

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

District E

FINAL REPORT OF MAJOR MINE-EXPLOSION DISASTER
MINE NO. 2
BLUE BLAZE COAL COMPANY
HERRIN, WILLIAMSON COUNTY, ILLINOIS

January 10, 1962

By

F. J. Smith
District Supervisor

J. R. Summary
Federal Coal-Mine Inspector

C. M. Dovidas
Federal Coal-Mine Inspector

S. J. Douglas
Federal Coal-Mine Inspector (Electrical)

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INTRODUCTION

A gas and dust explosion occurred in Mine No. 2 of the Blue Blaze Coal Company, 2 miles northwest of Herrin, Illinois, about 6:30 p.m., Wednesday, January 10, 1962, and caused the death of 11 men. These eleven were the only persons in the mine and all died from suffocation, burns and/or forces.

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

Bureau of Mines investigators believe the explosion originated in room 2 off 3 north entry at the neck of the second north crosscut when an explosive mixture of methane-air was ignited by an electric arc or spark from a piece of electrical equipment. The explosion was propagated by methane and coal dust.

Forces of the explosion radiated from room 2 off the 3 north entry and spread west and north, south and west towards the main shaft, and west and south into the holed-through abandoned sealed north working section at room 1 off the 1 north entry. All of the forces converged at the bottom of the main shaft, traveled up the shaft and dispersed upon reaching the surface.

GENERAL INFORMATION

Mine No. 2 is located 2 miles northwest of Herrin, Williamson County, Illinois. Coal was transported from the mine in autotrucks.

The operating officials of the company were as follows:

Claud Gentry	Owner	Route 2 Carterville, Illinois
Virgil E. Woodburn	Mine Manager and Day Shift Leader	Cambria, Illinois
Ray Woodis	Night Shift Leader	Herrin, Illinois

On January 10, 1962, a total of 30 men was employed; 6 on the surface and 24 underground on two coal-producing shifts. The average daily production was reported to be 280 tons of coal. The mine is opened by a concrete-lined shaft 168 feet deep and a 16-inch cased pilot hole which was primarily used as a refuse hole for the blasted strata for the enlargement of the air shaft. The workings are in the Illinois No. 6 coal bed, which averages 106 inches in the present mining area and dips very slightly to the north and east.

In 1956 a 7- by 10-foot concrete-lined slope was driven near the present side of the cased pilot hole for the proposed 6-foot circular air shaft. The slope was driven to a depth of 210 feet and collapsed

unexpectedly, due to caving ground and an inrush of what is locally referred to as quicksand. Plans for opening the mine were suspended until April 23, 1959, when ground was broken for the present hoisting shaft. The hoist or main shaft was completed November 24, 1960; however, the further development of the mine was temporarily halted until the surface structures were erected. Coal on one shift was first produced July 30, 1961, and continued to be produced intermittently until the day of the explosion. A full crew on the second shift started to produce coal nine working shifts prior to the disaster.

The partly completed air shaft, located 520 feet east of the main shaft, was started November 7, 1961. The 6-foot circular steel-lined air shaft had been driven periodically to a depth of 70 feet below the surface soil and to within 74 feet of the coal bed at the time of the explosion.

The immediate roof is a medium-firm gray shale which is about 12 inches in thickness, overlaid by 12 feet of hard shale, 3 to 5 feet of limestone, and by 49 feet of sandstone, successively. The immediate roof disintegrates after it is exposed to the mine atmosphere, and to protect it from weathering approximately 12 to 18 inches of top coal is left. The floor is a smooth soft fire clay that also disintegrates when exposed to the mine atmosphere.

The analysis of a coal sample from the Illinois No. 6 coal seam obtained from a coal company located in the immediate vicinity is as follows: Moisture - 7.2 percent; volatile matter - 34.8 percent; fixed carbon - 51.0 percent; ash - 7.0 percent.

Numerous tests conducted by the Bureau of Mines have shown that coal dust having a volatile ratio of 0.12 is explosive and that the explosibility increases with an increase in the volatile ratio. The volatile ratio of the coal in this mine as determined from the aforementioned analysis is 0.40, indicating that the dust is explosive.

A Federal inspection had not been made of this mine prior to the disaster. A Bureau of Mines roof-bolt representative visited the mine and issued a roof-bolt plan on July 31, 1961, but the mine was idle on several occasions when a Federal inspector visited it or contacted some of the employees to determine if the mine were in operation. The mine did not come under the provisions of Title II of the Federal Coal Mine Safety Act until January 1962, by virtue of the fact that less than 15 men were employed underground until that time.

MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods: The mine was being developed by a panel, room-and-pillar method and pillars were not extracted. Main entries were driven in sets of seven, 16 feet wide on 50-foot centers. Room-panel entries were being driven 16 feet wide on 50-foot centers in sets of 2 and 3 at various intervals. The first room crosscuts were used as shuttle-car roadways and were referred to as entries by the management. Rooms were driven 18 to 22 feet wide on 50-foot centers to various depths, and crosscuts were generally 18 feet wide and 60 feet apart.

The mine is surrounded by worked-out mines and provisions had been made in the projected development to allow 200 feet of coal for a barrier pillar between the mine and abandoned properties.

Bolts were used exclusively for roof support throughout the mine, and with one exception, were being installed according to the recommendations of the Bureau's roof-control representative.

A loading-machine unit was operated on each of the two coal-producing shifts.

Blasting: All coal in the mine was undercut by a rubber-mounted cutting machine and was broken down on shift by means of compressed air. Explosives were not used underground.

Ventilation and Mine Gases: Ventilation was induced by a 24-inch, electrically driven, centrifugal fan operated blowing and circulating approximately 7,500 cubic feet of air a minute. The fan was operated continuously and was installed on the surface, offset a few feet from the main shaft and was attended constantly. Room-panel and temporary stoppings were normally constructed of lumber covered with wood fiber; however, brattice cloth was used occasionally for temporary stoppings until replaced by lumber. No doors were used in the mine; however, two double-thickness brattice cloth curtains were suspended from a wooden frame near the shaft bottom. Permanent stoppings were built of concrete blocks.

The air was directed into the mine through a 22-1/2-inch metal air duct which extended from the fan down the hoist shaft and through a circular hole in the poured concrete lining of the shaft. The air duct was constructed of a series of empty 55-gallon capacity oil drums that were joined by welding after the ends were removed from the barrels.

A split system of ventilation was used in this mine. A small split of air ventilated the temporarily idle main west section and a larger split was ventilating the active working area which included the 1, 2 and 3 north room-panel entries and the main east entries. The air entering the mine through the cased pilot hole of the air shaft combined with the air returning from the north entries and returned out the main east haulage and parallel entries and up the hoist shaft. No air readings were recorded in the mine examiner's book.

The mine was not classified gassy by the Illinois Department of Mines and Minerals. Preshift examinations were made of the entire mine for gas and other hazards by the mine manager and night shift leader for their respective shifts. On-shift examinations were made by the mine manager for gas and other hazards during the day shift; however, an on-shift examination apparently was made only for other hazards on the night of the explosion, since a flame safety lamp was not found in the mine during the investigation. The mine manager did state that he thought he detected gas in a roof cavity about three months prior to the day of the disaster; however, it was not noted in the record book. The analysis of air samples collected during State inspections of the mine showed a maximum methane content of 0.08 percent. There were no known oil or gas wells penetrating the coal bed in the area being worked.

Dust: The mine in general was dry, but water was present on the floor in the main east entries in by the north working section and in 6 and 7

east air course entries outby the north working section. The entire north working section was dry and dusty. Loose coal and coal-dust accumulations were present along the main east haulage road, at the hopper near the main shaft and throughout the north working section. Rock dust was applied daily by hand and the main entries had been rock-dusted by machine.

During the investigation, 20 mine-dust samples were collected in the main east and north entries and all of them contained less than 65 percent incombustible (see Table 2). A sample for coke was collected in room 2 off 3 north entry at the second north crosscut where the explosion was believed to have originated and at the junction of main east track entry and 2 north. The mine-dust samples collected were not representative of mine conditions prior to the explosion, as coal dust thrown into suspension and deposited on the rock-dusted surfaces increased the combustible content.

Transportation: Eight-ton Jeffrey trolley locomotives were used to haul the 8-ton, all-steel, drop-bottom-type coal cars from the north working section to the coal hopper located south of the main shaft. The coal was then loaded into a 5-ton skip and hoisted to the surface where it was prepared for domestic trade and for resale to another coal company.

Electricity: Power was purchased at 4,160 volts, three phase, and was transformed to 440, 220, and 110 volts for use on the surface and underground, with the exception of the surface motor generator, which operated at 4,160 volts on the primary side. Alternating current equipment

underground consisted of a coal conveyor at the shaft bottom, and two water pumps, all 440-volt type. Direct-current power was generated at 250 volts by a 400 kilowatt conversion unit located in the hoist house. Direct current was transmitted into the mine by two plastic pipe-enclosed 1,000,000 circular mil copper cables installed in an 8-inch cased bore-hole. Power was transmitted along the motor roads and face region by 320,000 circular mil (6/0) trolley wire and 750,000 circular mil feeder lines, all well installed on insulators.

Face equipment consisted of a Joy 11BU loader, Joy 10SC shuttle car, Joy 10RU cutting machine, Joy CD41 coal drill, and a Jeffrey 56 RDR roof-bolting machine, all operated from the direct-current system. Face equipment was permissible with the exception of the roof-bolting machine, which lacked only an approval plate. Face equipment was fairly new and maintained in a permissible condition. The 10SC shuttle car contactor enclosure cover had been removed by the second shift which exposed a considerable array of electrical arcing devices, and repair work was in progress at the time of the explosion. Upon inspection it was discovered that a main contact on one of the tram reversing contactors would not close, therefore, the shuttle car could have only trammed towards the face on one motor at high speed and no tramming would have been possible at low speed in the same direction. The 10SC shuttle car is a four-wheel drive type with a tram motor mounted on each side and each tram motor driving the two wheels on its respective side. Jockeying the shuttle car near the loader with the described fault would have been difficult

as the car would have jumped on forward tram and probably frequently outed the overload relay. The regular mechanic was not working on the night of the explosion and repair work on the shuttle car was being done by members of the face crew, who apparently were not experienced in such work. This fact was self-evident when it was discovered that they had started to disassemble the wrong contactor. Under such conditions it was customary at this mine to try the equipment with the power on, and with one person observing the contactors. The removal of the enclosure cover would provide several gas ignition sources which could have and probably did provide the primary ignition, as there was evidence that gas had burned in the enclosure.

Face equipment controller positions were checked after the ignition and all equipment was in an "off" position, except the coal drill which was apparently drilling at the time. Trailing cables were not provided with short-circuit protection at the nip ends, except the loader which had a 300-ampere fuse type nip. Temporary splices in trailing cables ranged in number from none to eight; all were fairly well made with the exception of one splice in the shuttle car cable which was bare. Trailing cables were listed as fire resistant, with the exception of some 75 feet of cable on the roof-bolting machine.

Illumination and Smoking: Permissible electric cap lamps were used for portable illumination underground, and fixed electric lights were installed at the underground shop, at the hopper and at frequent intervals along the haulage roads. Smoking was prohibited underground; however, smokers'

articles were listed among the personal effects of one of the explosion victims. A damaged and corroded cigarette lighter was also found on the main east haulage road near the coal hopper but apparently it had been discarded sometime before the explosion.

Mine Rescue: A mine rescue team was not maintained at the mine and none of the mine personnel had been trained in mine rescue work in recent years. The nearest State-maintained mine rescue station and mine rescue teams were at Benton, Illinois, about 17 miles from the mine. Other State-maintained teams were from 20 to 178 miles away and were available. Each rescue station is equipped with the necessary gas-detection devices, McCaa 2-hour self-contained oxygen breathing apparatus, Chemox 3/4-hour oxygen-generating breathing apparatus, and all-service gas masks. A box containing 6 self rescuers was kept underground in the shop near the shaft bottom. The underground employees were not searched for smokers' articles before entering the mine.

Two travelways, one of which was in intake air, were provided from the working section to the main shaft bottom; however, the main shaft was the only way out of the mine to the surface. A check-in and check-out system was in effect, and the men used assigned numbered electric cap lamps as a means of identification while underground.

Several fire extinguishers and rock dust were available on the surface and underground for fire-fighting purposes. Water furnished by the city of Herrin was also available on the surface for fire-fighting purposes.

STORY OF EXPLOSION AND RECOVERY OPERATIONS

Participating Organizations: These include the Blue Blaze Coal Company, the Illinois Department of Mines and Minerals, United Mine Workers of America and U. S. Bureau of Mines.

The following Illinois State mine rescue teams assisted with the recovery operations: Benton No. 1 and No. 2, DuQuoin and Eldorado.

Activities of Bureau of Mines Personnel: A representative of Mine Safety Appliances Company, Benton, Illinois, notified J. R. Summary, Federal coal-mine inspector, Benton, Illinois, of the explosion about 8:25 p.m., Wednesday, January 10, 1962. Mr. Summary immediately notified F. J. Smith, District Health and Safety Supervisor, District E, who, with Harry Schrecengost, Technical Assistant, U. S. Bureau of Mines, Washington, D. C., was on a special assignment in Benton, Illinois, at the time of the occurrence. Mr. Smith then relayed the information to other Bureau of Mines personnel. F. J. Smith, Harry Schrecengost and J. R. Summary left Benton, Illinois, at about 8:45 p.m., and arrived at the mine about 9:20 p.m. Federal Inspectors B. J. Dona, M. R. Messersmith, C. M. Dovidas, S. J. Douglas, J. A. McCune, J. P. Sheridan and Louis Lorenzo arrived at various times between 10:30 p.m., January 10 and 2:15 a.m., January 11. James Westfield, Assistant Director--Health and Safety, and R. W. Whittaker, Federal coal-mine inspector, arrived about 2:30 p.m., January 11. Federal inspectors H. E. Basinger, Brank Beck, J. R. Laird and J. A. Mower, stationed at Madisonville, Kentucky, arrived Sunday afternoon, January 13, and assisted in restoring ventilation in the mine to permit an investigation of the disaster the following day.

The bodies of the 11 victims were recovered at various times during the night of January 11 by rescue teams using oxygen-breathing apparatus, and by 12:40 a.m., January 12, all bodies were removed from the mine.

Mining Conditions Immediately Prior to the Explosion: The weather on January 10, 1962, from 7:00 a.m., until noon consisted of scattered clouds and from 1:00 p.m., to 4:00 p.m., it was clear. The temperature at Herrin, Illinois, airport during this period ranged from 4 degrees below zero at 6:00 a.m., to 6 degrees above zero.

Records of barometric pressure on January 10, 1962, are as follows:

Barometer Readings, January 10, 1962

The accepted standard barometer reading at the mine is 29.80.

<u>Time</u>	<u>Barometric pressure</u>	<u>Time</u>	<u>Barometric pressure</u>
1:00 A.M.	30.15	1:00 P.M.	30.30
2:00 A.M.	30.17	2:00 P.M.	30.30
3:00 A.M.	30.19	3:00 P.M.	30.30
4:00 A.M.	30.20	4:00 P.M.	30.30
5:00 A.M.	30.20	5:00 P.M.	30.30
6:00 A.M.	30.20	6:00 P.M.	30.30
7:00 A.M.	30.20	6:30 P.M.	Time of Explosion
8:00 A.M.	30.20	7:00 P.M.	30.30
9:00 A.M.	30.25	8:00 P.M.	30.30
10:00 A.M.	30.30	9:00 P.M.	30.30
11:00 A.M.	30.30	10:00 P.M.	30.30
Noon	30.30	11:00 P.M.	30.30
		Midnight	30.30

At noon on January 9, 30-1/2 hours prior to the time of the explosion, the recorded barometric pressure was 30.00 and it continued

on a gradual rise until a high of 30.30 was recorded at 10:00 a.m., January 10, 1962, after which it leveled off and remained steady until midnight. The atmospheric pressure was not a contributing factor in the explosion. The mine was in operation at the time of the explosion and had been on an 8:00 a.m., and 4:00 p.m., operation since Monday, January 8, 1962. The fan was operating and the mine examiners did not record any unusual conditions in the mine.

Evidence of Activities and Story of Explosion: At the beginning of the 4:00 p.m., to midnight shift on January 10, eleven men entered the mine and all the men except the cager and two motormen walked to the working section. The underground employees reached the working section presumably without mishap, and all the coal-producing workmen had been in face regions approximately 2-1/2 hours when the explosion occurred. Conditions found after the explosion indicated that coal was being produced as usual. The mine examiner's record book at the mine showed a preshift examination of the entire mine had been made for the on-coming shift. Methane was not reported and the air was traveling in its normal course and quantity.

Normal operating procedure at this mine required all the day shift crew to be on the surface, except the mine manager, before the afternoon crew was permitted underground. The hoisting engineer on the afternoon shift stated that on January 10, 1962, at about 3:30 p.m., after all the crew was lowered, normal operation of the mine followed. A trip of coal was being hoisted out of the mine and at approximately 6:25 p.m., the skip was lowered to the bottom and was stopped for about

a minute when he heard a whirring and hissing sound similar to a short-circuit in high voltage power cable, followed by a terrific vibrating sound. The generator set was only a few feet from the hoist controls and, being concerned about the high voltage power, he pulled the power cut-off switch on the generator, stopping the set. Upon turning around he observed the hoisting cables vibrating, followed by a jet black column of smoke or dust pouring out of the shaft accompanied by a deafening whirring and vibrating sound. After waiting a few minutes he walked outside and around the corner of the hoist house and disconnected the 440-volt power to the mine. He walked back into the building housing the hoist, bath room, supplies and air compressor. The Airdox compressor was still in operation, and he then tried to call underground by telephone but could not get an answer. Realizing then that an explosion had occurred, he shouted from the hoist room door to the topman who was in the mine office to call the owner of the mine and tell him there had been an explosion in the mine. The owner-operator returned to the mine immediately and assisted in the recovery operations.

During the development of the main east entries toward the proposed air shaft, a set of north entries was driven to a depth of about 312 feet, with 5 rooms driven off to the west approximately 165 feet in depth and 4 rooms driven off to the east to a depth of about 87 feet. This was to provide storage room for rock and refuse that was dropped down the 16-inch pilot hole when sinking the 6-foot diameter air shaft. The panel was abandoned because of the distance and time it took to haul

refuse from the shaft to unload in the panel, and because the panel would have to be ventilated and inspected it was closed January 7, 1962, by concrete-block stoppings. To facilitate the sinking of the air shaft and to offset the operating cost, the 1, 2 and 3 north room-panel entries off 7 main east were driven to increase production and to provide a closer area for storing the refuse from the shaft sinking operation.

All coal was mined with conventional mobile electric equipment, and the coal drill was the only piece of face equipment in operation when the explosion occurred. The roof-bolting machine was parked in No. 2 room off the 1 north while the face of the place was being broken down by compressed air by the shooter and the roof-bolt drill operator who occasionally helped the shooter. The explosion forced the drill boom of the roof-bolting machine about 8 inches into the partly broken down fall of coal, and the shooting shear strip was perforated in the shooting shell found in the bottom hole on the left side of the face. The bodies of the shooter and roof-bolt operator were found alongside of the roof-bolting machine. The mining machine was parked about 25 feet from the undercut face of No. 2 room off 3 north and had many new bits set in the cutter chain. The idle loading machine waiting for the shuttle car under the boom of the loader to be repaired was in the second crosscut north off No. 2 room off 3 north. The coal-drill operator was drilling the first hole in the last crosscut being driven east off 3 north, and the loading machine used to load rock and material from the air shaft sinking operations was parked on 3 north entry between 4 and 5 main east entries. All the controls of the face

equipment were in the "off" position, except the coal-drilling machine. The 8 bodies of the victims in the 1, 2, and 3 north working section were found near their working places, except the shift leader whose body was found on 2 north entry about 25 feet from the end of the track and near the nipping station. One of the mining machine men was found near the spare rock and material loading machine, one motorman was found near the east end of the coal hopper at the hoisting shaft, the other motorman was in an empty coal car next to the motor on the 3 east haulage road about 80 feet from the coal hopper, and the bottom man or cager was found near his station at the skip hopper loading conveyor on the south side of the hoisting shaft. The victims died from one of the following causes: Burns, inhaling hot gases, lack of oxygen, or violence.

The day shift mine manager and shift leader stated that on January 10, he knew the No. 1 room off 1 north was near the closed abandoned north workings. He instructed the afternoon shift leader not to cut the face but did not take further action to assure that his oral instruction was followed. Sometime after the 4:00 p.m., shift started to work the closed abandoned north workings were penetrated by an opening of about 90 square feet by cutting and breaking down the coal in No. 1 room off 1 north permitting methane to enter into the air current ventilating the 1, 2, and 3 north working section. The gas then was apparently ignited by an electric arc or spark while

repairs were being made in the control panel of the shuttle car. The cover was removed from the control box, the repairman's tools were nearby, and there was evidence of burning in the control compartment. The shuttle car was positioned behind the loading machine in the second crosscut left in room 2 off 3 north and extended part way into the intersection.

From the written report made in the mine examiner's record book, dated January 10, 1962, a preshift examination of the mine was made for the day and afternoon shifts and indicated the mine to be in safe condition. Testimony of day shift workmen was to the effect that tests for methane were frequently made on shift by the mine manager. The day shift mine manager stated he handed a flame safety lamp to the afternoon foreman, but no lamp was found underground.

The explosion destroyed all the stoppings underground. Only minor damage was done to the trolley, power feeder wires, telephone lines and the 3 locomotives near the hoisting shaft. The face equipment appeared to be in good condition, except for the burnt seats on the shuttle car and a seared tire on the mining machine. The major damage was done in the immediate vicinity of the shaft bottom, shaft, and to the coal skip which was at the shaft bottom.

The explosion resulted in the loss of production from the entire mine. The closure Order on the entire mine issued January 11, 1962, remains in effect.

Recovery Operations: Claud Gentry, owner, after informing Ray McCluskey, district State mine inspector, of the explosion proceeded to the mine. Immediately after arriving at the mine, Gentry and McCluskey viewed the damage and discussed what was to be done to get underground as quickly as possible. While calls were being made for State mine rescue teams and other emergency units, work on installing a temporary auxiliary fan operating exhausting at the 16-inch pilot hole at the proposed air shaft was started to establish temporary ventilation underground, because the metal tubing from the main fan installed in the hoisting shaft was destroyed by the explosion. Considerable delay was encountered in hoisting and removing the coal skip from the damaged shaft and arranging for other temporary hoisting equipment. A truck-mounted winch was obtained and a small cage with enclosed sides that could accommodate two men was fastened to the winch rope and swung into the shaft. The fan at the air shaft was exhausting about 2,500 cubic feet of air a minute, and to increase the ventilation another auxiliary fan operating exhausting was set in parallel, increasing the quantity of air to about 3,500 cubic feet a minute. Numerous difficulties were encountered in getting on and off the 2-man cage at the surface and shaft bottom. At approximately 11:45 p.m., the lowering of rescue team members wearing oxygen-breathing apparatus began, and about 4:00 a.m., January 11, all bodies were accounted for. There were no survivors. In the meantime,

an auxiliary blower fan with 18-inch tubing was obtained and the tubing was extended down to the shaft bottom landing to ventilate the immediate area around the bottom. This fan was capable of producing about 4,000 cubic feet of air a minute.

At about 11:10 p.m., January 11, the first body was brought to the surface and by 12:40 a.m., January 12, all bodies were hoisted out of the mine. On January 13, to facilitate the transportation of men and material into the mine, a triple deck construction cage that had been used when sinking the shaft was put into operation, utilizing the main hoist. On January 14, a voluntary crew of 13 men wearing gas masks, when the occasion required, constructed semi-permanent stoppings so that the small quantity of air available would clear the mine enough to conduct an investigation.

INVESTIGATION OF CAUSE OF EXPLOSION

Investigation Committee: The underground investigation of the cause of the explosion was begun on January 15, 1962. Members of the official investigation committee were:

Illinois Department of Mines and Minerals

William J. Orlandi	Director
Harold V. Richmond	Inspector At Large

Illinois Mining Board

H. E. Mauck	Member
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Blue Blaze Coal Company

Claud Gentry	Operator and Owner
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United Mine Workers of America

Floyd Morris

Special Representative
District No. 12

United States Bureau of Mines

James Westfield

Assistant Director--Health
and Safety

F. J. Smith

District E. Supervisor

Other representatives of the afore-mentioned organizations participated in different phases of the underground investigation of the disaster. Bureau of Mines representatives included: Messrs. B. J. Dona, M. R. Messersmith, J. A. McCune, J. P. Sheridan and Louis Lorenzo.

William J. Orlandi, Director of the Illinois Department of Mines and Minerals, conducted an official hearing on the investigation of the explosion by interrogating the owner-operator, day shift mine manager and employees of the company at the Mine Rescue Station, Benton, Illinois, January 18, 1962. The purpose of the hearing was to hear and record all testimony relevant to conditions and practices in the mine prior to and on January 10, 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 United Mine Workers of America, Illinois Department of Mines and Minerals, U. S. Bureau of Mines, and the mine owner-operator participated in the questioning of witnesses.

Methane as a Factor in the Explosion: The mine was not classed gassy by the Illinois Department of Mines and Minerals. Reportedly, methane was never detected in the mine with a permissible flame safety lamp, except for the one time that the mine manager thought he might have found a very

small amount in a roof cavity. This trace of methane was detected in one of the east entries just after breaking away from the shaft bottom about 150 feet. The analyses of air samples collected during State inspections of the mine showed a maximum methane content of 0.08 percent. Testimony of the day shift mine manager and employees was that gas had not been detected during their working shift, and none was reported to have been detected during recovery operations. The analyses of 9 air samples collected at various locations underground after recovery operations had been completed and during the investigation showed the maximum amount of methane to be 0.40 percent. The maximum quantity of air the fan was producing was estimated to be approximately 7,500 cubic feet a minute. No written record of air measurements taken underground was available at the mine.

Fragile, globular coke droplets adhering to the roof and ribs, indicative of burning gas, were found on the south rib of the second crosscut from the face of No. 2 room off 3 north, the west rib of 3 north entry between the last open crosscut and the crosscut being driven between 2 and 3 north entries, the north rib of the last open crosscut between 2 and 3 north entries and the east rib of the last open crosscut between Nos. 2 and 3 rooms west of the closed abandoned north workings. Soot streamers were found about 100 feet east of the main hoisting shaft, in the abandoned north entries, 1, 2 and 3 north working section and to within about 200 feet of the faces of the main east entries.

Obviously, methane that was released by cutting into the closed abandoned north workings entered the ventilating current and was ignited by an electrical arc or spark while repairs were being made in the shuttle car control panel in No. 2 room off the 3 north.

Flame: Evidence of heat and flame, in the form of coke, soot or partly burned paper, canvas and wood, was observed in the north working section, in the abandoned north entry panel, in the main east entries about 100 feet inby and about 350 feet outby the north working section. (See Appendix B).

A total of 22 mine-dust samples, including two for coke only, was collected after the explosion, starting at a line across the 7 east entries about 100 feet inby the shaft bottom and continuing along the east entries at various intervals and into the main north working section to within about 100 feet of the north entry working faces. (See Tables 2 and 3 and Appendix B). The presence of coke in the mine-dust samples is one of the criteria by which extent of the flame was fixed, even though it is possible that such coke in the main east entries may have been blown there. All of the samples collected contained coke ranging in quantities from small to very large, and the two samples collected specifically for coke contained large and very large amounts. Coke was plastered on the roof and ribs at and near the intersection of the 3 east and 2 north haulage roads. Extremely heavy coke was evident in the 3 north entry inby the last open crosscut to within 50 feet of the face and in the last open crosscut between Nos. 2 and 3 north entries. A small amount of coke was

observed on the east rib in the last open crosscut between rooms 2 and 3 which were driven west off the abandoned closed north entries.

Forces: Difficulty was not experienced in discerning the direction of forces. Coking and evidence of slow burning gas were on the roof, ribs and equipment at and near the intersection of room 2 and the blind crosscut in room 2 being driven towards room 3. The emanation of forces was from this area outward and extended throughout the entire mine, converged at the main shaft bottom, continued up the shaft and upon reaching the surface dispersed into the atmosphere. The only evidence underground of extreme violence was observed at and near the bottom of the main shaft. All of the stoppings were blown out. The stoppings in the north entries were driven in a westerly direction and with the exception of one, all concrete-block stoppings were blown in a southerly direction.

Probable Point of Origin: The consensus of the Bureau of Mines investigators is that the explosion originated at the last crosscut turned north off No. 2 room off 3 north where the shuttle car was being repaired.

Factors Preventing Spread of Explosion: The explosion spread throughout the mine and out the shaft, dissipating into the atmosphere.

Summary of Evidence: Conditions observed in the mine during recovery operations and the investigation following the disaster, together with information obtained from company officials, State mine inspector, workmen, and mine records, provided evidence as to the cause and the point of origin of the explosion. The evidence from which the conclusions of the Federal investigators are drawn is summarized as follows:

1. Records of the preshift examinations of the mine indicated no unusual conditions.

2. The Illinois No. 6 coal bed in the area is "gassy". All abandoned mines surrounding this mine were classified gassy.

3. The roof bolter was apparently assisting the shooter prepare coal in room 2 off 1 north since this was common practice. The shearing strip in the Airdox shell indicated that the shell was discharged prior to the explosion.

4. The roof bolt machine was apparently parked in the 1 north entry at room 2 and the forces of the explosion rammed it into the loose coal at the face of room 2. The chuck of the roof bolt drill was imbedded about 8 inches into the partially blasted coal face. The shooter and roof bolter were the only persons working in the rooms off the 1 north entry.

5. The coal drill was the only piece of electrical face equipment in operation at the time of the explosion and had drilled a top hole about 4 feet in depth in the right corner of room 4 off the 3 north entry.

6. The mining machine was not in operation. It had been pulled back about 25 feet from the recently cut face of room 2 off 3 north and apparently the operator and his helper had just changed bits and were waiting to undercut the crosscut after the coal was loaded out.

7. The loading machine operator had loaded about 2 shuttle cars of coal out of the crosscut in room 2 and repositioned his loading machine and loaded about 500 pounds of coal into the shuttle car when he stopped loading to assist in repairing the disabled shuttle car.

8. The shuttle car was being repaired. The control panel cover had been removed, exposing contactors which readily would provide a source of ignition with the trailing cable connected to the source of power.

9. The workmen trying to repair the shuttle car apparently deenergized the power before work was done on the machine. The shift leader found near the nipping station may have energized the power to the shuttle car for test purposes, which in turn may have created the arc or spark within the open control panel.

10. On-shift examinations for gas were apparently not always made, since a flame safety lamp was not found in the slightly damaged north working section after the explosion.

11. Methane probably entered the ventilating current from the abandoned closed north panel which was holed-through shortly after the start of the 4:00 p.m., shift and was carried by the ventilating current to where repairs were being made on the shuttle car.

12. Boreholes were not drilled in advance of the face when No. 1 room off the 1 north entry was being driven by the second shift crew within 50 feet of the abandoned north panel.

13. All forces emanated from room 2 off the 3 north entry.

14. Face equipment was fairly new, and with the exception of the roof-bolting machine which lacked only an approval plate, all the equipment was in permissible condition.

15. The coal is highly volatile, and the mine surfaces were dry, except at a few locations.

16. Coal dust in the immediate area entered into the explosion, which then picked up all the fuel necessary for propagation from the accumulations of coal throughout the north working section.

17. Smokers' articles were listed among the personal effects found on one of the victims of the explosion and an old discarded cigarette lighter found near the coal hopper indicated that smoking was practiced to some extent underground. Management did not have a searching program to assure that smokers' articles were not carried into the mine.

18. Fragile, globular particles of coke that would be indicative of slow burning gas were found adhering to the roof and ribs in No. 2 room off 3 north entry, in the 3 north entry, in the last open crosscut between Nos. 2 and 3 north entries, and in the last open crosscut between rooms 2 and 3 driven west in the abandoned north panel.

19. Plastered coke was observed on the roof and ribs at and near the intersection of the 3 east and 2 north haulage roads. Soot streamers were observed 100 feet inby the main shaft, in the abandoned north panel, in the entire north working section and to within 200 feet of the faces of the main east entries.

Cause of Explosion: The Federal inspectors are of the opinion that the disaster was caused by the ignition of methane in the air current in

room 2 off 3 north entry at the entrance to the second north crosscut. Methane apparently entered the ventilating current from the abandoned north panel that had been penetrated. The gas was ignited by an arc or spark from the open control panel while repairs were being made on the shuttle car. Coal dust in the immediate area entered into the explosion, which then picked up all the fuel necessary for propagation from the accumulations of coal throughout the north working section.

RECOMMENDATIONS

1. Officials whose regular duties require them to inspect working places should have in their possession, and should use, when underground, a suitable permissible device capable of detecting methane and oxygen deficiency.

2. In all underground face workings in a gassy mine where electrically driven equipment is operated, examinations for methane should be made with a permissible flame safety lamp by a person trained in the use of such lamp before such equipment is taken into or operated in face regions, and frequent examinations for methane should be made during the operation of the equipment.

3. Whenever any working place in an underground mine approaches within 50 feet of abandoned workings in such mine, as shown by surveys made and certified by a competent engineer or surveyor, which cannot be inspected and which may contain dangerous accumulations of water or gas a borehole or boreholes should be drilled to a distance

of at least 20 feet in advance of the working face of such working place. Such boreholes should be drilled sufficiently close to each other to insure that the advancing face will not accidentally hole through into such workings. Boreholes should also be drilled not more than eight feet apart in the rib of such working place to a distance of at least 20 feet and at an angle of forty-five degrees. Such rib holes should be drilled in one or both ribs of such working place as may be necessary for adequate protection of persons working in such place.

4. Coal dust and loose coal should not be permitted to accumulate in dangerous quantities in active underground workings of a mine.

5. Where rock dust is applied, it should be distributed by such methods to insure application to the top, floor, and sides of all open places 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 methane in the ventilating current.

6. The effectiveness of rock-dust applications should be determined as necessary.

7. The quantity of air reaching the last open crosscut in any pair or set of entries should not be less than 6,000 cubic feet a minute.

8. At least once each week, a properly certified or competent person should measure the volume of air entering the main intakes and

leaving the main returns, the volume passing through the last open cross-cut in each active entry, and the volume at the intake and return of each split. A record of such measurements should be kept in a book on the surface, and the record should be open for inspection by interested persons.

9. Tests for methane with a permissible flame safety lamp, a permissible methane detector, or by chemical analysis should be made at least once a week by the mine manager or other properly certified person designated by him in the return of each split where it enters in the main return, at seals and in the main return. A record of these examinations and tests should be kept at the mine.

10. Each day, the mine manager and each assistant should enter plainly and sign with ink or indelible pencil in a book provided for that purpose a report of the condition of the mine or portion thereof under his supervision, which report should state clearly the location and nature of any danger observed by them or reported to them during the day, and the report should state what action, if any, was taken to remedy such danger.

11. Permissible junction or distribution boxes should be used for making multiple-power connections in working places where dangerous quantities of methane may be present or may enter the air current.

12. Only flame-resistant trailing cables should be used underground.

13. Trailing cables should be provided with short-circuit protection.

14. Temporary splices in trailing cables should be made in workmanlike manner, mechanically strong, and well insulated.

15. A program should be established to insure that trailing cables containing as many as five temporary splices will be removed from the equipment and service until such splices have been vulcanized.

16. The practice of smoking, carrying matches, lighters, and smoking materials underground should be prohibited, and management should initiate a search program to assure that smokers' articles are not carried into the mine.

17. The intentional creation of any arc, spark, or open flame should be prohibited, except as provided in Section 209(g)(6) of the Act.

18. Only development work necessary to connect the main opening with the air shaft should be done when opening a new mine.

19. A second means for men to escape from the mine in an emergency should be provided before the mine resumes operation.

20. Mine explosions, mine fires and fatal accidents should be reported immediately and by the quickest available means to the nearest office of the Federal coal-mine inspector or other representative of the Health and Safety Activity, United States Bureau of Mines.

ACKNOWLEDGMENT

The cooperation of the owner and employees, Illinois Department of Mines and Minerals, United Mine Workers of America and various coal companies in the area during this investigation is gratefully acknowledged.

Respectfully submitted,

/s/ F. J. Smith

F. J. Smith
District Supervisor

/s/ J. R. Summary

J. R. Summary
Federal Coal-Mine Inspector

/s/ C. M. Dovidas

C. M. Dovidas
Federal Coal-Mine Inspector

/s/ S. J. Douglas

S. J. Douglas
Federal Coal-Mine Inspector (Electrical)

Approved by:

/s/ James Westfield
Assistant Director--Health and Safety

/s/ Marling J. Ankeny
Director

ANALYSES OF AIR SAMPLES

DATE COLLECTED January 13, 1962

COLLECTED BY J. R. Summary

MINE BOTTLE NO.	LABORATORY NO.	COMPANY LOCATION IN MINE	PERCENT IN VOLUME				NITROGEN	CUBIC FEET AIR PER MINUTE	CUBIC FEET METHANE 24 HOURS
			CARBON DIOXIDE	OXYGEN	METHANE	CARBON MONOXIDE			
A3787	14972	S E air-course entry due north of power and sand borehole	0.16	20.50	0.37	0.033	78.94		
A3788	14973	4th haulage road 1 crosscut west of hoisting shaft	0.78	19.83	0.19	0.12	79.08		
A3799	14974	return upcast shaft from small fan	0.06	20.80	0.10	present less than 0.01	79.04	2,000	2,900
A3800	14975	return upcast shaft from large fan	0.10	20.73	0.21	present less than 0.01	78.96	3,000	9,100
A3858	14976	3 E haulage road 5 feet east of power and sand borehole	0.06	20.75	0.09	present less than 0.01	79.10		
A3859	14977	4 E haulage road 5 feet east of power and sand borehole	0.10	20.75	0.18	0.012	78.96		

ANALYSES OF AIR SAMPLES

TABLE 1

DATE COLLECTED January 16, 1962

COLLECTED BY J. R. Summary

MINE BOTTLE NO.	No. 2 LABORA- TORY NO.	COMPANY Blue Blaze Coal Company	LOCATION IN MINE	PERCENT IN VOLUME				CUBIC FEET		CUBIC FEET METHANE IN 24 HOURS
				CARBON DIOXIDE	OXYGEN	METHANE	CARBON MONOXIDE	NITROGEN	AIR PER MINUTE	
S239	15079		near face crosscut north off No. 2 room off 3 north off 7 east	0.11	20.54	0.40	none	78.95		
A625	15080		near face of No. 4 room west off abandoned north panels off 7 east	0.04	20.76	0.20	none	79.00		
A626	15081		last open crosscut between abandoned north panels off 7 east	0.15	20.74	0.11	none	79.00		

IAB. NOS. 28260-28261

TABLE 2 ANALYSES OF DUST SAMPLES DATE COLLECTED January 16, 1962

MINE No. 2		COMPANY Blue Blaze Coal Company		COLLECTED BY B.J.Dona and J.A.McCune	
SAMPLE NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE	
1	Area	EXPLOSION SAMPLES track entry 1 and 2 north east intersection	Very large	30.4	
2	"	No. 2 room off 4 north, 50 feet inby room neck	Large	29.8	

IAB. NOS. 28262-28281

Sheet No. 1

January 16, 1962

TABLE 3 ANALYSES OF DUST SAMPLES

MINE No. 2		COMPANY	Blue Blaze Coal Company	COLLECTED BY		B. J. Dona and J. A. McCune
SAMPLE NO.	SAMPLE OF DUST FROM	LOCATION IN MINE		ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE	
		EXPLOSION SAMPLES				
A-1		samples collected on main north entries, 15 feet inby A				
B-1	Floor	entry off main east at 50-foot intervals				
C-1	Band	entry not developed		Very large		44.8
D-1		too wet to sample		Large		42.5
A-2		entry not developed				
B-2	Band			Large		36.7
C-2	"			Small		29.2
D-2	"			Small		42.5
A-3		entry not developed				
B-3	Band			Large		33.2
C-3	"			Large		35.4
D-3	"			Large		37.6
E-3	"			Small		36.4
A-1		samples collected in main east entries, 100 feet inby main shaft bottom				
B-1	Band			Small		30.8
C-1	"			Large		48.4
D-1	Rib & Floor			Small		43.9
E-1	Band			Large		50.3
F-1	"			Small		54.7
G-1	"			Small		38.8
				Small		36.1

LAB. NOS. 28262-28281

Sheet No. 2

DATE COLLECTED January 16, 1962

TABLE 3 ANALYSES OF DUST SAMPLES

MINE No. 2 COMPANY Blue Blaze Coal Company COLLECTED BY B.J.Dona and J.A.McCune

SAMPLE NO.	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	AS-RECEIVED PERCENT INCOMBUSTIBLE
A-2		samples collected in main east entries, 325 feet inby main shaft bottom		
B-2		too wet to sample	Large	39.9
C-2	Band	too wet to sample	Large	37.1
D-2	"		Very Large	41.1
E-2	"		Very Large	42.2
F-2	"			
G-2	"	too wet to sample		

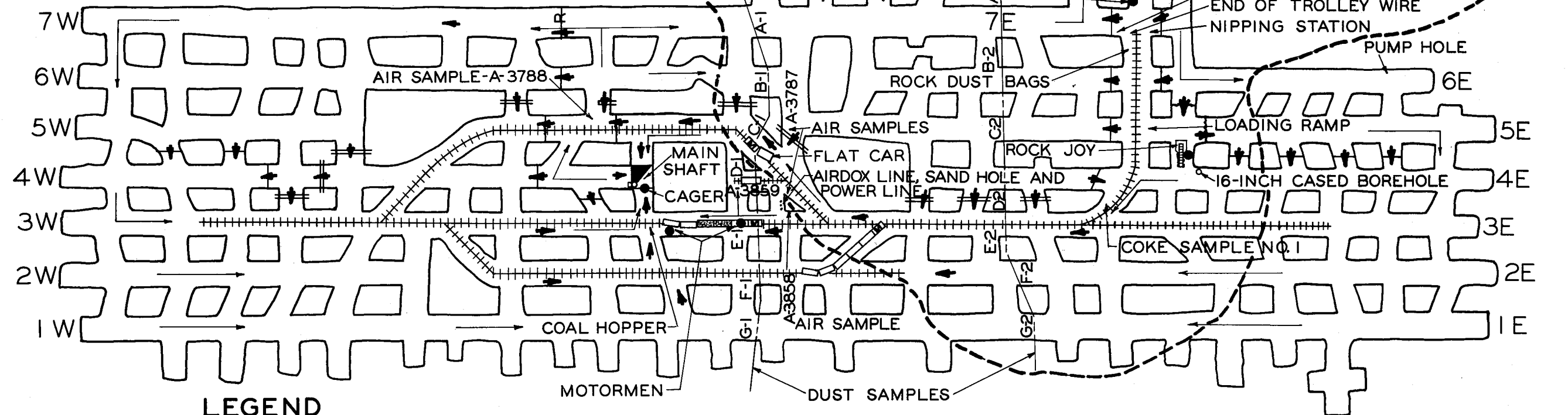
A P P E N D I X A

VICTIMS OF EXPLOSION - MINE NO. 2
BLUE BLAZE COAL COMPANY

January 10, 1962

	<u>Name</u>	<u>Age</u>	<u>Occupation</u>	<u>Marital Status</u>	<u>Number of Dependents</u>	<u>Total Years Experience In Mines</u>
1.	John Barkus	54	Shuttle-Car Operator	Married	1	30
2.	Ralph Brandon	50	Shooter	Married	3	17
3.	William Gartner	55	Loading- Machine Operator	Married	1	30
4.	Willie Gulley	43	Cager	Married	2	15
5.	George A. Horsley	55	Driller	Married	3	30
6.	Joseph H. Kimmel	44	Roof Bolter	Married	1	20
7.	Melvin G. Ramsey	42	Cutting Machine Man	Married	2	20
8.	Virgil Tanner	55	Motorman	Married	3	30
9.	Ira Williams	60	Motorman	Married	1	35
10.	Roy Woodis	47	Shift Leader	Married	3	25
11.	Ira Yewell	65	Cutting Machine Man	Married	1	40

MINE EXPLOSION-JANUARY 10, 1962



NOTE:
FORCES EXTENDED THROUGHOUT THE ENTIRE MINE.
THE GREATEST FORCES WERE NEAR AND AT THE
BOTTOM OF THE MAIN SHAFT.