UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DISTRICT C

FINAL REPORT OF MAJOR MINE EXPLOSION DISASTER

BISHOP MINE
POCAHONTAS FUEL COMPANY, DIVISION OF CONSOLIDATION COAL COMPANY
McDOWELL COUNTY, WEST VIRGINIA
(Near Bishop, Tazewell County, Virginia)

October 27, 1958

By

William R. Park
District Supervisor

Edward M. Lewis
Federal Coal-Mine Inspector

George Noe
Federal Coal-Mine Inspector

and

Elwood Menta
Federal Coal-Mine Inspector

Originating Office - Bureau of Mines
Mount Hope, West Virginia
W. R. Park, District Supervisor
Health and Safety District C

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INTRODUCTION

An explosion occurred in the Bishop mine of the Pocahontas Fuel Company, Division of Consolidation Coal Company, near Bishop, Tazewell County, Virginia, about 8:28 a.m., Monday, October 27, 1958. Twenty-two men were killed by the explosion; all died from burns and/or forces. None of the other 185 men in the mine at the time of the explosion was injured; however, 37 men in the inby Pine Ridge left and Pine Ridge main sections observed forces, dust, and fumes from the explosion enter their working areas. These men erected barricades and remained behind the barricades until they were rescued. The men were in good physical condition when rescued. The men in the Pine Ridge main section were removed from behind the barricade about 9:35 a.m., and the men in the Pine Ridge left section were removed from behind the barricade at 10:15 a.m., October 27.

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. 5 working place (No. 3 Drainway entry), 2 left off Pine Ridge left section, where an explosive mixture of methane-air was

ignited when shots fired at the face of No. 6 place blasted through to No. 5 place. Forces of the explosion extended throughout the 2 left entries to the junction of the 2 left entries and Pine Ridge left entries, then spread right and left at this junction, and were dissipated as they traveled right toward the Daniel main entries and left toward the faces of the Pine Ridge left and Pine Ridge main entries.

GENERAL INFORMATION

The Bishop mine, previously known as the No. 34 mine, of the Pocahontas Fuel Company, Division of Consolidation Coal Company, is in McDowell County, West Virginia, near Bishop, Virginia, and it is served by the Norfolk and Western Railway Company. The operating officials of the company on October 27, 1958, were:

A. V. Sproles	President	Pocahontas, Virginia
P. P. Ferretti	Vice President-Operations	Pocahontas, Virginia
Michael O'Brien	Special Assistant to the President	Itmann, West 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
Joseph McClellan	Superintendent	Bishop, Virginia
Howard Clark	Assistant Superintendent	Bishop, Virginia
Roscoe Mayberry	Mine Inspector	Bishop, Virginia
Riley Yates	Mine Foreman	Bishop, Virginia

A total of 655 men was employed; 111 on the surface and 544 underground, 3 shifts a day, and produced an average of 6,500 tons of coal daily. Production for the first 9 months of 1958 was 1,034,891 tons of coal. The last Federal inspection of this mine prior to the disaster was made September 23-26 and 30 and October 6-7, 1958. Access into the mine is by 8 drifts and 2 concrete-lined shafts into the Pocahontas Nos. 3, 4, and 5 coal beds; the shafts are 315 and 320 feet in depth, respectively. At the time of the explosion, mining was being done only in the No. 3 coal bed, which averaged 72 inches in thickness in the areas being mined and dipped slightly south of west. The intervals between the Nos. 3, 4, and 5 coal beds are 120 and from 2 to 15 feet, respectively. The Nos. 3, 4, and 5 coal beds have been interconnected at several locations by open passageways.

The immediate roof is unconsolidated shale, from 8 to 20 inches in thickness. The main roof is laminated shale and sandstone beddings, from 20 to 40 feet in thickness. Kettlebottoms, slips, and slickenside

were about 80 feet apart. Pillars were recovered by an open-end method. Pillar lifts were 18 to 20 feet in width. A high percentage of coal is recovered in this mine.

Bolts were used for roof support in all areas of the mine except in pillar lifts. In some areas, cribs, posts, and crossbars were installed to supplement the roof bolts. Conventional timbering was done in pillar lifts including breaker posts and/or cribs. The roof-support plan for both solid and pillar work required that additional supports be provided where needed. Seven loading-machine sections in developing areas and 3 continuous-miner sections in pillar areas were operated daily. In the loading-machine sections, coal was bottom cut and sheared vertically near the center of the cut to an average depth of 9-1/2 feet with rubber-tired universal mining machines and loaded into shuttle cars with tractor-mounted loading machines.

Explosives and Blasting: Permissible explosives, Duobel C, 1-1/8- by 8-inch cartridges, and Gelobel C, 1-1/4- by 8-inch cartridges, were used for blasting, and the blasting supplies were transported underground in specially constructed explosives cars and stored temporarily in well-constructed section boxes. Holes for blasting were drilled before or after the coal was cut, and the shot holes were charged and fired by designated shot firers. Generally, a cut was blasted with 6 shot holes and 3 holes were placed on each side of the shear cut; 2 holes were near each rib and 2 holes were placed near the middle of the coal bed and 3 to 4 feet from the shear. All shot holes in a place were charged and then the 3 shots on a side of the shear were usually wired together and fired simultaneously. Six to eight cartridges of explosive were used in each shot hole. Incombustible material was used for stemming, and permissible multiple-shot blasting units were used for firing the shots. During the October Federal inspection, suitable examinations for methane were made before and after blasting.

During the recovery work following the explosion, a powder bag containing 13 cartridges of Gelobel C was found on the floor near the right rib and approximately 75 feet outby the face of No. 5 working place in 2 left section; a cardboard box containing 50 electric detonators was lying on the floor near the bag of explosives.

After the explosion, 200 cartridges of Gelobel C and Duobel C explosive from the 2 left section magazine and the 13 cartridges of explosive found near the face of No. 5 working place were carried to the surface, and these explosives and 5 cases of explosives from different manufacturer's lots were taken from the surface storage magazine and tested for permissibility requirements in the Bureau of Mines laboratories at Bruceton, Pennsylvania. Chemical analyses, complete field tests, and gallery tests were made of selected samples of the explosives; none of the samples caused an ignition in the gallery.

Twenty-two cartridges of Gelobel C and 34 cartridges of Duobel C explosives and 12 electric detonators in a closed wooden box were found scattered near the day-shift shot firer's body at the empty track switch. Later the explosives were collected and brought to the section magazines. The total number of cartridges of explosives, including those found near the shot firer's body, counted in the section magazine boxes after the explosion was 2,518, including 623 cartridges of Gelobel C and 1,895 cartridges of Duobel C. There were 512 electric detonators in the section storage box in the crosscut immediately outby the explosives-storage boxes.

Ventilation and Gases: Ventilation in the mine (the Pocahontas No. 3 coal bed only) was induced by 3 axial-flow fans, operated exhausting and circulating through the mine approximately 734,000 cubic feet of air a minute. 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, and intake air in each set of developing entries was coursed through the center entries in each set, split right and left near the faces, and returned through the outside entries. Each pillar section was ventilated with a separate split of intake air, and effective bleeder entries were provided.

The quantities of air reaching the last open crosscuts and the intake ends of pillar lines ranged from 16,380 to 32,800 cubic feet a minute during the October 1958 Federal inspection.

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

Location	Volume of Air, c.f.m.	Methane, Percent	Cubic Feet of Methane in 24 Hours
Last open crosscut, left side, Pine Ridge mains	18,200	0.47	120,000
Last open crosscut, right split, Pine Ridge mains	21,000	0.50	150,000
Last open crosscut, right side, Tunnel headings	19,740	0.09	26,000
Last open crosscut, left side, Tunnel headings	24,000	0.06	21,000

Location	Volume of Air, c.f.m.	Methane, Percent	Cubic Feet of Methane in 24 Hours
Last open crosscut, left side, 2 left off Pine Ridge	22,700	0.37	120,000
Last open crosscut, right side, 2 left off Pine Ridge	16,380	0.80	190,000
Last open crosscut, right side, Pine Ridge left	22,800	0.21	69,000
Last open crosscut, left side, Pine Ridge left	22,700	0.36	120,000
Last open crosscut, left side, 2 right Low Gap	32,800	0.00	
Last open crosscut, right side, 2 right Low Gap	21,600	0.10	31,000
Main return, Road Fork fan	88,000	0.16	200,000
Main return, No. 34 fan	91,800	0.04	53,000
Main return, No. 1 Horsepen fan	248,000	0.44	1,600,000
Main return, No. 2 Horsepen fan	248,800	0.44	1,600,000

The mine is classed gassy by the West Virginia Department of Mines and by the Bureau of Mines. During a ventilation survey completed September 3, 1958, the mine was liberating methane at a calculated rate of 3,260,000 cubic feet in 24 hours. Fire bosses made preshift examinations for gas and other hazards Sunday night for the 12:00 to 8:00 a.m. shift, Monday, and stayed over to make the preshift examination for the shift starting at 8:00 a.m.; the remainder of the week, the fire bosses made preshift examinations for the 8:00 a.m. to 4:00 p.m. shift. Other preshift examinations for succeeding shifts were made on shift by the section foremen during their regular tour of duty. The fire boss' record books showed that gas was detected in the following places in the 2 left off Pine Ridge section as listed hereafter during the period October 1 to 27, 1958, inclusive:

Date	Working Places	Comments
1	No. 5	Gas, needs canvas
2	No. 5	Gas, recently shot

Date	Working Places	Comments
2	No. 6	Gas, recently shot
6	No. 4	Joy waiting for gas to clear
9	No. 4	Gas, recently shot
9	No. 7	Gas, needs canvas
15	No. 5	Gas, recently shot
15	Nos. 6 and 7	Gas, needs canvas
16	No. 8	Gas, recently shot
17	No. 5	Gas, recently shot
20	No. 2	Joy machine waiting for gas to clear
23	Nos. 4 and 5	Gas, recently shot
24	No. 4	Gas, recently shot
24	No. 5	Machine waiting for gas to clear
24	No. 7	Gas in cavity
27	No. 7	Machine waiting for gas to clear
27	No. 8	Gas, recently shot

The fire boss' records show that the foremen conducting the preshift examinations for the other 2 operating shifts a day in 2 left off Pine Ridge section did not detect gas during October 1958.

On-shift examinations for gas and other hazards were made by fire bosses, section foremen, assistant foremen, and the general mine foreman, but, with few exceptions, records of such on-shift examinations were not made. Generally, records were made to show how hazards reported by the preshift examiners were corrected.

Operators of electrical face equipment were instructed to make suitable tests for gas before electrical equipment was taken to the working faces and frequently while the equipment was operated at the faces. Following the explosion, company officials gave thorough gas-testing examinations to 358 employees who were required to use flame safety lamps in the performance of their duties, and 38 of the men examined failed to pass the required tests, primarily because of faulty vision. Several of the men examined failed to detect gas until the flame reached the gauzes, and several men did not detect gas until it exploded in the lamp. A number of the men who failed the initial gas-testing examination passed the examination successfully after being fitted with corrective glasses. All others who failed the gas-testing examination were assigned work that did not require the use of flame safety lamps. Company officials are continuing the gas-testing examinations.

Two section foremen and seven other employees in the 2 left section had flame safety lamps at the time of the explosion, and the

lamps were sent to the laboratories of the Bureau of Mines in Pittsburgh, Pennsylvania, for testing and examination. The lamps did not ignite methane in any of the 32 tests made, and the lamps were in permissible condition, except that lamp No. 68 was assembled from a combination of 2 approved types and, therefore, was not permissible.

The 2 left off Pine Ridge left section (explosion area) consisted of a set of 6 entries turned off Pine Ridge left entries and driven a distance of about 2,900 feet. Until shortly before the disaster, the 6 entries were ventilated with intake air coursed through the Nos. 3, 4, and 5 (center) entries, split right and left near the faces, and returned through the outside Nos. 1, 2, and 6 entries. During a Federal ventilation survey of the mine in September 1958, 49,000 cubic feet of intake air a minute was coursed through the 3 center entries; 28,000 and 21,000 cubic feet of air a minute was measured in the immediate returns, Nos. 1 and 6 entries, respectively. However, after the ventilation survey was completed, a new set of entries (Drainway entries) was turned right off 2 left entries and the 2 left entries and the Drainway entries were developed simultaneously with one set of face equipment and one loading ramp. Engineer's survey stations for Nos. 6, 5, and 4 Drainway entries were made September 24 and October 9 and 16, 1958, respectively. The turning and driving of the Drainway entries with the 2 left entries required ventilation changes in the immediate face regions (see Appendix C). Previous to turning the Drainway entries, 3 entries left and 3 entries right of 2 left were ventilated with separate splits of air; whereas, on the day of the explosion, the left split of air ventilated 5 entry faces and the right split of air was coursed through 4 additional entry faces. Providing adequate face ventilation for the additional entries necessitated the use of additional check curtains and line brattice, which in turn increased the hazards of air leakage and ventilation interruptions.

Coal and Rock Dust: The following information was obtained from the October 1958 Federal inspection report: The mine ranged from wet to dry, and the dry parts were rock-dusted to within 40 feet of the faces. An excessive amount of dust was not raised into the air during normal mining operations, and coal dust, loose coal, or other combustible materials were not accumulated in dangerous quantities in the active underground workings. A rock-dust survey was made in the 7 entries of 2 right, Low Gap section. A total of 27 dust samples was collected on pattern in the entries, and 8 samples were collected at spot locations in other parts of the mine. The incombustible content of 1 of the samples collected in the survey area was less than the minimum required; however, additional rock dust was applied in this location before the close of the inspection.

According to the company inspector, the day-shift crews were responsible for the cleaning of loose coal and coal dust in the Nos. 1 and 2 entries and for the wetting of these entry roadways. The second-shift and third-shift crews were responsible for the same procedures in

the Nos. 3 and 4 entries and Nos. 5 and 6 entries, respectively. When loading operations were delayed or interrupted for any reason, the men not performing their regular duties were assigned to clean the roadways and apply rock dust where needed. Five 50-pound bags of rock dust, or more if needed, were supposed to be distributed by hand in the area for each cut of coal removed in the loading-machine sections. In continuous-miner places, the surfaces of the places were required to be kept wetted to the last application of rock dust, and when the miners had been moved out of a place, the place was to be cleaned up and rock-dusted to within 15 feet of the face. Generalized rock-dusting outby loading points was done with rock-dusting machines on week-ends and during idle periods. Company records show that 4,610 tons of rock dust were applied, and 1,034,891 tons of coal were produced during the first 9 months of 1958; this amounts to almost 9 pounds of rock dust used per ton of coal produced. Water is piped to each working place to be used for allaying dust during mining operations and for wetting down shuttle-car roadways.

After the explosion, examination of the 2 left entries, Pine Ridge left entries, and Pine Ridge main entries revealed that the sections were covered with a layer of coal dust and/or soot. This layer of dust was thickest in the 2 left entries and progressively became thinner as the explosion forces were dissipated in traveling in the Pine Ridge left and Pine Ridge main entries. Evidence that the areas had been rock-dusted was apparent throughout the sections, and excessive accumulations of coal dust and loose coal were observed only in the face regions inby the haulage loop and at several other scattered locations. The areas inby the haulage loop in each of the 3 sections had been rock-dusted by hand and very little, if any, rock dust had been applied to the roof in these areas. The fire boss' record books showed that the 2 left roadways needed cleaning for 6 consecutive days (October 22-27) prior to the explosion. These records showed that the roadways were wetted down on 2 different days in the period October 22-27. A mine safety committeeman testified that he was in the 2 left section between 5:00 and 6:00 a.m., on the day of the explosion and had discussed the need of cleaning the dirty roadways with the section foreman.

Rock-dusting of the areas was the principal factor in preventing further spread of the explosion, and during the investigation 174 samples of the mine dust were collected in the areas affected by the explosion forces (see Table 2 and Appendix C). About 56 percent (96) of the samples collected contained less than 65 percent incombustibles. Of the 48 samples collected in 2 left entries, 38 or 79 percent contained less than 65 percent incombustibles and 21 of these samples of 43 percent contained less than 50 percent incombustibles. Of the 72 samples collected in the Pine Ridge main entries, 32 or 43 percent contained less than 65 percent incombustibles and 11 of these samples contained less than 50 percent incombustibles. Of the 54 dust samples collected in the Pine Ridge left entries 26 or 48 percent contained less than 65 percent incombustibles and 11 of

the samples contained less than 50 percent incombustibles. Twenty-four of the fifty-eight substandard dust samples in the Pine Ridge main and Pine Ridge left sections were collected in areas immediately adjacent to the entrances to 2 left section. Dust samples collected after the explosion in 2 left entries and in Pine Ridge main and Pine Ridge left entries at locations adjacent to 2 left entries 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.

The following information supports this contention, an explosion occurred in a Nicholas County, West Virginia, mine, October 28, 1958. The explosion occurred in a set of 3 entries where a pattern, rock-dust survey had been conducted the week previously by a Federal inspector during a regular inspection of the mine. A rock-dust survey in the same locations after the explosion showed definitely that coal dust thrown into suspension and deposited on rock-dusted surfaces decreased the incombustible content of the mine dust in the areas sampled before the explosion. Notwithstanding the fact that additional rock dust was applied in the area after the original survey and before the explosion, 11 of 14 comparable areas sampled after the explosion showed incombustible decreases, ranging from 4.0 to 23.7 percent and averaging 10 percent.

Transportation: Permissible-type cable-reel shuttle cars were used for face haulage; they discharged the coal directly into 5-ton capacity steel mine cars, which 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 self-propelled man-trip 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, and 2,300 volts alternating current, was used on the surface; and 275 volts direct current was used underground. Alternating current was transmitted by armored cables through drill holes from the surface to the 3 rectifier stations and to air-compressor stations underground. These stations were of fireproof construction and were ventilated by separate splits of air. Trolley, feeder, and power wires were installed on insulators and sectionalized with cutout switches. The electric face equipment was the permissible type and was in a permissible condition at the close of the October Federal inspection. The trailing cables on the mobile equipment were fire-resistant and were provided with short-circuit protection. Temporary splices in trailing cables were made with splicing rings and were well insulated. At the time of the October Federal inspection, operators of electrically driven equipment made suitable tests for gas before taking the equipment into the face regions and at frequent intervals thereafter.

The face electric equipment in the 2 left entries was examined after the explosion by a Federal electrical inspector and a company electrician. This equipment was in permissible condition, except that 1 bolt was missing from the headlight lens cover and 1 bolt was missing from the headlight resistance cover on the standard-drive shuttle car (Jeffrey MT 67) and 1 bolt was loose on the contactor compartment cover on the opposite standard-drive shuttle car (Jeffrey MT 67).

None of the electric face equipment was in an immediate face area, and examination of the equipment indicated that none of it was being operated when the explosion occurred.

Illumination and Smoking: All employees used permissible electric cap lamps for portable illumination underground. Fixed electric lights were installed at frequent intervals along the haulageways. Smoking was not permitted or observed underground at the time of the October Federal inspection, and the underground employees were searched for smokers' articles at least once each week at the shaft bottom.

Mine Rescue: A mine-rescue team was not maintained at the mine; however, a fully equipped and trained team was maintained at the 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, an estimated 50 percent of the underground employees had not 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 man-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, pump, and rectifier set; and adequate supplies of rock dust were placed at strategic locations throughout the mine. 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, president, I. M. Sampson, general superintendent, and Louis

Roncaglione, director of safety and mine inspection, of the operating company; Charles Ferguson, safety director, and James Leeber, Jr., safety director, United Mine Workers of America; Crawford L. Wilson, director, West Virginia Department of Mines; and representatives of the Bureau of Mines.

Five mine-rescue teams of the following companies assisted: United States Steel Corporation (two teams), New River and Pocahontas Consolidated Coal Company, Olga Coal Company, and Pocahontas Fuel Company, Division of Consolidation Coal Company.

Activities of Bureau of Mines Personnel: Crawford L. Wilson, director, West Virginia Department of Mines, informed W. R. Park, district supervisor, of the explosion at 9:30 a.m., October 27. Park notified other Bureau of Mines personnel of the occurrence. Inspector Noe arrived at the mine about 10:45 a.m., Inspector McGinity at 11:20 a.m., Inspectors Vickers and Menta arrived at the mine about 11:40 a.m., and additional Bureau representatives at the following times: Griffith - 12:15 p.m., Park and Charlesworth - 12:30 p.m., Hovanec - 12:40 p.m., J. D. Micheal - 1:00 p.m., Puskas, Ulshafer, and Lewis - 3:00 p.m., and Zeleskey - 4:00 p.m. Cordray, Westfield, Gallagher, and Childers arrived at the mine during the morning of October 28. Inspector Noe entered the mine immediately after his arrival, and on arriving at the mine, McGinity, Menta, Vickers, Griffith, Micheal, and Park 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 22 victims were recovered at various times during the day; the first body was found near the section explosives magazine; the other bodies were inby and nearer the faces, and all bodies were recovered by 4:15 p.m., October 27.

Westfield, Park, Noe, Menta, and Childers assisted with the official underground investigation. Childers examined the electrical equipment and circuits in the explosion area. Inspectors Vickers, Menta, Puskas, McGinity, and Ulshafer were on duty on various shifts in the explosion area until the area was restored to normal operating condition.

Mining Conditions Immediately Prior to the Explosion: The weather on October 27 was cloudy with overcast skies and intermittent rain. The temperature at Bluefield, West Virginia, about 13 miles by air from Bishop, ranged from a low of 38 to a high of 44 degrees, Fahrenheit. Records of barometric pressure taken by the Olga Coal Company at Coalwood, West Virginia, about 15 miles by air from Bishop, on October 26 and 27, 1958, are as follows:

Sunday, October 26, 1958

Time	Barometric Pressure
8:00 a.m.	28.35
9:00 a.m.	28.35
10:00 a.m.	28.35
11:00 a.m.	28.37
12:00 noon	28.37
1:00 p.m.	28.38
2:00 p.m.	28.36
3:00 p.m.	28.35
4:00 p.m.	28.36
5:00 p.m.	28.30
6:00 p.m.	28.31
7:00 p.m.	28.30
8:00 p.m.	28.30
9:00 p.m.	28.30
10:00 p.m.	28.35
11:00 p.m.	28.35
12:00 midnight	28.35

Monday, October 27, 1958

Time	Barometric Pressure
1:00 a.m.	28.35
2:00 a.m.	28.35
3:00 a.m.	28.35
4:00 a.m.	28.35
5:00 a.m.	28.35
6:00 a.m.	28.35
7:00 a.m.	28.35
8:00 a.m.	28.35
9:00 a.m.	28.35

It is believed that the slight change in atmospheric pressure in the 24 hours prior to the time of the explosion was not a contributing factor.

The records indicate that conditions on each underground working section were normal during the 12:00 to 8:00 a.m. shift, and unusual conditions were not reported by the preshift examiners for the day-shift crew of October 27.

Evidence of Activities and Story of Explosion: At the beginning of the 8:00 a.m. to 4:00 p.m. shift, 179 men entered the mine, and they were transported in special self-propelled man-cars to their respective sections. Underground employees reached their respective sections without mishap, but some of the men had not reached their section working faces when the explosion occurred. In addition to the 179 day-shift employees, 28 men from the 12:00 to 8:00 a.m., shift worked overtime; 8 such employees in the 2 left section.

The dispatcher's records show that the day-shift men arrived on the 2 left section at 8:24 a.m., or about 4 minutes before the explosion occurred.

According to the superintendent, Joseph McClellan, local mine officials and several higher company officials were in the mine office discussing the various sections that they intended to visit Monday, October 27, when they observed rock dust being blown out of the intake and man shaft, which was about 30 feet from the office window. Realizing

that it had taken a strong force other than one caused by a roof fall or runaway trip to force rock dust out of the shaft against the intake air current, the officials proceeded on the assumption that an explosion had occurred somewhere in the mine. Immediately, a man was sent to each mine fan to make sure that it was kept operating, all electric power was disconnected from the mine, and men were located at the central oil switch to make sure that there was no interruption of power to operate the fans. Howard Clark, assistant superintendent, Riley Yates, general mine foreman, and R. E. Goss, third-shift general foreman, were placed in charge of the shaft operations. Contact by telephone was made to all points of the mine except 2 left off Pine Ridge left section. Men were instructed to walk out of the mine as quickly as possible, but the foremen of the Pine Ridge left section and the Pine Ridge main section informed the surface officials that concussion from the explosion was felt in their sections, thick clouds of dust were present, and, therefore, they intended to short-circuit the ventilation and barricade themselves in the face areas of the sections. Surface officials agreed and employees from the 2 sections quickly erected the barricades and entered the barricaded areas. Men from all other sections contacted began walking out of the mine immediately and arrived on the surface without mishap. Two foremen and 13 other employees (midnight and day-shift crews) were performing their duties in Pine Ridge left section when the explosion occurred. Although the section was affected only slightly by the explosion, the foremen and their men decided that they would barricade themselves. They knocked out half a stopping between Nos. 5 and 6 entries at the fourth crosscut outby the faces and erected canvas stoppings in the third crosscut outby the faces of Nos. 5 and 6 entries, in No. 6 entry inby the fourth crosscut from the face, and in Nos. 1, 2, 3, 4, and 5 entries between the last crosscuts.

The midnight and day-shift foremen and 20 of their men were performing their duties in the Pine Ridge main section when the explosion occurred. The section was affected very little by the explosion, but the foremen and their men decided that they would barricade themselves. They knocked out the third and fourth stoppings from the faces on the left split and the stopping between the Nos. 4 and 5 entries in the fourth crosscut outby the faces, and erected canvas stoppings in Nos. 1, 2, 3, 4, 5, and 6 entries between the third and fourth crosscuts outby the faces. Canvas stoppings were installed at already existing check curtains where convenient, and all stoppings were made of 3 or 4 plys of canvas (see Appendix C). In each case, the barricades were erected so that the main air and water pipelines were included in the barricaded area. This was a very foresighted precaution.

Marvin Hall, assistant general superintendent, Grover Asbury, division superintendent, and Roscoe Mayberry, company mine inspector, reached the barricaded men in the Pine Ridge main section about 9:35 a.m., and led the men outby the affected areas. The same 3 officials and additional officials reached the barricaded men in the Pine Ridge left section about 10:15 a.m., October 27, and also led them to safety.

The procedures 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 after a previous explosion and during a Bureau of Mines accident prevention course conducted recently for the officials and other employees of this mine. The foremen and the men in the two sections used good judgment in barricading themselves rather than attempting to walk out through air of unknown quality.

Company rules require that the boom men on each shift notify the dispatcher located near the main drift portal when the crews arrive on their respective sections, when the first car of coal is loaded, and further notify the dispatcher hourly of the number of cars of coal loaded. Details regarding unusual delays or anticipated delays are also reported to the dispatcher. The dispatcher's report for the 12:00 to 8:00 a.m. shift, October 27, shows that 52 cars of coal were loaded at the end of the shift by the 2 left section crew; this was about average for the crew. The report also shows that a shuttle car was out of operation from about 6:05 to 6:15 a.m., and the car-spotting hoist was inoperative from about 6:20 to 7:00 a.m.

It is an ordinary practice in this mine for a section crew or part of such crew to remain on their section loading coal, performing preparation duties, timbering, cleaning roadways, or rock-dusting until relieved by the oncoming shift at the working faces. Section foremen have blanket authorization to work crew members overtime for cleaning roadways, rock-dusting, timbering, or emergency work. However, section foremen are not to permit overtime for the loading of coal or the preparation of working places for loading unless a general foreman first authorizes such work. About 7:00 a.m., October 27, the 2 left section foreman requested permission through the dispatcher to work overtime loading coal. Although the dispatcher was advised by the general foreman that the 2 left crew was not to work overtime loading coal, the dispatcher did not talk to the 2 left section foreman until 7:51 a.m., when the foreman advised that coal loading was completed, but 8 men were working overtime to erect a crib, clean roadways, and install roof supports for a new ramp.

Examination of the 2 left section after the disaster revealed that none of the face electric equipment was being operated in the immediate face areas at the time of the explosion. Location of the bodies and equipment indicated that several of the midnight-shift employees were cleaning the No. 4 entry roadway with the loading machine and shuttle cars, the day-shift crew was proceeding from the section man-trip station to the faces, and the face of No. 6 entry was being blasted when the explosion occurred. It was also evident that the face of No. 5 working place (No. 3 Drainway entry) had been blasted shortly before No. 6 entry was blasted.

Arthur Booth, a regular loading-machine operator's helper, worked on the cutting machine during the shift prior to the explosion,

and he was one of the four 12:00 to 8:00 a.m., employees who left the 2 left section for the surface about 7:45 a.m., October 27. Booth's testimony of the cutting-machine crew's activities during their shift, October 27, is summarized as follows:

The 2 left section crew found 7 full cuts and a scrap cut ready for loading when they arrived on the section. During the shift, the cutting-machine crew undercut, sheared, and drilled the shot holes in the faces of Nos. 8, 7, and 6 working places (actually Nos. 5 and 4 Drainway entries and No. 6 entry of 2 left entries, respectively) and had drilled the shot holes and completed about half the undercut in No. 5 working place (No. 3 Drainway entry). Booth left the face of No. 5 place (No. 3 Drainway entry) about 7:35 a.m., for travel to the surface, as previous commitments did not permit him to work overtime. Cutting operations were delayed at the beginning of the shift while No. 8 working place (crosscut between Nos. 5 and 6 Drainway entries) was pinned and face ventilation was improved to clear the place of gas. Unusual conditions were not encountered in the cutting and drilling of No. 7 working place, but the first shot hole in the left rib side of No. 6 working place (No. 6 entry of 2 left entries) was drilled through into No. 5 place. Shot holes were drilled to a depth of about 10 feet, but the rib hole was only about 7 feet in depth when it was drilled through. The other 5 shot holes in the face were drilled before the face was cut; none of these holes was drilled through to No. 5 place. During the undercutting of No. 6 working place, the cutter bar "holed through" into No. 5 place for a lineal distance of 3 to 4 feet. The drilling and cutting into No. 5 from No. 6 working places were discussed with the shot firer, but the section foreman was not informed.

The shot firer charged and prepared the 6 shot holes in No. 6 working place for blasting and then came to No. 5 working place, while the first half of the undercut was being made. When Booth left No. 5 working place for the surface, the shot firer was waiting at the last inby crosscut for the cutting operations to be completed, and no other places were ready for blasting.

Booth estimated that undercutting, shearing, and drilling of a face takes about 40 to 45 minutes, and he believed that it would take at least 20 minutes after he left the face to complete cutting and shearing operations in No. 5 place. Completion of cutting operations in No. 5 working place in the estimated time and moving the machine from the face would permit the shot firer to begin charging the shot holes and prepare the face for blasting about 8:00 a.m. As the explosion occurred at 8:28 a.m., the shot firer had about 28 minutes time in which to charge 6 shot holes, blast the 6 shots in No. 5 working place, and then blast the 6 shots in No. 6 working place.

Observing of shot firers in similar working sections inby and outby 2 left section following the explosion showed that the time of

charging and preparing 6 shot holes in an entry face for blasting averaged 15 minutes. These observations also showed that periods of time ranging from 8 to 26 minutes were needed to clear the places of gas after the first series of 3 shots were blasted, and periods of time ranging from 8 to 17 minutes were needed to clear the places of gas after the last series of 3 shots were blasted. These observations indicate that it requires 30 to 45 minutes to blast an entry face and clear the face of gas. However, such time for blasting likely can be decreased by wiring all shots at a face together and firing them simultaneously, a practice in violation of the State blasting permit.

Cutting operations were also observed in conjunction with the aforementioned blasting operations. These observations showed that the time required to undercut an entry face ranged from 10 to 50 minutes and averaged 26.5 minutes. Time required to complete shear cuts ranged from 5 minutes to 50 minutes and averaged 32 minutes. Methane liberations were greatest during the shearing operations.

Investigation of the disaster revealed that in the approximate 50 minutes from the time Booth left the face of No. 5 working place until the explosion, undercutting and shearing operations were completed, the face was blasted, and No. 6 working place was blasted. In No. 6 working place, the shot face, four 18-foot long bus wires, detonator leg wires, and the blasting cable fastened to the detonator leg wires indicated that the 6 shots were wired together and blasted simultaneously. At least 1 of the left rib holes shot through and formed an opening of 3 to 4 feet into No. 5 working place, about 37 feet outby the face of No. 5. A 3- to 4-inch wide crevice was also made from No. 6 to No. 5 working places by the blasting; this crevice showed that gas had burned intensively in the crevice. The blasting cable was on the floor from the face outby along the right rib of No. 6 entry to and about 10 feet inby the left corner of No. 7 working place, a total distance of about 50 feet. The firing ends of the blasting cable indicated that they were being used at the time of the explosion. The body of the shot firer was found about 100 feet outby the firing station (see Appendix D). The line brattice in No. 5 working place was installed along the right rib of the place and adjacent to No. 6 place.

The locations of the bodies in 2 left section indicated that the only work in progress other than the aforementioned blasting at the time of the explosion was the cleaning of the shuttle-car roadway in No. 4 entry (see Appendix C). The loading machine being used was in the No. 4 entry, 125 feet inby and headed toward the loading point. One shuttle car, apparently having just been unloaded, was found at the ramp with the boom raised over the mine car. The other shuttle car being used was empty in No. 4 entry, 50 feet inby the loading machine, where it had apparently drifted after the explosion. Two mine cars of road cleanings had been loaded when the explosion occurred. The roof-bolting

machine was in No. 4 entry just clear of the last open crosscut, and the cutting machine in use was in the last open crosscut at the entrance to No. 5 entry of 2 left entries. Spare equipment was located as follows: A loading machine in No. 1 entry, 175 feet outby the face; a shuttle car in No. 3 entry, 600 feet outby the face; and a cutting machine in No. 4 entry, 650 feet outby the face.

The fact that all forces emanated from No. 5 working place and large quantities of gas burned in this area proves unquestionably that flame from the blasting in No. 6 working place ignited an explosive methane-air mixture in No. 5 place. Work of completing the undercut, making the shear cut, and then blasting the cut in No. 5 place in 50 minutes was performed too rapidly to allow the large amounts of methane liberated during these operations to be diluted and carried away by the ventilating current. Because the aforementioned operations in No. 5 place had to be completed in 50 minutes, the face of No. 6 place must have been blasted immediately after No. 5 was blasted. Whether the shot firer failed to examine for gas in No. 5 place after blasting, failed to detect gas that was present, or erroneously was of the opinion that there was no hazard in blasting No. 6 place while gas was present in No. 5 place is conjectural and will never be known. Another factor that will never be known is exactly how methane in No. 5 place was ignited by the blasting through from No. 6 place. The line brattice in No. 5 place had been installed along the right rib and adjacent to No. 6 place and the intake air in No. 5 place should have traveled in the space between the line curtain and the right rib. Therefore, when No. 6 place was blasted through to No. 5 place, resultant flame should have entered intake air only, as methane liberated at the face of No. 5 place should have traveled on the side of the line curtain farthest from No. 6 place.

Examination of the No. 5 working place showed that the line curtain was almost completely burned from the last open crosscut to within 37 feet of the shot face. The farthest inby shreds of the destroyed (burned) line brattice in No. 5 working place were nailed to a bolted header block in the roof just outby the opening from No. 6 working place. Line brattice inby the last fastened shreds was lying on the mine floor, some of this brattice cloth was in and partly covered by the loose coal at the opening from No. 6 working place, and this canvas was neither damaged nor burned severely. Several days after the explosion, this section of slightly damaged line brattice was reinstalled on its original fasteners (nails in bolted header blocks). An end was reinstalled on the original nail closest to the face of No. 5 place, and the line brattice was extended outby. The reinstalled line brattice was about 12 feet in length and extended to within 5 feet of the burned canvas shreds just outby the opening from No. 6 place. The reinstalling of this line brattice indicated that line curtain had been installed from the last open crosscut to within 9 or 10 feet of the face prior to blasting operations. Exactly what happened to the missing 5 feet of line curtain and

exactly why the line curtain nearest the face of No. 5 place was not burned almost entirely as was the canvas outby could not be determined definitely; however, the fact that this section of line curtain was not burned severely is almost positive proof that the curtain was out of its fasteners and on the floor when the gas burned in the working place; evidence of extreme heat and intense burning were present in the area. Whether the shot firer intentionally loosened the inby end of the line curtain and dropped it to the mine floor so it would not be damaged by blasting in Nos. 5 and 6 places or whether the inby curtain was knocked down by the blasting in No. 5 place will never be known but either might have occurred and would have caused a methane accumulation in No. 5 working place that would easily be ignited when No. 6 place was shot through to No. 5 place. The possibility that the inby end of the line curtain in No. 5 place was knocked down when No. 6 place blasted through to No. 5 place and the explosion occurred moments later must be considered, but the investigators believe that either of the two previously mentioned events are more likely to have occurred. Ventilation at the face of No. 5 working place might also have been interrupted completely or partially for seconds or longer prior to or during the blasting operations while employees were moving the loading machine and shuttle cars from the face of No. 2 entry of 2 left entries to No. 4 entry roadway and/or during the cleaning of this shuttle-car roadway with the face equipment. Certainly, moving the equipment to No. 4 entry required that the machinery be taken through some of the check curtains controlling the ventilating current, and cleaning the roadway might have caused opening, raising, or damaging of check curtains sufficiently to interrupt ventilation at the face of No. 5 working place. If such a ventilation interruption occurred, even for a relatively short period of time, immediately after No. 5 place was blasted, gas would have accumulated sufficiently in No. 5 place to be ignited when No. 6 place was shot through. A ventilation interruption immediately after blasting and at a time when the inby portion of the line curtain in No. 5 place was on the floor would cause methane to accumulate in an area most favorable for ignition by a shot or shots being blasted into such area.

The fire bosses' report shows and the employees testified that methane was detected on numerous occasions in the 2 left working places, and machines had to be stopped frequently and wait for gas to be cleared from the faces of the places. Employees also testified that places were bypassed occasionally because of excessive gas in the places and because immediate roof material (rash) had to be taken down. To provide adequate ventilation at the working faces required check curtains maintained in good condition and line brattice well installed close to the faces. In some instances, particularly after blasting, it was necessary to install line curtain partway across the faces.

The explosion damaged 2 overcasts and destroyed 15 block stoppings, 4 regulators, and several check curtains.

The explosion resulted in loss of production from the entire mine from October 27 until November 3, when all sections except the affected 2 left entries off Pine Ridge entries resumed operations, and the Director of the Bureau of Mines released the 2 left section for operation, November 19, 1958.

Recovery Operations: Immediately after notifying higher company officials at other locations of the occurrence, several of the higher company officials who were at the mine informed Clark, in charge of shaft operations, that they were entering the mine and would travel first to the Pine Ridge main section, as they assumed that this section would be affected least by the explosion. On arriving at the mouth of Pine Ridge main entries the overcast was examined and found to be undamaged. The recovery crew then proceeded to travel the intake airways, they checked permanent stoppings on the right and left and finding them undamaged, proceeded to near the face regions of the Pine Ridge main section, released the 22 men from behind the barricade at 9:35 a.m., and then sent the section employees to the surface. The recovery crew then traveled to the Pine Ridge left overcasts, where they were met by other company officials. Louis Roncaglione, director of safety and mine inspection, was placed in charge of recovery work at this location, and the party traveled to the face regions of the Pine Ridge left section. The 15 men behind the Pine Ridge left barricade were released at 10:15 a.m., and sent to the surface. The recovery crew then returned to the entrance of 2 left off Pine Ridge left entries. One of the two overcasts at this location was damaged. Temporary repairs were made to the overcast, and the recovery crew then began traveling into the 2 left section. Stoppings on the right and left were checked and repaired as needed. At a point approximately 1,000 feet outby the face areas of the 2 left section, representatives of the West Virginia Department of Mines, United Mine Workers of America, and the Bureau of Mines began joining the recovery party. The recovery crew, assisted by 2 mine-rescue teams, established a fresh-air base in No. 3 entry at survey station No. 7966, approximately 1,000 feet outby the faces (see Appendix C). A mine-rescue team, wearing oxygen-breathing apparatus, explored each intake and return entry and crosscuts for a distance of approximately 360 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. 3, 4, and 5 entries. This procedure was followed as the recovery crews advanced toward the faces of the 2 left entries. 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 2 left entries lessened the possibility of forcing an explosive mixture of methane-air over an undiscovered fire or fires. Ventilation to the faces of the 2 left entries was reestablished and the areas near the faces were examined by 4:45 p.m., October 27. The bodies of the 22 victims were located and removed from the face areas by 5:30 p.m.

Company and union representatives and State and Federal inspectors explored the 2 left entries as ventilation was reestablished. Restoring ventilation was relatively simple, as blown-out stoppings were replaced rapidly with temporary stoppings constructed of brattice cloth.

A crew of men began repairing the damaged overcast and replacing permanent stoppings in the 2 left entries, and additional men began cleaning up and rock-dusting the Pine Ridge main and Pine Ridge left sections October 29, 1958.

INVESTIGATION OF CAUSE OF EXPLOSION

Investigation Committee: The underground investigation of the cause of the explosion was begun on October 28, 1958, and completed several days later. Members of the official investigation committee were:

West Virginia Department of Mines

Crawford L. Wilson	Director
Paul Lingo	Director of Mine Rescue and Accident Prevention
Harry Harmon	Inspector-at-Large
D. J. Lee	Roof-Bolt Inspector
Lewis Payne	Electrical Inspector

Pocahontas Fuel Company, Division of Consolidation Coal Company

P. P. Ferretti	Vice President-Operations
Michael O'Brien	Special Assistant to President
J. W. Pero	Assistant Vice President
I. M. Sampson	General Superintendent
M. E. Hall	Assistant General Superintendent
G. L. Asbury	Division Superintendent
J. S. McClellan	Superintendent
Louis Roncaglione	Director of Safety and Mine Inspection
R. J. Baugh	Ventilation Engineer

United Mine Workers of America

Louis Schuler	Assistant to the Safety Director, U. M. W. A.
James Leeber, Jr.	Safety Director, District 29
William Sheppard	Field Representative, District 29
Andrew L. Johnson	President, Local Union No. 6025

United States Bureau of Mines

James Westfield	Assistant Director--Health and Safety
William R. Park	District Supervisor
Edward M. Lewis	Coal-Mine Inspector
George Noe	Coal-Mine Inspector
Elwood Menta	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, Cordray, Childers, McGinity, Puskas, Ulshafer, Zeleskey, and J. D. Micheal.

Paul Lingo, director of mine rescue and accident prevention 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 Bishop, Virginia, October 29, 1958. The purpose of the inquiry was to hear and record all testimony relevant to conditions and practices in the mine prior to and on October 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

Paul Lingo	Director of Mine Rescue and Accident Prevention

Pocahontas Fuel Company, Division of Consolidation Coal Company

P. P. Ferretti	Vice President-Operations

United Mine Workers of America

Charles Ferguson	Safety Director

United States Bureau of Mines

William 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. An inspector of the Bureau of Mines completed a ventilation survey of the mine September 3, 1958. During this survey and the October Federal inspection, the mine was liberating methane at a calculated rate of 3,260,000 and 3,453,000 cubic feet, respectively, in 24 hours. Air measurements made in the immediate returns of 2 left section during the ventilation survey and analytical results of air samples collected in these returns at the same time and comparable air measurements and analytical results obtained during the October Federal inspection are as follows:

Location	Volume of Air, c.f.m.	Methane, Percent	Cubic Feet of Methane in 24 Hours
Immediate return, left split September 1958	28,000	0.42	169,344
Immediate return, right split September 1958	21,000	0.67	202,608
Immediate return, left split October 1958	22,700	0.37	120,000
Immediate return October 1958	16,380	0.80	190,000

The aforementioned air measurements show that in the short period of time (about a month) between the ventilation survey and the inspection, the volume of the ventilating current in 2 left section decreased 10,000 cubic feet a minute and methane liberated in 24 hours decreased about 60,000 cubic feet. However, at the time of the explosion, a new set of entries was being turned right off 2 left entries, and 4 of these entries, Nos. 3, 4, 5, and 6 Drainway entries, had been driven distances ranging from 30 to 225 feet. The 4 additional Drainway entries were being developed in conjunction with the six 2 left entries and with the same set of face equipment; the developing of 9 entries simultaneously necessitated that more than 3 entry faces be ventilated with a split of air. On October 27, the left split of air was coursed through 5 working faces and the right split ventilated 4 working places (see Appendix C). Consequently, greater amounts of methane were liberated in the section, and the increase in the number of check curtains and line brattice necessary to conduct air to the working faces increased the hazards of air leakage and ventilation interruptions by damage to the check curtains and line brattice.

Company officials stated during the investigation that the quantity of air in the 2 left entries was increased sufficiently as the new Drainway entries were turned to dilute and carry any increased methane liberation and air leakage resulting from the increased number of check curtains and line brattice. Records of company air readings in 2 left on October 9 and 23, 1958, show that the quantity of air was increased as follows:

	October 9	October 23
Immediate return, left split	17,000 c.f.m.	22,000 c.f.m.
Immediate return, right split	15,000 c.f.m.	22,600 c.f.m.

The aforementioned air measurements show that the volume of air in the immediate split returns of 2 left section was increased 12,600 cubic feet a minute in the period between October 9 and October 23. However, comparison of the air measurements on October 23 with air measurements made in 2 left entries in September during a Federal ventilation survey indicates that the total quantity of air circulated in 2 left decreased 4,400 cubic feet a minute in the period from September 3 to October 23.

Testimony of company officials and employees during the investigation indicated that gas was encountered in the 2 left working places daily, and on occasion sufficient gas was encountered to necessitate shutting down the electrical face equipment. Furthermore, working places were occasionally bypassed during the loading cycle to permit gas liberated in these places to be diluted and carried away. Officials and employees agree that it was necessary to keep measurable volumes of air sweeping the faces to keep the working places reasonably clear of methane, and any interruption of face ventilation, even for short periods, resulted in gas accumulating at the faces. The heaviest gas liberations in working places occurred during cutting, shearing, and blasting operations.

Unquestionably, the disaster resulted from the ignition of a large quantity of methane that was liberated during blasting operations in No. 5 working place (No. 3 Drainway entry). The ignition occurred when 1 or more shots from the face of No. 6 entry of 2 left entries blasted through into No. 3 Drainway entry, where the face had been blasted shortly before. Fragile, globular coke droplets adhering to the roof and ribs, indicative of slow burning gas, were found in nearly every part of the 2 left entries and Drainway entries for a distance of about 150 feet outby the faces. The aforementioned evidence of burning gas was not found elsewhere in the explosion area.

Flame: Evidence of heat or flame, in the form of ashes, coke, soot, or partly burned paper, canvas, and wood, was observed in the 2 left section throughout the face regions and for a distance of approximately 1,900 feet outby. The victims of the explosion, all found within 875 feet of the faces of 2 left section, were burned severely. Evidence of flame was not found anywhere in the affected areas except in 2 left section.

Evidence of explosives having been discharged by forces or flame was not found, although 13 cartridges of explosive in a rubber bag and 50 electric detonators in a cardboard container were found about 75 feet outby the face of the working place where the explosion originated. Quantities of explosives and detonators were near and in the section explosives-storage boxes in crosscuts about 825 feet outby the face of No. 3 entry of 2 left entries.

A total of 174 dust samples was collected in the Pine Ridge main entries, Pine Ridge left entries, and 2 left entries off Pine Ridge left entries (see Table 2 and Appendix C). 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 flame was fixed, although it is possible that such coke farthest from the face regions of 2 left section may have been blown there. Thirty-four of the forty-eight samples collected in 2 left entries contained coke ranging in quantities from traces to very large particles. Samples of dust collected from the top of 5 of the 16 loaded cars at the loading point contained small amounts of coke. Coke that ranged from a fraction of an inch to more than an inch in thickness was plastered on roof bolts, on roof-bolted cap pieces, and on other material for a distance of about 1,900 feet outby the faces of the 2 left entries. Several of the dust samples collected in the Pine Ridge entries near the junction of Little Horsepen entries contained coke, but it is assumed that such coke at this location resulted from the February 1957 explosion.

Forces: Difficulty was not 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 2 left section, and the emanation of forces was from these face regions outward to Pine Ridge left entries, a distance of about 2,900 feet, then west into the Pine Ridge left and Pine Ridge main entries, distances of about 900 and 1,900 feet, respectively, and northeast to the man-shaft a distance of about 7,000 feet. Three mine cars across No. 4 entry of 2 left entries at a 4-way intersection about 1,300 feet outby the faces were blown off the track and the car in the middle of the entry was overturned by the forces of the explosion. The trolley wire was blown down at the same location. Pieces of canvas and other material in the 2 left entries were blown outward. One concrete-block stopping in the first crosscut between Nos. 5 and 6 Drainway entries, a distance of about 250 feet outby the face of No. 6 entry of 2 left entries, was blown toward No. 6 Drainway entry and outward from the face of No. 6 entry of 2 left entries. Five of the six stoppings destroyed between Nos. 5 and 6 entries of 2 left entries were blown toward No. 6 entry and the other one was blown toward No. 5 entry. The stopping across No. 5 entry, opposite the regulator, was blown toward the mouth of the entries. Six concrete-block stoppings that were destroyed between Nos. 2 and 3 entries of 2 left entries were blown toward No. 2 entry. A stopping installed across No. 2 entry, opposite the regulator, was blown toward the mouth of the entry. An overcast at the intersection of No. 2 entry of Pine Ridge left entries and No. 4 entry of 2 left entries and an overcast in No. 1 entry of Pine Ridge right entries were damaged slightly.

Forces of the explosion dissipated rapidly after reaching the junction of 2 left and Pine Ridge left entries.

Probable Point of Origin: The consensus of the investigators of the Bureau of Mines is that the explosion originated about 35 feet outby the face of No. 3 Drainway entry at a location where shots from No. 6 entry of 2 left entries blasted through into No. 3 Drainway entry.

Factors Preventing Spread of Explosion: The areas affected by the explosion are shown on the mine map (Appendix B). 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 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, 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 examination made several hours before the explosion.

2. The Pocahontas No. 3 coal bed in the area is extremely "gassy," and normal mining operations cause large liberations of methane at working faces. Generally, the greatest liberation of methane occurs during the cutting, shearing, and blasting operations.

3. The eight 12:00 to 8:00 a.m., employees working overtime in 2 left section undercut and sheared a face and blasted 2 coal faces, although the general night foreman authorized overtime for cleaning roadways, erecting cribs, and making a new loading ramp.

4. All forces emanated from No. 3 Drainway entry off 2 left entries.

5. The turning of the Drainway entries off 2 left entries and the simultaneous developing of both sets of entries required that the number of working places ventilated by the left air split be increased from 3 to 5 and by the right air split from 3 to 4 and required a comparable increase in the number of check curtains and line brattice to ventilate the 9 working faces.

6. The use of additional check curtains and line brattice for ventilating 9 working places as compared with 6 working places increased the hazards of air leakage and interruptions of the ventilating air current in the face regions.

7. Generally, check curtains and line brattice were erected with single plys of brattice cloth, and line brattice was fastened only to bolted cap pieces at the roof and about 4 feet apart. Such installations permitted excessive air leakage and damage by blasting and by equipment and men passing through the line brattice and check curtains.

8. The bodies of the 22 men in the 2 left section were found within 40 to 875 feet of the working faces. It is extremely doubtful that any of these men, except the third-shift shot firer, moved more than a few feet after the explosion, and most of the day-shift employees were traveling to their posts of duty when the explosion occurred.

9. The fire-boss' record book for 6 consecutive days, including the day of the explosion, showed that the 2 left shuttle-car roadways needed cleaning, and a mine safety committeeman, who was in the 2 left section several hours before the explosion, testified that the parts of the roadways he observed were dirty. The fire-boss' record book showed that the dirty roadways in 2 left section were wetted down on 2 different days during the period October 22-27. Dangerous accumulations of loose coal and dust were present on these roadways during the investigation.

10. Areas inby the mine-car loading points were rock-dusted by hand, and the rock-dusting inby the loading point in 2 left section appeared to be inadequate.

11. Rock-dusting outby the mine-car loading points was generally adequate, as explosion propagation was stopped by the rock-dust applications.

12. Plastered coke found in the 2 left face regions and outby the face areas indicated that coal dust assisted in propagation of the explosion. How extensive this explosion would have been and how far flame and forces would have traveled if the areas of 2 left section inby the loading point had been cleaned and rock-dusted adequately are conjectural. However, it is almost certain that the magnitude of the explosion would have been decreased considerably if the areas had been clean and rock-dusted adequately.

13. The fire boss, who examined the 2 left section for the shift prior to the explosion, reported that the machine was waiting for gas to clear in No. 7 working place and gas was detected in No. 8 working place shortly after blasting. This fire boss detected gas 15 times in 10 different days during his preshift examinations of 2 left section in the period October 1 to 24, 1958. Such gas was generally found during cutting operations or immediately after blasting.

14. Employees testified that working places were occasionally bypassed by the loading machine because such places were not clear of gas liberated during blasting operations, and although developing sections were ventilated with two air splits, loading, cutting, and blasting operations occurred simultaneously occasionally in one split of air.

15. Work of completing the undercut, making the shear cut, and then blasting the cut in No. 5 place in 50 minutes was performed too rapidly to allow the large amount of methane liberated during these operations to be diluted and carried away by the ventilating current.

16. None of the face electric equipment was in the immediate face areas or being operated at the time of the explosion.

17. Several of the midnight-shift employees were cleaning the roadway in No. 4 entry of 2 left entries with a loading machine and shuttle cars, the day-shift crew was proceeding from the section man-trip station to the working faces, and the face of No. 6 entry was being blasted when the explosion occurred.

Cause of the Explosion: The Federal investigators are of the opinion that the disaster was caused by the ignition of methane liberated from the face of No. 3 Drainway entry following blasting operations at the face. This methane was ignited when shots fired at the face of No. 6 entry of 2 left entries blasted through into No. 3 Drainway entry, 30 to 37 feet outby the face. Coal dust in the areas inby the mine-car loading point entered into the explosion and aided in its propagation.

RECOMMENDATIONS

The following recommendations are made to prevent similar disasters:

1. Examinations for methane should be made immediately before firing each shot or group of shots and after blasting is completed. Shots should not be fired in any place where methane can be detected with a flame safety lamp.

2. Before firing shots in an area where there is a possibility of blasting through to an adjacent place, the person firing the shots should carefully examine such adjacent place with a flame safety lamp immediately before blasting and be certain that methane is not present before the shots are fired. Drilling through or cutting through to an adjacent place should always require that the aforementioned precautions are followed.

3. When working places are cut and/or drilled through to an adjacent place, employees performing the drilling and cutting operations should advise the section foreman of the occurrence, and the foreman should then supervise the blasting operations to be certain that the necessary safety precautions are taken.

4. In mines that liberate gas freely, new sets of entries should not be turned and developed simultaneously with an older set of entries. Projected new entries should not be turned and developed until permanent and adequate ventilation facilities are provided for each set of entries.

5. The use of check curtains to control main ventilating currents should be held to the absolute minimum, and check curtains should be constructed of several layers of brattice cloth and installed and maintained as reasonably airtight as possible or other effective means such as doors should be used to control the air currents.

6. 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 or curtains to permit equipment to pass through, the check curtain or curtains should be put back in place as soon as the equipment has passed.

7. In mines that liberate gas freely, line brattice should be installed and maintained to minimize the possibility of methane accumulating in the working places. The line curtain should be fastened securely at the top, bottom, and middle to conduct a sufficient quantity of air to developing working faces.

8. Any man whose duties require that he examine for gas with a flame safety lamp should not be permitted to use such lamp until he has demonstrated thoroughly his competency to assemble properly and positively detect the presence of methane and oxygen deficiency. Men who are required to examine for gas regularly should be reexamined at least annually for competency with the use of the lamp.

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

10. 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 and the report should show what action, if any, was taken to remedy the danger or dangers. Frequent reporting of gas in an area should be investigated by higher officials and remedial action should be taken immediately.

11. Loose coal and coal dust should not be permitted to accumulate in dangerous quantities in underground workings.

12. Management officials should take whatever action is needed to have officials correct promptly serious hazards reported to them or listed in the mine record books.

13. Rock dust should be applied with portable rock-dusting machines or wet rock-dusting should be done in the areas inby the mine-car loading points.

14. Where rock dust is applied, it should be applied 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.

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

16. Each flame safety lamp should be assembled only with parts approved for the particular type lamp.

17. Each person should have a self-rescuer while underground, and he should be thoroughly familiar with its safe maintenance, use, and limitations.

18. Serious consideration should be given to the problem of eliminating intensive methane liberations during normal mining operations, and especially during cutting, shearing, and blasting operations in this gassy mine.

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Respectfully submitted,

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APPENDIX A

VICTIMS OF EXPLOSION, BISHOP MINE

POCAHONTAS FUEL COMPANY, DIVISION OF CONSOLIDATION COAL COMPANY

October 27, 1958

Shift	Name	Age	Occupation	Marital Status	Number of Dependents
First	M. D. McKinney	55	Brattice Man	Married	2
First	Bandy Beavers	57	Shot Firer	Married	1
Third	Tony Vilacha	53	Roof Bolter	Married	1
First	Coloso Wilson	49	Boom Man	Married	4
Third	Ulysses D. Spradlin	36	Loading-Machine Operator	Married	2
Third	James H. Neeley	25	Shuttle-Car Operator	Married	2
First	Doris Stiltner	33	Electrician	Married	4
Third	Jack Garland	34	Shuttle-Car Operator	Married	3
First	John Gates	53	Electrician	Married	3
First	Neil Rutherford	49	Section Foreman	Married	1
Third	Elbert Wilfong	47	Electrician	Married	2
Third	Galvin Blankenship	49	Section foreman	Married	1
First	Sam Gillespie	43	Shuttle-Car Operator	Married	1
First	Fred Earl Bandy	53	Cutting-Machine Operator's Helper	Married	1
First	Kenneth C. Sexton	44	Loading-Machine Operator	Married	6
First	Louis A. Ferguson	46	Loading-Machine Operator's Helper	Married	4

Shift	Name	Age	Occupation	Marital Status	Number of Dependents
First	Robert Winningham	38	Shuttle-Car Operator	Married	7
Third	Arthur Hill	58	Shot Firer	Married	1
Third	Holliday Sutherland	46	Cutting-Machine Operator	Married	5
First	Alex Adderton	52	Roof Bolter	Married	2
First	Harold Dangerfield	39	Roof Bolter	Married	4
First	William D. Johnson	47	Cutting-Machine Operator	Married	4