UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DISTRICT C

FINAL REPORT OF MAJOR MINE EXPLOSION DISASTER
NO. 31 MINE
POCAHONTAS FUEL COMPANY, INCORPORATED
McDOWELL COUNTY, WEST VIRGINIA
(Near Amonate, Tazewell County, Virginia)

December 27, 1957

By

William R. Park
District Supervisor

Edward M. Lewis
Federal Coal-Mine Inspector

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Originating Office - Bureau of Mines
Mount Hope, West Virginia
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Health and Safety District C

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INTRODUCTION

An explosion occurred in the No. 31 mine of the Pocahontas Fuel Company, Incorporated, near Amonate, Tazewell County, Virginia, about 6:35 p.m., Friday, December 27, 1957. Eleven men were killed by the explosion; all died from burns and/or forces. None of the other 147 men in the mine at the time of the explosion was injured; however, 14 men, including a foreman, were entrapped when forces of the explosion destroyed the section ventilation facilities (stoppings and an overcast). The 14 men erected a barricade in 2 right off Q left headings and remained behind the barricade until they were rescued about 4 hours later (12:00 midnight December 27) by a recovery crew; these men were in good physical condition when rescued.

The names of the victims, their ages, marital status, occupations, and the number of their dependents are listed in Appendix A of this report.

Bureau of Mines investigators believe that the explosion originated in No. 4 entry of Q left airways when an explosive mixture of methane-air was ignited by an electric arc or spark from the face electric equipment or a power conductor. Forces of the explosion extended throughout the Q left airways to the junction of Q left airways and Q left headings and then spread right and left at the Q junction and were dissipated as they traveled right toward the man shaft and left toward the faces of Q left headings.

GENERAL INFORMATION

The No. 31 mine of the Pocahontas Fuel Company, Incorporated, is in McDowell County, West Virginia, near Amonate, Virginia, and it is served by the Norfolk and Western Railway Company. The operating officials of the Pocahontas Fuel Company, Incorporated, on December 27, 1957, were:

A. R. Matthews	President	Pittsburgh, Pennsylvania
A. V. Sproles	Executive Vice President	Pocahontas, Virginia
P. P. Ferretti	Vice President-Operations	Pocahontas, Virginia
J. W. Pero	Assistant Vice President	Bluefield, Virginia
I. M. Sampson	General Superintendent	Pocahontas, Virginia
M. E. Hall	Assistant General Superintendent	Pocahontas, Virginia
W. J. Skewes	Chief Engineer	Pocahontas, Virginia
Louis Roncaglione	Director of Safety and Mine Inspection	Pocahontas, Virginia
G. L. Asbury	Division Superintendent	Pocahontas, Virginia
P. R. Williams	Superintendent	Amonate, Virginia
J. H. Johnson	Assistant Superintendent	Amonate, Virginia
Walter Beene	Mine Inspector	Amonate, Virginia
Earl Parker	Mine Foreman	Amonate, Virginia

A total of 754 men was employed; 118 on the surface and 636 underground, 3 shifts a day, and produced an average of 6,500 tons of coal daily. Production for the first 11 months of 1957 was 1,427,879 tons of coal. The last Federal inspection of this mine prior to the disaster was made September 30, October 9-11, 14, and 16-18, 1957. Access into the mine was by several drifts and 2 concrete-lined shafts, 265 and 530 feet in depth, into the Pocahontas No. 4 coal bed, which averaged 78 inches in thickness in the areas being mined and dipped to the southwest an average of about 15 percent.

The immediate roof is generally stratified sandstone, 2 feet or more in thickness; however, at a few locations the coal bed is overlain by 1 to 18 inches of shale. The shale and sandstone were of such a nature that artificial roof support was required. Cover over the coal bed ranges from a few feet to 1,000 feet in thickness. The floor is fire clay or shale. The analysis of a coal sample from the Pocahontas No. 4 coal bed in this mine as obtained from Technical Paper No. 626, Analysis of West Virginia Coals, published by the United States Bureau of Mines, is as follows:

	Percent
Moisture	1.6
Volatile Matter	23.2
Fixed Carbon	69.3
Ash	5.9
	100.0

Numerous tests by the Bureau of Mines have shown that coal dust having a volatile ratio of 0.12 is explosive and that the explosibility increases with an increase in the volatile ratio. The volatile ratio of the coal in this mine as determined from the aforementioned analysis is 0.25, indicating that the dust from this coal is explosive.

There is no record of an explosion having occurred in the No. 31 mine prior to December 27, 1957. Major mine explosions that have occurred in nearby mines include:

Mine	Date	Location	Lives Lost
Algoma No. 7	September 15, 1902	Algoma, W. Va.	17
Grapevine	February 26, 1905	Wilcoe, W. Va.	7
Tidewater	July 5, 1905	Vivian, W. Va.	5
Tidewater	November 4, 1905	Vivian, W. Va.	7
Standard	August 1, 1911	Welch, W. Va.	6
Bottom Creek	November 18, 1911	Vivian, W. Va.	18
King	March 28, 1916	Kimball, W. Va.	10
Carswell	July 18, 1919	Kimball, W. Va.	7
Shannon Branch No. 3	May 13, 1927	Capels, W. Va.	8
Keystone No. 2	April 2, 1928	Keystone, W. Va.	8
No. 1	January 10, 1940	Bartley, W. Va.	91
Carswell	January 22, 1941	Carswell, W. Va.	6
Havaco No. 9	January 15, 1946	Havaco, W. Va.	15
No. 34	February 4, 1957	Near Bishop, Va.	37

MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods. An entry-and-block system of mining was followed. Multiple entries, in sets of 5 to 7 and turned at various intervals, were driven 18 feet wide on 75- or 80-foot centers, and crosscuts were turned on 75- or 80-foot centers. Pillars were recovered by an open-end method and pillar lifts were about 23 feet in width. A high percentage of coal was recovered in this mine.

Bolts were used for roof support in all areas of the mine, except in pillar lifts where the minimum standards for roof support required that a double row of posts be set on the open side and at least 1 row of posts be set on the pillar side. Posts were required to be set on 4-foot centers and to within 4 feet of the faces. Breaker posts were set in the pillar sections, and the roof-support plan required that additional supports be provided where needed. Coal was bottom cut in solid work, where feasible, and top cut in pillar work. The cuts, sheared vertically off center, averaged about 8 feet in depth. The cuts and shears were made with rubber-tired mining machines. Eleven sections were operated daily and an extra continuous miner section and an extra Joy loading machine section were

maintained for operation while equipment was inspected and repaired and other work done on an idled section. This procedure caused each section to be idle for a day periodically. There were 9 sections operated with conventional loaders and 4 sections operated with continuous miners. Faults were encountered frequently and excessive grades were common in this mine.

Explosives and Blasting. Permissible explosives were used for blasting, and the blasting supplies were transported underground in specially constructed cars and stored temporarily in suitable section boxes. Incombustible stemming was used. Three top and three bottom holes were drilled for blasting in each cut. All shot holes were charged and then fired, usually two at a time, by means of permissible multiple-shot blasting devices. Designated shot firers charged and fired the shot holes. During the last Federal inspection, suitable examinations for methane were made before and after blasting.

Ventilation and Gases. Ventilation was induced by 3 electrically driven axial-flow fans, operating exhausting and circulating through the mine approximately 633,000 cubic feet of air a minute. A spare fan was provided at the Johnny Branch shaft. Each fan was operated continuously, installed in a fireproof structure on the surface, offset from its mine opening, provided with explosion doors, a recording pressure gage, and a device to give alarm should the fan slow down or stop. Overcasts and permanent stoppings were constructed of incombustible material. Temporary stoppings were constructed of lumber and/or brattice cloth. Check curtains and line brattice were used to conduct air in the face regions. Ventilation doors were not installed in the mine. Each set of entries (section) was ventilated with a separate split of intake air; however, in the Q left headings, Beech Fork entries, and M entries, intake air was coursed through the center entries of each set, split right and left near the faces, and returned by way of the outside entries. The quantities of air reaching the last open entry crosscuts and the intake ends of pillar lines during the October 1957 Federal inspection ranged from 6,600 to 31,000 cubic feet a minute.

The following air measurements and methane determinations were made during the October 1957 Federal inspection:

Location	Volume of air, c.f.m.	Methane, percent	Cubic Feet of Methane in 24 Hours
Main return, No. 3 airway Dunford shaft	152,000	0.25	547,200
Main return, No. 2 airway Dunford shaft	170,000	0.44	1,077,120

Location	Volume of air, c.f.m.	Methane, percent	Cubic Feet of Methane in 24 Hours
Main return, No. 2 airway Johnny Branch shaft	46,000	0.16	105,984
Main return, No. 1 airway Johnny Branch shaft	47,000	0.04	27,072
Main return, No. 3 airway Johnny Branch shaft	86,000	0.23	284,832
Immediate return, No. 5 heading - P-2 section	25,000	0.07	25,200
Immediate return, No. 1 heading - Shaft entries	26,000	0.06	22,464
Immediate return, No. 7 heading - Q headings	31,000	0.87	388,368
Immediate return, No. 3 heading - K section	16,000	0.32	73,728
Immediate return, No. 3 heading - M section	15,000	0.71	153,360
Immediate return, No. 5 heading - Beech Fork section	14,000	0.64	129,024
Immediate return, No. 1 heading - Beech Fork section	15,000	0.54	116,640
Immediate return, No. 7 heading - O section	25,000	0.07	25,200

According to measurements made by the section foreman December 27, 1957, the quantity of air in the immediate return of Q left airways was 32,400 cubic feet a minute.

The mine is classed gassy by the West Virginia Department of Mines and by the Bureau of Mines. During the October 1957 Federal inspection, the mine was liberating methane at a calculated rate of 2,824,416 cubic feet in 24 hours. Fire bosses made preshift examinations for gas and other hazards for the 12:00 to 8:00 a.m., shifts; other preshift examinations for succeeding shifts were made on shift by the section

foremen during their regular tour of duty. The regular fire bosses examine the entire mine once during each 24-hour period. Employees testified that sufficient gas to necessitate shutting down the electric equipment was encountered one or more times daily after December 5 in the Q left airways. However, the fire boss' record books showed that they detected gas only three times in Q left airways during the period from December 5 to 27, 1957.

Each section foreman completes a production and delay record daily; this record for the Q left airways on the 8:00 a.m., to 4:00 p.m., shift December 9, 1957, contains the following delay: "1:30 to 1:50 p.m., 20-minute delay, gas had to clear up, clean out water sprays." On the same shift, December 23, 1957, the following delay was reported: "9:20 to 9:45 a.m., 25-minute delay, put oil in miner-repair canvas stopping (gas)."

On-shift examinations for gas and other hazards were made by section foremen, assistant foremen, and the mine foreman, but records of such on-shift examinations were generally not made. In most instances, records were not made to show how hazards reported by the preshift examiners were corrected, and occasionally the fire bosses did not record the exact location where gas was detected.

Operators of electrical face equipment were instructed to make suitable tests for gas before such equipment was taken to the working faces and frequently while the equipment was being operated at the faces. The cutting-machine operators were instructed to test for gas before taking the machines to the working faces, after cutting two-thirds of the distance across faces or at least every 15 minutes, whichever occurred first, and after completion of the cuts. Continuous-miner operators were instructed to test for gas every 15 minutes or oftener if necessary. Loading-machine operators were instructed to test for gas before the machines were taken to the faces and at intervals not to exceed 30 minutes. However, during the October Federal inspection, tests for methane were not made before electrically driven equipment was taken into the face regions of No. 3 heading off No. 7 heading Q left section, left side, or in No. 5 heading Beech Fork section, and frequent examinations for methane were not made during drilling operations in P-1 main heading.

The section foreman, fire boss, and continuous-miner operator in the Q left airways section had flame safety lamps at the time of the explosion. The three lamps were sent to the Bureau of Mines laboratories in Pittsburgh, Pennsylvania, for testing and examination. These tests showed that the three lamps were in permissible condition, and they did not ignite methane in any of the 25 tests made.

Coal and Rock Dust. The following information was obtained from the October 1957 Federal inspection report: The mine was dry, except for accumulations of water in some of the working places in the Q and P headings.

Water was used to allay dust during cutting and loading operations, including dust made by the continuous miners. Excessive accumulations of coal dust and loose coal were present at several locations, but this loose coal and coal dust was removed from the mine before the close of the inspection. Excessive coal dust was not in the air during the various mining operations. Rock dust was applied in several areas during the inspection, and the rock-dust applications were maintained to within 40 feet of the faces, including all open crosscuts, at the close of the inspection. The back entries, haulage entries, and the intake airways connected by open crosscuts to main haulageways were rock-dusted adequately. The incombustible content of the 12 dust samples collected from rock-dusted areas during the inspection ranged from 80.0 to 97.0 percent.

According to the superintendent, the loading-machine operators' helpers were required to shovel any loose coal and dust from along the ribs to the middle of the places so that the material could be loaded by machines. If loading operations were delayed or interrupted, all of the men available on the section were required to clean up loose coal and dust. In loading-machine sections, rock dust was to be maintained to within 40 feet of the faces, including the last open crosscuts. In continuous miner places, the surfaces of the places were to be kept wetted to the last application of rock dust and when the miners had been moved out of the places the places were to be cleaned up and rock-dusted to within 15 feet of the faces. Four 50-pound bags of rock dust, or more if needed, were to be distributed by hand in the area for each cut of coal removed. Generalized rock-dusting was done by machines on week-ends, during idle periods, and in some cases by portable rock-dusting machines between shifts. Company records show that 4,166 tons of rock dust were applied, and 1,427,879 tons of coal were produced during the first 11 months of 1957; this amounts to about 6 pounds of rock dust used per ton of coal produced.

After the explosion, examination of the Q left airways and the Q left headings revealed that the sections were covered with a layer of coal dust and/or soot. This layer of dust was thickest in Q left airways and progressively became thinner as the explosion forces were dissipated in traveling into Q left headings and Q entries. Evidence that the areas had been rock-dusted was apparent throughout the sections, and excessive accumulations of coal dust were observed only in the face regions inby the haulage loops and in several other scattered locations.

Rock-dusting of the areas was the principal factor in preventing further spread of the explosion, and during the investigation 119 samples of the mine dust were collected in the areas affected by the explosion forces (see Table 2). Only 21 of the 119 samples contained more than 65 percent incombustibles, and the samples with sufficient incombustibles were collected generally in fringe areas where the explosion forces were weakest. None of the 35 samples collected in Q left airways contained

60 percent incombustibles, and only 8 of these 35 samples contained more than 50 percent incombustibles. Twenty-one of the 84 samples collected in Q entries and Q left headings contained more than 65 percent incombustibles and 26 additional samples in these areas contained more than 50 percent incombustibles. The remaining 37 samples collected contained less than 40 percent incombustibles; however, the dust samples collected were not representative of mine dust conditions prior to the explosion, as coal dust thrown into suspension and deposited on rock-dusted surfaces decreased the incombustible content.

Transportation. Permissible-type cable-reel shuttle cars were used for face haulage; they discharged the coal directly into 6-1/2-ton capacity mine cars or onto belt conveyors which discharged the coal into the cars. The cars were hauled by trolley locomotives to the surface. The rolling equipment was maintained in reasonably good repair. The tracks were well maintained and the clearance space along the haulageways was free of obstructions. Shelter holes were provided at 80-foot intervals, and shelter holes or more than 6 feet of clearance was provided at switch throws. Men were transported in 12 special self-propelled man-trip cars and in regular mine cars. Special self-propelled cars were provided for transporting a few men at a time, such as officials, inspectors, and repair men.

Electricity. Electric power, 110, 220, 440, 13,200, and 33,000 volts alternating current, was used on the surface; and 110, 440, and 13,200 volts alternating current and 275 volts direct current was used underground. Alternating current was transmitted by armored cables through drill holes from the surface to underground compressor stations, rectifier stations, and a pump room. These stations and pump room were of fireproof construction and were ventilated by separate splits of air. Trolley, feeder, and power wires were installed on insulators and sectionalized with cut-out switches. The electric face equipment was permissible type and was in permissible condition at the close of the October Federal inspection. The trailing cables on the mobile equipment were fire-resistant, and the cables and the mobile electric equipment were provided with overload protection. Temporary splices in size No. 1 or larger cables were made with splicing rings; splices in trailing cables with smaller conductors were made by tying the broken conductors with square knots. Splices were insulated with rubber and friction tape and the conductors were not taped together at the splices. At the close of the October Federal inspection, operators of electrically driven face equipment made suitable tests for gas before taking the equipment into the face regions and at frequent intervals thereafter.

None of the face electric equipment in the Q left airways was in permissible condition when examined by a Federal electrical inspector and company electricians after the explosion. This equipment had major

permissibility deficiencies, any one of which could have ignited an explosive methane-air mixture. At the time of the explosion, 3 pieces of the equipment were in No. 4 entry of Q left airways, the only place being advanced. The face of No. 4 entry was about 75 feet inby the last crosscut, and the miner was at the face. The loading machine was picking up the coal from the floor and loading into a 9 SC shuttle car. The continuous miner had the following major permissibility deficiencies: A bolt missing from the cover on each of the top and bottom contactor compartments and openings in excess of 0.004 inch into each compartment. Other deficiencies on the miner were: Headlight not sealed and locked and the control fuses in the top contactor compartment were shunted by wires connecting the fuse lugs. Major deficiencies in the loading machine were: Openings in excess of 0.004 inch in the tramming control and reset compartments. Other deficiencies were: Locks and seals missing on the left head motor inspection cover and on the left traction motor. The trailing cable had 14 splices. The headlight on the 9 SC shuttle car lacked 1/2 inch of being screwed tight; other deficiencies were: Two inspection covers on the contactor compartment were not locked and sealed, and the trailing cable had 9 splices, 2 of which were bare. A 6 SC shuttle car was in the last open crosscut between Nos. 3 and 4 entries; 2 bolts were missing from the cover to the resistance compartment for the headlight and this compartment and the contactor compartment had openings in excess of 0.004 inch. Other deficiencies on this shuttle car included: Insufficient packing in the gland, the shield on the rear headlight was loose, the trailing cable had 16 splices, and the brake inspection compartment and front headlight were not locked and sealed. The gland for the auxiliary power cable in the control box for the belt headpiece was not packed adequately. The investigators do not believe forces or heat of the explosion were responsible for these deficiencies.

The surfaces of the excessive opening into the top contactor compartment of the continuous miner showed evidence of dust, soot, and smoke. The outer side of the cover plate at the opening had a groove cut in it extending diagonally from the corner of the cover plate. The groove appeared to have been made prior to the explosion and possibly by a gathering arm of a loading machine; this damage to the cover likely was responsible for the excessive opening into the compartment. Employees and officials who were familiar with the operation of the miner stated that it could not be determined definitely by the position of the controls whether the miner was being operated at the time of the explosion. The body of the miner operator was found on the side opposite and about 35 feet outby the controls of the machine. In addition, there was no coal on the conveyor of the miner and the ripper head was about 3 inches from the coal face. Power controls for the loading machine and 9 SC shuttle car and other evidence indicated that this equipment was being operated when the explosion occurred.

During the October Federal inspection, repairs were made and the following equipment was restored to permissible condition: The

continuous miner and Nos. 19 and 20 shuttle cars in Q right section, No. 1 side; the continuous miner in the Dip entries; a shuttle car in Q right, No. 2 side; a shuttle car and a mining machine in the Shaft entries; No. 7 shuttle car in L-5 section; and the loading machine in K section.

Illumination and Smoking. All persons used permissible electric cap lamps for portable illumination underground. Smoking was not permitted or observed underground at the time of the October Federal inspection, and searches for smokers' articles were conducted frequently. The clothes of the victims were examined by the morticians, and no evidence of smoking materials or lighters were found in any of the clothes.

Mine Rescue. A mine-rescue team was not maintained at the mine; however, a fully equipped and trained team was maintained at an affiliated company's McComas mines. Fully equipped and regularly trained mine-rescue teams were also available at the Gary mines of the United States Steel Corporation and at the Berwind mines of the New River and Pocahontas Consolidated Coal Company. Several other mine-rescue teams and a fully equipped State mine-rescue truck were within a 50-mile radius of the mine. Self-rescuers were available for purchase by the underground employees; however, only about 6 employees had purchased self-rescuers. Sufficient escapeways were available from each working section to the surface, and direction signs were posted conspicuously to indicate the escapeways. In addition to the automatic elevator, an emergency stairway was provided in the Dunford shaft. The check-in and check-out system provided positive identification upon the person of each individual underground.

Each cutting machine and continuous miner was equipped with a hand-type fire-extinguishing unit and another unit was kept at the shuttle-car discharge point on each section. Each locomotive was equipped with a fire extinguisher. A fire-extinguishing unit was provided at each compressor station, substation, and at the pump room, and an adequate quantity of rock dust was placed at air-compressor stations, pumps, along belt lines, and at other strategic locations. Water was piped to the faces of all working places and a steel water-tank car of 1,000 gallons capacity, equipped with a high-pressure pump and 300 feet of hose with nozzles, was provided for the mine.

STORY OF EXPLOSION AND RECOVERY OPERATIONS

Participating Organizations. Officials of the several organizations who took part in the direction of the recovery work include: A. V. Sproles, executive vice president, P. P. Ferretti, vice president, and Louis Roncaglione, director of safety and mine inspection, of the operating company; James Leeber, safety engineer, United Mine Workers of America; Crawford L. Wilson, chief, West Virginia Department of Mines; and Marling J. Ankeny, director, and James Westfield, assistant director, Bureau of Mines.

Five mine-rescue teams of the following companies assisted: United States Steel Corporation, American Coal Company of Allegany County, New River and Pocahontas Consolidated Coal Company, and Island Creek Coal Company.

Activities of Bureau of Mines Personnel. Crawford L. Wilson, chief, West Virginia Department of Mines, notified District Supervisor W. R. Park of the explosion about 8:50 p.m., December 27, 1957, and an official of the company advised Federal Inspector Zeleskey of the occurrence about the same time. Park and Zeleskey notified other Bureau of Mines personnel of the occurrence. Inspector Menta arrived at the mine about 11:00 p.m., and Inspectors Zeleskey and Noe arrived at the mine about 11:50 p.m. Inspectors Wiley, Allen, Aspenwall, and Pendergast arrived at the offices and man shaft about 11:30 p.m., and additional Bureau representatives arrived at the mine the next day, December 28, at the following times: McGinity - 1:00 a.m.; Park and Furin - 1:15 a.m.; Vickers, Puskas, and Fumich - 7:00 a.m.; W. B. Michael - 10:00 a.m.; Ankeny, Westfield, and Hock - 10:30 a.m.; and Lewis - 11:45 a.m. Inspectors J. D. Micheal and Ulshafer reported at the mine December 30. Inpsector Menta entered the mine immediately after his arrival, and on arriving at the mine, Zeleskey, Noe, Park, and Furin were briefed regarding the explosion damages and underground activities; after the briefing, these men entered the mine and assisted with the restoring of ventilation in the affected areas and the recovery of the bodies.

The bodies of the 11 victims were recovered at various times during the morning of December 28; the first 2 bodies were found near the trolley locomotive in a crosscut between Nos. 3 and 4 entries of Q left airways. These bodies were removed from the area about 3:00 a.m.; the other 9 bodies were located inby and nearer the faces and all bodies were removed to the surface by 8:00 a.m.

Ankeny, Westfield, Park, Furin, Lewis, Noe, Menta, and Zeleskey assisted with the underground investigation and official hearing to determine the cause of the explosion.

Inspectors Vickers, J. D. Micheal, McGinity, Fumich, Puskas, and Ulshafer participated in the underground investigation and W. B. Michael examined the electrical equipment and circuits in the explosion areas. Inspectors Vickers, Ulshafer, and Menta remained on duty on separate shifts each day in the explosion area; the three inspectors remained at the mine until permanent ventilation was reestablished in the explosion area, January 13, 1958.

Mining Conditions Immediately Prior to the Explosion. The weather on December 27, 1957, varied from fair to cloudy, and the temperature at Bluefield, West Virginia, about 40 miles by air from Amonate, Virginia, ranged from a low of 19 to a high of 54 degrees, Fahrenheit.

Records of barometric pressures taken by the Olga Coal Company, at Coalwood, West Virginia, about 13 miles by air from Amonate, Virginia, on December 26 and 27, 1957, are as follows:

Thursday, December 26, 1957

Time	Barometric Pressure
2:00 a.m.	28.25
4:00 a.m.	28.20
6:00 a.m.	28.15
8:00 a.m.	28.15
10:00 a.m.	28.15
12 Noon	28.15
2:00 p.m.	28.15
4:00 p.m.	28.20
6:00 p.m.	28.25
8:00 p.m.	28.30
10:00 p.m.	28.35
12 Midnight	28.35

Friday, December 27, 1957

Time	Barometric Pressure
2:00 a.m.	28.40
4:00 a.m.	28.40
6:00 a.m.	28.42
8:00 a.m.	28.45
10:00 a.m.	28.45
12 Noon	28.45
2:00 p.m.	28.35
4:00 p.m.	28.30
6:00 p.m.	28.30
8:00 p.m.	28.30
10:00 p.m.	28.30
12 Midnight	28.25

It is believed that the slight change in atmospheric pressure was not a contributing factor in the explosion.

The mine was idle on Tuesday, Wednesday, and Thursday, December 24-26, 1957, except that men (supervisors) entered the mine to check the general mine ventilation and other conditions. The records indicate that each underground working section was fire bossed prior to the beginning of the first shift, 12:00 to 8:00 a.m., December 27, 1957, and all conditions were recorded in the preshift records as normal.

Evidence of Activities and Story of Explosion. At the beginning of the shift (4:00 p.m., to 12:00 midnight) 158 men entered the mine and they were transported in special section man-cars to their respective sections, except that the men working in the Shaft entries section walked from the bottom of the man shaft to their section, a distance of approximately 2,000 feet. Underground employees reached their respective sections without mishap, and all had been in the face regions from 1-1/2 to 2 hours when the explosion occurred. Conditions found after the explosion indicated that coal was being produced in each section in the usual manner.

Marlin Pruitt, section foreman on the 8:00 a.m., to 4:00 p.m., shift, made the preshift examination of the Q left airways section about 2:00 p.m., for the oncoming shift on December 27, 1957; Pruitt reported that he did not detect gas and the air was traveling in its normal course and quantity. Pruitt stated further that he did not detect gas on the section at any time during the shift before the explosion. However, the

ventilation engineer, Robert Gray, detected a small amount of gas at the face of No. 7 entry of Q left airways early in the morning of December 27. This gas was cleared promptly by tightening a check curtain.

Thomas Bailey, assistant night foreman, was traveling in a jeep toward the Q left sections when the explosion occurred; Bailey was on a curve at the mouth of Q entries, about 4,000 feet outby Q left airways, when he was aware of the disturbance. A brakeman about 150 feet outby Bailey reported that he was knocked down by the forces of the explosion. Bailey traveled to a telephone and then notified the mine superintendent, assistant superintendent, and other mine officials that something, most likely an explosion, had occurred underground. Bailey and others contacted by telephone all underground working sections except Q left airways and Q left headings. All men contacted were advised that an explosion had occurred and that they were to proceed to the surface. These men, a total of 133, were in areas of the mine unaffected by the explosion and, consequently, were uninjured and returned to the surface unassisted. Bailey and several others traveled to the man shaft and thence to the surface, where plans were made to examine those parts of the mine where contact by telephone could not be made after the explosion.

A section foreman and 9 men were producing coal in the Q left airways section when the explosion occurred; a fire boss was also in the section. The bodies of the 11 men were found within 35 to 300 feet of the face of No. 4 entry. It is extremely doubtful that any of these men moved more than a few feet after the explosion, and all were apparently performing normal duties in connection with production of coal. The bodies of the 11 men showed that they had been killed immediately by flame and forces of the explosion.

A section foreman and 13 men were performing normal coal-producing duties in the Q left headings section when the explosion occurred. These entry face regions were affected only slightly by the explosion, but telephone lines were blown down and stoppings were blown out, short-circuiting the intake air currents at the intersection of Q left airways and Q left headings, a distance of 2,500 feet outby the working faces of Q left headings.

The section foreman and the other men in the Q left headings section realized that an explosion had occurred, but none of the men knew immediately whether the explosion originated in their section or in other parts of the mine. The foreman was near the cutting-machine crew and roof bolters, and he knew that these men were uninjured. The foreman and several of the employees visited the working faces and found the loading machine in No. 6 entry. After visiting No. 6 entry, the foreman and men were certain that the explosion did not originate in the Q left headings section. Several of the men removed the trailing cable nips from the power source, and they attempted to reach the cut-out switches to deenergize the power circuits, but these men were unable to reach the cut-out switches because of dense

smoke and fumes. These men then returned to the section "dinner hole" and decided they should barricade themselves in 2 right off Q left headings. They procured 2 rolls of brattice cloth and the necessary tools and traveled to 2 right entries, a distance of 500 feet outby the faces of Q left headings. A first barricade consisting of 4 brattice-cloth stoppings was erected near the faces of the idle 2 right entries. A second barricade, consisting of 7 brattice-cloth stoppings, was erected across the Nos. 1, 2, 3, 4, 5, 6, and 7 entries about 200 feet outby the idle faces and outby the first barricade in 2 right entries. The stoppings were made of 4 and 5 layers of brattice cloth. During the erection of the barricades, several men returned to their working places in Q left headings for brattice cloth and for the lighted flame safety lamps left at the faces. The 14 men entered the second barricade and remained therein for approximately 4 hours; they were rescued about 12:00 midnight by a recovery crew. The 14 men showed no ill effects of their imprisonment and all were in good physical condition when rescued. The entrapped victims planned to use the small barricade near the faces of 2 right entries if the air in the outer barricade became contaminated.

The actions that should be taken and the value of barricading in the event men are trapped by a fire or explosion were discussed in detail during company safety meetings and conferences during the 6 months previous to this explosion. During one of the safety meetings, the section foreman trapped in Q left headings had discussed with higher company officials the area where a barricade should be erected if necessary. The location picked as most suitable by all concerned was the area used on the night of the explosion. The entrapped section foreman stated that the discussion on barricading during the safety meetings contributed materially to the actions of the crew after the explosion. The entrapped men deserve the highest commendation for using good judgment in barricading themselves rather than trying to escape from the section. If they had tried to escape by walking from the section to the man shaft they would, unquestionably, have died from the explosion fumes. When the 14 entrapped men were certain that an explosion had occurred in an outby section of the mine, all were agreed that their best chance of survival consisted of barricading themselves until rescued, and all collaborated in the erection of the barricades.

Several days before the explosion, company officials began making plans and arrangements to reduce drastically the daily output and, consequently, the working force at the No. 31 mine. Rumors of the impending layoff of a large number of men at the No. 31 mine spread and had been widely discussed by the mine employees. The rumors concerning a large layoff were confirmed about 5:00 p.m., December 27, 1957, when a notice was posted on the mine bulletin board advising that the following men were laid off at the end of the 4:00 p.m., to 12:00 midnight shift, December 27; the notice contained the names of about 500 men and foremen, the greater part of the working force. Although most of the men affected

were aware that their names would be on the list, there was much discussion and questioning by trolley phone and telephone by men underground to surface employees as to whose names were listed. Work layoffs have demoralizing effects on work habits, and a layoff of this magnitude certainly would have effected the underground employees adversely. Whether the demoralizing effect of the layoff contributed to the conditions that caused the explosion will never be known; however, it is highly probable that the thoughts and actions of the men would have been effected to such an extent that they were less alert.

Company rules require that the boom men on each shift notify the dispatcher located near the bottom of the man shaft when the crews arrive on their respective sections and further notify the dispatcher hourly of the amount of coal loaded and amount expected to be loaded in the next hour. Details regarding unusual delays or anticipated delays are reported to the dispatcher. Shortly before the explosion, the boom man in the Q left airways advised the dispatcher that his crew had loaded nine cars of coal and that loading operations would be slower during the next hour, as the crew had to haul supplies. Company officials mentioned that the Q left airways section was three or four cars behind normal production at the time of the explosion.

Although the boom man in the Q left airways section advised the dispatcher shortly before the explosion that nine cars of coal had been loaded during the shift, examination of the section after the disaster showed that the ninth car of coal had not been loaded completely and this car was under the belt conveyor loading point. Further examination of the section revealed that the needed supplies (crossbars) mentioned by the boom man to the dispatcher had been procured, as this material was in the 6 SC shuttle car in the last crosscut and adjacent to No. 4 entry. The foreman for this section on the shift preceding the explosion stated that such supplies had been left on empty mine cars in the haulage loop and that it was necessary to take a shuttle car through check curtains to procure the supplies. The bodies of the roof bolters and shuttle-car operator were found in the crosscut at the 6 SC shuttle car; these men were the likely face employees who would pick up supplies and the locations of their bodies indicate that the explosion occurred just as they returned to No. 4 entry or immediately thereafter.

The No. 4 entry was the only place in Q left airways section being advanced December 27; normally, coal produced with the continuous miner was discharged onto the floor, picked up with a Joy loading machine, transferred into a shuttle car, thereafter unloaded onto a belt conveyor, and then loaded into regular mine cars (see Appendixes E and F). The face of No. 4 entry had been advanced about 75 feet inby the last crosscut, and the continuous miner was on the left side of the place, but it could not be determined definitely by the position of the controls whether the

miner was being operated when the ignition occurred. There was no coal on the miner conveyor, the ripper head was about 3 inches from the coal face, and the operator's body was found on the side opposite and about 35 feet outby the controls of the machine. Power controls for the loading machine and 9 SC shuttle car indicated that this equipment was being operated, and the conveyor on the loader was full of coal and the shuttle car was nearly loaded when the explosion occurred; the shuttle car was apparently forced or moved outby a short distance and lodged against the corner of the crosscut rib. The body of the loader operator was found near the machine controls, and the shuttle-car operator's body (mechanic) was a few feet outby the controls of the shuttle car. There was no coal on the belt conveyor, and the body of the boom man was near the belt controls. The haulage crew arrived on the section only a short time before the explosion; the bodies of the brakeman and motorman were at the locomotive on the turn into the haulage loop. It is believed that the fire boss rode to the working section with the haulage crew and that he did not have time to examine the face areas; the bodies of the section foreman and the fire boss were found along the conveyor just inby the belt drives.

Evidence of a large quantity of gas having burned in the face regions of Q left airways proves unquestionably that gas accumulated in most of these entries. This gas accumulation could have occurred only as a result of a ventilation interruption or a short-circuiting of the air current from some of the working places. The method of ventilating the area and examination after the explosion indicate that the most logical explanation for such short-circuiting is that the check curtains in No. 3 entry were open for some time previous to the explosion.

During the March 1957 Federal inspection of the mine, the Q left airways section was being operated with a conventional loading machine and accessories. The section was ventilated with a separate split of air; intake air was conducted to the face regions through Nos. 4, 5, 6, and 7 entries and Nos. 1, 2, and 3 entries were used as return airways. Intake air was conducted to No. 7 entry by means of check curtains; thereafter by means of line curtain to the face; and thence progressively to the faces of Nos. 6, 5, 4, 3, 2, and 1 entries. About 1 percent of methane was present in the immediate return (No. 1 entry) during the inspection, and it is an accepted fact that air coursed along solid ribs in the Pocahontas No. 4 coal bed becomes contaminated with methane. Because of the relatively high percentage of methane in the immediate return and the contaminating of the intake air with methane before it reached the first working face, the Federal inspector recommended verbally and in his report of the inspection that the Q left airways section should be ventilated with two splits of intake air. The inspector suggested that intake air be coursed through the three center entries, split right and left near the working faces, and returned through the outside entries. Several days after the inspection was completed, the Q left airways section was abandoned and the face electric equipment was removed, and work had not been resumed in the Q left airways section when the mine was examined by a Federal inspector in June and October 1957.

The analytical results of an air sample collected during the March inspection in intake air in No. 7 entry before the air reached the first working face contained 0.21 percent methane, indicating that the intake air was being contaminated with methane before it reached the first working face. An air sample collected in the immediate return of the split (No. 1 entry) during the same inspection contained 0.94 percent methane in 15,000 cubic feet of air a minute. The analytical results of these air samples were received after the section was temporarily abandoned.

On December 5, 1957, coal production with a continuous miner was resumed in the section. Additional airways had been provided and after several days operation the quantity of air ventilating the section was increased from 15,000 to 32,500 cubic feet a minute, but coursing of the air through the face regions was the same as in March when the section was abandoned temporarily. On the day of the explosion, 9 permanent stoppings had been erected between Nos. 5 and 6 entries, an additional stopping had been partly completed, and cinder blocks had been placed in 2 additional crosscuts. Completion of the 3 aforementioned stoppings and minor changes in check curtains and line brattice would have permitted the Q left airways section to be ventilated with 2 air splits. Local management officials stated during the investigation that the second split in the section was being provided because they planned to move a second continuous miner into the section as soon as the second split of air was provided.

Face employees in the Q left airways section testified during the investigation that the working faces had not been ventilated adequately from the time the section resumed operations until the explosion and that gas was encountered daily from December 5 until the day of the explosion, December 27. These employees stated further that on several occasions sufficient gas had been encountered to necessitate shutting down the face electric equipment for as much as a half-hour. Compressed air was used on at least two occasions to remove gas from a working face. The underground officials differed some with face employees on the adequacy of face ventilation in the Q left airways section, but these foremen agreed that gas had been encountered in the working places frequently and on several occasions in sufficient quantities to necessitate shutting down electric equipment. Officials and employees stated that it was necessary to tighten and/or repair check curtains and/or line brattice before the gas could be cleared from the working face on each occasion.

The explosion destroyed approximately 71 concrete-block stoppings, 1 overcast, 1 regulator, and 5 canvas check curtains. Trolley wire, telephone lines, and a compressed air pipe line were blown down at several locations. A metal cover was blown off the locomotive and a reel of feeder wire was blown outward for approximately 150 feet in the Q left airways. Damage to equipment was negligible.

The explosion resulted in loss of production from the entire mine from December 27 until January 6, when 3 working sections resumed operations. Seven other working sections were ready for operation on January 6, but market conditions did not permit operation of these sections. Permanent ventilation was restored in the 2 affected sections, Q left airways and Q left headings, January 13, 1958, and these sections were cleaned up and rock-dusted, the electric face equipment was restored to permissible condition, and the sections resumed normal coal-producing operations January 23, 1958.

Recovery Operations. Immediately after being notified of the explosion Paul R. Williams, mine superintendent, advised higher company officials of the occurrence and then proceeded to the man-shaft openings. Upon arriving at the man shaft, Williams had the ventilating fans examined; the examination revealed that the fans were apparently not damaged and were operating satisfactorily. When Williams received the information regarding ventilation in the Q left airways and Q left headings, he instructed the recovery crew to explore the area leading to the Q left headings. Exploration in this area quickly revealed stoppings blown out, the first such stoppings were out on the right side of the Q left headings at the intersection of Q left airways. This crew of men erected temporary brattice-cloth stoppings in the crosscuts to restore ventilation and permit travel and exploration into the Q left headings. This procedure was followed and permitted rapid advance into the area where the 14 men were barricaded. After the 14 barricaded men were rescued and sent to the surface, the recovery crew was instructed to proceed into the Q left airways section and to reestablish ventilation by means of temporary brattice-cloth stoppings if they found stoppings blown out. The recovery crews were supplemented by higher company officials and representatives of the West Virginia Department of Mines, United Mine Workers of America, and the Bureau of Mines, each of whom proceeded underground shortly after his arrival at the mine. After the necessary tests were made in the returns at the mouth of the entries, the recovery crews accompanied by 2 mine-rescue teams advanced into the Q left airways. This recovery crew replaced several blown-out stoppings with temporary brattice-cloth stoppings to restore ventilation, permit travel, and establishment of a fresh-air base in No. 3 entry, directly opposite the overcast (see Appendix D). A mine-rescue team, wearing oxygen-breathing apparatus, explored each intake and return entry and crosscut for a distance of about 450 feet inby the fresh-air base. The team then returned to the fresh-air base and reported their findings to the men directing the recovery work. As fires were not encountered, the explored area was cleared of gas by installing check curtains across the Nos. 4, 5, and 6 entries. This procedure was followed as the party advanced toward the faces of the Q left airways. Fresh-air bases were moved inby as rapidly as the areas were explored and cleared of methane. The procedure of reestablishing ventilation only in the explored parts of the Q left airways section lessened the possibility of forcing an explosive mixture of methane-air over an undiscovered fire or fires. Ventilation to the faces of the Q left airways

entries was reestablished and the areas near the faces were examined by 6:00 a.m., December 28. The bodies of the 11 victims were located and removed from the face areas by 7:00 a.m.

Recovery operations in and exploration of the Q left headings were similar to those followed in the Q left airways. Fresh-air bases were established and oxygen-breathing apparatus crews explored each entry and crosscut for a distance of about 450 feet inby the fresh-air base before ventilation was restored in the area.

Company and union representatives and State and Federal inspectors explored the Q left airways and the Q left headings as ventilation was reestablished. Restoring ventilation in these entries was relatively simple, as blown-out stoppings were replaced rapidly with temporary stoppings constructed of brattice cloth.

A crew of men began replacing an overcast and permanent stoppings in the Q left airways and permanent stoppings in Q left headings on December 20, 1957. Additional men began cleaning up and rock-dusting the affected sections January 4, 1958.

On January 13, 1958, 17 days after the explosion, and after ventilation was reestablished essentially as it had been prior to the explosion, an air sample was collected in air returning from the faces in each of the Nos. 2, 3, 4, 5, 6, and 7 entries of Q left airways. The methane content of the air samples collected in these 6 entries ranged from 0.11 to 0.25 percent in 6,100 to 10,900 cubic feet of air a minute, even though coal had not been produced in the area for 17 days, new check curtains and line brattice had been installed, equipment had not passed through checks or line brattice, and more air was reaching the working faces than normally. An air sample was also collected in the immediate split return in No. 1 entry, and the methane content of this sample was 0.18 percent in 26,000 cubic feet of air a minute (see Table 1). These air samples show clearly that large amounts of methane are liberating in the area and the working faces can be kept reasonably clear of gas only when continuous and large volumes of air are sweeping the working faces.

After the aforementioned air samples were collected, two separate splits of intake air were provided to ventilate the Q left airways section. Intake air was coursed through the center entries, split right and left near the faces, and returned through the outside entries. At that time, 21,600 cubic feet of air a minute was measured in the right split, No. 7 entry and 17,300 cubic feet of air a minute was measured in the left split, No. 1 entry. Air samples were collected in the immediate returns; the left and right splits contained 0.08 and 0.10 percent methane, respectively.

INVESTIGATION OF CAUSE OF EXPLOSION

Investigation Committee. The underground investigation of the cause of the explosion was conducted on December 28, 1957, and January 2, 1958. Members of the official investigation committee were:

West Virginia Department of Mines

Crawford L. Wilson	Chief
W. C. Sturgill	Assistant to the Chief
D. J. Lee	Inspector-at-Large
J. A. Philpott	Inspector-at-Large
Norman Ratliff	District Inspector

Pocahontas Fuel Company, Incorporated

P. P. Ferretti	Vice President
J. W. Pero	Assistant Vice President
I. M. Sampson	General Superintendent
M. E. Hall	Assistant General Superintendent
Louis Roncaglione	Director of Safety and Mine Inspection
G. L. Asbury	Division Superintendent
P. R. Williams	Superintendent
R. J. Baugh	Ventilation Engineer

United Mine Workers of America

James Leeber, Jr.	Safety Engineer, District 29
C. H. Phillips	Field Representative, District 29
Thomas Vernon	Safety Committeeman
Walter Beavers	Safety Committeeman
William Duty	Safety Committeeman

United States Bureau of Mines

M. J. Ankeny	Director
James Westfield	Assistant Director--Health and Safety
W. R. Park	District Supervisor
John Zeleskey	Federal Coal-Mine Inspector
Frank Furin	Federal Coal-Mine Inspector
Elwood Menta	Federal Coal-Mine Inspector
George Noe	Federal Coal-Mine Inspector
E. M. Lewis	Federal Coal-Mine Inspector

Many other representatives of the aforementioned organizations participated in the different phases of the underground investigation of the disaster. Bureau of Mines representatives included: Messrs. Vickers, McGinity, Ulshafer, Puskas, Fumich, J. D. Micheal, and W. B. Michael.

Crawford L. Wilson, chief of the West Virginia Department of Mines, conducted an official inquiry and investigation of the explosion by interrogating a number of officials and employees of the company in the mine offices at Amonate, Virginia, December 31, 1957. The purpose of the inquiry was to hear and record all testimony relevant to conditions

and practices in the mine prior to and on December 27, and to determine therefrom, if possible, the cause of the explosion. Some of the information thus obtained is included in this report. Representatives of the operating company, United Mine Workers of America, West Virginia Department of Mines, and Bureau of Mines questioned the officials and employees during the inquiry. The following men represented the several organizations during the inquiry.

West Virginia Department of Mines

Crawford L. Wilson	Chief
L. M. Morris	Assistant Chief

Pocahontas Fuel Company, Incorporated

P. P. Ferretti	Vice President
J. W. Pero	Assistant Vice President

United Mine Workers of America

Charles Ferguson	Safety Director

United States Bureau of Mines

W. R. Park	District Supervisor

Methane as a Factor in the Explosion. The mine is classed gassy by the West Virginia Department of Mines and by the Bureau of Mines, and methane has been detected in the mine on numerous occasions. During the three Federal inspections completed in March, June, and October of 1957, the mine was liberating methane at a calculated rate of 2,209,248, 4,114,984, and 2,824,416 cubic feet, respectively, in 24 hours. During the March 1957 inspection, the immediate return air from the Q left airways section contained 0.94 percent methane in 15,000 cubic feet of air a minute. In March, coal was mined in the Q left airways section with a conventional loading machine and accessories, but the section was abandoned temporarily several days after the inspection was completed. During the October 1957 Federal inspection, the immediate return air from the Q left headings contained 0.87 percent methane in 31,000 cubic feet of air a minute.

The idle Q left airways were reactivated December 5, 1957, and the seven entries were developed with a continuous miner. The plan of developing the section with the continuous miner consisted of: First, advancing No. 1 entry for a distance of 80 feet; next, advancing No. 2 entry 80 feet; and then in turn, advancing Nos. 3, 7, 6, 5, and 4 entries a distance of 80 feet. After each entry, except No. 4, was advanced 80 feet, it was stopped temporarily, and crosscuts were not provided at the faces to connect the entries. When No. 4 entry was advanced 80 feet, the

continuous miner was turned left and connecting crosscuts were made from No. 4 to No. 1 entry; thereafter, the miner was returned to the face of No. 4 entry, turned right, and connecting crosscuts were driven from No. 4 to No. 7 entries (see Appendix F). This method of advancing entries required that each temporarily idle entry be ventilated with line curtain extending 80 to 90 feet from the last open crosscut to near the face. Analyses of air samples collected December 11 and 18, 1957, by company officials in the immediate return of the Q left airways section showed 0.24 and 0.29 percent methane in 24,600 and 32,400 cubic feet of air a minute, respectively.

Testimony of company officials and employees during the investigation indicated that gas was encountered in the working places in Q left airways daily after December 5, and on several occasions sufficient gas was encountered to necessitate shutting down the electric equipment. Officials and face employees in Q left airways differed on the adequacy of face ventilation in the section in December, but all concerned agreed that it was necessary to keep measurable volumes of air sweeping the working faces to keep the faces reasonably clear of methane, and any interruption of face ventilation resulted in gas accumulating at the faces.

It is believed that the air current was short-circuited from the face regions of Nos. 3, 4, 5, 6, and 7 entries of Q left airways shortly before the explosion occurred while normal mining operations were being performed in the section. Lack of adequate ventilation would permit methane to accumulate promptly in these entries. It is conceivable that methane accumulated in these entries with the ventilation facilities (checks and/or line curtain) in need of tightening or repair, and the accumulating methane was ignited before it was detected. However, the more logical conclusion is that the methane accumulation resulted from a direct interruption of the air current, such as a short-circuit caused by the opening, raising, or destroying of a check curtain. It is believed that the short-circuit of the ventilating current occurred when several of the face employees traveled with a shuttle car from No. 4 entry through the inby crosscut to No. 3 entry and thence through two check curtains to the haulage track to procure supplies needed in No. 4 entry. It is possible that the check curtains in No. 3 entry were opened or raised and fastened by the men to permit the shuttle car passage or the canvas checks were destroyed by the shuttle car in traveling through the curtains. Opening, raising, or destroying these check curtains, more than momentarily, would immediately short-circuit the air from the face regions of Nos. 3, 4, 5, 6, and 7 entries and cause gas to accumulate therein, particularly in Nos. 6 and 7 entries. Closing or repairing the check curtains after a ventilation interruption would cause the air current to again flow in its normal course, into No. 7 entry, thence to the faces of Nos. 6, 5, 4, 3, 2, and 1 entries, and methane that had accumulated in Nos. 7, 6, and 5 entries would be forced through No. 4 entry where it was ignited. The aforementioned circumstances would easily permit methane moving in the air

current to be ignited by electric equipment before it could be detected with a flame safety lamp hanging on the equipment. Supplies had been procured from the storage pile near the haulage tracks and were in the shuttle car in the last open crosscut between Nos. 3 and 4 entries when the explosion occurred.

The extensive accumulation of methane in the Q left airways and in the Q left headings following the short-circuiting of ventilation in these sections after the explosion proves clearly that large amounts of methane are liberated in the face regions and from the coal ribs. Six hours after the explosion, 2 to 5 percent of methane was present in all seven of the Q left airways entries about 1,100 feet outby the faces. About 56 hours after the explosion, 2 to more than 5 percent of methane was present in all seven of the Q left headings entries about 1,750 feet outby the faces.

Fragile, globular coke droplets adhering to the roof and ribs, indicative of slow burning gas, were found in nearly every part of the seven Q left airway entries from the loop to the faces. Soot streamers were found on the roof in the inby end of Nos. 1 and 2 entries. The aforementioned evidences of burning gas were not found anywhere else in the explosion area (see Appendix D).

Flame. Evidence of heat or flame, in the form of ashes, coke, soot, or partly burned paper, canvas, and wood, was observed throughout the seven Q left airway entries from the face regions for a distance of approximately 1,400 feet outby. The victims of the explosion, all found within 300 feet of the face of No. 4 entry Q left airways, were burned severely. Evidence of flame was not found anywhere in the affected areas except in Q left airways.

Explosives were not used to blast coal in the Q left airways section, and evidence of explosives having been discharged by forces or flame was not found anywhere in the areas affected by the explosion.

A total of 119 mine dust samples was collected after the explosion in the affected areas (see Table 2 and Appendix D). The results of analysis for incombustible content and tests for coke in the mine dust samples are shown in Table 2. The presence of coke in the mine dust samples is one of the criteria by which extent of the flame was fixed, even though it is possible that such coke in the outby end of the Q left airways may have been blown there. Twenty-eight of the 35 samples collected in the Q left airways contained coke ranging in quantities from traces to very large particles. None of the other 84 samples collected in the affected areas contained coke. Coke that ranged from a fraction of an inch to more than an inch in thickness was plastered on roof bolts, lips of cuts in the roof, on roof-bolted cap pieces, and on other material at many locations in the Q left airways.

Forces. No difficulty was experienced in discerning the direction of forces. Extensive coking and considerable evidence of slow burning gas were on the roof, ribs, and floor in the face regions of Q left airway entries, and the emanation of forces was from these face regions outward to the junction of Q left airways and Q left headings, a distance of about 1,400 feet, then northeast into Q left headings for a distance of about 2,500 feet, and southwest into Q entries for a distance of about 4,000 feet. The covers on the trolley locomotive in the haulage loop in Q left airways were blown south; a reel of feeder wire was carried about 150 feet south of the overcast; and pieces of canvas and other material in the face regions of Q left airways were blown outward (south).

Three concrete-block stoppings installed about 300 feet outby the faces and across Nos. 2, 3, and 6 entries of Q left airways were blown outward (south). All stoppings destroyed between Nos. 1 and 2 and Nos. 3 and 4 entries of Q left airways, except one, were blown west, and all stoppings destroyed, except one, between Nos. 6 and 7 and Nos. 4 and 5 were blown east. Stoppings in the Q left headings were blown south toward the No. 7 entry. Two stoppings installed across the Nos. 1 and 2 Q entries were blown west.

Forces of the explosion dissipated rapidly after reaching the junction of Q left airways and Q left headings. Evidence of extreme violence was not observed at any location in the explosion area.

Probable Point of Origin. The concensus of the Bureau of Mines investigators is that the explosion originated in the face area of No. 4 entry of Q left airway entries.

Factors Preventing Spread of Explosion. The areas affected by the explosion are shown on the mine map (Appendix C). Forces of the explosion extended throughout the Q left airways, into and throughout the greater part of the Q left headings, and into the Q and P entries for a distance of 4,000 feet. Forces subsided rapidly as they spread east and west at the junction of the Q left airways and Q left headings. Evidence of flame was observed only in the Q left airways of the affected areas. The diluting and quenching effect of the rock dust applied was the principal factor in preventing further spread of this explosion. Other factors acting in combination that helped limit the explosion were: The cooling effect of the extensive rib, roof, and floor surfaces of the numerous entries in the path of the explosion; and ample open areas for expansion of forces, resulting in a reduction of flame speed and temperature.

Summary of Evidence. Conditions observed in the mine during recovery operations and the investigation following the disaster, together with information available from previous Federal coal-mine inspection reports and that obtained from company officials, workmen, and mine records,

10. The method of advancing the seven Q left airway entries, progressively driving Nos. 1, 2, 3, 7, 6, 5, and then 4 without connecting crosscuts until No. 4 entry was driven, required the use of more than 500 feet of canvas line curtain to ventilate the faces. Maintaining this amount of line curtain and necessary check curtains reasonably airtight, which was necessary to keep the faces free of methane, required constant vigilance, examination, and repair.

11. The haulage loop in the Q left airways section extended from No. 4 entry left to No. 2 entry and then right to No. 6 entry (a distance of about 300 feet) and then back to No. 4 entry. Installation of the haulage loop crosswise from No. 2 to No. 6 entries because of excessive grades, rather than in the adjacent Nos. 3 and 5 entries paralleling the haulage entry, restricted the number of return entries to one and necessitated the use of two additional temporary check curtains to control the main air current.

12. Dangerous accumulations of coal dust were present at several locations in the face regions of Q left airways, and excessive amounts of fine coal dust were present on the floor inby the overcast in the Nos. 5, 6, and 7 entries of Q left airways after the explosion.

13. Sufficient rock dust was not applied in the face regions inby the loading points in the explosion areas, but rock-dusting outby the loading points was generally adequate, as explosion propagation was stopped by the rock-dust applications.

14. Men whose names were listed on the layoff notice posted about 1-1/2 hours before the explosion occurred were generally aware that they were working their last shift, and the worry and demoralizing effect of their being without work likely caused less alertness on their part to everyday working conditions, practices, and hazards.

Cause of the Explosion. The Federal investigators are of the opinion that the disaster was caused by the ignition of a large quantity of methane that had accumulated in the Nos. 3, 4, 5, 6, and 7 entries of Q left airways during normal mining operations. Gas had accumulated in these working places as a result of short-circuiting of the ventilating current, which occurred when check curtains in No. 3 entry were opened or raised and fastened or destroyed while supplies were being procured from an outby location. The gas was ignited by an electric arc or spark from a piece of face electric equipment in No. 4 entry or from a trailing cable to this equipment. Coal dust in the immediate face areas entered into the explosion and aided in its propagation.

RECOMMENDATIONS

The following recommendations are made to prevent similar disasters:

1. In mines that liberate gas freely, each mechanically loading section being developed in virgin coal with more than four parallel entries should be ventilated with a current of intake air coursed through the center entries, split right and left near the face regions, and returned through the outside entries.

2. The use of check curtains to control main ventilating currents should be held to the absolute minimum, and check curtains in use should be installed and maintained as reasonably airtight as possible.

3. Check curtains should not be deliberately opened or raised and fastened in place under any circumstances. If it is necessary to open or raise a check curtain to permit equipment to pass through, the check curtain should be put back in place as soon as the equipment has passed.

4. When check curtains are torn, destroyed, or impaired to the extent that ventilation to working faces is interrupted, electric power to face electric equipment should be "cut off" immediately; then all working faces and the atmosphere in the open crosscuts nearest the faces should be examined for methane. If gas is detected, the face electric equipment should not be energized until the gas is removed and ventilation restored.

5. Each working face should be ventilated with a current of air that is sufficient in velocity and volume to keep methane from accumulating at the face.

6. Employees should not use compressed air to remove gas from working faces under any circumstances, and officials should not use or permit employees to use compressed air to remove gas from working faces.

7. The company's maintenance program for face electric equipment should be implemented to the extent that such equipment will be kept in permissible condition.

8. Splices in trailing cables should be well insulated, and a program should be established to require that trailing cables containing a fixed number of temporary splices will be removed from the equipment and service until such splices have been vulcanized.

provided evidence as to the cause and the origin of the explosion. The evidence from which the conclusions of the Federal investigators are drawn is summarized as follows:

1. Records of the fire-boss examinations of all working sections list no unusual condition observed during the examinations made several hours before the explosion.

2. The Pocahontas No. 4 coal bed in the area is extremely "gassy," and normal mining operations cause large liberations of methane at working faces. Any interruption of face ventilation during normal coal-producing operations will cause gas to accumulate at the working faces.

3. The crew in the Q left airways section was engaged in the normal production of coal when the explosion occurred.

4. All forces emanated from the face area of No. 4 entry of the Q left airways.

5. The Q left airways section was ventilated with a split of intake air, which was coursed to the face of No. 7 entry and thence progressively through the last open crosscuts to the faces of Nos. 6, 5, 4, 3, 2, and 1 entries and then returned through No. 1 entry.

6. Evidence of a large quantity of gas having burned in the face regions of the Q left airways proves unquestionably that gas had accumulated in most of these entries. This gas accumulation could have occurred only as a result of short-circuiting the air current from these places. The method of ventilating the area and examination after the explosion indicate that the most logical explanation for such short-circuiting is that the check curtains in the No. 3 heading were opened or raised and fastened or were destroyed for some time previous to the explosion.

7. The bodies of the 11 men in the Q left airways crew were found within 35 to 300 feet of the face of No. 4 entry. It is extremely doubtful that any of these men moved more than a few feet after the explosion, and all were apparently performing normal duties in connection with production of coal.

8. All of the face electric equipment in the Q left airways section was in nonpermissible condition when examined after the explosion. Air coursed through three of the temporarily idle entries, of necessity, flowed directly by and over the face electric equipment.

9. Each one of the four pieces of face electric equipment, including two trailing cables, was capable of igniting gas, and no other likely source of ignition was found at or near the point of origin.

9. Where working places in mines that liberate gas freely are advanced with a continuous miner and are then temporarily idled without connecting crosscuts at the faces, such places should be ventilated with an air current that is coursed through the active working place, then through the idled places, and thence directly into the return airways.

10. Examinations for gas in face workings should be made at intervals sufficiently frequent to detect the presence of methane before it reaches dangerous proportions.

11. Foremen should record clearly, in a daily report book provided for that purpose, the location and nature of any danger observed by them or reported to them during the work shift. The report should show what action, if any, was taken to remedy the danger and should also include any action taken to correct hazards reported by fire bosses. Frequent reporting of gas in an area should be investigated by higher officials and remedial action should be taken immediately.

12. Coal dust and loose coal should not be permitted to accumulate in dangerous quantities in any active underground workings.

13. Rock dust should be distributed uniformly on the roof, ribs, and floor and maintained in such quantity that the incombustible content of the combined coal dust, rock dust, and other dust will not be less than 65 percent, plus 1 percent for each 0.1 percent of methane present in the ventilating current.

14. A program and methods whereby adequate rock-dusting can be done in the face regions should be adopted and put into effect immediately.

15. Dust samples should be collected and analyzed periodically to determine the effectiveness of rock-dust applications.

16. Consideration should be given to installing only standard track loops in working sections. Preferably, such loops should be installed in a maximum of three entries, the haulage entry and the adjacent parallel entry on each side of the haulage entry.

17. A self-rescuer should be provided for each person underground, who should be thoroughly instructed as to its safe maintenance, use, and limitations.

ACKNOWLEDGMENT

The writers acknowledge gratefully the courtesies extended and the help given by officials and other members of the United Mine Workers of America, officials and employees of the operating company, and representatives of the West Virginia Department of Mines and the United States Bureau of Mines.

Respectfully submitted,

/s/ William R. Park

William R. Park
District Supervisor

/s/ Edward M. Lewis

Edward M. Lewis
Federal Coal-Mine Inspector

/s/ John Zeleskey

John Zeleskey
Federal Coal-Mine Inspector

Approved by:

/s/ James Westfield

James Westfield
Assistant Director--Health and Safety

/s/ Marling J. Ankeny

Marling J. Ankeny
Director

APPENDIX B

NAMES OF BARRICADED MEN, NO. 31 MINE

POCAHONTAS FUEL COMPANY, INCORPORATED

December 27, 1957

Name	Age	Occupation
Robert F. Buskill	43	Roof Bolter
William Crawford Carico	39	Electrician
Albert Taze Cook	28	Roof Bolter
Herbert Lester Gravely	46	Roof Bolter
Mitchell Harris	28	Shuttle-Car Operator
Reece A. Jackson	56	Mining-Machine Operator
Claude Berten Mutter	45	Shot Firer
Albert Millard Myers	35	Shuttle-Car Operator
Thomas Edward Pruitt	50	Loading-Machine Operator
Ezra Barrett Presley	47	Bratticeman
A. E. Sparks	50	Mining-Machine Operator
George Olbert Sparks	33	Loading-Machine Operator's Helper
Paul Thompson	48	Boom Man
Woodrow Evans	44	Section Foreman

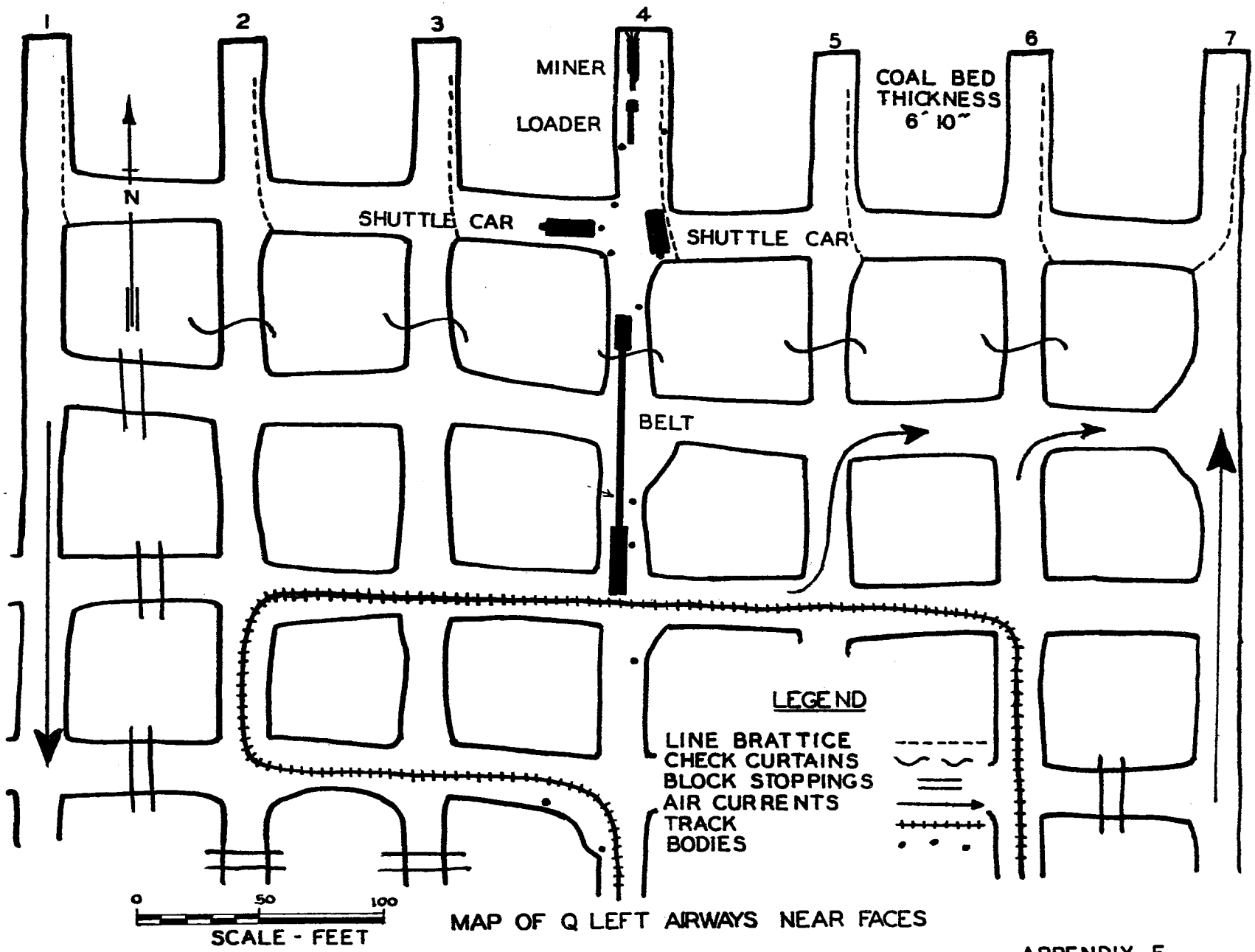
APPENDIX A

VICTIMS OF EXPLOSION, NO. 31 MINE

POCAHONTAS FUEL COMPANY, INCORPORATED

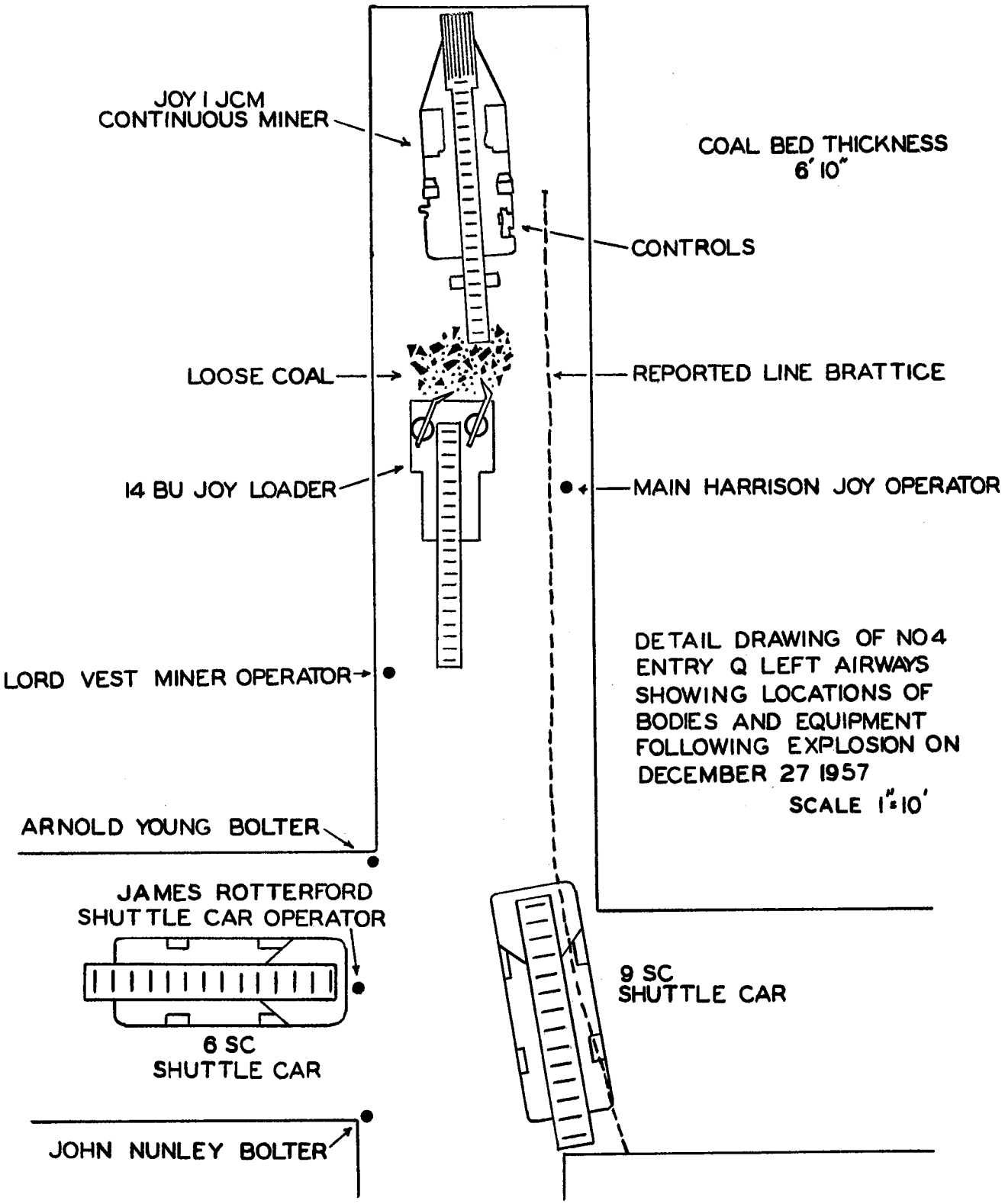
December 27, 1957

Name	Age	Occupation	Marital Status	Number of Dependents
Archie Reece Alicie	32	Brakeman	Married	4
William R. Amos	50	Fire Boss	Married	8
James Chiles	51	Boom Man	Married	3
Howard Fields	37	Section Foreman	Married	3
Main B. Harrison	43	Loading-Machine Operator	Married	6
Gilmer Eugene Monk	26	Electrician	Married	3
John Edmon Nunley	30	Roof Bolter	Married	5
Herman Boyd Perry	50	Motorman	Married	2
James R. Rutherford	28	Loading-Machine Operator's Helper	Married	3
Lloyd E. Vest	36	Miner Operator	Married	4
Arnold W. Young	30	Roof Bolter	Married	6



MAP OF Q LEFT AIRWAYS NEAR FACES

APPENDIX E


JOY 1 JCM
CONTINUOUS MINER
COAL BED THICKNESS
6' 10"
CONTROLS
LOOSE COAL
REPORTED LINE BRATTICE
14 BU JOY LOADER
MAIN HARRISON JOY OPERATOR
LORD VEST MINER OPERATOR
DETAIL DRAWING OF NO4
ENTRY Q LEFT AIRWAYS
SHOWING LOCATIONS OF
BODIES AND EQUIPMENT
FOLLOWING EXPLOSION ON
DECEMBER 27 1957
SCALE 1"=10'
ARNOLD YOUNG BOLTER
JAMES ROTTERFORD
SHUTTLE CAR OPERATOR
9 SC
SHUTTLE CAR
6 SC
SHUTTLE CAR
JOHN NUNLEY BOLTER

APPENDIX F

ANALYSES OF AIR SAMPLES

Table 1

Collected January 1958

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY John Zeleskey

Bottle No.	Laboratory No.	Location in Mine	PERCENT IN VOLUME					Cubic Feet Air Per Minute	Cubic Feet Methane in 24 Hours
			Carbon Dioxide	Oxygen	Methane	Carbon Monoxide	Nitrogen		
0-4598	317477	Air 65 ft. from face No. 4 heading Q left airways between line brattice and rib, return side.	0.10	20.84	0.25		78.81	8,400	30,240
0-4602	317478	Air 72 ft. from face No. 3 heading Q left airways between line brattice and ribs, return side.	0.09	20.85	0.18		78.88	10,920	28,305
0-4610	317479	Immediate return air from split from seven headings in No. 1 heading Q left airways, 97 ft. from face.	0.06	20.82	0.18		78.94	26,000	67,392
P-3323	317480	Air 68 feet from face No. 5 heading Q left airways between line brattice and rib, return side.	0.06	20.87	0.21		78.86	7,280	22,015
P-3325	317481	Air 60 feet from face No. 6 heading Q left airways between line brattice and rib, return side.	0.10	20.79	0.12		78.99	6,090	10,524

ANALYSES OF AIR SAMPLES

Table 1 Cont.

Collected January 1958

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY John Zeleskey

Bottle No.	Laboratory No.	Location in Mine	PERCENT IN VOLUME					Cubic Feet Air Per Minute	Cubic Feet Methane in 24 Hours
			Carbon Dioxide	Oxygen	Methane	Carbon Monoxide	Nitrogen		
P-3334	317482	Air 66 feet from face No. 2 heading Q left airways, between line brattice and rib, return side.	0.08	20.85	0.20		78.87	9,100	26,208
P-7950	317483	Air 53 feet from face No. 7 heading Q left airways between line brattice and rib, return side.	0.09	20.84	0.11		78.96	8,470	13,416
O-4596	317679	Immediate return air from split after ventilation was split No. 7 heading right side Q left airways (three places).	0.06	20.90	0.10		78.94	22,000	31,680
O-4607	317680	Immediate return air from split from four places right side No. 7 heading Q headings.	0.07	20.83	0.22		78.88	18,000	57,024
P-3328	317681	Immediate return air from split (three places) No. 1 heading Q headings.	0.07	20.69	0.11		79.13	17,000	26,928
P-3345	317682	Immediate return air from split after ventilation was split No. 1 heading left side Q left airways (four places).	0.05	20.83	0.08		79.04	17,000	19,584

LAB. NOS. F-65722 to F-65743 Sheet No. 1

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY Elwood Menta

Sample No.	Sample of Dust From	Location in Mine	Alcohol Coke Test Amount of Particles	As-Received Percent Incombustible
		Q MAINS		
M-1	Band	No. 1 "back" entry, 125 feet inby station No. 285.	Trace	22.2
M-2	Band	No. 2 "back" entry, 50 feet inby station No. 1089.	None	31.1
M-3	Band	No. 3 entry, haulage road, 62 feet inby station No. 1112.	None	77.9
M-4	Band	No. 4 "parallel" entry, 62 feet inby station No. 1111.	None	76.1
M-5	Band	No. 5 "back" entry, 45 feet inby station No. 1027.	None	73.8
M-6	Band	No. 6 "back" entry, 36 feet inby station No. 1070.	None	38.9
M-7	Band	No. 4 "back" entry, 45 feet outby station No. 1377.	None	66.6
M-8	Band	No. 3 "back" entry, 130 feet inby station No. 1307.	None	58.9
M-9	Band	No. 2 entry, haulage road, 30 feet inby station No. 1324.	None	69.8
M-10	Band	No. 1 "parallel" entry, 108 feet inby station No. 1325.	None	49.0
M-11	Band	No. 2 "back" entry, 25 feet inby station No. 2025.	None	38.3
M-12	Band	No. 3 "parallel" entry, 70 feet inby station No. 2016.	None	33.7
M-13	Band	No. 4 "parallel" entry, 135 feet inby station No. 1431.	None	46.5

LAB. NOS. F-65722 to F-65743 Sheet No. 2

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY Elwood Menta

Sample No.	Sample of Dust From	Location in Mine	Alcohol Coke Test Amount of Particles	As-Received Percent Incombustible
		Q MAINS		
M-14	Band	No. 5 entry, haulage road, 20 feet inby station No. 2091.	None	58.0
M-15	Band	No. 6 "back" entry, 15 feet inby station No. 2092.	None	55.4
M-16	Band	No. 7 "back" entry, 70 feet inby station No. 2093.	None	68.6
M-17	Band	No. 7 "back" entry, 36 feet inby station No. 2284.	None	35.4
M-18	Band	No. 6 "back" entry, 24 feet outby station No. 2214.	None	45.2
M-19	Band	No. 5 entry, haulage road, 25 feet outby station No. 2213.	None	46.8
M-20	Band	No. 4 "parallel" entry, 30 feet outby station No. 2212.	None	63.3
M-21	Band	No. 3 "parallel" entry, 25 feet outby station No. 2211.	None	36.9
M-22	Band	No. 2 "back" entry, 50 feet outby station No. 2210.	None	28.8

LAB. NOS. F-65790 to F-65824 Sheet No. 1

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY George Noe

Sample No.	Sample of Dust From	Location in Mine	Alcohol Coke Test Amount of Particles	As-Received Percent Incombustible
		Q LEFT AIRWAYS		
N-1	Band	25 feet outby station No. 1431, No. 7 entry (intake airway).	None	38.4
N-2	Band	25 feet outby station No. 1430, No. 6 entry (intake airway).	None	48.0
N-3	Band	25 feet outby station No. 1429, No. 5 entry (intake airway).	None	36.5
N-4	Band	25 feet outby station No. 1428, No. 4 entry (track).	None	51.9
N-5	Band	25 feet outby station No. 1427, No. 3 entry (return airway).	Trace	56.9
N-6	Band	120 feet inby station No. 2813, No. 2 entry (return airway).	Trace	41.7
N-7	Band	25 feet outby station No. 1597, No. 1 entry (return airway).	Trace	46.4
N-8	Band	25 feet inby station No. 1558, No. 1 entry (return airway).	Small	53.7
N-9	Band	25 feet inby station No. 1606, No. 2 entry (return airway).	Small	30.1
N-10	Band	25 feet inby station No. 1516, No. 3 entry (return airway).	Trace	44.0
N-11	Band	25 feet inby station No. 1605, No. 4 entry (track).	None	58.0
N-12	Band	25 feet inby station No. 1604, No. 5 entry (intake airway).	None	35.3
N-13	Band	25 feet inby station No. 1603, No. 6 entry (intake airway).	None	46.1

LAB. NOS. F-65790 to F-65824 Sheet No. 2

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY George Noe

Sample No.	Sample of Dust From	Location in Mine	Alcohol Coke Test / Amount of Particles	As-Received Percent Incombustible
		Q LEFT AIRWAYS		
N-14	Band	25 feet inby station No. 1602, No. 7 entry (intake airway).	None	41.4
N-15	Band	25 feet outby station No. 1827, No. 7 entry (intake airway).	Small	51.2
N-16	Band	110 feet outby station No. 1857, No. 6 entry (intake airway).	Small	55.6
N-17	Band	25 feet outby station No. 1828, No. 5 entry (intake airway).	Trace	58.3
N-18	Band	25 feet outby station No. 1826, No. 4 entry (track).	Trace	35.1
N-19	Floor & Ribs	25 feet outby station No. 1853, No. 3 entry (return airway).	Trace	35.0
N-20	Floor & Ribs	260 feet outby station No. 1954, No. 2 entry (return airway).	Large	48.3
N-21	Band	337 feet outby station No. 1986, No. 1 entry (return airway).	Large	58.6
N-22	Band	25 feet inby station No. 1986, No. 1 entry (return airway).	Very Large	22.6
N-23	Band	25 feet inby station No. 1955, No. 2 entry (intake airway).	Large	31.0
N-24	Band	25 feet inby station No. 1983, No. 3 entry (intake airway).	Large	39.7
N-25	Band	25 feet inby station No. 1984, No. 4 entry (intake, conveyor belt line).	Large	41.6
N-26	Band	25 feet inby station No. 1938, No. 5 entry (intake airway).	Large	24.4

LAB NOS. F-65790 to F-65824 Sheet No. 3

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY George Noe

Sample No.	Sample of Dust From	Location in Mine	Alcohol Coke Test / Amount of Particles	As-Received Percent Incombustible
		Q LEFT AIRWAYS		
N-27	Band	25 feet inby station No. 1939, No. 6 entry (intake airway).	Large	34.5
N-28	Band	25 feet inby station No. 1940, No. 7 entry (intake airway).	Trace	49.8
N-29	Band	50 feet outby face, No. 7 entry.	Trace	28.1
N-30	Band	50 feet outby face, No. 6 entry.	Trace	24.2
N-31	Band	50 feet outby face, No. 5 entry.	Trace	37.3
N-32	Band	50 feet outby face, No. 4 entry.	Small	29.5
N-33	Band	50 feet outby face, No. 3 entry.	Small	34.5
N-34	Band	50 feet outby face, No. 2 entry.	Small	30.3
N-35	Band	50 feet outby face, No. 1 entry.	Small	34.5

LAB. NOS. F-65765 to F-65789 Sheet No. 1

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957 January 1958

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY James D. Micheal

Sample No.	Sample of Dust From	Location in Mine	As-Received Percent Incombustible
J-1	Ribs & Floor	No. 4 entry (haulage road), Q mains, 50 feet outby station No. 2842.	56.3
J-2	Ribs & Floor	No. 3 (parallel entry), Q mains, 100 feet outby station No. 976.	54.7
J-3	Ribs & Floor	No. 3 (parallel entry), Q mains, 50 feet outby station No. 774.	52.4
J-4	Ribs & Floor	No. 4 entry (haulage road), 50 feet outby station No. 773.	53.4
J-5	Ribs & Floor	No. 4 entry (haulage road), 50 feet outby station No. 14895.	68.2
		Q MAINS	
J-6	Ribs & Floor	No. 3 (parallel entry), 100 feet outby station No. 14923.	61.5
J-7	Ribs & Floor	No. 3 entry (haulage road), 50 feet outby station No. 14810.	81.8
J-8	Ribs & Floor	No. 4 entry (haulage road), 60 feet outby station No. 14809.	85.0
J-9	Ribs & Floor	No. 5 (parallel entry), 60 feet outby station No. 14807.	75.9
J-10	Ribs & Floor	No. 6 (parallel entry), 30 feet inby station No. 14808.	35.5
J-11	Ribs & Floor	No. 5 entry (haulage road), 50 feet outby station No. 2338.	53.1
J-12	Ribs & Floor	No. 4 (parallel entry), 50 feet outby station No. 2337.	56.1
J-13	Ribs & Floor	No. 3 (parallel entry), 50 feet outby station No. 2336.	56.6

LAB. NOS. F-65765 to F-65789 Sheet No. 2

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957 January 1958

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY James D. Micheal

Sample No.	Sample of Dust From	Location in Mine	As-Received Percent Incombustible
J-14	Ribs & Floor	No. 3 (parallel entry), 50 feet outby station No. 2493.	51.9
J-15	Ribs & Floor	No. 4 (parallel entry), 50 feet outby station No. 2492.	76.5
J-16	Ribs & Floor	No. 5 entry (haulage road), 50 feet outby station No. 2491	68.6
J-17	Ribs & Floor	No. 5 entry (haulage road), 50 feet outby station No. 2641.	49.7
J-18	Ribs & Floor	No. 4 (parallel entry), 50 feet outby station No. 2642.	77.2
J-19	Ribs & Floor	No. 3 (parallel entry), 50 feet outby station No. 2643.	55.3
J-20	Ribs & Floor	No. 5 entry (shuttle-car roadway), 50 feet inby station No. 2891.	33.9
J-21	Ribs & Floor	No. 4 entry (shuttle-car roadway), 50 feet inby station No. 2890.	29.8
J-22	Ribs & Floor	No. 3 entry (shuttle-car roadway), 50 feet inby station No. 2889.	30.8
J-23	Ribs & Floor	No. 5 entry (shuttle-car roadway), 80 feet outby face.	26.5
J-24	Ribs & Floor	No. 6 entry (shuttle-car roadway), 80 feet outby face.	35.3
J-25	Ribs & Floor	No. 7 entry (return airway), 50 feet inby station No. 2893.	32.9
		NOTE: ALCOHOL COKE TEST REVEALED NO COKED PARTICLES PRESENT IN ANY OF THESE SAMPLES (NOS. J-1 THROUGH J-25).	

LAB. NOS. F-66460 to F-66475 Sheet No. 1

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED January 1958

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY Anthony Puskas

Sample No.	Sample of Dust From	Location in Mine	As-Received Percent Incombustible
T-1	Band	No. 6 entry, Q mains (return airway), 50 feet outby station No. 2640.	77.8
T-2	Band	No. 7 entry, Q mains (return airway), 50 feet outby station No. 2639.	66.2
		2 RIGHT OFF Q MAINS	
T-3	Band	No. 1 entry (intake airway), 220 feet outby face.	46.6
T-4	Band	No. 2 entry (intake airway), 300 feet outby face.	43.9
T-5	Band	No. 3 entry (shuttle-car roadway), 60 feet outby station No. 2732.	46.0
T-6	Band	No. 4 entry (parallel), 60 feet outby station No. 2733.	51.4
T-7	Band	No. 5 entry (parallel), 60 feet outby station No. 2734.	51.2
T-8	Band	No. 6 entry (return airway), 60 feet outby station No. 2735.	66.8
T-9	Band	No. 7 entry (return airway), 60 feet outby station No. 2736.	45.6
		Q MAINS	
T-10	Band	No. 7 entry (return airway), 110 feet inby station No. 2489.	68.5
T-11	Band	No. 6 entry (return airway), 30 feet inby station No. 2490.	53.4
T-12	Band	No. 6 entry (return airway), 40 feet outby station No. 2339.	69.1

LAB. NOS. F-66460 to F-66475 Sheet No. 2

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED January 1958

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY Anthony Puskas

Sample No.	Sample of Dust From	Location in Mine	As-Received Percent Incombustible
		Q MAINS	
T-13	Band	No. 6 entry (return airway), 40 feet outby station No. 923.	52.1
T-14	Band	No. 5 entry (return airway), 40 feet outby station No. 924.	71.6
T-15	Band	No. 6 entry (return airway), 40 feet outby station No. 771.	48.8
T-16	Band	No. 5 entry (return airway), 40 feet outby station No. 772.	51.3

ALCOHOL COKE TEST revealed no coked particles present in any of these samples. (Nos. T-1 to T-16 inclusive.)

LAB. NOS. F-65722 to F-65743 Sheet No. 1

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957 January 1958

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY Ward R. Vickers

Sample No.	Sample of Dust From	Location in Mine	Alcohol Coke Test Amount of Particles	As-Received Percent Incombustible
		Q LEFT		
V-1	Rib & Floor	45 feet outby station No. 2849, No. 1 entry.	None	47.7
V-2	Rib & Floor	55 feet inby station No. 926, No. 2 entry.	None	66.4
V-3	Rib & Floor	20 feet outby station No. 801, No. 2 entry.	None	58.3
V-4	Rib & Floor	245 feet outby station No. 2797, No. 1 entry.	None	76.9
V-5	Rib & Floor	30 feet outby station No. 2571, No. 1 entry.	None	40.3
V-6	Rib & Floor	40 feet inby station No. 14897, No. 2 entry.	None	33.2
V-7	Rib & Floor	25 feet outby station No. 2512, No. 1 entry.	None	55.5
V-8	Rib & Floor	15 feet outby station No. 586, No. 2 entry.	None	44.4
		Q HEADINGS		
V-9	Rib & Floor	30 feet outby station No. 2209, No. 1 entry.	None	46.6
V-10	Rib & Floor	35 feet outby station No. 2334, No. 1 entry.	None	39.1
V-11	Rib & Floor	30 feet outby station No. 2335, No. 2 entry.	None	50.4
V-12	Rib & Floor	30 feet inby station No. 2494, No. 2 entry.	None	49.6
V-13	Rib & Floor	30 feet inby station No. 2495, No. 1 entry.	None	52.7

LAB. NOS. F-65744 to F-65764 Sheet No. 2

TABLE 2 ANALYSES OF DUST SAMPLES COLLECTED December 1957 January 1958

MINE No. 31 COMPANY Pocahontas Fuel Company, Incorporated COLLECTED BY Ward R. Vickers

Sample No.	Sample of Dust From	Location in Mine	Alcohol Coke Test Amount of Particles	As-Received Percent Incombustible
		Q HEADINGS		
V-14	Rib & Floor	30 feet inby station No. 2645, No. 1 entry.	None	53.9
V-15	Rib & Floor	120 feet inby station No. 2604, No. 2 entry.	None	42.7
V-16	Rib & Floor	30 feet inby station No. 2888, No. 2 entry.	None	31.1
V-17	Rib & Floor	125 feet inby station No. 2887, No. 1 entry.	None	25.1
V-18	Rib & Floor	115 feet inby station No. 2889, No. 3 entry.	None	28.7
V-19	Rib & Floor	120 feet inby station No. 2890, No. 4 entry.	None	33.9
V-20	Rib & Floor	135 feet inby station No. 2893, No. 7 entry.	None	32.0
V-21	Rib & Floor	25 feet inby station No. 2892, No. 6 entry.	None	29.0