COAL FATAL

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

DISTRICT B

REPORT OF GAS EXPLOSION
LLEWELLYN SHAFT
R. G. JOHNSON COMPANY (CONTRACTOR)
FARMINGTON, MARION COUNTY, WEST VIRGINIA

April 30, 1965

By

Matthew I. Duncan and W. D. Baldwin
Federal Coal Mine Inspectors

and

C. D. McMaster
Federal Coal Mine Electrical Inspector

Originating Office - Bureau of Mines
Morgantown, West Virginia
John J. Dougherty, Acting Subdistrict Manager
Morgantown, West Virginia, Subdistrict, Health and Safety District B

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INTRODUCTION

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

A violent gas explosion that occurred at 6:44 p.m., Friday, April 30, 1965, in the Llewellyn shaft that was sunk to the Pittsburgh coal bed under contract by the R. G. Johnson Company from the Mountaineer Coal Company, Division of Consolidation Coal Company. Four employees working in the shaft were killed instantly. Harold Swartz and Robert Patterson, who were working in a water ring in the shaft, were hoisted from the shaft about 10 minutes after the explosion occurred. Swartz received a slight wound on the scalp and an injured little finger on the right hand. Patterson was not injured. Five employees engaged in various duties on the surface were not affected by the explosion. The names of the men killed, ages, occupation, marital status, number of dependents, and experience are shown in Appendix A. It is believed that one of the lights suspended in proximity of the shaft bottom was broken by a falling object, and the resultant arcing caused by a short circuit ignited the accumulation of methane-air mixture. Property damage was confined to the wooden scaffold (platform) which was blown from the shaft, a broken steel rope attached to the platform, light wire, and some of the concrete forms in the west approach on the shaft bottom.

GENERAL INFORMATION

The Llewellyn shaft sunk to the Pittsburgh coal bed, by the R. G. Johnson Company for the Mountaineer Coal Company is along Llewellyn Run about 5 miles west of Farmington, Marion County, West Virginia.

The names and addresses of the operating officials of R. G. Johnson Company are as follows:

S. C. Johnson	President	Washington, Pennsylvania
R. G. Johnson, Jr.	Vice President	Washington, Pennsylvania
W. B. Johnson	Vice President	Washington, Pennsylvania
Ralph Fullerton	Superintendent, R. G. Johnson Company	Washington, Pennsylvania
Blaine Sisson	Superintendent, Llewellyn Shaft	Waynesburg, Pennsylvania
Francis Shriver	Assistant Superintendent, Llewellyn Shaft	Waynesburg, Pennsylvania

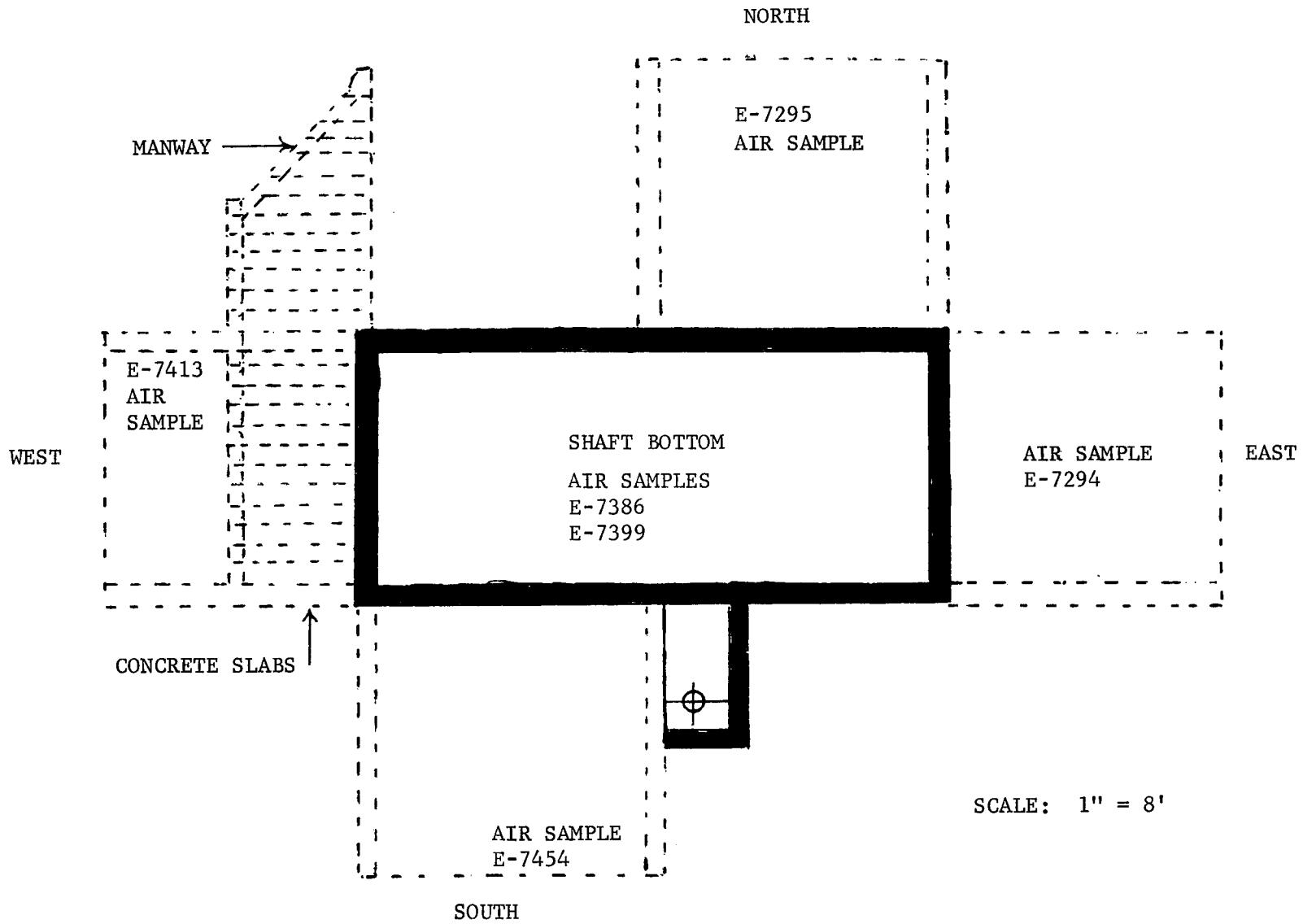
The shaft, started August 21, 1964, was terminated in the 90-inch thick Pittsburgh coal bed at the time of the mishap. A total of 25 men was employed on 2 shifts--14 on the day shift and 11 on the second shift. The main west entries of Consol No. 9 mine were being driven toward and were about 1,000 feet from the shaft at the time of the explosion. The shaft was inspected March 23, 1965, in conjunction with a regular Federal inspection of Consol No. 9 mine.

MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods: The Llewellyn shaft, 28 feet and 8 inches by 12 feet, was sunk to a depth of 577 feet to the bottom of the Pittsburgh coal bed. Four approaches, 12 and 14 feet wide, were developed 15 feet off the shaft bottom and a manway had been driven 14 feet off the west approach. The approaches were lined with concrete to within 2 feet of the faces and the forms supporting the concrete were found in good condition, except in the west approach where they were damaged by the explosion. The shaft walls have been completely faced with concrete, but the curtain wall for the shaft compartments had not as yet been installed. The shaft when completed will consist of two 12- by 14-foot compartments which will be utilized for intake and return airways and man-hoisting facilities. Metal inserts to be used for the elevator guides have been installed 8 feet apart, flush with the concrete wall. Three water rings, 6 feet high and 3-1/2 feet wide, were installed in the shaft at depths of 81, 283, and 550 feet. The water rings were sealed with a concrete wall 12 inches in thickness, and a sheet-metal door 1/4 inch thick, 2 feet wide, and 3 feet high was installed at each water ring on the west side of the shaft.

Explosives: Explosives were not being used in the shaft. The last blasting operations were made in the coal on April 15, 1965.

Ventilation and Gases: Ventilation in the shaft was induced by two centrifugal-type blower fans. The fans were installed on the surface at distances of 6 and 8 feet from the top of the shaft; one fan, 28 inches in diameter, was powered by a 15-horsepower motor and had a rated capacity of 4,000 cubic feet of air a minute; the other fan, 30 inches in diameter, powered by a 10-horsepower motor,


NORTH
MANWAY
E-7295
AIR SAMPLE
E-7413
AIR
SAMPLE
WEST
SHAFT BOTTOM
AIR SAMPLES
E-7386
E-7399
AIR SAMPLE
E-7294
EAST
CONCRETE SLABS
SCALE: 1" = 8'
AIR SAMPLE
E-7454
SOUTH

APPENDIX E

had a rated capacity of 3,840 cubic feet of air a minute. Fifteen-inch-diameter, corrugated tubing extended from each fan along the west corners of the shaft to within 28 and 33 feet of the shaft bottom. The size, shape, and extent of tubing reduced very considerably the quantity of air delivered at the outlet ends for effective work. Also, the distances at which the ends of the tubings were terminated from the shaft bottom affected appreciably the efficiency of the ventilation. The shaft was sunk to the Pittsburgh coal bed, which is known to be gassy in this area. Oil and gas wells penetrate the coal bed in the area, many of which are either abandoned or plugged; the two nearest active wells are 2,500 and 3,500 feet away from the shaft. Two permissible flame safety lamps maintained in good condition were provided. Reportedly, preshift and on-shift examinations were made and the fans were started about 30 minutes before the examiner entered the shaft to make his preshift examination for the day shift and were kept operating until the end of the second or afternoon shift while men were in the shaft. However, the superintendent stated that on more than one occasion he found but one fan being operated while men were working in the shaft and that he would on such occasions start the second fan but would say nothing about it. The only certified person employed worked on the day shift and made both the day and afternoon preshift examinations for gas; however, he had not worked since April 22, 1965. Since that day the superintendent and day-shift foreman made the gas tests for the day shift while the assistant superintendent and afternoon-shift foreman made similar tests for the evening shift. Neither of the four was certified under the mining laws of West Virginia, but they had qualified for gas testing with a flame safety lamp--the test and instruction was given them by a State mine inspector. The fire-boss record book shows that gas was detected for the first time in the shaft on March 29, 1965, then on April 2, 8, 9, 12, 13, 14, 16, 19, 20, and 21, 1965. The superintendent stated he made the preshift examinations on April 23 to April 30, 1965. The fire-boss record book shows examinations were made April 23, 26, 27, and 28, but there were no entries for preshift examinations for April 29 and 30. The superintendent stated that on April 30, 1965, at 12:30 p.m., when he visited the shaft bottom, Robert Anderson, shift foreman who was already at the bottom, told him that he had just tested for gas against the coal faces and detected a small amount of methane but did not consider it to be serious as long as the fans were running. Anderson stated he made his last test for gas before the explosion at about 2 p.m. and did not detect any accumulation. The assistant superintendent and his afternoon-shift foreman did not take a flame safety lamp or other methane detecting device into the shaft the evening of the explosion. The on-the-job officials in charge of sinking the shaft obviously were aware that methane gas was being liberated roundabout the shaft bottom and that extra vigilance was called for to safeguard against a gas-air mixture accumulating. Air samples (see Table 1) collected at the foot of the shaft and in proximity of the exposed coal faces in the offsets 17 hours after the explosion, and with both fans running since the previous day further proves that methane was being freely liberated into the developed area roundabout the foot of the shaft and that neither the shaft bottom nor the sheltered offset areas were being properly ventilated.

Dust: The shaft was concrete lined and the coal surfaces were definitely wet; there was 4 to 8 inches of water on the floor. There was no evidence that coal dust entered into the explosion.

Electricity: The only electricity used in the shaft was 110 volts alternating current to the suspended incandescent lights.

Illumination and Smoking: Illumination in the shaft was provided by two-conductor rubber-covered extension cables used to convey the 110 volts alternating-current electric power down the shaft for two Killark vapor-tight light fixtures and two "spotlight" seal-beam lights. The 150-watt seal-beam lights had porcelain sockets mounted on 6-inch square by 1-inch boards with 1/2-inch mesh wire screen guards; they were suspended to a depth of 50 feet by No. 12 rubber-covered cables. The vaportight light fixtures were equipped with 200-watt bulbs and suspended by two-conductor No. 10 rubber-covered cables, one on the east side and one on the west side of the shaft to a depth of 550 feet, approximately 27 feet from the shaft bottom. Workmen used permissible electric cap lamps for portable illumination. The seal-beam lights and cables were blown to the surface during the explosion; the cables, sockets, and seal beams were found intact. One vaportight light fixture and cable which were still suspended in the shaft were reeled to the surface, and, after close examination, showed no sign of an ignition source. The other rubber-covered cable, which pulled apart at the top of the shaft, was found on the shaft floor. The metal housing of this vaportight light fixture was broken where the cable entered the housing and the power conductors were torn from the socket terminals and were in contact with each other as indicated by blisters on the strands of each conductor.

As far as could be ascertained, smoking was not permitted or done by men while working in the shaft, and "No Smoking" signs were posted on the surface in the vicinity of the shaft. However, a smoker's lighter was found in the clothing worn by one of the victims and loose cigarettes were found on the surface near some of the victims. Regular searches were not made for smokers' articles.

Mine Rescue: Several mine-rescue teams were available within a 20-mile radius of the shaft. Two men from the Consol No. 9 mine, mine-rescue team, wearing oxygen-breathing apparatus, were lowered into the shaft about 12:25 p.m. on May 1, 1965, and made an exploratory trip to the bottom of the shaft before other persons were permitted to enter.

STORY OF EXPLOSION AND RECOVERY OPERATIONS

Participating Organizations:

R. G. Johnson Company
West Virginia Department of Mines
United States Bureau of Mines

Activities of Bureau of Mines Personnel: Matthew I. Duncan, Federal Coal Mine Inspector, was notified of the explosion at 7:10 p.m., April 30, 1965, by a telephone call from R. D. Patterson, compensation administrator for Mountaineer Coal Company. Duncan immediately notified John J. Dougherty, Acting Subdistrict Manager, Morgantown, West Virginia.

Matthew I. Duncan and W. D. Baldwin, Federal Coal Mine Inspectors, arrived at the shaft at 8:15 p.m., offered their assistance and conferred with State department of mines personnel and company officials, from whom they learned that all of the victims had been found on the surface. Other Bureau of Mines personnel who visited the shaft and participated in various phases of the investigation were:

John J. Dougherty	Acting Subdistrict Manager
C. D. McMaster	Federal Coal Mine Electrical Inspector
W. L. Evans	Federal Coal Mine Inspector

Evidence of Activities and Story of Explosion: Blaine Sisson, superintendent, Llewellyn shaft, R. G. Johnson Company, stated he made a preshift examination with a permissible flame safety lamp at the bottom of the shaft about 7:30 a.m., April 30, 1965, for the first shift and reported the shaft clear of gas. Robert Anderson, day-shift foreman, stated he made tests about 12:15 p.m. and found a small accumulation of gas at the coal face. Anderson also said he made a preshift examination at the bottom of the shaft at 2 p.m. the same day and found no accumulation of gas, only liberation at the faces of the approaches.

The first shift on the day of the occurrence removed the forms from some of the cement work near the bottom and cleaned up some scrap material from the shaft bottom and completed their day's work without incident. The second shift crew entered the shaft at 3:30 p.m. The night superintendent assigned Swartz and Patterson to clean out the water rings and he accompanied them in the bucket to the first water ring to explain the work he wanted done. Four other workmen were detailed to clean and paint the metal inserts in the shaft wall, starting at the top of the shaft using the 11- by 14-foot wooden scaffold suspended from one of the shaft hoisting ropes. The tools on the platform included an air-powered chipping hammer, a couple of screw drivers, one hand hammer, two paint brushes, two steel brushes, and two cans of paint. The material that was removed from the metal inserts was permitted to fall down the shaft. The night superintendent, after instructing the men working in the water ring, on returning up the shaft in the bucket observed the four men working on the scaffold.

The two men completed cleaning out the first water ring in approximately 1-1/2 hours. The tools used by these men included a wrecking bar, two shovels, one saw, and an 8-pound sledge hammer. The material removed from the water ring, loose rock, some pieces that weighed as much as 10 pounds, was shoveled through the metal doorframe and fell to the bottom of the shaft. After finishing work in the first water ring, these men went to the surface, via the bucket,

for 10 or 15 minutes and then to the second water ring, 283 feet from the surface, to start removing the extraneous material. They found some wooden forms in this water ring so they called up the shaft for a saw. The top man lowered the saw to the men working on the platform, who then lowered it to the men at the second water ring, about 50 feet below. The men had been working in the second water ring about 30 minutes when the explosion occurred at 6:44 p.m. One of these men, closest to the door, was slightly injured. After waiting a few minutes for the smoke and heat to subside, they went to the door, got in the bucket and called up the shaft to be hoisted to the surface. The force of the explosion was so violent that the four men working on the scaffold were killed instantly when they were blown out of the shaft to the surface. The scaffold, some light wire, and tools were scattered for several hundred feet over the area around the top of the shaft. Property damage was confined to the wooden scaffold (platform), a broken 7/8-inch nonspin steel rope that was attached to the scaffold, light wire, and some of the concrete forms in the west approach at the bottom of the shaft.

Recovery Operations: There was no fire and the victims were all found on the surface the evening of the occurrence.

INVESTIGATION OF CAUSE OF EXPLOSION

The investigation of the explosion was started April 30, 1965, by representatives of R. G. Johnson Company, the West Virginia Department of Mines, and the U. S. Bureau of Mines. The investigation was continued through May 6, 1965.

The members of the investigating committee consisted of the following persons:

R. G. Johnson Company

R. G. Johnson, Jr.	Vice President
W. B. Johnson	Vice President
Ralph Fullerton	Superintendent

West Virginia Department of Mines

Leslie C. Ryan	Inspector-at-Large
John M. Ashcraft	Assistant Inspector-at-Large
E. H. John	District Mine Inspector

United States Bureau of Mines

John J. Dougherty	Acting Subdistrict Manager
Matthew I. Duncan	Federal Coal Mine Inspector
W. L. Evans	Federal Coal Mine Inspector
W. D. Baldwin	Federal Coal Mine Inspector
C. D. McMaster	Federal Coal Mine Electrical Inspector

The hearing conducted by the West Virginia Department of Mines on May 1, 1965, in the company office near the head of the shaft, was headed by Leslie C. Ryan, Inspector-at-Large, assisted by other State personnel. Mr. Ryan invited other interested parties, including representatives of the R. G. Johnson Company and the Bureau of Mines to participate in the interrogation; also, other persons who might have knowledge of events prior to the explosion or practices which might have set the stage for the disaster.

Methane as a Factor in the Explosion: Approximately 17-1/2 hours after the mishap, with both fans having been in operation continuously since the explosion, two men from the Consol No. 9 mine-rescue team wearing oxygen-breathing apparatus were lowered to the shaft bottom. Tests made by them on the shaft bottom with a P-1 methane detector showed 1-1/2 percent methane which is indicative that methane was being liberated freely from the coal faces of the approaches to the shaft bottom. When these two men were hoisted to the surface and reported their findings, the shaft superintendent, representatives of the West Virginia Department of Mines, and U. S. Bureau of Mines were lowered to the shaft bottom. Tests were made with a P-1 and Riken methane detectors on the shaft bottom, at the entrances to the approaches, and near the coal face in each approach. Methane was detected in amounts of 1-1/2 percent to more than the maximum reading of 6 percent on the Riken detector. Two air samples in bottles Nos. E-7386 and E-7399 collected on the shaft bottom, near the center, and 5 feet above the floor indicated 1.42 and 1.45 percent methane; also, air samples Nos. E-7454, E-7413, E-7294, and E-7295, collected in each approach at the coal faces close to the roof in the cavity inby the last roof brace of the concrete forms, about 15 feet from the side of the shaft, indicated 80.0, 69.3, 54.5, and 53.4 percent methane, respectively. The fans were operating and the ends of the metal tubings were extended to within 28 and 33 feet from the shaft bottom, the same as before the explosion.

After these air samples were collected, a larger fan was installed to replace the smaller of the two original fans and the metal tubing of one fan was extended to within approximately 13 feet of the shaft bottom and provided with an inverted wye-type tube at the end to more thoroughly diffuse the airflow and reduce the methane content of the air at the shaft bottom to less than 1 percent. The analytical results of the six air samples collected during the investigation are listed in table 1. Unquestionably, the disaster resulted from the ignition of a large quantity of methane that was liberated from the Pittsburgh coal bed at the shaft bottom.

Flame: There was no evidence of flame except during the original explosion.

Forces and Point of Origin: Statements of witnesses and evidence at the shaft indicated that the forces of the explosion originated near the shaft bottom and extended out the top of the shaft for several hundred feet.

Summary of Evidence: Conditions in the shaft during the investigation after the explosion, together with information obtained from a hearing and from company officials and shaft records, provided evidence from which the conclusions of the Federal investigators are drawn is summarized as follows:

1. There was one explosion in which only methane was involved (coal dust not involved at all).

2. The explosion occurred at 6:44 p.m., April 30, 1965. The time was corroborated by the statements of witnesses and a stopped watch worn by one of the victims.

3. The four men working on the scaffold (platform) about 230 feet below the shaft coping were killed instantly.

4. No blasting was done in the shaft since April 15, 1965.

5. Methane was being liberated freely in the four approaches driven approximately 15 feet into the Pittsburgh coal bed at the shaft bottom.

6. The discharge ends of the fan tubings extended to only within 28 to 33 feet of the shaft bottom and the volume and velocity of air delivered was insufficient to prevent dangerous accumulations of methane--further, no means was provided to deflect any of the available air into the offset coal faces for ventilating purposes.

7. Witnesses testified, under oath, that both fans were operating continuously during the second or afternoon shift.

8. The person making the preshift examinations was not certified by the State department of mines.

9. The findings of the preshift examinations were not recorded for any of the shifts on April 29 and 30, 1965, the latter date being the date of the explosion.

10. The damaged vaportight light used for supplemental illumination was suspended in the shaft to within 27 feet of the bottom and was exposed to damage from falling material.

11. The damaged condulet of the light indicated that it had been hit by some falling object.

12. Fused ends of several broken wire strands of the connecting wires in the light cable indicated that a short circuit had occurred.

Cause of Explosion: Methane, being liberated freely from the coal faces in the approaches accumulated and gravitated to or was moved in an enriched state toward the source of ignition which was suspended in the shaft approximately 27 feet from the bottom.

RECOMMENDATIONS

The following recommendations are made to prevent similar disasters:

1. The discharge ends of the fan tubings should be extended to a point in the shaft where the air will be directed to the locations where methane is being liberated, maintained in good condition, and the fans and air conductors should be of a size and capacity to provide air of sufficient volume and velocity to dilute and carry away flammable or harmful gases.

2. The persons making the preshift examinations should be certified by the West Virginia Department of Mines.

3. The findings of the preshift examiners, including the preshift examination results for the shift currently working the shaft, should be entered in the fire-boss's record book.

4. Frequent examinations for methane should be made during each working shift.

5. Only permissible-type portable flood lights should be used when necessary to supplement personal permissible lighting.

6. Regular searches should be made for smokers' articles.

ACKNOWLEDGMENT

The writers acknowledge gratefully the cooperation of officials and employees of the R. G. Johnson Company, representatives of the West Virginia Department of Mines, and the various law enforcement agencies, including the State police, sheriff's officers, the Mannington police, and the Auxiliary police.

Respectfully submitted,

/s/ Matthew I. Duncan

Matthew I. Duncan
Federal Coal Mine Inspector

/s/ W. D. Baldwin

W. D. Baldwin
Federal Coal Mine Inspector

/s/ C. D. McMaster

C. D. McMaster
Federal Coal Mine Electrical Inspector

Approved by:

John J. Dougherty
Acting Subdistrict Manager

ANALYSES OF AIR SAMPLES

TABLE 1

DATE COLLECTED May 1, 1965

MINE Llewellyn Shaft COMPANY R. G. Johnson Company COLLECTED BY M. I. Duncan

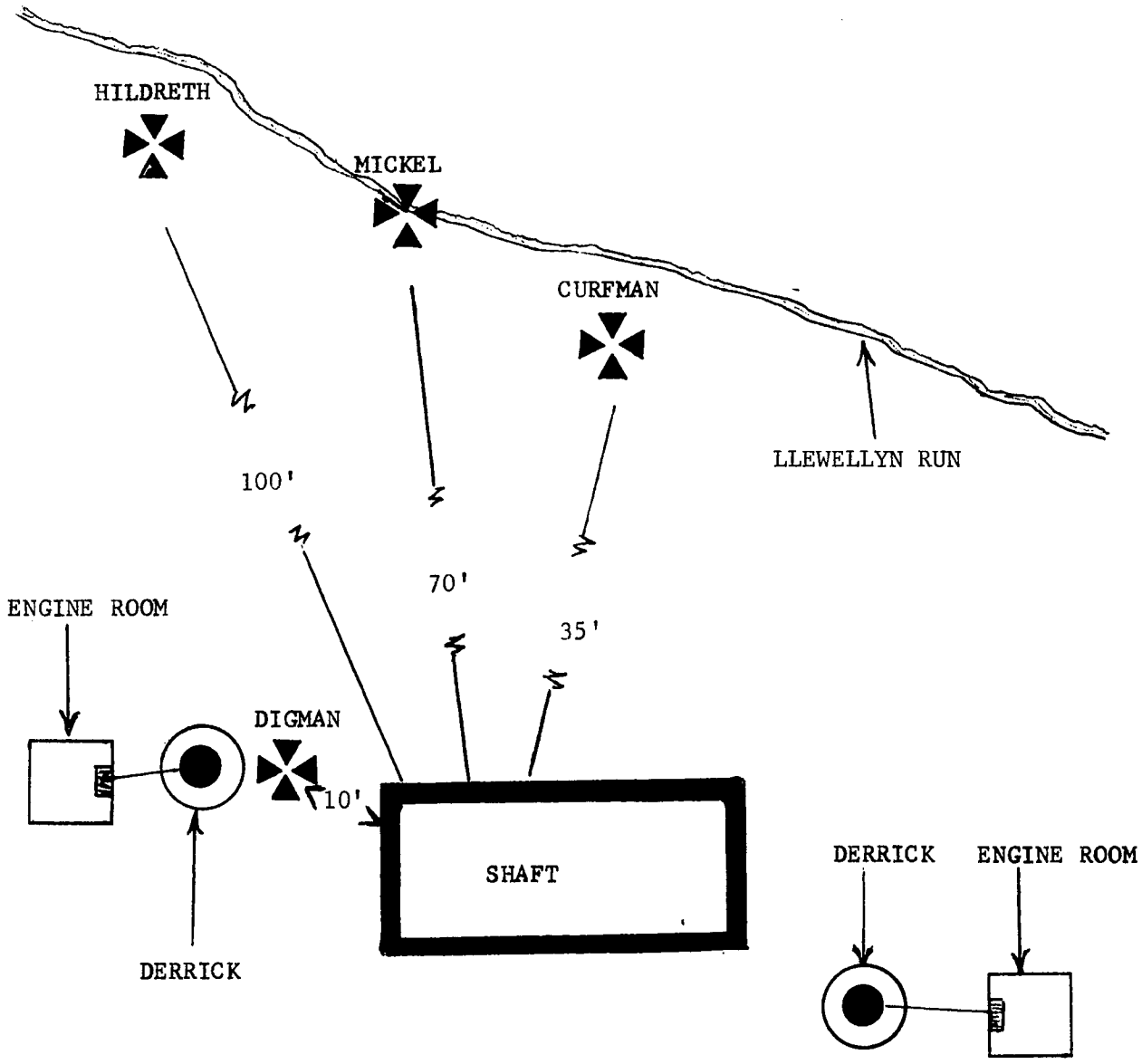
BOTTLE NO.	LABORATORY NO.	LOCATION IN MINE	PERCENT IN VOLUME						CUBIC FEET AIR PER MINUTE	CUBIC FEET METHANE IN 24 HOURS
			CARBON DIOXIDE	OXYGEN	METHANE	CARBON MONOXIDE	NITROGEN			
E7386	55408	shaft bottom near center of shaft 5 feet from floor	0.10	20.59	1.42	none	77.89			
E7399	55409	shaft bottom near center of shaft 5 feet from floor	0.15	20.57	1.45	none	77.83			
E7454	55325	face sample in Pittsburgh coal seam at bottom of Llewellyn shaft south side	4.7	3.1	80.0	none	12.2			
E7413	55326	face sample in Pittsburgh coal seam at bottom of Llewellyn shaft west side	3.7	5.8	69.3	none	21.2			
E7294	55327	face sample in Pittsburgh coal seam at bottom of Llewellyn shaft east side	3.3	8.5	54.5	none	33.7			
E7295	55328	face sample in Pittsburgh coal seam at bottom of Llewellyn shaft north side	3.1	9.8	53.4	none	33.7			

APPENDIX A

VICTIMS OF EXPLOSION IN LLEWELLYN SHAFT
R. G. JOHNSON COMPANY (CONTRACTOR)

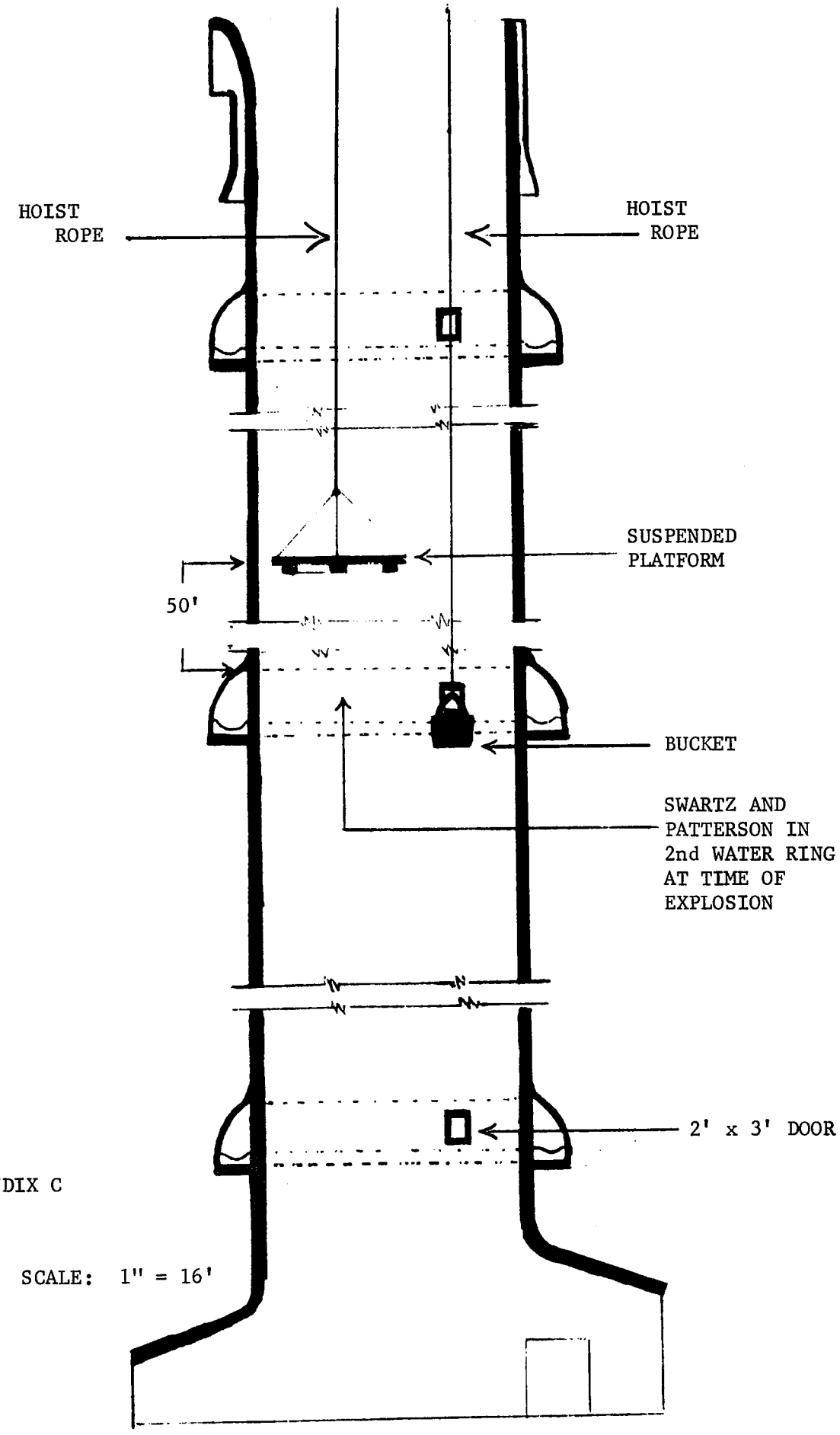
April 30, 1965

NAME	AGE	OCCUPATION	MARITAL STATUS	DEPENDENTS	EXPERIENCE IN SHAFTS
Glenn Curfman	36	Shift Foreman	Married	5	11 years
Chester Hildreth	31	Driller	Married	4	8 months
Robert Digman	33	Driller	Single	0	8 months
Donald Mickel	33	Driller	Single	0	8 months



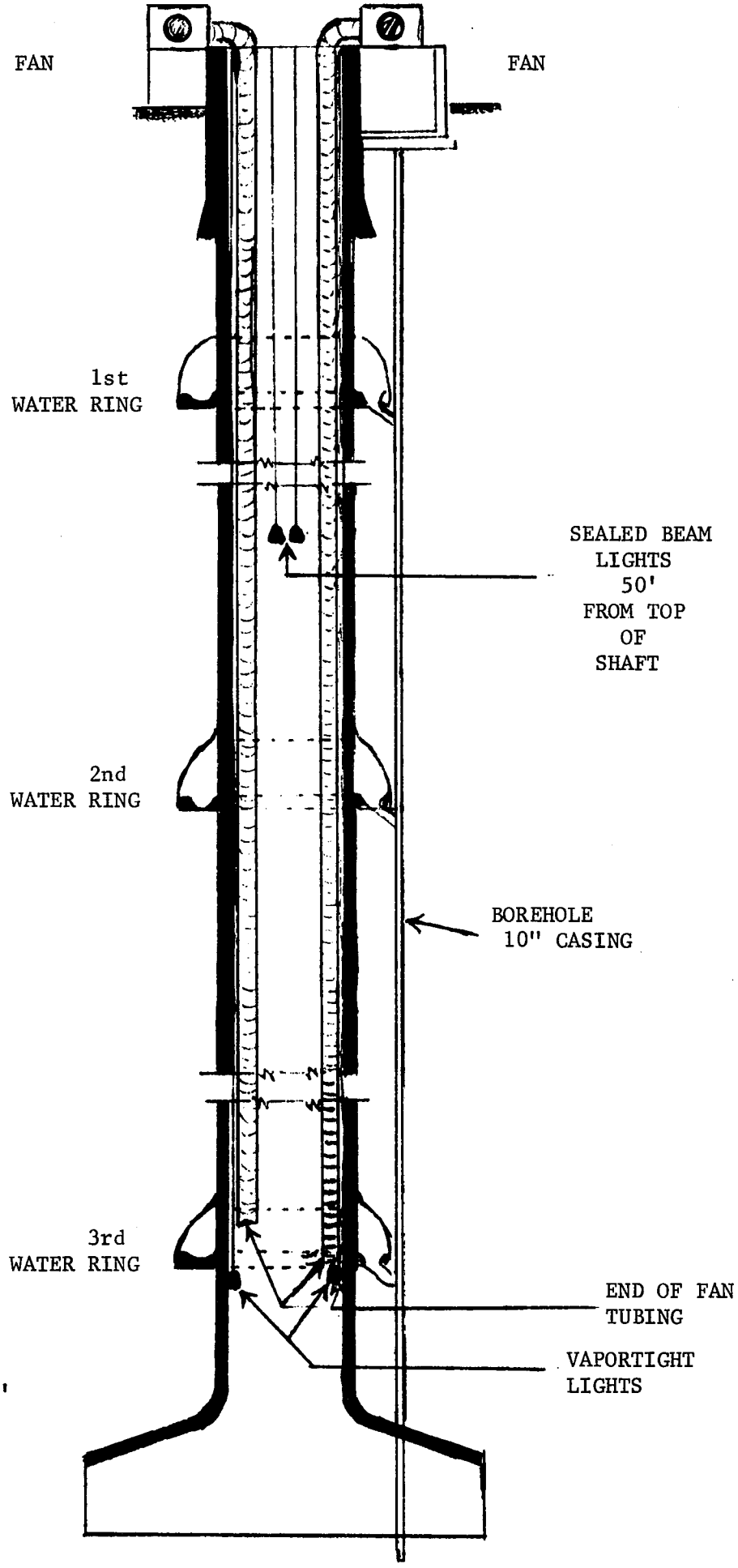
APPENDIX B

SCALE: 1" = 16'



APPENDIX C

SCALE: 1" = 16'



APPENDIX D

SCALE: 1" = 16'