the time of the explosion. In addition to those taking part in the investigation, David Francis, Chairman of the Board, Princess Coals, Incorporated, and A. H. Mandt, Commissioner, Kentucky Department of Mines and Minerals were present during the official hearing.

The following personnel of Princess Coals, Incorporated, was interviewed during the hearing:

William Osborne	Third-Shift Maintenance Foreman
Jesse Webb	General Mine Foreman
Ray Spears	Safety Director
William Whitaker	Third-Shift Mine Foreman, No. 4 Mine
James Risner	Motorman

Budge Moore, roof bolter, and Jimmy Joe Gray, general laborer, were interviewed July 31, 1967, by representatives of the investigation committee.

Methane and/or Dust as a Factor in the Explosion: The mine is classed gassy by the Kentucky Department of Mines and Minerals and by the Bureau of Mines, and methane had been detected with a flame safety lamp in the mine. An air sample collected in the main return during the Federal inspection completed December 15, 1966, showed a methane liberation from the mine of 86,000 cubic feet in 24 hours. Air samples collected in face areas of both coalbeds during Federal inspections since 1962 contained from 0 to 0.47 per centum of methane. Methane in concentrations in excess of 4.00 per centum was detected during the investigation on the day of the explosion in an unventilated area about 10 feet inby the entrance to the intake slope extending to the Elkhorn No. 1 coalbed, and an air sample collected in the same area on the following day, and after ventilation had been partially restored, contained 1.44 per centum of methane. The amount of methane found in the explosion area during the investigation increased noticeably as the tests were made toward the slopes to the Elkhorn No. 1 coalbed, and the highest percentages of methane detected were in the slopes.

Coal dust had very little, if any, effect on this explosion. The incombustible content in 21 of the 50 dust samples collected in a survey in 8 right entries after the explosion ranged from 65.2 to 83.6 per centum. The incombustible content in the remaining 29 samples ranged from 30.1 to 63.9 per centum. See Table 3. The dust samples were collected primarily to determine the extent of flame and the presence of coke in the area and were not necessarily representative of mine dust conditions prior to the explosion.

Flame: Evidence of heat and flame, in the form of soot and burned pieces of paper, was present for a distance of about 500 feet inby and outby the point of ignition in No. 2 entry and in parts of Nos. 1, 3, 4, and 5 entries. The exposed parts of the victims' bodies received third-degree burns. The dust samples collected in the explosion area contained small to large amounts of coke. Generally, the dust samples that contained the large amounts of coke were in Nos. 1, 2, 3, and 4 entries at points 620 to 1,220 feet inby the mouth of 8 right entries. See Table 3.

Forces: The explosion forces radiated throughout most of the 8 right section. Several man doors in concrete-block stoppings and brattice-cloth stoppings in crosscuts between the intake and return airways in 8 right were blown out, and the overcast at the mouth of 8 right was partially destroyed. Other evidence of forces was minimal.

Point of Origin: The explosion originated along No. 2 entry, 8 right, in the general vicinity of the hoist and the end of the hoist rope.

Factors Preventing Spread of Explosion: All evidence indicated that the explosion was relatively weak, and the factors that likely caused this to be a weak explosion and inhibited propagation were:

1. The ignition of the methane was in a location surrounded on three sides by worked-out and abandoned areas which permitted expansion of forces and prevented a quick pressure buildup.

2. Rock dust had been applied in the immediate area of the ignition.

3. Dangerous accumulations of coal dust were not present in the area.

4. The accumulated methane was possibly near either the minimum or maximum explosive point.

Summary of Evidence: Conditions observed in the mine during the investigation following the explosion, together with information available from previous Federal coal mine inspection reports and that obtained from a hearing and from company officials, workmen, and the 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 as follows:

1. This was primarily a gas explosion, and very little coal dust entered into the explosion.

2. Presumably, the men in the 8 right section were killed almost instantly.

3. Mining operations in the Elkhorn No. 1 coalbed were discontinued in January 1965, in the 8 right section in Elkhorn No. 3 coalbed in January 1967, and all mining equipment, except a coal drill, hoisting equipment, haulage tracks, and trolley wire had been removed from the section. Except for use as a loaded-car sidetrack, 8 right was considered by company officials to be abandoned.

4. Sufficient ventilation was not maintained in the abandoned 8 right section.

5. A preshift examination was not made in the 8 right section before the men entered the area or before the hoist was taken into No. 2 entry.

6. Weekly examinations were not made regularly in abandoned areas.

7. A cigarette and cigarette lighter (closed) were found alongside the body of the inby victim. Part of a package of cigarettes (5) was found in the middle of the track near the end of the hoist rope and a half-full can of Prince Albert smoking tobacco was found in the same vicinity. No smoking articles were listed among the personal effects found on the victims.

8. Air samples collected in the face areas during previous Federal inspections contained from 0 to 0.47 per centum methane.

9. The flame safety lamp carried by the third-shift foreman could not be located.

10. A rock fall, about 225 feet long, had occurred on 8 right haulageway about 500 feet inby the mouth sometime between January 13 and 18, 1967, and the rock fall prevented recovery of the equipment with locomotives and equipment carriers.

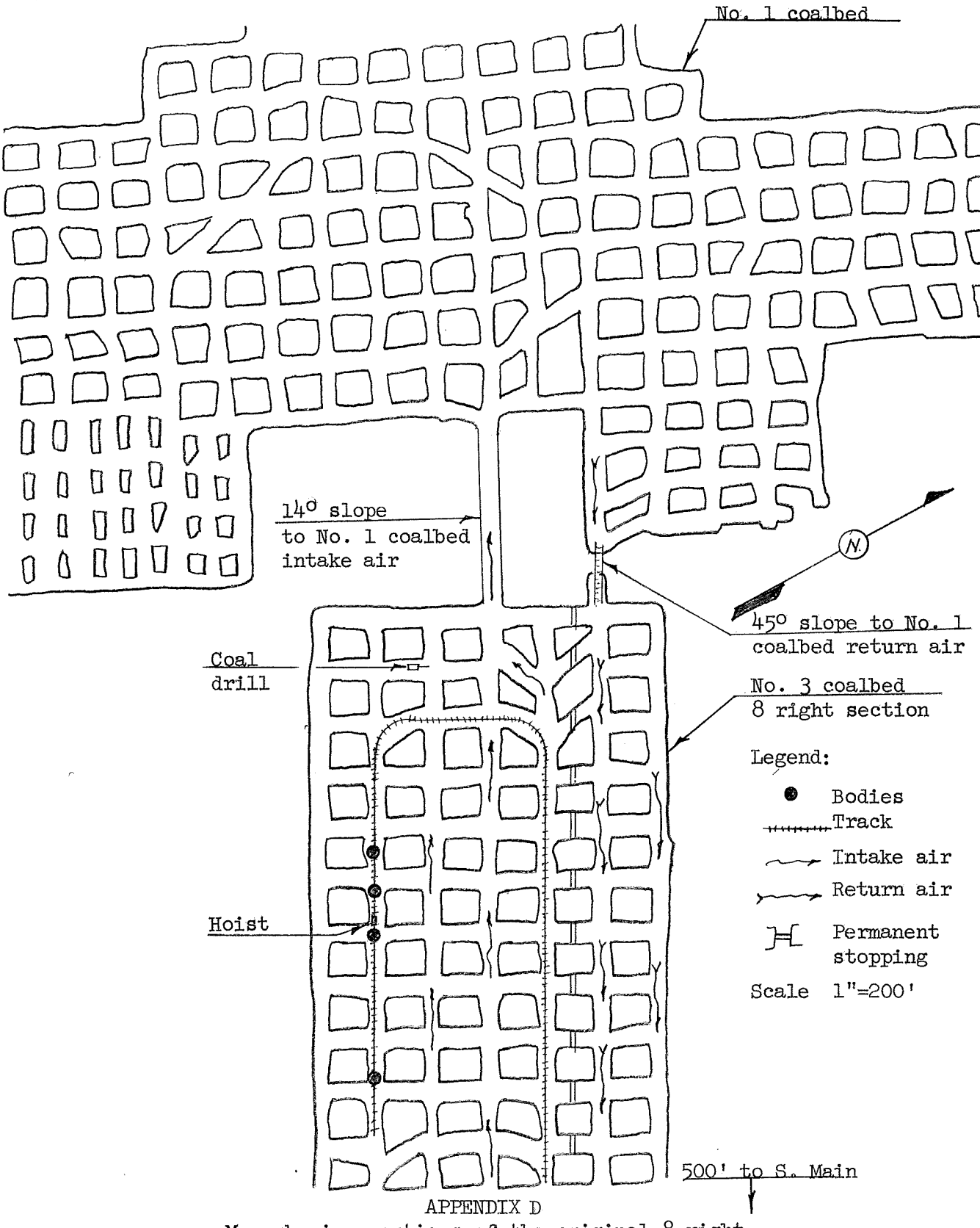
11. Work was in progress to take the hoist, under its own power and by use of the hoist rope, to recover a coal drill in the abandoned 8 right section.

12. The hoist, equipped with an open-type motor, was not provided with a power-control switch, and power to the hoist was controlled on July 25, 1967, by connecting and disconnecting (nipping) one of the power wires to the trolley wire.

13. On July 28, 1967, the power circuit to the hoist was completed by contacting the negative conductor of the hoist against one of the rails of the haulage track in the No. 2 entry. The end of the negative power conductor used to contact the rail and complete the power circuit to the hoist was found open.

14. It could not be determined whether check curtains were erected across any of the entries by the crew assigned to remove the drill.

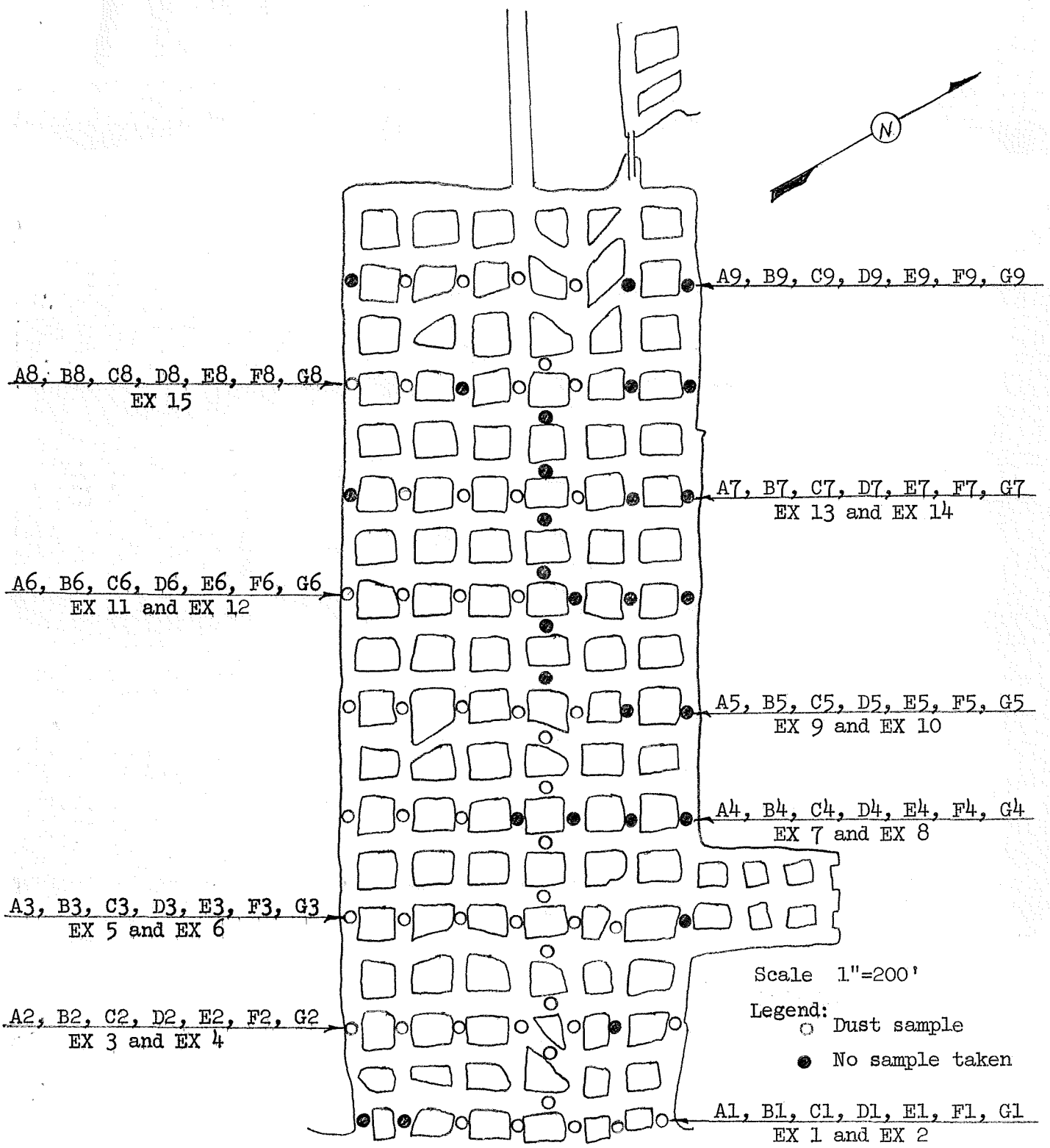
Cause of Explosion: The Federal investigators are of the opinion that the explosion was caused by the ignition of an explosive methane-air mixture in the general vicinity of the hoist and the end of the hoist rope along No. 2 entry, 8 right, by an electric arc or spark, since the hoist, with an open-type motor, was energized by touching the negative power conductor to a track rail, or when a workman attempted to light a cigarette with a cigarette lighter.



APPENDIX D

Map showing portions of the original 8 right (No. 3 coalbed) and a portion of the No. 1 coalbed

NO. 1 MINE
PRINCESS COALS, INCORPORATED,
PRINCESS ELKHORN DIVISION
DAVID, FLOYD COUNTY, KENTUCKY
July 28, 1967



APPENDIX E
Map of 8 right section showing locations
of dust samples collected after the explosion

NO. 1 MINE
PRINCESS COALS, INCORPORATED,
PRINCESS ELKHORN DIVISION
DAVID, FLOYD COUNTY, KENTUCKY
July 28, 1967

ANALYSES OF AIR SAMPLES

TABLE 1 DATE COLLECTED July 29 and 31 and August 1, 196

Elkhorn Division

MINE No. 1 COMPANY Princess Coals, Incorporated, Princess COLLECTED BY Raymond Linville

BOTTLE NO.	LABORATORY NO.	LOCATION IN MINE	PERCENT IN VOLUME					CUBIC FEET AIR PER MINUTE	CUBIC METHAN 24 HO
			CARBON DIOXIDE	OXYGEN	METHANE	CARBON MONOXIDE	NITROGEN		
		EXPLOSION SAMPLES							
H1747	80158	intake at top of slope between Nos. 1 and 3 Elkhorn coal beds	0.42	20.13	0.68	less than 0.01	78.77		
H1709	80159	intake near fall of roof in slope between Nos. 1 and 3 Elkhorn coal beds	0.46	19.90	0.85	0.01	78.78		
G5560	80160	intake in slope 10 feet from top	0.56	19.26	1.44	0.03	78.71		
H922	80161	intake No. 4 entry 8 right at top of slope	0.36	20.67	0.81	none	78.16		
H898	80162	return behind main fan	0.17	20.66	0.07	none	79.10	90,000	91,0
H2335	80163	intake in slope between Nos. 1 and 3 Elkhorn coal beds	0.24	20.85	0.09	0.02	78.80		
H2336	80164	return off slope between Nos. 2 and 3 Elkhorn coal beds	0.16	20.65	0.28	none	78.91		

LAB. NOS. 234241-234292 Sheet No. 1

TABLE 3 ANALYSES OF DUST SAMPLES DATE COLLECTED July 29-31 and August 1, 1967

MINE No. 1 COMPANY Princess Coals, Incorporated, Princess Elkhorn Division COLLECTED BY N. L. Adams

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBI
			EXPLOSION SAMPLES survey area = 8 right off south mains 0 + 0 = centerline No. 6 entry south main No. 1 entry 8 right		
	A1		0 + 30' wet, no sample		
234241	A2	band	0 + 170'	small	68.6
234242	A3	"	0 + 320'	small	63.9
234243	A4	"	0 + 470'	small	65.2
234244	A5	"	0 + 620'	large	73.2
234245	A6	"	0 + 770'	large	40.3
	A7		0 + 920' gob, no sample		
234246	A8	"	0 + 1,070'	large	59.3
	A9		0 + 1,220' gob, no sample		
			No. 2 entry 8 right		
	B1		0 + 30' gob, no sample		
234247	B2	"	0 + 170'	none	54.0*
234248	B3	"	0 + 320'	small	39.6
234249	B4	"	0 + 470'	small	49.0
234250	B5	"	0 + 620'	large	77.1
234251	B6	"	0 + 770'	small	78.3
234252	B7	"	0 + 920'	trace	66.0*
234253	B8	"	0 + 1,070'	large	71.6
234254	B9	"	0 + 1,220'	small	72.9
			No. 3 entry 8 right		
234255	C1	"	0 + 30'	none	60.3
234256	C2	"	0 + 170'	none	42.0*
234257	C3	"	0 + 320'	trace	65.5*
234258	C4	"	0 + 470'	large	51.9
234259	C5	"	0 + 620'	large	51.2
234260	C6	"	0 + 770'	large	47.3

LAB. NOS. 234241-234292 Sheet No. 2

TABLE 3 ANALYSES OF DUST SAMPLES DATE COLLECTED July 29-31 and August 1, 1967

MINE No. 1 COMPANY Princess Coals, Incorporated, Elkhorn Division, Princess COLLECTED BY N. L. Adams

LAB NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBI
234261	C7	band	0 + 920'	large	47.5
	C8		0 + 1,070' gob, no sample		
234262	C9	"	0 + 1,220'	very large	53.7
			No. 4 entry 8 right		
234263	D1	"	0 + 30'	trace	38.0*
234264	D2	"	0 + 170'	none	54.0*
234265	D3	"	0 + 320'	trace	35.0*
	D4	"	0 + 470' lost in transit		
234266	D5	"	0 + 620'	small	30.1
234267	D6	"	0 + 770'	small	43.9
234268	D7	"	0 + 920'	large	46.2
234269	D8	"	0 + 1,070'	large	37.4
234270	D9	"	0 + 1,220'	large	51.7
			No. 5 entry 8 right		
234271	E1	"	0 + 30'	trace	50.0*
234272	EX1	"	left crosscut No. 5 entry	none	55.5
234273	EX2	"	left crosscut No. 5 entry	none	57.0
234274	E2	"	0 + 170'	trace	70.0*
234275	EX3	"	left crosscut No. 5 entry	none	56.8
234276	EX4	"	left crosscut No. 5 entry	none	60.0
234277	E3	"	0 + 330'	none	78.5*
234278	EX5	"	left crosscut No. 5 entry	none	83.5*
234279	EX6	"	left crosscut No. 5 entry	trace	82.0*
234280	E4	"	0 + 470' coke test only	none	
234281	EX7	"	left crosscut No. 5 entry	none	78.5*
234282	EX8	"	left crosscut No. 5 entry	small	67.4
234283	E5	"	0 + 620'	trace	76.0*
	EX9		fall, no sample		
	EX10		same		
	E6		same		

TABLE 3 ANALYSES OF DUST SAMPLES DATE COLLECTED July 29-31 and August 1, 1967

MINE No. 1 COMPANY Princess Coals, Incorporated, Princess Elkhorn Division COLLECTED BY N. L. Adams

LAB. NO.	CAN NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBL
	EX11		gob, no sample		
	EX12		same		
234284	E7	band	0 + 920'	small	83.6
	EX13		gob, no sample		
	EX14		same		
234285	E8	"	0 + 1,070'	small	82.9
234286	EX15	"	left crosscut No. 5 entry	large	66.9
234287	E9	"	0 + 1,220'	large	80.6
			No. 6 entry 8 right		
234288	F1	"	0 + 30'	none	77.0*
234289	F2	"	0 + 170' coke test only	none	
234290	F3	"	0 + 320'	none	76.0*
	F4		0 + 470' pillared area, no sample		
	F5		0 + 625' same		
	F6		0 + 770' same		
	F7		0 + 920' same		
	F8		0 + 1,070' wet, no sample		
	F9		0 + 1,220' same		
			No. 7 entry 8 right		
234291	G1	"	0 + 30'	none	60.7
234292	G2	"	0 + 170'	none	37.5*
	G3		0 + 320' lost in transit		
	G4		0 + 470' pillared area, no sample		
	G5		0 + 620' same		
	G6		0 + 770' same		
	G7		0 + 920' same		
	G8		0 + 1,070' wet, no sample		
	G9		0 + 1,220' same		

*By Volumeter

RECOMMENDATIONS

The following recommendations are made to prevent similar occurrences:

1. A thorough examination for gas and other dangerous conditions by a certified foreman or fire boss shall be made in idle, abandoned, or similar areas in gassy mines, immediately before other employees are permitted to enter or work in such areas.

2. Abandoned or idle areas shall be effectively ventilated or sealed, and, if ventilated, they shall be examined regularly and a record of the examination kept.

3. When the volume of air being circulated through a section of a mine is reduced for any reason, sufficient examinations and air readings should be made to ascertain that all affected areas are adequately and effectively ventilated.

4. Smoking and the carrying of smokers' articles underground in this gassy mine shall be prohibited, and a more positive and more frequent search program shall be put in effect.

5. Rock dust shall be distributed upon the roof, ribs, and floor and maintained in such quantity that the incombustible content of the combined rock dust, coal dust, and other dust will not be less than 65 per centum, plus 1 per centum for each 0.1 per centum of methane in the ventilating current.

6. Electric equipment should be provided with switches of safe design and construction.

7. Power wires to electric equipment should have adequate carrying capacity.

8. Explosives and detonators should be stored in section boxes or magazines, and they should be removed when sections are abandoned.

9. A suitable checking system that will provide positive identification upon the person of every individual underground should be put into effect.

10. The pressure-recording gage for the main fan should be maintained in operating condition.

ACKNOWLEDGMENT

The writers gratefully acknowledge the courtesies, cooperation and assistance extended by officials and employees of Princess Coals,

Incorporated, the Kentucky Department of Mines and Minerals, the United Mine Workers of America, and the representative of Underwriters Safety and Claims.

Respectfully submitted,

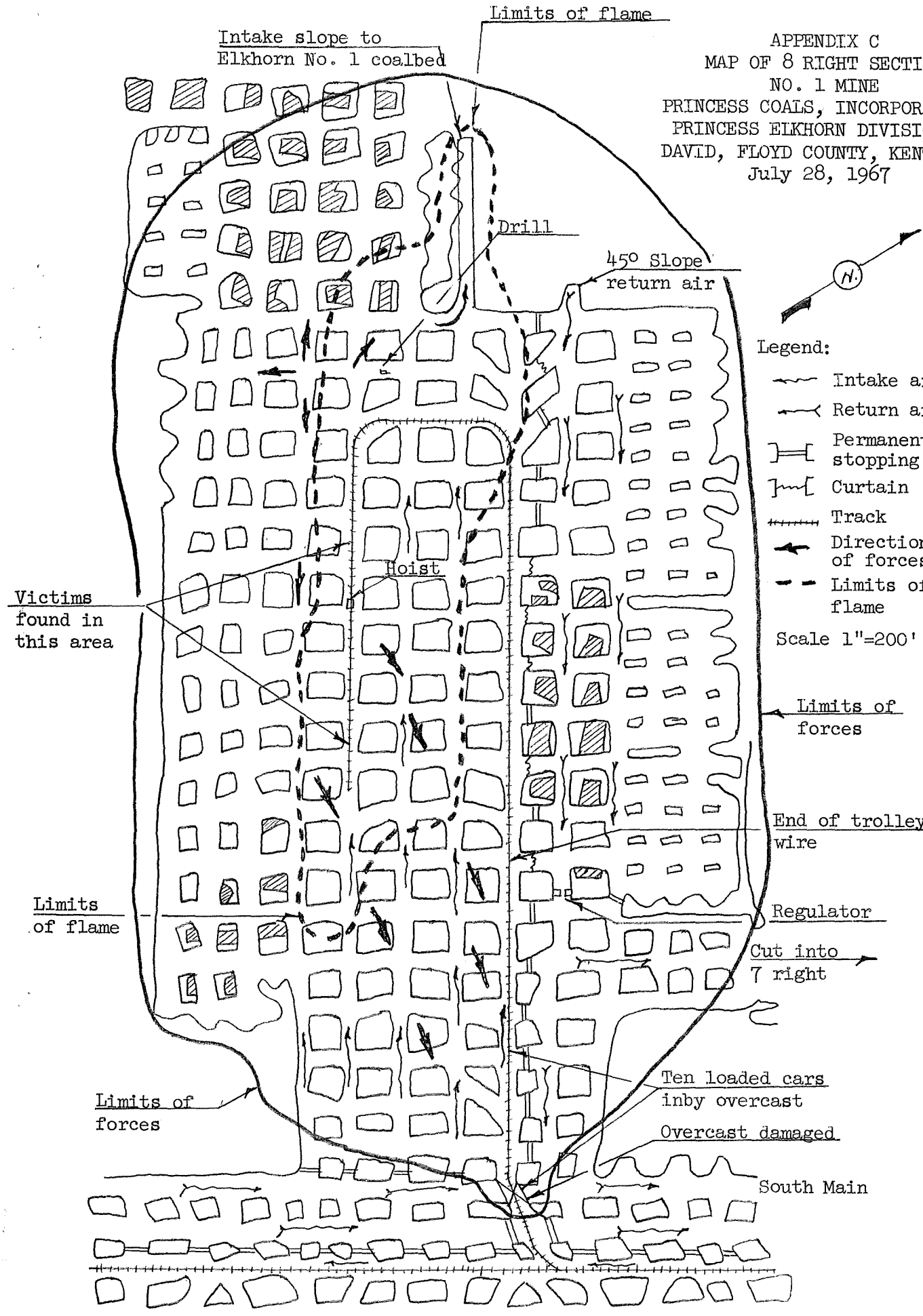
/s/ Raymond Linville
Raymond Linville

/s/ James P. Begley
James P. Begley

Approved by:

G. W. Parry
Subdistrict Manager

APPENDIX C
MAP OF 8 RIGHT SECTION
NO. 1 MINE
PRINCESS COALS, INCORPORATED,
PRINCESS ELKHORN DIVISION
DAVID, FLOYD COUNTY, KENTUCKY
July 28, 1967



APPENDIX A

VICTIMS OF MINE EXPLOSION, NO. 1 MINE

PRINCESS COALS, INCORPORATED, PRINCESS ELKHORN DIVISION

July 28, 1967

Name	Age	Number of Dependents	Occupation	Mining Experience
William B. Titlow	56	2	General Third-Shift Mine Foreman	38 years
Ancil Turner	37	4	General Laborer	8 years
George Cavins	56	3	General Laborer	30 years
Shannon Turner	46	1	General Laborer	18 years

APPENDIX B
MAP OF EXPLOSION AREA
NO. 1 MINE
PRINCESS COALS, INCORPORATED
PRINCESS ELKHORN DIVISION
DAVID, FLOYD COUNTY, KENTUCKY
July 28, 1967