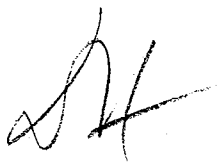
FINAL REPORT, GAS AND DUST EXPLOSION, MACBETH MINE, HUTCHINSON COAL COMPANY, MACBETH, W. VA., SEPTEMBER 2, 1936

By

C. W. Owings,
Associate Mining Engineer

and

P. P. Senio,
Junior Safety Instructor



DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

FINAL REPORT, GAS AND DUST EXPLOSION, MACBETH MINE, HUTCHINSON COAL COMPANY, MACBETH, W. VA., SEPTEMBER 2, 1958

By

C. F. Cudnegs,
Associate Mining Engineer

and

P. P. Benio,
Junior Safety Instructor

DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

C O N T E N T S

	Page
Introduction	1
Location	2
Employees	3
Mine openings	3
Coal bed	3
Method of mining	4
Ventilation	5
Haulage	9
Lighting	10
Machinery underground	10
Explosives	11
Drainage	11
Dust	12
Samples of dust	13
Rock dust	14
Mine-rescue equipment	15
Safety organization	15
Supervision and discipline	15
Fire fighting	16
Mine conditions immediately prior to the disaster	16
Previous explosions and fires	16
Property damage	17
Forces	17
Evidence of heat or flame	18
Rescue and recovery operations	19
State inspectors' conclusions	22
Summary of evidence	22

CONTENTS - Cont'd

Page

Cause of explosion 26

Lessons to be learned. 27

Recommendations. 27

Acknowledgments. 29

Mine maps

FINAL REPORT, GAS AND DUST EXPLOSION, MACBETH MINE, HUTCHINSON COAL COMPANY, MACBETH, W. VA., SEPTEMBER 2, 1936

By C. W. Owings and P. P. Senio

Introduction:

An explosion of gas and dust occurred between 1:15 and 1:30 p.m., September 2, 1936, in the MacBeth mine of the Hutchinson Coal Company, at MacBeth, W. Va., resulting in the death of 10 men, 8 of whom died as a result of burns and violence, and the injury of 1 man due to inhalation of afterdamp. This man was rescued and revived after the explosion. No men tried to protect themselves by a barricade; however, 2 of the men could have saved themselves if they had remained in the working place or erected a barricade. The accident undoubtedly resulted from ignition of gas by a cable-reel locomotive near the face of 14 room off 13 right entry. The flame was restricted to 12 and 13 right entries. Rock dust had been applied during December 1935 along the haulage road on 13 right entry as far as room 8. A water hole on 12 right entry and in rooms 7 and 8 between 11 and 12 right undoubtedly prevented flame extending into 11 right and entries outby. It is believed that the rock dust at 13 right played an important part in extinguishing the flame.

The Bureau of Mines was notified in Pittsburgh by Associated Press about 6:00 p.m. F. E. Griffith, who was in Charleston, W. Va., at the time, and C. W. Owings, who was at Madison, W. Va., were not notified until Mr. J. J. Forbes reached them by telephone from Pittsburgh, Pa. C. W. Owings was reached at Sharples, W. Va., at 9:50 p.m., September 2, and F. E. Griffith was notified at 9:00 a.m., September 3.

C. W. Owings proceeded to MacBeth and found that H. P. Rhinehart, chief of the West Virginia Department of Mines; P. D. McMurrer, director of safety of the West Virginia Department of Mines; and J. F. White and Young Lawson, mine inspectors, West Virginia Department of Mines, were underground. H. P. Farley, mine inspector, West Virginia Department of Mines, was on the surface at the time the Bureau's representative arrived. He was informed that the assistance of himself and the Bureau of Mines was not needed, as on 13 right entry the roof was falling ahead of and behind the rescuers, necessitating timbering of the roof before further attempt to rescue the bodies could be made. C. W. Owings entered the mine the next morning and conferred with the rescuers. He remained underground at the scene of rescue operations until the last bodies were recovered about 5:00 p.m. that day. Four oxygen breathing apparatus crews were on hand and at least one crew was underground ready for immediate use if necessary; however, all recovery operations were made with gas masks but without respiratory protection.

Locations:

The MacBeth mine is situated in Logan County, West Virginia, at MacBeth. The mine is served by the Chesapeake & Ohio Railway. The mine is owned and operated by the Hutchinson Coal Company, with general offices in the Jacobs Building, Fairmont, W. Va., and local offices for the Logan division at MacBeth, W. Va. The principal operating officials are:

H. L. Hutchinson,	president,	Fairmont, W. Va.
T. E. Johnson,	vice president in charge of operations,	Fairmont, W. Va.
W. H. Myers,	general superintendent,	MacBeth, W. Va.
H. N. Clendening,	mining engineer,	MacBeth, W. Va.
E. W. Stafford,	mine foreman,	MacBeth, W. Va.

Employees:

The average employment is about 175 men, of which number 28 work on the surface and the balance are employed underground on two shifts. There are approximately 100 coal loaders employed, 76 on the day shift and 24 on the night shift.

The average production is approximately 1,300 tons per day.

Mine openings:

The coal is reached by means of a rock slope driven at an angle of 36 degrees for a distance of about 640 feet, to intersect the coal bed. In addition to the slope, there are two shafts approximately 120 feet deep. The shafts are about 300 feet apart, and one shaft is about 75 feet from the slope.

Coal bed:

Development is in the Eagle coal bed, which averages 6 feet in thickness, although the coal bed is much thinner in some parts of the mine. The coal bed dips toward the face of the main heading, having an elevation of 531 feet at 13 right and 606 feet at 2 right. The average grade of the haulage road is approximately 1.36 percent in favor of the empty trips.

The roof is shale, but apparently disintegrates upon exposure to air, causing it to fall rather readily. In order to protect the roof, the coal is cut near the top of the bed, leaving a layer of coal, shale, and a bony parting about 8 inches thick to form the immediate roof.

Coal in the Mehue mine, which adjoins the MacBeth mine, has been sampled by Bureau of Mines representatives. The average analysis of this coal is as follows: Moisture, 2.8%; volatile matter, 33.7%; fixed carbon, 58.8%; ash, 4.8%; sulphur, .7%; B.t.u., 14,330.

The ratio of volatile matter to volatile matter plus fixed carbon is equal to .36. This analysis indicates that the coal is of bituminous rank and having a volatile to combustible ratio only slightly less than the Pittsburgh coal bed. Dust from the Eagle coal is practically as explosive as the Pittsburgh coal dust.

The coal in the Delmo mine was sampled in 1931 by W. J. Rose and J. O. Marshall, Jr.

Method of mining:

Coal is extracted on a room-and-pillar panel system. A set of 6 entries extend from the foot of the slope to the face of the main entries, at which point 2 pairs of entries are driven at an angle of about 10 degrees, and parallel to the barrier pillar protecting the Gabney mine of the same company. Pairs of entries are turned to right and left at distances of 350 feet. These panel entries are driven about 20 feet wide on 50-foot centers. Consequently, from the air course of one set of entries to the haulage entry of the next set of entries inby is 300 feet, leaving a pillar of 200 foot thickness; room 1 is driven 250 feet from the main entry and 90 feet inby is driven room 2. Rooms are driven 20 feet wide with crosscuts about 80 feet apart. These 2 rooms are driven to intersect the air course of the next set of entries outby. They are used for ventilating purposes. Rooms 7 and 8 and 13 and 14 are driven for ventilation purposes as the entries advance. When a set of entries reaches the limit, rooms are driven and the coal extracted on a full retreat system. Coal is all mined by hand. The coal is first top-cut by means of Jeffrey 29-B nonpermissible-type mining machines.

On main entries some cross bars are used to support the roof, but in general support is obtained by means of posts set about 3 to 4

feet apart on both sides of the track. The same procedure is followed in rooms. Split props serve as timber. Cap pieces are made from boards 2 inches thick and of various widths. The props are about 18 inches long. Posts are placed within 5 feet of the face before the coal is cut, and generally the posts are not advanced until the cut is loaded out. By placing the timber 3 or 4 feet apart, the roof is apparently well supported.

Ventilation:

The mine is ventilated on two splits of air; each side of the mine is being ventilated by separate splits of air. Ventilation is induced by a 4- by 10-foot Robinson multiblade fan, protected by an explosion door and provided with suitable doors to reverse the direction of the air current. On September 22, 1936, the fan was delivering 73,120 cubic feet of air per minute. The fan is not provided with a water gage, but it was estimated that the pressure on the air was 1-1/4 to 1-1/2 inches. The fan is driven by a 100-horsepower General Electric induction-type motor, 3 phase, 60 cycles, 220 volts, and 240 amperes, at 880 r.p.m. The motor drives the fan by 10 "C" section V belts. The fan is housed in a brick and steel building, the fan casing being of steel whereas the walls are of brick. The roof is of wood and a door leading into the side of the fan is also constructed of wood. In the motor compartment of the fan house oil was stored in several containers provided with pumps. Electric wires leading from the fan starting switch were supported on iron hooks and carried through the wooden window frame, without protection or insulators. Other miscellaneous material was stored in the compartment, forming a fire hazard which should not be allowed to exist.

On August 15, two weeks before the explosion, approximately

85,000 cubic feet of air per minute was being exhausted by the fan. Of this quantity about 8,500 cubic feet a minute was available for the split of air ventilating the right side of the mine, starting at 16 right entry. In the last crosscut in 13 right, 4,320 cubic feet of air per minute was measured. A few days before the explosion a sample of air collected on 13 right entry just inby room 9 showed a methane content of .63 percent, according to the company chemist.

On September 2, 1936, the fire boss, L. R. Hill, entered the mine at 1:02 a.m. and returned to the surface at 5:00 a.m. He reported finding no gas in the 13 right section, although gas had been found in rooms 13 and 14 every 3 or 4 days previously. Practically no overcasts are used except near the air shaft. Gob stoppings are used, or in some cases masonry stoppings are used, along the main entry. In side entries wooden stoppings are used, but no means are provided for stopping leaks between joints in the boards. Line brattice is used to conduct air to the face of workings.

Prior to the explosion the air came in the two middle entries on 2 west flat to a point just inby the turn-out to 16 right, at which point the air split, passing through a cross-over to the 2 left entries; part of the air then returned through the left side of the mine, and the remainder proceeded to the face of the main entries and returned through the right side of the mine. On August 15 less than 9,000 cubic feet of air per minute was passing through the last crosscut in main entries. The air in the last crosscut on 13 right, on August 15, was 4,320 cubic feet per minute. On September 22, 1936, after ventilation had been restored, the course of the air had been changed so that the entire quantity of air was conducted to 14 right, where it was split, part of the air passed through 1 and 2 rooms off 15 right and thence through 16

Table 1.- Analysis of mine air samples, MacBeth mine, September 1936

Laboratory No.	Location in mine	Percent				Cu. ft. of air per minute	Cu. ft. methane per 24 hours
		Carbon dioxide	Oxygen	Methane	Nitrogen		
61052	14 right, room 7	0.04	20.90	0.05	79.01	10,800	
	Behind brattice, 13 right, 14 room	-	-	-	-	5,400	
61055	Face of room 14, 13 right	0.07	20.68	1.07	78.18		
	Face of crosscut 18 feet outby face of room 13, 13 right	0.09	20.84	1.18	78.06		
61063	50 feet inby 13 right, room 8 (return from 13 right)	0.03	20.94	0.46	78.67	6,340	45,308
	Two main returns:						
61051	Return air near shaft	0.10	20.79	0.24	78.87	33,430	115,707
61056	do.	0.09	20.78	0.23	78.90	44,640	147,119
	Total return					78,120	262,826

right and the main headings to the left side of the mine. A second split was carried through 14 right air course. Opposite room 7, 10,800 cubic feet of air per minute was measured on September 22, 1936. This current was then conducted through room 14, driven to 13 right, after the explosion. A curtain across room 14 off 13 right just outby the first crosscut directed the current between the rib and line brattice to the face of room 14 off 13 right entry. A measurement taken at the entrance to this curtain showed 5,400 cubic feet of air passing toward the face. At the face there was a definite velocity of air which, however, was not strong enough to turn an anemometer. An air sample taken at the face of room 14 contained 1.07 percent methane. Several hours before this sample was taken there was an indication of a feeder, with gas issuing from the kerf. Indications are that the explosion occurred in this room and the feeder probably was present at the time of the explosion. The current of air returned from this face through the crosscut to the face of room 13 and thence to 13 right as far as room 9. At the face of the crosscut at room 13 on September 22, 1936, there was 1.18 percent methane in still air. In room 9 there was .46 percent methane in 6,000 cubic feet of air per minute, which is equivalent to 65,308 cubic feet of methane in 24 hours. Several days before the explosion the company chemist analyzed a sample taken at this point and found .33 percent methane in the air, indicating a potentially hazardous, gassy condition. The air current passes through room 9 to the faces of 12 right air course and entry pickup, returning through rooms 7 and 8 to 13 right entry, from which point it ventilates the remaining workings on the right side of the mine before returning to the upcast shaft. Normally the fan exhausts about 88,000 cubic feet of air per minute, but on September 22, 1936, there was 78,120 cubic feet of air per minute, divided as follows: 33,480 cubic feet per

minute returning from the left side of the mine, with a methane content of .24 percent, equivalent to 115,707 cubic feet of methane in 24 hours. The return from the right side of the mine was 44,640 cubic feet of air per minute, with a methane content of .23 percent, which is equivalent to 147,119 cubic feet of methane in 24 hours. The total quantity of methane liberated based on these samples is 262,826 cubic feet of methane in 24 hours, indicating that this is a definitely gassy coal mine. At the time of the investigation, improvements were being made. Wooden stoppings were being coated with cement to reduce air leakage. Six, and possibly 7, automatic mine doors were to be installed in entries where haulage was most frequent, in order to remove trap doors from the entry. Plans have been made for building overcasts, and at one point where one of the main entries has not been driven, a connection is now being made to provide an additional airway and to allow installation of an overcast.

It is believed that the plans for improving the ventilation are commendable and should be carried to completion as soon as possible. Furthermore, all of the workings outby 9 right should, if possible, be adequately sealed to prevent air leakage. It is believed, further, with a large cross-sectional area that a minimum of 10,000 cubic feet of air per minute should be maintained at the last crosscut in every set of entries. Entries driven 20 feet wide, with an average height of 4 feet and a cross-sectional area of 80 feet, will provide a velocity of 125 feet per minute with 10,000 cubic feet of air. A velocity less than this probably would be inadequate for diluting and removing explosive gas. Even under the improved ventilation, about three fourths of the quantity of air delivered by the fan is lost before it reaches the first working place.

The methane content in the return air from any set of entries should not exceed .25 percent and, if possible, it should be less than this percentage.

Haulage:

The track is laid to a gage of 48 inches; 30-pound rail is used on main haulage and side entries, laid on wooden ties; in rooms 20-pound rails are used, generally in conjunction with steel ties, although some wooden ties are used. The clearance is difficult to estimate, as it varies considerably, ranging from 2 to 4 feet. Crosscuts are used for shelter holes and in the side entries; these were free of debris. A wood and steel closed-type car is used. Cars are wider than ordinary and have a capacity of 3 tons. There are no endgates on the cars, as cars are dumped in a rotary dump. Consequently there is little spillage of coal from cars. Coal is hauled on the main line by a General Electric 13-ton trolley locomotive and a Goodman 10-ton 343 trolley locomotive. Coal is gathered with 7 cable-reel locomotives; 1 Jeffrey M.H.100, 8-ton cable-reel locomotive; 3 Jeffrey M.H.88, 6-ton cable-reel locomotives with a motor-driven R-6 reel; and 3 General Electric M.H.A. 6-ton cable-reel locomotives with CY-21 floating-type reels. Main haulage is on intake air and gathering haulage is on return air. Trolley wire is guarded at crossings with fire hose; this is not considered safe because during the investigation, several days after the explosion, while the locomotive was on the main entry at 14 right, the hose caught fire and strands were flaming along its entire length, caused by arcs formed when the head hook was moved along the wire. No flying switches were made while the investigators were present. During the last day of the investigation an empty car was attached to the gathering locomotive taking

the investigators and some mine employees to the slope bottom. On the way out, when the car was full, 2 men jumped on the rear bumper and rode to the slope bottom. The extent to which cars are coupled while moving could not be determined; however, one brakeman was observed to stand in the center of the track holding the coupling link while another car was pushed toward him. As the two cars came together, he jumped upon the bumpers to complete the coupling. This is a dangerous practice that might result in a fatality.

Lighting:

Bare electric lamps are installed on the slope bottom and at important turn-outs along the main haulage roads. Miners wear permissible Edison model K electric cap lamps. Haulage men, foremen, and a limited number of employees have lamps provided with polished reflectors. This is a decided advantage for haulage employees as, due to the undulating character of the haulage road, it is often difficult for the motorman to see the brakeman. But the concentrated beam may be seen when an ordinary type of light could not be discerned.

Machinery underground:

Coal is mined with 4 Jeffrey 29-B arcwall nonpermissible mining machines. Water is pumped by 4 nonpermissible-type pumps. Electric power underground is 250 volts direct current, except for the line of lights on the main slope, which are supplied with 110 volts alternating current. 0000 trolley wire is used and this is supplemented with two 500,000 circular mil. conductors. On the main haulage one of these feeder lines is suspended directly above the trolley wire on special hangers. Main haulage is further guarded by adequate bonding, but in butt entries, particularly at the face and in rooms, there is no bonding, resulting in sparks at the rail joints in rooms and at the end of haulage roads. Apparently

cables are spliced underground whenever a break occurs. Sectional switches are placed at the entrance to all butt entries and at intervals along main haulage roads.

Periodic inspection of electric equipment is not made.

Explosives:

Permissible explosives, Monobel 9 and 11 L.F. and Monobel C, are used for blasting. Holes are drilled by hand augers, producing a hole 1-3/4 to 2 inches in diameter. Explosives are delivered in a special trip in an insulated explosives car, then delivered to the sections. Miners store explosives in canvas knapsacks, in which detonators are also kept, placed in a cylindrical wooden container. Dry-cell batteries with recessed terminals are used for blasting by miners, who fire shots whenever they are ready. Miners are limited to one day's supply of explosives. No special niche is provided in the coal rib for storing explosives. In room 14 off 13 right near the point of origin of the explosion was found a knapsack containing 3 sticks of Monobel C explosive and an empty wooden detonator box, with the screw top missing, and a dry-cell battery placed in a tin tobacco can. The bag was lying on the floor near the rib, about 25 feet from the face. In the adjoining room no explosives container could be found, but 2 sticks of Monobel C were found on the rib at the entrance to the crosscut. Holes are cleaned with steel scrapers, and presumably the other end of the scraper is used for tamping the stemming into place, although this operation was not observed.

Drainage:

The mine, although containing pools of water in some places, could not be classed as a wet mine, inasmuch as only 4 pumps are used for dewatering the mine and only 2 of these are used for gathering sur-

vice. They are an Austin 6- by 6-inch pump with 50 gallons per minute capacity, and a 5- by 5-inch mining pump of the same capacity. Water is pumped to the surface by an Alberger 5-stage centrifugal pump with a rated capacity of 600 gallons per minute against a 330-foot head. It is now working against a 250-foot head, however. It is driven by a 125-horsepower nonpermissible motor. In addition to this pump, there is a Weinman 2-stage pump with a rated capacity of 300 gallons per minute. It is driven by a 75-horsepower direct-current compound-wound open motor.

Dust:

The coal is friable, causing the formation of considerable dust, which was present on the roof, rib, timber, and floor.

In general, the haulage roads were kept relatively free from accumulations of dust on the traveling side of the entry. The quantity of dust taken on the floor ranged from 100 to 132 grams in a strip 6 inches wide and approximately 20 feet long, or, roughly, 10 to 13 grams of through-20-mesh dust per square foot of roadway. On roof and ribs in non-rock-dusted areas, through-20-mesh dust ranged from 72 to 125 grams in strips 6 inches wide extending from floor to roof--approximately 5 feet in height--and across an entry a distance of 20 feet. In other words, the density of dust on roof and ribs ranged from about 5 to approximately 8 grams per square foot. The dust is not watered, although some rock dust is used. Cars are topped, although not excessively, due to the fact that the roof is low in a number of places. Cars are tight, as there are no endgates. These cars are dumped in a rotary dump, obviating the necessity of having endgates. This construction also reduces coal spillage on haulage roads.

Samples of dust:

Composition of the dust is shown in table 2.

The mine was sampled at 5 points in the explosion area and just outby this area. At the time the samples were collected the mine had been freshly rock-dusted and a definite estimate of the condition of the dust at the time of the explosion could not be obtained. The rock-dusted part of 13 right was so full of fallen material that samples could not be collected in this area. The first 3 analyses in table 2 of rib and roof dust and likewise of road dust are indicative of the dust in non-rock-dusted areas.

The volatile matter ranges from 26.6 to 28.9 percent; the fixed carbon from 59.2 to 61.7 percent; and the ash from 8.6 to 10.0 percent. The road-dust samples have closely the same general range. The ash content of road dust samples, however, is somewhat higher, ranging from 9.0 to 15.7 percent. It appears significant that the ash content increases progressively from the point of origin of the explosion, outby.

The explosibility of coal dust depends in a large measure upon the size of the dust, its composition, its inflammability, amount of gas in the mine air, the quantity and distribution of the dust, the source of ignition, and surrounding conditions. Of course, extraneous moisture--that is, moisture that is not part of the coal--enters into the explosibility of the coal dust in that wet dust is difficult to raise into a cloud sufficiently dense to cause an ignition or propagation of an explosion.

The U. S. Bureau of Mines has determined that the ratio of volatile matter to volatile matter plus fixed carbon gives a definite indication of the explosibility of coal dust. This ratio for the Eagle coal bed is approximately .36 and in the dust samples the ratio averages .31.

The screen tests indicate that the mine dust averages about 20 percent through-200-mesh. This size of dust from the Eagle coal bed may be rendered inert to explosibility by adding enough rock dust to maintain an ash content of the dust above 65 percent, this quantity of dust being sufficient to prevent propagation of an explosion with 1 percent of methane in the mine air.

Rock dust:

It has been the practice to rock-dust the MacBeth mine about once a year. The last application was in December 1935. The 13 right entry haulage road was rock-dusted as far as room 8 and on 14 right as far as room 2. Dust is applied with a Mine Safety Appliances Company high-pressure type rock-dust distributor; limestone dust is used. The effectiveness of rock-dusting immediately after the application of the dust is shown in table 2, in samples B-15766-67 and B-15774-75. The ash content of these samples at room 2 on 14 right was 48.6 percent on roof and rib and 60.7 percent on the floor; at 11 right, room 2, the ash content was 75.3 and 76.3 percent on roof and rib and on the floor, respectively.

Following the explosion, rock-dusting was extended to the face of all haulage roads, and it is now the intention of the management to extend the rock-dusting weekly.

It is believed that the rock-dusting schedule should be made to include all active working places, including air courses and rooms. Care should be taken to apply enough dust to maintain the ash content above 65 percent. If properly applied, as in 11 right, the density of 8 pounds of rock dust per linear foot of entry should provide adequate protection. The rock dust should be sampled about once a month at points

Table 2.- Analysis of dust samples, MacBeth mine, September 1936

Laboratory No.	Location in mine	Percent				Screen test of 20-mesh dust		
		Moisture	Volatile matter	Fixed carbon	Ash	Percent through 48-mesh	100-mesh	200-mesh
	Rib and roof dust							
B-15769	13 right, room 14, 35 ft. outby face	3.1	26.6	61.7	8.6	-	-	-
B-15771	13 right, 25 ft. inby room 9	2.5	28.9	59.2	9.4	58.8	31.2	21.6
B-15772	14 right, room 7, 30 ft. inby entry	3.5	27.0	59.5	10.0	45.0	28.6	17.5
B-15774	14 right at room 2	2.3	**	*49.1	48.6	-	-	-
B-15767	11 right at room 2	7.1	**	*17.6	75.3	81.5	71.6	60.7
	Road dust							
B-15768	13 right, room 14, 35 ft. outby face	3.5	26.0	61.5	9.0	52.2	29.6	18.7
B-15770	13 right, 25 ft. inby room 9	3.1	27.4	56.9	12.6	49.9	27.9	17.9
B-15773	14 right, room 7, 30 ft. inby entry	4.8	26.4	53.1	15.7	30.6	16.7	9.4
B-15775	14 right at room 2	4.3	**	*35.0	60.7	60.5	30.3	18.8
B-15766	11 right at room 2	5.9	**	*17.8	76.3	66.5	41.8	32.8

*Combustible only.
**These samples were taken in freshly rock-dusted areas.

Remarks: B-15769 contained a large amount of coked particles.
B-15771 contained small amounts of coked particles.
B-15772, B-15774, and B-15767 contained no coked particles.
B-15768 contained a considerable amount of coked particles.
B-15770 contained small amounts of coked particles.
B-15773, B-15775, and B-15767 contained no coked particles.

about 1,000 feet apart on all haulage roads. If difficulty is encountered in maintaining the ash content on roadways, it may be advisable to wet the road bed at frequent intervals to help allay the dust.

Mine-rescue equipment:

There are no self-contained oxygen breathing apparatus at the mine, although several trained crews with apparatus are within a short distance of the mine. The adjoining Dehue mine has a crew trained in oxygen breathing apparatus use. The company at the time of the explosion had 6 Burrell All-Service gas masks, although no system of inspection of the gas masks was in effect. The masks appeared to function satisfactorily during the explosion except for one mask, which was involved in the collapse of one of the rescuers. Whether this collapse was due to inhalation of carbon monoxide or to over-exertion of the rescuer was not definitely determined.

Safety organization:

The company does not employ a safety engineer, but a Holmes Safety Association chapter has been more or less active at this mine. The management appears eager to make a success of the chapter and to increase safety, but the men at the mine have not fully cooperated.

Supervision and discipline:

The mine was not observed while in operation, but from general observations it is believed that supervision is or should be effective. On the other hand, it is difficult to supervise the men as, in general, only 4 or 5 men are working close to each other. The mine foreman is supposed to visit each place during the shift and the assistant foremen also visit each place in their section once during each shift.

Fire fighting:

There is no fire-fighting organization maintained. Portable electric machines underground, as far as could be observed, are not protected with fire extinguishers.

Mine conditions immediately prior to the disaster:

The weather was cloudy and during the night of the explosion there were several hard rain storms. While no barometric reading could be obtained for this vicinity, the storms indicate a falling barometer at the time of the explosion. The mine was working on the day of the explosion, but had been idle the day before. The fan was operating normally and had not been stopped for any reason. The fire boss had reported the section of the mine clear of standing gas while making his rounds on the morning of the explosion. The section foreman had visited 13 and 14 rooms, 13 right, about 10:00 a.m. on September 2, 1936, at which time there was no indication of gas, although the coal had not been shot at that time.

Previous explosions and fires:

At least 12 mine explosions have occurred in this district. A list of these have been brought to the attention of the Bureau of Mines as follows:

Date	Mine	Number killed	Number injured	Type of explosion
Feb. 16, 1907	Yuma	2	2	Dust
June 22, 1916	Western Union No. 2	1	0	Gas
Mar. 31, 1919	Island Creek No. 2	1	0	Dust
July 4, 1921	Island Creek No. 13	1	0	Gas
Oct. 16, 1922	Island Creek No. 13	1	0	Dust
Feb. 19, 1925	Island Creek No. 7	0	5	Dust
Apr. 8, 1925	Macbeth	3	0	Gas and dust
Nov. 12, 1928	Dehue	1	0	Gas and dust
Nov. 5, 1931	Island Creek No. 2	5	0	Gas and dust
Nov. 30, 1931	Eagle No. 1	3	0	Gas and dust
July 31, 1932	Lyburn	2	0	Dust
Aug. 22, 1933	Dabney	3	0	Gas and dust

Five of the explosions occurred in the Eagle bed, all in mines contiguous to the MacBeth mine. Gas ignitions caused four of the explosions and coal dust was responsible for the fifth case. At least 3 fires have occurred in nearby mines in the last five years.

Property damage:

At least 22 stoppings were blown out and 4 doors were demolished by the explosion. In 13 right and 13 right air course the majority of the timbers were blown out by the force of the explosion. This caused the roof to weaken and fall for a considerable distance. In the 13 right air course the roof fell from room 9 to the next to the last break-through, and in 13 right entry the roof fell from the last crosscut for about 80 feet and from room 9 practically to the mouth of the entry. A fall occurred in room 9 at the first crosscut inby 13 right entry. Falls also occurred in 12 right air course pick-up and in 12 right pick-up. Eight stoppings were blown out in 16 right. Twelve stoppings in 14 right and, insofar as it was possible to determine, all the stoppings in 13 right were destroyed. In 11 right the stoppings in rooms 1 and 2 were damaged and brattice cloth curtains were blown down. A stopping in No. 5 main entry in the turn-out leading to 11 right was damaged. The mine resumed operations on September 21, 1936, nearly three weeks after the explosion. Room 14 was driven from 14 right to connect with room 14 on 13 right air course; a crosscut was driven through a chain pillar in 13 right and 14 and 13 rooms on 13 right will be worked from 14 right entry, as it would be uneconomical to clean up the falls on 13 right air course and entry.

Forces:

The direction of forces is shown on the attached map of the explosion area of the MacBeth mine. The forces apparently radiate from a point about 35 feet outby the face of 14 room off 13 right. Forces

extend toward the face and outby toward the mouth of the room. A branch of the force occurred at the break-through at room 14, passing into room 13 to the face, and probably outby again. There was little force in the face of 13 right entry and air course. Forces proceeded into 14 room off 13 right air course, but apparently there was little force to the explosion in this room. Considerable force was exerted in 13 right entry at least as far as room 7. A door between rooms 8 and 9 in this entry was completely demolished, and in several places ties were blown several feet outby while still attached to the rails. Two empty cars on the radius of the track leading to room 8 were blown from the track toward the rib, a distance of 5 to 6 feet.

Force definitely proceeded into room 9 to 12 right air course pick-up. Evidently at the face of 12 right air course the force had a twirling motion, as seen by the fact that a shovel had been blown toward the face and broken, whereas the miner working at the face was wrapped around a post 6 feet from the face, indicating an outby motion. Coke on exposed surfaces was principally on the inby side of posts, cross bars, and cap pieces, indicating an inward direction of flame. In rooms 7 and 8 off 13 right air course, the direction of force was definitely toward 14 right entry. This was particularly noticeable on 14 right opposite room 8, where material had been blown from room 8 onto the entry. All stoppings on 14 right had been blown from the entry toward the air course.

Evidence of heat or flame:

No evidence of heat or flame was found in 13 right entry and air course, probably due to the high velocity of the explosion. In the rooms, however, where the velocity was less, there was distinct evidence of flame. In room 14 off 13 right air course there was limited evidence of coke about 15 feet from the face, principally on cars, on the inby ends

and projections of the cars. Coke was also found in the crosscut being driven from this room. In 14 right off the entry there was coke on the outby end of two loaded cars and on the locomotive. Less coke was found on the inby end of these cars. An empty car caught between the rib and loaded car had coke near the end between iron straps and car body, on the side nearest to the right rib. An empty car in the crosscut between rooms 14 and 15 had coke plastered on the corner nearest room 14. In room 13 near the face and in the crosscut nearest the face there was copious coke on the posts, roof, and ribs. In 12 right pick-up there was also evidence of coking.

Where rooms 7 and 8 intersect 12 right, a large body of water existed, coming within a few inches of the roof. It appears likely that this body of water stopped the flame from entering 11 right entry and air course. On December 13, 1935, 13 right entry had been rock-dusted as far as room 8. The air appeared to be full of white dust after the explosion, according to the rescuers, indicating that the rock dust played a part in arresting the explosion.

Rescue and recovery operations:

Between 1:15 and 1:30 p.m. Walter Damron, assistant mine foreman on 13 right section, felt a concussion which he feared was an explosion. He proceeded on the haulage road from about 7 right inby until he was met by the locomotive hauling from that section. The crew stated that "13 right had blown up". He sent the locomotive crew to the slope bottom to notify the mine foreman and the superintendent on the surface that an explosion had occurred. The only telephone was located at the slope bottom. Mr. Damron then proceeded inby about as far as 13 right; he then retreated to about 8 or 9 right where he met the mine foreman, E. W. Stafford, Mr. Swanta, chemist, and several others carrying gas

masks. This party then proceeded as far as room 8 on 13 right, wearing gas masks, but the smoke was so dense that they had to retreat. Mr. Swantz had become distressed, either from excessive exertion, heat of the canister, or carbon monoxide entering through the gas mask. He got on his hands and knees and started to pull himself along by grasping the rail. Mr. Damron encouraged and assisted him as far as the fresh air, where he was left in charge of State inspectors and the mine superintendent. Mr. Stafford and Mr. Damron then went into 11 right, where 5 men had been working, but 2 men had escaped, as they had left about the time of the explosion. On 11 right turn-out on 2 west flats a miner was found breathing but unconscious; he was brought to fresh air with difficulty. These two rescuers went as far as room 2 on 11 right, where two men were found apparently dead from carbon monoxide poisoning. The bodies were still warm and an effort was made to carry them out. This was difficult in the low rooms and Mr. Stafford, who attempted to carry one man on his back, became exhausted after carrying the body about 8 or 10 feet. His canister became so hot that he dropped the man and as soon as he saw the door ahead of him he took off the gas mask and hastened to fresh air. He then proceeded to 10 right, where a man was found examining empty cars, being unaware that an explosion had occurred. In the meantime, the other party, including Mr. Swantz, had entered 14 right, where the air was relatively clear, and proceeded through rooms 7 and 8 to 13 right. Here Mr. Swantz once more became affected and had to be practically carried to fresh air. The State mine inspectors already listed arrived and oxygen breathing apparatus crews from the Stirrat mine of the West Virginia Coal & Coke Company, and the rescue crews from the Youngstown Sheet & Tube Company at Dehue and the Island Creek Coal Company at Holden had arrived and proceeded into 13 right section. The

two bodies on 11 right were recovered and recovery operations were conducted in 13 right by the use of gas masks, with a fresh-air base established in room 7 at 14 right.

The roof was cracking and falling in 13 right so that it was necessary to timber this area before proceeding farther in search of 8 bodies known to be in the section. Thirteen right air course had extensive caves from room 8 off of 14 right as far as the second crosscut from the face. There was also an extensive fall on 13 right entry opposite room 13 from next to the last crosscut to the last crosscut, and in the crosscut in the entry and air course. A brattice was placed across 13 right between rooms 7 and 8 and a line brattice was carried up 13 right from room 8 to the next to last break-through, through this crosscut, and as far as room 13 on the air course. About 8:00 a.m., September 8, the line brattice was extended into room 14 off of 13 right air course. Two bodies were recovered in this section and one about 15 feet outby the face. These men were burned, but not as severely as the others in this section.

Room 9 off of 13 right was then ventilated, and about 10:00 a.m., September 8, two bodies were recovered in 12 right pick-up driven from rooms 8 and 9. One body found in the last crosscut showed signs of having struggled after the explosion, as indicated by a clear space on the floor about 6 feet in diameter. At the face of the air course the body of a miner was found wrapped around the post, as if he had been driven outby, although a shovel blown forcibly against the face indicated that main force had been inby.

A tunnel was driven through the fallen material in the last crosscut between 13 right entry and air course. This tunnel was completed and four bodies discovered at 2:25 p.m., September 8. H. P.

Farley, State mine inspector; K. W. Stafford, mine foreman; and Walter Dameron, section foreman, entered through the tunnel and investigated, wearing no gas masks, but carrying flame safety lamps and one CO detector. The flame safety lamps could not be taken within 60 feet of the face due to the high concentration of methane; only a trace of CO could be detected. In room 14 were found bodies of the motor crew and a miner working in this section; the fourth body was found in the crosscut near the face of room 13. These bodies were recovered and brought on 13 right air course at 5:00 p.m.

State inspectors' conclusions:

It was the opinion of the State inspectors that the explosion was caused through the ignition of an accumulation of an explosive body of methane by an arc from a cable-reel locomotive, probably caused when the switch governing the cable-reel was turned on. The accumulation of gas was believed to have been caused by leaving open a door in room 14, in which room the explosion occurred.

Summary of evidence:

In 16 right all stoppings constructed of wood were damaged and blown from the entry toward the air course. In 14 right all of the stoppings as far as 8 right were damaged more or less severely, being blown from the entry toward the air course. Opposite rooms 7 and 8 loose material from these rooms had been blown onto 14 right entry. No evidence of coking was found in 14 right and rooms 7 and 8; dust samples collected at room 2 and room 7 showed no coke under test. Most of the posts in rooms 7 and 8 had been blown out toward 14 right.

At the time of the recovery operations and investigation, roof had fallen, practically blocking the air course from room 8 to the second

crosscut outby the face, and the large part of the air course and entry had fallen outby room 8. All stoppings and crosscuts that could be seen were blown from the entry toward the air course. Thirteen right had been rock-dusted as far as room 8 on December 13, 1935.

Three empty cars were found in the mouth of room 8 and the front car that was on the radius of the turn-out to room 8 had been blown from the track a distance of 4 feet. The door between rooms 8 and 9 had been completely demolished; only the sills remained. Ties at this point had been blown outby a foot or more at several places. In room 14 off 13 right air course a body was found on the crosscut, with indications that he had been thrown against the rib. His right shoulder and right side were cut. He was found between a post and the rib. Exposed surfaces of his body were burned. A loaded car was at the face. A second man was found about 15 feet away from the face beside an empty car. His false teeth had fallen out and a damaged dinner bucket was beside him. A loaded and two empty cars were at the face of this room. Slight indication of coking was found on the empty cars and also on the post. Some coking was also observed in the crosscuts. Forces were definitely into the rooms toward the face. At the face of 13 right and air course, timber was standing, but on the entry from the last crosscut outby all timbers were blown outward, indicating an outward force. A door between 13 and 14 rooms had been covered by a fall. In room 9 no coke could be observed, nor was any coke seen at the entry at the mouth of the room, although in dust samples collected at this point a small amount of coke was found. Coke was found near the last crosscut between 12 right and 12 right air course, picked up from room 9, indicating flame in this area.

Details of the explosion as found in rooms 13 and 14 are shown on a detail map of this section. At the mouth of room 14 a blasting cable was wrapped around a post, indicating an outward force. A door situated just outby a crosscut in room 14 was blown outby; a line brattice had also been blown down. At the entrance of the crosscut was found a cable-reel locomotive attached to two loaded cars and held in place through jamming against an empty car that evidently had drifted out of the crosscut. This car had been caught between the first loaded car and the lower rib of the crosscut. Coke was found on both ends of the loaded cars, although more pronounced on the outby side. Coke was found inby the end of the empty car, on the upper front corner of a second empty car in the crosscut, and on the rear of this car. The rear end of this empty car had been blown from the track toward the upper rib. A pile of coal and rock was found on the rear bumper of the car. The cable from the locomotive was lying under the cars and rolled in several large loops inby these cars. The cable had been run over at one point, but presumably not while the power was on the cable. A section about 10 feet long was cut from the inby end of the cable and brought to Pittsburgh for further examination. Several feet from the end was a splice which, when one layer was removed, showed where an arc occurred at the point of a splice clamp, as shown in photograph No. 1. A second view is shown in photograph 2, giving a clearer view of the splice. It was impossible to determine whether or not this was a recent arc.

The motorman's body was found near the right rib about 3 feet inby the crosscut; the brakeman's body was found inby about 10 feet on the left side of the track. Practically all of the posts were in place in room 14. About 40 feet away from the face was found the first sign of coking on the inby side of the post. About 10 feet inby coke was

found on the outby side of the post and from this point inby coke was found on both sides of the posts. Twenty-three feet from the face was found the miner working room 14. Nearby was found a knapsack containing 5 cartridges of Monobel C, a permissible explosive, an empty cylindrical detonator container, and a blasting battery contained in a Prince Albert tobacco can. The room was raising to a point about 35 feet outby the face of the place, from which point the room dipped toward the face. The coal had been top-cut and a part of the kerf left in the roof by the mining machine could be seen. One of these cuts in the roof occurred near the high points in the room. Following the explosion a gas feeder was said to have existed. At the time of the explosion the motorman probably had pushed one loaded car to the face and the brakeman had just finished coupling the cars. This was indicated by the fact that the locomotive reverse lever was pointed outby and the reel switch was in the "on" position, although the controller was in the "off" position. When found, the locomotive had a small pile of sand on the rail on the inby end. The cable being rolled up indicated that the locomotive and the cars had drifted down the grade after the explosion.

There was little evidence of force in the crosscut between rooms 13 and 14 except that a roll of blasting cable found near the rail 10 feet from room 13 was badly frayed. The fact that the cable was rolled indicates that it was not being used at the time of the explosion.

In room 13 practically all of the posts had been blown out as far as the second crosscut. A line brattice had been blown down, indicating some force, most of which was inby. From the crosscut to the face of the rooms, a distance of about 18 feet, heavy coking was observed on rib, roof, and posts.

Two cartridges of Monobel C were found lying on the gob on the

corner of the crosscut. There was no indication of burning. Three empty cars were in the crosscut, the outby one being uncoupled from the other two. In it was found the miner's cap. There was coking on the rear end of this car. The miner's body was found between this car and the rib. Considerable coking was observed in the crosscut and on the post, principally on the inby side. On the last two posts on the left side of the crosscut the coking was found near the bottom. Three pieces of burned newspaper were found near the first post at the face on the left rib.

Cause of explosion:

The conclusions of the Bureau engineers investigating the explosion are as follows:

1. Forces radiate from a point about 35 feet outby face of room 14 off 13 right entry, indicating that this is the point of origin of the explosion.

2. Coking indicates that the flame was relatively slow near the face of this room, with increasing velocity as the explosion progressed out of the room, gaining maximum violence near room 9 on 13 right entry. The burning was exceptionally slow near the face of 13 room. The flame extended to the face of 12 right pick-up. No flame extended inby 13 right.

3. It is believed that an electric arc caused by a cable-reel locomotive initiated the explosion by igniting gas near the highest point of the room about 35 feet away from the face. The burning gas then raised a cloud of coal dust and ignited it, resulting in a propagation of flame throughout the affected areas. There was no indication of smoking or the firing of shots. The arc could have been formed in three ways:

(a) It was the habit of the motorman to turn the cable-reel switch off and on quickly several times to take slack out of the cable

before turning on the controller. This may have caused an arc.

(b) An arc may have been drawn between the rail and a splice in the cable illustrated in the photographs.

(c) According to information obtained from several of the employees, arcs are caused at the rails when haulage equipment is being moved.

4. Rock dust played an important part in stopping the explosion.

Lessons to be learned:

The following lessons may be learned from this explosion:

1. Ventilation should be so controlled that a positive current of air is flowing at all times.

2. Each place should be visited by a supervisory official at least every 2 hours, and especially immediately after blasting.

3. All doors should be provided with a device for keeping them closed and latches for holding doors open should be prohibited.

4. Haulage, especially in room entries, should be done with animals or permissible-type electric locomotives; in fact, all underground electrical equipment should be of the permissible type.

Recommendations:

The Bureau of Mines can be of greater service to mine operators by recommending safe methods of operating. This report deals purely with the explosion hazard and the following recommendations are made, not in a critical sense, but in the belief that their adoption will prevent the occurrence of a similar disaster.

1. All abandoned workings and areas, if feasible, should be sealed.

2. Stoppings should be constructed of air-tight, noninflammable material.

3. Doors should be eliminated wherever possible, and most certainly no doors should be erected on main haulage roads. Where doors are used, they should be erected in pairs at such a distance apart that a trip of cars may pass through without having both doors open at the same time.

4. Overcasts should be erected at each set of butt entries, in order to eliminate as far as possible all doors. The air should be split in such a way that two or more splits of air will ventilate each side of the mine. Development sections should be ventilated separately from pillar sections.

5. At least 10,000 cubic feet of air per minute should be passed through the last crosscut in each set of entries.

6. All underground electrical equipment should be of permissible type, maintained under permissible conditions.

7. Blasting, if possible, should be done from the surface when all men are out of the mine or, if that is impracticable, blasting should be done by authorized shot firers between shifts. If neither of these methods is adopted, blasting should be done on shift only by authorized shot firers, who should make a careful test for gas before and after blasting.

8. The rock-dusting schedule should provide for rock-dusting all workings weekly. The rock dust should be kept to within at least 20 feet of the face.

9. Rock-dusted areas should be sampled monthly and determination of incombustible content of the dust should be made.

10. Incombustible content of the mine dust should be maintained at 65 percent or higher.

Form 6—137

U. S. BUREAU OF MINES

E—DESCRIPTION OF MINE

(1) State West Virginia (2) County Logan (3) Town MacBeth (Post office.)

(4) Mine sample of Dust (Material—for coal give classification.) (5) Coal field Logan (6) District Logan

(7) Mine Macbeth (a. Name.) Slope (b. Kind of opening—if shaft give depth.) (c. Height of opening above sea level.)

in town (d. Distance and direction from town.) (e. Sec., T., and R., if necessary.) C & O (f. Railroad connections.)

MacBeth (g. Shipping point.) (h. State if wagon mine or prospect and give distance from shipping point.)

(8) Coal bed Eagle (a. Name.) (b. Geologic system.)

(c. Formation.) (d. Dip, degrees.) (e. Strike, direction.)

(9) Mining system Room & Pillar, panel (Long wall, room and pillar, panels, etc.) (10) Undercutting xxxxxx Topcutting:Jeffrey 29B Arcwall (Name and type of machine.)

(11) Explosives Monobel C. (a. Used for coal.) (b. Used for roof or floor.)

(12) Operator Hutchinson Coal Co., MacBeth. (Name and address.)

(13) Sales agent Same, Fairmont, W. Va. (Name and address.)

(14) Output per day 1250 tons (Average—gross or net tons.) (15) Maximum day's output (During past year.) (16) Last year's output (Gross or net tons.)

(17) Output from advance workings, per cent 60 (At present.) (18) Lifetime of mine (Years—estimated.)

(19) Run-of-mine, per cent (Of output shipped.) (20) Is coal screened? (21) Type of screens

(22) Type of washer (23) Per cent of coal washed

(24) Maximum size washed (25) Sizes produced (Washed coal.)

(26) Sizes produced (Of coal not washed.) (27) Is coal picked? (State whether on car or belt.)

(28) Per cent of coal coked (At mine.) (29) Sizes coked (Screenings, crushed, washed, etc.)

(30) Type and number of ovens (31) Remarks (For any additional information indicate after subject by mark X if additional information is given here.)

Sampling of dust after explosion.

(32) Can Nos. H-610 : L-48 : 0-1 0-2 0-3 0-4 0-5 0-6 0-7 0-8 (Give Nos. of all samples forwarded.)

(33) Laboratory Nos. B-15766 : 767 : 768 769 770 771 772 : 773 774 775 (Laboratory to fill in immediately below corresponding can number.)

(34) Mine sampled at 5 (Number.) points, by C. W. Owings, Pgh., Pa. (Collector.) (Office.) on 9/22/36 (Date.), 19

Above information copied from Card A by FEH on 9/25/36, 19

6—6372

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No.____ Lab. No. B-15766

Sample of Road dust (through 20-mesh screen). Can No. H-610

Operator Hutchinson Coal Company Mine MacBeth

State W. Va. County Logan Bed Eagle

Town MacBeth

Location in mine 11 Rt. at Room 2.

Method of sampling Standard Gross weight, lbs.____ Net weight, gms. 382.0

Date of sampling 9/22/36 Date of Lab. sampling 9/29/36 Date of analysis____

For B. of M. section Mine Accident Collector C. W. Helms

		Air-dry Loss 5.5	Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
Proximate Analysis	Moisture		.5	5.9		
	Volatile matter					(a)
	Fixed carbon XXXXXXX Coab.		18.7	17.8	18.9	
	Ash		80.8	76.3	81.1	
			100.0	100.0	100.0	
Ultimate Analysis	Hydrogen					
	Carbon			GRAMS	PERCENT	
	Nitrogen On 20-mesh			96.0	20.1	
	Oxygen Through 20-mesh			382.0	79.9	
	Sulphur Total wt. of sample			478.0	100.0	
	Ash					
Calorific value determined	Calories					
	British thermal units					

	Cumulative per cent.
Screen test, through 20 mesh	100
through 48 mesh	66.5
through 100 mesh	41.8
through 200 mesh	32.8

Area from which sample was taken (sq. ft.)____

Date, October 5, 1936 (Signed) H. M. Cooper., *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

a This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test. Coked particles present - None.

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No. _____ Lab. No. B-15767

Sample of Rib & Roof dust (through 20-mesh screen). Can No. L-48

Operator Hutchinson Coal Company Mine MacBeth

State W.Va. County Logan Bed Eagle

Town MacBeth

Location in mine 11 Right at Room 2

Method of sampling Standard Gross weight, lbs. _____ Net weight, gms. 211.0

Date of sampling 9/23/36 Date of Lab. sampling 9/25/36 Date of analysis _____

For B. of M. section Mine Accident Collector C.W.Owings.

Air-dry Loss 8.6		Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
Proximate Analysis	Moisture	.3	7.1		
	Volatile matter				(a)
	Fixed carbon Comb.	18.8	17.6	18.9	
	Ash	80.7	75.3	81.1	
		100.0	100.0	100.0	
Ultimate Analysis	Hydrogen		Grab	Pencil	
	Carbon On 80-mesh		52.0	19.8	
	Nitrogen Through 20-mesh		211.0	80.2	
	Oxygen Total wt. of sample		263.0	100.0	
	Sulphur				
	Ash				
Calorific value determined	Calories				
	British thermal units				

	Cumulative per cent.
Screen test, through 20 mesh	100
through 48 mesh	81.5
through 100 mesh	71.5
through 200 mesh	60.7

Area from which sample was taken (sq. ft.) _____

Date, October 5, 1936 (Signed) H. M. Cooper., *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

[a] This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test. Coked particles present - None

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No. _____ Lab. No. B-15768

Sample of Road dust (through 20-mesh screen). Can No. 9-1

Operator Hutchinson Coal Company Mine MacBeth

State W.Va. County Logan Bed Eagle

Town MacBeth

Location in mine 13 Rt. Room 14, 35 ft. outby face.

Method of sampling Standard Gross weight, lbs. _____ Net weight, gms. 109.0

Date of sampling 9/23/36 Date of Lab. sampling 9/25/36 Date of analysis _____

For B. of M. section Mine Accident Collector C. W. Owings-P.P.Senio

		Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
	Air-dry Loss 1.8				
Proximate Analysis	Moisture	1.7	3.5		
	Volatile matter	36.5	36.0	37.0	39.8 (a)
	Fixed carbon	62.6	61.5	63.6	70.2
	Ash	9.2	9.0	9.4	
		100.0	100.0	100.0	100.0
Ultimate Analysis	Hydrogen		GRAMS	PERCENT	
	Carbon On 20-mesh		58.0	34.7	
	Nitrogen Through 20-mesh		109.0	65.3	
	Oxygen Total wt. of sample		167.0	100.0	
	Sulphur				
	Ash				
Calorific value determined	Calories				
	British thermal units				

	Cumulative per cent.
Screen test, through 20 mesh	100
through 48 mesh	52.2
through 100 mesh	29.6
through 200 mesh	16.7

Area from which sample was taken (sq. ft.) _____

Date, October 5, 1936 (Signed) H. M. Cooper., *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

a This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test - Coked particles present--considerable amount.

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No._____ Lab. No. B-15769

Sample of Rib & Roof dust (through 20-mesh screen). Can No. 0-2

Operator Hutchinson Coal Company Mine Macbeth

State W. Va. County Logan Bed Eagle

Town MacBeth

Location in mine 13 Right Room 14, 35 ft. outby face.

Method of sampling Standard Gross weight, lbs._____ Net weight, gms. 72.0

Date of sampling 9/22/36 Date of Lab. sampling 9/25/36 Date of analysis_____

For B. of M. section Mine Accident Collector C.W.Owings-J.P.Menio

		Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
	Air-dry loss 1.4				
Proximate Analysis	Moisture	1.7	3.1		
	Volatile matter	26.9	26.6	27.4	30.1 (a)
	Fixed carbon	62.7	61.7	63.8	69.9
	Ash	8.7	8.6	8.8	
		100.0	100.0	100.0	100.0
Ultimate Analysis	Hydrogen		GRAMS	PERCENT	
	Carbon On 20-Mesh		39.0	35.1	
	Nitrogen Through 20-Mesh		72.0	64.9	
	Oxygen Total wt. of sample		111.0	100.0	
	Sulphur				
	Ash				
Calorific value determined	Calories				
	British thermal units				

Cumulative per cent.

Screen test, through 20 mesh 100

through 48 mesh _____

through 100 mesh NO SIZE

through 200 mesh _____

Area from which sample was taken (sq. ft.) _____

Date, October 5, 1936 (Signed) H. M. Cooper., *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

a This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test. Coked Particles present--Large Amount.

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No. _____ Lab. No. B-15770

Sample of Acad dust (through 20-mesh screen). Can No. 0-3

Operator Kubanimon Coal Company Mine MacBeth

State W. Va. County Logan Bed Eagle

Town MacBeth

Location in mine 13 Rt. at room 8.

Method of sampling Standard Gross weight, lbs. _____ Net weight, gms. 152.0

Date of sampling 9/22/36 Date of Lab. sampling 9/25/36 Date of analysis _____

For B. of M. section Mine Accident Collector C.W.Owings-P.P.Senio

		Air-dry Loss: 1.5	Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
Proximate Analysis	Moisture		1.6	3.1		
	Volatile matter		27.0	27.4	26.2	32.6 [a]
	Fixed carbon		57.2	56.2	58.8	67.5
	Ash		14.2	13.6	15.0	
			100.0	100.0	100.0	100.0
Ultimate Analysis	Hydrogen			ORANGE	PINKISH	
	Carbon			82.0	80.3	
	Nitrogen			1.2.0	1.1.7	
	Oxygen			184.0	100.0	
	Sulphur					
	Ash					
Calorific value determined	Calories					
	British thermal units					

Through 20-mesh
Total wt. of sample

	Cumulative per cent.
Screen test, through 20 mesh	100
through 48 mesh	49.0
through 100 mesh	37.9
through 200 mesh	17.9

Area from which sample was taken (sq. ft.) _____

Date, October 5, 1936 (Signed) H. M. Cooper, *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

[a] This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test. Coked Particles Present - Small amounts.

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No. _____ Lab. No. B-15772

Sample of Roof & Rib dust (through 20-mesh screen). Can No. 0-5

Operator Hutchinson Coal Company Mine MacBeth

State W. Va. County Logan Bed Eagle

Town MacBeth

Location in mine 14 Rt. Room 7, 30 ft. inby 14 Rt.

Method of sampling Standard Gross weight, lbs. _____ Net weight, gms. 112.0

Date of sampling 9/22/36 Date of Lab. sampling 9/25/36 Date of analysis _____

For B. of M. section Mine Accident Collector C. W. Owings-P. P. Senio

		Air-dry Loss 1.8	Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
Proximate Analysis	Moisture		1.7	3.5		
	Volatile matter		27.5	27.0	28.0	31.2 (a)
	Fixed carbon		60.6	59.5	61.6	68.8
	Ash		10.2	10.0	10.4	
			100.0	100.0	100.0	100.0
Ultimate Analysis	Hydrogen			Grams	PERCENT	
	Carbon	On 20-mesh		67.0	37.4	
	Nitrogen	Through 20-mesh		112.0	62.6	
	Oxygen	Total wt. of sample		179.0	100.0	
	Sulphur					
	Ash					
Calorific value determined	Calories					
	British thermal units					

	Cumulative per cent.
Screen test, through 20 mesh	100
through 48 mesh	45.0
through 100 mesh	26.8
through 200 mesh	17.5

Area from which sample was taken (sq. ft.) _____

Date, October 5, 1936 (Signed) H. M. Cooper., *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

a This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test. Coked Particles Present - None.

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No.____ Lab. No. B-15773

Sample of Road dust (through 20-mesh screen). Can No. 0-6

Operator Hutchinson Coal Company Mine MacBeth

State W. Va. County Logan Bed Eagle

Town MacBeth

Location in mine 14 Right Room 7, 30 Ft. inby 14 Rt.

Method of sampling Standard Gross weight, lbs.____ Net weight, gms. 128.0

Date of sampling 9/22/36 Date of Lab. sampling 9/25/36 Date of analysis____

For B. of M. section Mine Accident Collector C.W. Owings-P.O. Senio

	Air-dry Loss 3.1	Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
Proximate Analysis	Moisture	1.7	4.8		
	Volatile matter	27.3	26.4	27.8	33.3 (a)
	Fixed carbon	54.8	53.1	55.7	66.7
	Ash	16.2	15.7	16.5	
		100.0	100.0	100.0	100.0
Ultimate Analysis	Hydrogen		GRAMS	PERCENT	
	Carbon On 20-mesh		52.0	28.9	
	Nitrogen Through 20-mesh		128.0	71.1	
	Oxygen Total wt. of sample		180.0	100.0	
	Sulphur				
	Ash				
Calorific value determined	Calories				
	British thermal units				

	Cumulative per cent.
Screen test, through 20 mesh	100
through 48 mesh	39.6
through 100 mesh	16.7
through 200 mesh	9.4

Area from which sample was taken (sq. ft.)____

Date, October 5, 1936 (Signed) H. H. Cooper., *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

a This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test. Coked Particles Present - None.

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No._____ Lab. No. B-15774

Sample of Rib & Roof dust (through 20-mesh screen). Can No. 0-7

Operator Hutchinson Coal Company Mine MacBeth

State W. Va. County Logan Bed Eagle

Town MacBeth

Location in mine 14 Rt. at Room 2.

Method of sampling Standard Gross weight, lbs._____ Net weight, gms. 79.0

Date of sampling 9/23/36 Date of Lab. sampling 9/25/36 Date of analysis_____

For B. of M. section Mine Accident Collector C.W.Spings-P.P.Senio

		Air-dry Loss 1.3	Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
Proximate Analysis	Moisture		1.1	2.3		
	Volatile matter					(a)
	~~Fixed Carbon~~ Comb.		49.6	49.1	50.2	
	Ash		49.3	48.6	49.8	
			100.0	100.0	100.0	
Ultimate Analysis	Hydrogen			~~GRAB~~	~~PROXIMAT~~	
	Carbon On 20-mesh			36.0	31.3	
	Nitrogen Through 20-mesh			~~77.0~~	~~66.7~~	
	Oxygen Total wt. of sample			115.0	100.0	
	Sulphur					
	Ash					
Calorific value determined	Calories					
	British thermal units					

	Cumulative per cent.
Screen test, through 20 mesh	100
through 48 mesh	
through 100 mesh	NO SIZE
through 200 mesh	

Area from which sample was taken (sq. ft.)_____

Date, October 5, 1936 (Signed) H. M. Cooper., *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

a This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test. Coked Particles Present - None.

6-261

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DUST-ANALYSIS REPORT

Test No. _____ Lab. No. B-15775

Sample of Road dust (through 20-mesh screen). Can No. 0-8

Operator Hutchinson Coal Company Mine MacBeth

State W.Va. County Logan Bed Eagle

Town MacBeth

Location in mine 14 Rt. at Room 8

Method of sampling Standard Gross weight, lbs. _____ Net weight, gms. 113.0

Date of sampling 9/23/36 Date of Lab. sampling 9/25/36 Date of analysis _____

For B. of M. section Mine Accident Collector C.W.Owings-P.P.Senio

		Coal (Air dried)	Coal (As received)	Coal (Moisture free)	Coal (Moisture and ash free)
	Air-dry Loss 3.5				
Proximate Analysis	Moisture	.8	4.3		
	Volatile matter				(a)
	Fixed carbon	36.3	35.0	36.6	
	Ash	62.9	60.7	63.4	
		100.0	100.0	100.0	
Ultimate Analysis	Hydrogen		GRAMS	PERCENT	
	Carbon	On 20-mesh	36.0	24.2	
	Nitrogen	Through 20-mesh	113.0	75.8	
	Oxygen	Total wt. of sample	149.0	100.0	
	Sulphur				
	Ash				
Calorific value determined	Calories				
	British thermal units				

	Cumulative per cent.
Screen test, through 20 mesh	100
through 48 mesh	60.5
through 100 mesh	30.3
through 200 mesh	18.8

Area from which sample was taken (sq. ft.) _____

Date, October 5, 1936 (Signed) H. M. Cooper., *Chemist.*

U. S. GOVERNMENT PRINTING OFFICE

a This figure is the ratio of volatile combustible to total combustible.

6—8752

Alcohol Coke Test. Coked Particles Present - None.

11. A crew of at least 5 men, preferably 10, should be trained in the use of oxygen breathing apparatus at least twice a year.

12. Gas masks should not be used in recovery operations, except by persons trained in their use, and then only when supported by an oxygen breathing apparatus crew.

Acknowledgments:

The Bureau's representatives were accorded every courtesy by Mr. Johnson, Mr. Myers, Mr. Stafford, and Mr. Denron during the recovery operations and the ensuing investigation. It is only through such cooperation that the U. S. Bureau of Mines can render maximum benefit to the mining industry.

Respectfully submitted,

C. W. Owings.

C. W. OWINGS,
Associate Mining Engineer

P. P. Senio

P. P. SENIO,
Junior Safety Instructor