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# COAL FATAL

REPORT OF EXPLOSION IN ZERO MINE  
HANLAN FUEL COMPANY  
YANNEY, KENTUCKY  
DECEMBER 9, 1932

By

J. F. Davies  
District Engineer

And

E. H. Hodgson  
Senior Safety Instructor

DEPARTMENT OF COMMERCE

BUREAU OF MINES

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**And**

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**INTRODUCTION**

A coal dust explosion occurred about 8:30 A.M. central time Friday December 9, 1932 in the Zero Mine of the Harlan Fuel Company, Yancey, Harlan County, Kentucky. The explosion involved all of the active portion of the mine and resulted in the death of 23 men. Fourteen men escaped unassisted. Several of the bodies were severely burned. Eight men died of carbon monoxide, 3 of whom had traveled about 1200 feet and one about 600 feet.

The Norton station of the Bureau of Mines was notified by telephone at 1:10 P.M. eastern time, or 12:10 P.M. central time, by Mr. Charles Guthrie, General Superintendent of the Harlan Fuel Company, who advised that he believed there had been an explosion. J. F. Davies and E. H. Hodgson left a few moments later with equipment from the Norton Safety Station in the Bureau of Mines truck, arriving at 2:20 P.M. central time.

Evidently nothing effective had been done from the time of the explosion until about 11:40 A.M. central time when Mr. James F. Bryson, Director of Safety of the Harlan County Coal Operators' Association, accompanied by Roy Conis, District Mine Inspector, arrived. They, accompanied by several others, went into the mine. When they encountered the debris they returned to the outside to get material to advance ventilation, and returned into the mine.

J. F. Davies and E. H. Hodgson arrived at 2:20 P.M. central time. Mr. Davies immediately proceeded into the mine accompanied by Mr. C. P. Collier, Mining Engineer, and met Mr. Bryson and his party returning to the outside for material. At about 2:50 P.M. actual recovery operations began and proceeded uninterruptedly until about 6:30 A.M. December 10th when all of the bodies had been recovered and the entire explosion area explored.

On December 12th the investigation was conducted in which J. F. Davies and E. H. Hodgson of the Bureau of Mines assisted and collected air and dust samples in the explosion area.

#### PREVIOUS EXPLOSIONS

No previous explosion has ever occurred in this mine.

#### LOCATION

Mines Zero, 1, 2, 3, 4, and 5 of the Harlan Fuel Company are located at Yancey, Harlan County, Kentucky, all of the coal passing over one tippie. The mine tippie is served by a spur from Catron's Creek branch of the Cumberland Division of the Louisville and Nashville Railroad.

### COMPANY OFFICIALS

The officials of the company are:

E. Guthrie	President	Knoxville, Tenn.
Charles Guthrie	General Superintendent	Yancey, Kentucky.
C. P. Collier	Mining Engineer	Yancey, Kentucky.
Victor H. Guthrie	Superintendent	Yancey, Kentucky.
No foreman is employed.		

### EMPLOYEES AND PRODUCTION

The mine is opened by two drifts, one of which serves as main haulageway and main intake airway. There are inside connections, one entry of which serves as a return airway through a portion of Number 2 Mine.

#### The Coal Bed:

The Harlan Bed worked in this mine is a hard, bright, bituminous coal. The coal bed lies flat, but with undulations. The roof is a hard sandstone. The floor is fire clay, underlain by sandstone. The coal varies from 42 to 56 inches and over most of the mine contains a hard fire clay parting which will average about 6 inches in thickness lying about 10 to 16 inches above the floor.

#### Coal Analysis:

The average analysis of the coal from the Harlan Bed as given in Technical Paper 308, "Analysis of Kentucky Coals", and of samples collected in a mine nearby, is as follows:

	<u>Per Cent</u>
Moisture	3.4
Volatile Matter	35.1
Fixed Carbon	57.5
Ash	4.0

The ratio of volatile matter to total combustible is .379.

To render dust of this coal inert and to prevent propagation of an ex-

plosion in case no gas is present will require at least 61 per cent of incombustible in the dust. Of this amount the moisture and ash content of this coal provide approximately 7.4 per cent.

#### Coal Preparation:

Coal from all of the mines is prepared in the one tippie, which is equipped with shaker screens, loading boxes, and a conveyor. There are three loading tracks, but 5 sizes of coal, are produced.

Drop bottom mine cars are used and the coal falls into a bin and is conveyed down to the tippie about 40 feet below and 100 feet distant.

#### DUST

Dust from this coal, when suspended in the air, is explosive. From the evidence this explosion was propagated by coal dust, this being evidenced by coking throughout the flame area. The active portion of the mine is very dry and dusty. The haulage roads showed evidence of considerable spilled coal, much of which was very fine. For several months previous to the explosion all of the machine cuttings and all coal which passed through forks with prongs spaced  $1\frac{1}{2}$  inches apart has been thrown into the gob. In all of the rooms the gob extends to within 10 to 12 feet of the face. This material is also gobbled in the entries.

Samples of dust were collected at different places in the mine. Table 1 shows the location at which they were taken; the kind of dust, as roof and rib, or floor; and the approximate analyses. The mine is dry and dusty. The locations at which the dust samples were taken are shown on the map by "D-1", etc. The individual dust analysis report sheets are included in the Appendix.

TABLE 1  
ANALYSES OF DUST SAMPLES, 1932  
ZERO MINE

Lab. No.	Samp. No.	Kind	Location	Per Cent			Per Cent-As Rec'd Basis				Remarks
				Thru 20 M.	Thru 100 M.	Thru 200 M.	Comb.	H <sub>2</sub> O	Ash	Total Incomb.	
A-98071	1	Rib & roof	Opp. #7 ra. on 1 L hdg. off Zero main.	59.8			83.6	1.1	15.3	16.4	Not rock-dusted.
72	2	Floor	Opp. #7 ra on 1 L hdg. off Zero main.	73.1	49.7	32.3	76.7	1.1	22.2	23.3	" " "
73	3	Rib & roof	Opp 2nd x-cut outby face 1 left aircourse.	61.5			91.5	1.2	7.3	9.5	" " "
74	4	Floor	Opp 2nd x-cut outby face 1 left aircourse.	65.8			91.5	1.4	7.1	9.5	" " "
75	5	Rib & roof	20' inby #10 x-cut on 1 left aircourse.	56.3			84.1	1.1	12.9	13.9	" " "
76	6	Floor	20' inby #10 x-cut on 1 left aircourse.	70.5	32.9	19.5	85.6	1.2	13.2	14.4	" " "
77	7	Rib & roof	Opp #5 x-cut on 1st left heading.	58.1			84.7	1.3	14.0	15.3	" " "
78	8	Floor	Opp #5 x-cut on 1st left heading.	67.6	23.3	16.6	81.6	1.3	17.1	18.4	" " "
79	9	Rib & roof	Opp #5 x-cut on 1st left aircourse.	63.6			73.2	1.1	23.7	24.8	" " "
80	10	Floor	Opp #5 x-cut on 1st left aircourse.	69.4	37.2	25.1	79.6	1.2	20.2	21.4	" " "
81	11	Rib & roof	Mouth 1 L a.c. on Zero main aircourse.	80.5			80.8	0.8	18.4	19.2	" " "
82	12	Floor	Mouth 1st L a.c. on Zero main aircourse.	59.7			87.8	1.3	10.9	12.2	" " "
83	13	Rib & roof	20' outby 1 L a.c. on Zero main.	63.9	49.7	31.5	75.5	1.2	23.3	24.5	Rock-dusted.
84	14	Floor	20' outby 1 L a.c. on Zero main.	67.9			73.5	1.1	25.4	26.5	" "

(Continued)

Lab. Samp. No.	No.	Kind	Location	Per Cent			Per Cent-As Rec'd Basis				Remarks
				Thru 80 M	Thru 100 M	Thru 200 M	Comb.	H <sub>2</sub> O	Ash	Total Incomb.	
85	15	Rib & roof	500' outby 1st L a.c. on Zero main.	65.0			71.3	1.1	27.6	83.7	Rock-dusted.
86	16	Floor	500' outby 1st L a.c. on Zero main.	57.1			71.2	1.0	27.8	83.8	" "
87	17	Rib, roof, & floor.	500' outby 1st L a.c. on Zero main aircourse.	71.8			85.1	1.1	15.8	14.9	Not rock-dusted.

The total incombustible content of all of the samples was far below that required to prevent propagation of an explosion, even those collected in the rock-dusted area.

Samples D-13, D-14, D-15, and D-16 were collected in the rock-dusted area and show respectively 47.8, 51.9, 53.3, and 56.6 per cent total incombustible, whereas the per cent of incombustible required to prevent propagation, as indicated by the volatile ratio (.379), is at least 61.

#### METHOD OF MINING

The room and pillar method of mining is used. Four main entries are driven abreast, from which room entries are turned at intervals of about 600 feet. Room entries are driven in pairs. The rooms are turned off the inby entry advancing. Main entries are driven about 20 feet wide and room entries about 18 feet wide. Rooms are turned at intervals of 60 feet and are driven about 40 feet wide. All of the rooms are turned off the entries full width, there being no narrow room necks. No pillars are being extracted at the present time. The room track is carried near the outby rib of each room to near the face where it turns at right angles and parallels the face, the track paralleling the face being moved up with each cut. A row of safety posts are supposed to be carried between the track and the face at all times. This, however, is evidently not done systematically.

#### Ventilation and Gases:

The mine is rated as non-gassy by the Kentucky Department of Mines. No gas inspections are ever made.

The mine is ventilated by one continuous current which passes into Mine Number 2, there joining the air current which ventilates Number 2 Mine, both returning to the fan which is located in what is known as Number 1 opening.

The Zero Mine and Mine Number 2 are ventilated by means of a 3 x 5 double inlet Jeffrey centrifugal fan, operated exhausting. The fan is located out of a direct line of forces, and is protected by explosion doors. The fan drift and housing is of brick construction with a concrete roof. The explosion doors are of a light board construction. No water gauge measurements were available. The volume measured just inby of this fan was 45,000 cubic feet per minute. The fan is belt-driven from a 35 H.P. 230 volt direct current motor. The mine was ventilated, as indicated on the map, by a continuous current. All of the doors and stoppings are of wood.

Measurements and air samples were taken after the ventilation had been temporarily restored. The locations of these samples and air measurements are shown on the accompanying map. Analyses and descriptions of these samples are given in Table 2, and the official laboratory report sheets are included in the Appendix.

Sample bearing laboratory number 56757, which was collected 60 feet inby the fan and in the full return from both Zero and Number 2 Mine, contained but 0.01 per cent methane. This calculated for 24-hour period indicates 6566.4 cubic feet of methane is carried out of these two mines in 24 hours.

Sample bearing laboratory number 56753, which was collected at the face of the 1st Left entry off the Zero Main South, contained 0.02

TABLE 2  
ANALYSES OF AIR SAMPLES  
ZERO MINE, 1932

Lab. Bottle		Location	CO <sub>2</sub>	O <sub>2</sub>	CH <sub>4</sub>	H <sub>2</sub>	Air CH <sub>4</sub> , Cu.Ft.		Remarks
No.	No.						Volume	in 24 hours.	
56756	635	2nd x-cut from face on 1st L a.c. off Zero main.	.05	20.93	.00	79.02	14,400		Outby second open crosscut.
56757	633	60' back fan (full ret.)	.14	20.64	.01	79.21	45,600	6,566.4	Full return from Zero & #2.
56758	654	Face of 1 L main hdg off Zero main.	.05	20.78	.02	79.15			60' inby last open crosscut.

per cent methane. The point at which this sample was collected was about 60 feet in by a small hole through the chain pillar which was serving as the last open crosscut.

Sample bearing laboratory number 56756, which was collected just out by the second open crosscut from face of the 1st Left aircourse and in the air current that had traveled about 8000 feet underground, contained no methane and the analysis shows 20.95 per cent oxygen.

These analyses indicate that small amounts of methane are liberated in this mine. The percentages of oxygen in all of the samples indicate that the mine is, from a health standpoint, adequately ventilated.

During the recovery work and the investigation no gas was detected by the use of a flame safety lamp.

#### Haulage:

The track gauge is 42 inches.

Main haulage roads are laid with 40 pound rails. In rooms 20 pound rails on steel ties are used. All switches are laid on wood ties.

Two 6-ton locomotives of the reel and trolley type are used for all haulage purposes.

Drop bottom type cars are used. These are of all metal or of composite construction. They are fairly well maintained, but considerable fine coal was lost along haulageways when the fines were being hauled out of the mine. The cars are about 1½ ton capacity.

#### Lighting:

Carbide lights are used by all persons underground.

#### Machinery Underground:

All of the cutting is done by a Jeffrey 35HB type electric

mining machine. All of the gathering and haulage is done with 2 trolley and real type locomotives.

There is one stationary mine pump electrically operated, the power being taken from the trolley wire.

Power:

Electric power is purchased from the Kentucky Utilities Power Company at 2300 volts, alternating current. A sub-station near the portal contains a General Electric synchronous converter, transformers, and the necessary switchboards. The sub-station is housed in a building of wood frame and corrugated iron. There were no insulating mats or platforms provided in front of the switchboards. No trolley wires are guarded.

Explosives:

All of the coal is shot down with Pallet powder and fuse. On the long faces (30 to 40 feet) three shots are usually used with from 1½ to 2 sticks in the center hole and 2 sticks in each of the rib holes. Clay is presumably used for tamping, however, the two shots which caused the explosion had been tamped with dummies filled with fine coal dust, although the shots at the face of this room showed evidence of having been tamped with clay. The shots at the face, however, had been tamped and fired by the regular shot firer at night, while the shots in the crosscut had been tamped and fired by the miner. Evidently the shot firer uses clay for tamping as all of the holes in the rooms on this entry showed evidence of having been tamped with clay.

Shooting is frequently done during the day and such shots are prepared and fired by the miner. No check is made of the number of shots so fired nor of the amount of powder used in these shots.

Just outby of Room 1 and located in the crosscut against the wooden brattice there was kept a large wooden box in which fuse and Pellet powder was stored for the use of the miners for shooting during the day. After the explosion two full and three parts of rolls of fuse were found in this box, and about 2/3 of a case of Pellet powder and although paper had been scorched this Pellet powder had not been ignited. The box was badly damaged and the part case of Pellet powder had been thrown out of the box by the violence of the explosion. In the gob in Room 5 and directly in front of the crosscut where the two shots blew through one stick of Pellet powder together with a short length of fuse were found partly buried in the gob. In Room 6 at the inby corner of the crosscut and about 14 feet away from one of the shots which caused the explosion two sticks of Pellet powder and a length of fuse were found. This instance, together with the other evidences of carelessness in the handling and storage of Pellet powder, indicated either gross ignorance or utter disregard of the hazards of careless handling and storage of explosives underground. The relatively large quantities of blasting materials, which were accessible to all persons underground and available for either judicious or injudicious use, would seem to indicate either disregard or carelessness on the part of the company officials, and might tend toward carelessness on the part of the miner who might otherwise exercise ordinary care in the storage and use of explosives.

Evidently the explosives are hauled into the mine in the ordinary mine car and by means of electric locomotives, which is a decidedly dangerous practice, and particularly so with black powder in any of its forms (granular, Pellet, Blackstix).

The main explosives magazine is located alongside the empty car tracks above the tipples. It is constructed of native stone and is about from 400 to 1000 feet from several of the camp dwellings.

Evidently supplies of explosives are hauled up the supply incline by means of regular mine cars and a wire rope operated by means of an electric hoist. This is a decidedly dangerous practice, as explosives of any type should never be hauled either by an electric locomotive or an electrically operated rope hoist unless in an insulated car.

The original plan of the company was to fire all shots at night, as there is a shot firer with each machine crew who presumably drills, tamps, and fires all shots. However, this good plan, which tends toward greater safety, is at least in part nullified by the practice of shooting during the day when all men are in the mine, and evidently without proper supervision. It is believed that even when permissible explosives are properly used and fired electrically during the shift such shooting should be done by either an authorized shot firer or one of the supervising officials and not by the miner himself.

Drainage:

All of the active portion of this mine is dry and dusty. Only one pump, operated electrically and located adjacent to the main haulage and approximately 1200 feet from the nearest active working place is required to handle all of the water in the mine.

During the recovery operations there was some water standing in small pools on the main haulageway, but in all probability the pump had not been operated for 2 or 3 days previous to the explosion and although there was some evidence of slight violence in this vicinity there was no

evidence of flames having traveled nearer than 1400 feet of these slight accumulations of water, and therefore there is no evidence that these accumulations in any way affected the explosion.

Rock-dusting and Watering:

Some rock-dusting had been done in this mine. The main haulageway had been rock-dusted to a point about 100 feet outby of the intersection of the first Left aircourse and the Zero Main South. This rock-dusting had been done nearly a year previous. The aircourse paralleling this haulageway on the left had not been rock-dusted nor had the two aircourses paralleling this haulageway on the right been rock-dusted. No rock-dusting had been done in the active working portions of the mine. How effective the original rock-dusting was at the time of its application is not known.

No watering has ever been done.

Checking System:

A check board is provided at the portal for the purpose of checking in and out. However, some of the bodies found were without any means of identification.

It is believed that a checking system should be provided which requires that the life check be carried about the person at all times while underground. Such checking system should also, with a reasonable degree of accuracy, indicate where the employee will be located while in the mine.

Conditions Immediately Prior to the Explosion:

The explosion occurred at about 8:30 A.M. Friday December 9, 1932, and at a time when all of the day shift were in this and the adjacent mine. There were 47 men in the Zero Mine and 57 men in the Number

3 Mine adjacent to the Zero Mine at the time of the explosion.

No pre-shift examination was made.

At the time of the explosion no supervising official had entered the Zero Mine. Although the superintendent was intending to go into this mine and was on his way toward the portal of the mine when the explosion occurred.

A haulage crew with an electric locomotive and 20 empty cars were in the First Left entry off the Zero Main South, and presumably were just entering to place empties at the moment of the explosion. Apparently both the motorman and coupler were riding the locomotive at the time. Apparently something had caused the motorman to throw the control lever to the out position and probably to throw the reverse lever, as the control was in the out position and the reverse was slightly off center. The locomotive was uncoupled from the trip and evidently the uncoupling had been forced, as the chain was attached to the empty car but was free of the locomotive and the coupling pin on the locomotive was bent. The locomotive was about 10 feet outby of the nearest empty car of the trip.

Inasmuch as there was no evidence of great violence at this point it is believed that something occurred which caused the motorman to attempt a hasty retreat, and reverse his locomotive and probably some of the cars of the trip were off the track and the hard jerk of the locomotive bent the coupling pin and released the chain coupling.

There were 4 loaded cars at the face of Room 1, Room 2, and Room 3, and apparently all of the men were following their usual routine just previous to the explosion. However, evidently something occasioned most of them to come on to the entry, and in all probability the first

shot blowing through occasioned considerable flame and probably a strong wind, the second shot probably causing the explosion, there being time interval in between which permitted several of the men to reach the entry from their working places.

Rescue and Recovery Work:

The General Superintendent and others noticed a reversal of the air current at the portal of the Zero Mine which blew very light materials and leaves in the opposite direction to which intake air would have moved them. There was a slight hissing sound characteristic of air movement under pressure. This was the only indication on the outside of any unusual occurrence.

The Mining Engineer was in the Number 2 Mine which connects with the Zero Mine. He was near a door when he felt the violence of the explosion, which blew open a door near him. He immediately closed this door and hurried to a telephone and called the outside, talking to the General Superintendent. He advised that in his opinion an explosion had occurred in the Zero Mine.

After a few minutes had elapsed some of the men who escaped from a section of the Zero Mine came out along the haulage to the intake portal of the Zero Mine.

The General Superintendent placed a call for Mr. James F. Bryson, Director of Safety, Harlan County Coal Operators' Association, Harlan, Kentucky. Mr. Bryson was assisting in a mine inspection in a mine some 25 miles distant from Harlan and it was not until about 10 A.M. when he received the word. He, accompanied by the District Mine Inspector Roy Gonia, hastened to Harlan, secured the equipment, and proceeded as promptly

as possible to the mine. Shortly after his arrival, having been advised that 14 men had come out of the mine after the explosion, he, accompanied by several others, proceeded into the mine and repaired a door at the 10 Face and Zero Main haulage intersection. This door had been slightly damaged by the explosion.

He then proceeded along the Zero Main haulage way to the point where it turned south. Near this point and in a crosscut between the haulage and the intake aircourse a burning timber was found and the fire extinguished. They proceeded a short distance beyond this point and then returned to the outside.

Upon Mr. Bryson's arrival at the mine, which was about 12 M. central time, he advised the General Superintendent, Mr. Guthrie, to advise Davies of the U. S. Bureau of Mines at Norton, and at about 12:10 P.M. central time or 1:10 P.M. eastern time Mr. Davies received the message at Norton and a few moments later, accompanied by Mr. Hodgson, Senior Safety Instructor, he left Norton, Virginia with the equipment in one of the U. S. Bureau of Mines trucks, arriving at the mine at 2:20 P.M. central time. Mr. Davies immediately entered the mine, accompanied by Mr. C. P. Collier, Mining Engineer, and proceeded until he met Mr. Bryson and his party returning to the outside for materials.

The trolley wire was out in two places and all of the electric power was cut off of the adjacent mines.

Crews were assembled and material loaded into mine cars and the rescue parties again entered the mine. Ventilation was conducted by means of temporary brattices and the recovery work proceeded uninterruptedly

until all of the bodies had been located and hauled out of the mine, the last body being recovered at about 8:30 A.M. central time December 17th. Temporary ventilation of the entire mine had been accomplished and every place cleared of after-damp and inspected for possible fire.

Four bodies were found just inby intersection of 1 Left and Zero Main haulageway; two bodies just outby of the second crosscut outby the face of the First Left aircourse; three on the entry just outby of Room 7; one about 15 feet inby of the entry in Room 6; three on the entry in front of Room 5; one at the face of Room 4; two on the entry between Rooms 2 and 3; and one in Room 2 about 25 feet inby the entry. The bodies of the motorman and scupler were found lying one on each side of the locomotive. These locations are indicated on the map. One body was found in Room 3, one in Room 4, one in Room 9, and one in the entry between Rooms 10 and 11 of the entry which parallels the Zero Main on the right. It was from this entry that the men (14) came that escaped after the explosion. One of the men that escaped said that as far as he knew none of those that escaped talked to either of the four men who were found dead on this entry after the explosion. He believed that had those men hurried out as did the 14 they may have escaped. This man was in Room 11 when the explosion occurred. He came to the entry and put on his coat, threw away a chew of tobacco, and took a drink of water, then noting that ventilation had resumed the regular direction, hurried out through smoke and dust and escaped. He described the force as not much greater than an ordinary windy shot.

#### Mine Conditions After the Explosion:

The official investigation was made December 12th by representatives of the mining company, Mr. V. H. Guthrie and Mr. C. P. Collier; Mr.

James F. Bryson, Director of Safety, Harlan County Coal Operators' Association; Mr. John F. Daniel, Chief, Kentucky Department of Mines; Mr. Roy Conia, District Mine Inspector; Mr. A. D. Sisk, District Mine Inspector; Mr. J. F. Davies, District Engineer, U. S. Bureau of Mines; and Mr. E. H. Hodgson, Senior Safety Instructor, U. S. Bureau of Mines.

The principal damage to the mine was the blowing out of stoppings and doors.

The explosion evidently was initiated by a blown-out shot or shots which had been drilled from the Number 6 Room to apparently a very few inches of having been drilled through into Room 5. See sketch in Appendix. These two shots were placed entirely on the solid. No undercutting had been done. Apparently two shots fired sometime previously, probably the last work day, had been shot from the solid. At three other places where crosscuts had been made, evidently the shots had been placed on the solid. It is believed that the inby shot went first and dislodged a small amount of coal. Evidently this hole had been drilled not more than 14 inches of having been drilled through, and it appeared as though this shot may have broken down the coal and probably exposed the powder in the outby shot, which when it exploded expended all of its forces into the air, which was, no doubt, heavily laden with coal dust thrown into suspension by the previous shot.

Apparently there was an appreciable time interval between the discharge of the first shot and of the second, the first shot probably having been a very windy shot throwing into suspension appreciable quantities of dust and occasioned most of the men to hasten to the entry from the working places either with the intention of escaping or of learning

the cause, as evidently several had left their working places, one man having left his cap at the face, his body being found in the room neck, others leaving their caps and lamps near their buckets, and those farther removed reaching the entry with their caps and lamps on their heads.

Apparently the second shot initiated the widespread explosion, forces of more or less degree of intensity radiating from the vicinity of Rooms 5 and 6, the forces of lesser degree apparently moving inby Room 6, the forces moving outby from Room 5 gaining in intensity to the area around the mouth of Room 1 where evidently the intensity of violence increased very materially and traveled outby along the haulageway and air-courses.

At the intersection of the 1 Left entry with the Zero South Main aircourse apparently the maximum intensity had been reached and dropped very appreciably at the intersection and apparently only enough violence passing inby and outby along the Zero South Main entries to demolish light wooden stoppings. However, the flame evidently spread along the intake aircourse and haulageway with the greatest intensity outby along the unrock-dusted air course paralleling the haulageway on the left. Slight coking was in evidence throughout this area, even on the haulageway which had been rock-dusted about a year previous. However, in the air course the flame was intense enough to set fire to a timber standing in a crosscut on the turn of the Zero South Mains.

Very heavy coking was found in the room neck of Rooms 5, 6, and 7, and along the entry and in the room necks of Rooms 4, 3, and 2. The coke deposits extended into Rooms 2, 3, 4, and 5, to a point inby of the last open crosscuts of these rooms. The coke deposits extended only a

short distance into Room 5 and slightly farther into Room 7. At a point about 35 feet in Room 7 coke deposits disappeared and soot streamers took its place, these streamers diminishing toward the face. In Room 8 coke deposits were found diminishing for a distance of about 90 feet in, with probably a very slight coking to the face. In Room 9 the coke deposits extended only about 20 feet into this room. No coke deposits were observed in Room 10 nor in the entry for a distance slightly beyond Room 9. However, there was slight coking in the second crosscut outby of the face of the aircourse and for a short distance outby of this crosscut in the aircourse, although two bodies found in this area showed only slight indications of heat.

The board stoppings in crosscuts 9, 10, and 11 between the entry and air course were moved toward the haulage entry while the stoppings from all of the other crosscuts outby were demolished and apparently had moved toward the aircourse excepting the crosscut just outby of Room 1. In this crosscut the board stopping and the powder box were moved toward the entry.

A trip of 29 cars was found on the entry, the inby car being directly in front of Room 1. The 15th, 16th, 17th, and 18th car, counting from the outby car, were off the track. They, however, showed only relatively light violence. The 23rd car was also off the track. The cable reel off the locomotive was jammed underneath the locomotive and it appeared as though the locomotive had run onto it. The headlight on the outby end of the locomotive had been torn loose and was found 22 feet outby of the locomotive. The body of the motorman was found on the right-hand side of the locomotive and near the outby end with one of the steel

coverings of the locomotive lying on top of him. The body of the coupler was found on the left-hand side of the locomotive and at the inby end. Both bodies were severely burned.

#### STATE INSPECTOR'S CONCLUSION

A copy of the published report of the Chief of the Kentucky Department of Mines is included in the Appendix.

#### SUMMARY OF EVIDENCE AS TO THE CAUSE, ORIGIN, AND PROPAGATION OF THE EXPLOSION

There was evidence of forces radiating from the vicinity of Rooms 6 and 5 off 1st Left off Zero Main South.

There was evidence of intense heat on the roof in Room 5 directly in front of the two blown-out shots in the unfinished crosscut between Rooms 5 and 6.

There was heavy coking along the entry and in the room necks of Rooms 2, 3, 4, 5, 6, and 7, and into Rooms 2, 3, 4, and 5 beyond the last open crosscut.

The evidence indicated that two shots had blown out in Room 5 at the unfinished crosscut between Rooms 5 and 6.

#### MEN KILLED IN EXPLOSION

##### White:

Tom Massengill  
Esau Massengill  
Henry Hibbard  
Herman Eddie  
Charles Davenport  
Henry Massengill  
Garrett Massengill  
Calvin Massengill  
Campbell Massengill  
O. A. Romie  
George Hendricks

**Negrees:**

Arthur Woods  
Harold Woods  
Eugene Woods  
Ben Fields  
Luther Jones  
James Davis  
Robert Benbo  
William Newell  
Alfred Graves  
William Reynolds  
Harrison Jackson  
Mace Thurnbolt

1. Loader in Zero Main.
2. Loader in Zero Main.
3. Loader in End Left.
4. Loader in Zero Main.
5. Loader in 1st Left aircourse.
6. Loader in Room 9.
7. Loader in Room 6.
8. Loader in Room 10.
9. Loader in 1st Left Entry.
10. Loader in Room 5.
11. Loader in Room 7.
12. Track Man.
13. Loader in Room 8.
14. Loader in Room 4.
15. Loader in Room 3.
16. Loader in Room 2.
17. Loader in Room 1.
18. Coupler.
19. Motorman.
20. Loader in Room 3, Room entry paralleling Zero Mains on right.
21. Loader in Room 4.
22. Loader in Room 9.
23. Loader in Room 10.

### **FIRST-AID AND MINE-RESCUE**

First-aid training was conducted at Yancoy for the employees of this company. This was finished in May of 1932, and all but a very few men completed the training.

No Mine-Rescue training was done.

No first-aid materials are kept underground. An exceptionally well equipped doctor's office is maintained in the office building and in charge of the resident Doctor. The nearest hospital is located at Barlan, 6 miles distant.

### **RECOMMENDATIONS**

The following recommendations are offered with a view of preventing recurrence of such disaster.

1. That only permissible explosives be used.
2. That permissible explosives be used in charges not exceeding the prescribed permissible charge of one and one-half pound.
3. That all holes be tamped to the collar of the hole with incombustible material, preferably clay secured outside of the mine.
4. That all shots be fired electrically.
5. That all shooting be done after each shift and at a time when all persons are out of the mine excepting the regularly employed shot firers.
6. That no hole be drilled beyond the undercut.
7. That shooting from the solid be positively prohibited.
8. That strict supervision be exercised.
9. That the storage of explosives in quantities underground be discontinued and preferably that all unused explosives be re-

- turned to the outside and properly accounted for and stored safely.
10. That the hauling of explosives in regular mine cars and by electrically operated locomotive or hoist be prohibited and that effectively insulated cars be used for the transportation of all explosives.
  11. That all machine cuttings and fine coal be loaded out before any shot is fired in that place.
  12. That the mine be thoroughly and effectively rock-dusted, such rock-dust to be maintained to within 40 feet of all active faces.
  13. That all open lights be excluded from the mine.
  14. That a no-smoking rule be put into effect and strictly enforced.
  15. The storage magazine now in use presents a serious hazard in that it is too close to dwellings. Serious consideration should be given to abandoning it and constructing one in a safe location where protection will be provided by the hill sides and suitable barricades.
  16. A strict check-in-and-out system should be put into effect. This system should provide that a means of identification be carried about the person and should, to a reasonable degree of accuracy, show where the man will be located while underground.

#### **ACKNOWLEDGMENTS**

The writers wish to express their appreciation of the cooperation, assistance, and courtesies extended by the company officials.

Respectfully submitted,

Joseph F. Davies  
District Engineer

E. H. Hodgson  
Senior Safety Instructor

APPROVED:

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(Copy)

KENTUCKY DEPARTMENT OF MINES  
LEXINGTON, KENTUCKY

December  
Fifteen  
1932

To all Officials of All Coal Companies  
State of Kentucky

Gentlemen:

No doubt you are all aware of the explosion which occurred on Friday, December 9 at approximately 9:30 A.M. in the Zero mine of the Harlan Fuel Company, Yancey, Kentucky in which 23 workmen lost their lives.

In order that you more fully understand what actually occurred and in order that you might take immediate steps to correct your own situations in the event they need correcting, please be advised as follows:

The roof, ventilation, timbering and general physical conditions of the mine were good.

It was the custom in this mine for the usual shooting to be done by the regular shot-firers at night and only pop shots were fired during the day. The pop shots consist of shots where the coal failed to be broken by the shots fired at night.

The fan was running exhaust pulling the air in at the regular mine opening and returning at the fan.

Pellet powder was used thru-out, being ignited by the regular fuse.

The seam of coal on the 1st Left section where the explosion occurred is made up of from 14 to 18 inches of coal on the bottom with a 5 to 7 inch slate parting next and with approximately 2 to 2½ feet of coal above with an excellent slate roof.

The cutting was done on the bottom and, of course, in mining the seam a considerable portion of the parting slate mixed with the bottom strata of coal making same very dirty and high in ash. On this account considerable of the fine coal was gobbed along with the slate parting.

On the one Left entry off the Main there were 10 rooms besides the heading and air course working. The rooms were driven approximately 50 feet wide with the track being carried on the right side of the room and then turned on an angle in line with and across the face. The remaining space on the left side of room track being well posted and filled with gob material.

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(Copy)

To All Officials  
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There were a total of 18 men working on the 1st Left section including 12 loaders, motormen, brakemen, and trackmen. There were 4 men working in the Main Headings proper, and in addition to the above there were 18 men including motormen, brakemen, and day-men on the Barrier entry on the opposite side and parallel to Main Heading and just a little toward the outside from the mouth of 1st Left.

The location of where the bodies of the 4 men working in the Main Headings were found indicated that these men evidently knew something had happened and had left their working places and started to the outside, the bodies being found on the Main Heading just a short distance in by where 1st Left turned off Main Heading.

14 of the 18 men working on the Barrier entry were able to walk to the outside in safety after the explosion occurred, the other 4 working in the 4 in by places were unable to get to safety altho from the location of the bodies it was evident they had left their working places and proceeded some little distance toward the outside before being overcome.

All members of the investigating party felt somewhat sure that the 4 men working in the Main Headings and the 4 men working in the in by places on the Barrier entry could have made it to the outside if they had been equipped with "Self-Rescuers".

The following will give you a picture of the system of ventilation. The air going up the air course side of 1st Left, thru the last crosscut to the Heading and down thru the rooms on the heading side, back up the Main and thru the working places there, and then back down thru the working places on the Barrier entry and thence to the fan.

A locomotive pushing 30 empty cars happened to be on the entry at the time of the explosion, the headlights and top covers were blown off to a point some 20 feet down the entry, while the 15th, 16th, 17th, and 18th cars in by from the motor and up the entry were wrecked, the remainder of the cars were on the track, except the last three of the 30 car trip which were off the track opposite No. 1 room. In some instances pieces of boards were wedged beneath the cars as the explosion traveled down the entry, in other instances material was wedged under the cars as it traveled back up the entry.

The investigation disclosed that the explosion resulted in very little violence, this was indicated by the fact that the trip of cars which was in direct path of the explosion was damaged very little.

There were 10 rooms working on the 1st Left entry. The rooms being turned on 60 foot centers and as the practice was to drive the rooms approximately 30 feet wide, this left a small pillar between the rooms and it was found that in driving the crosscut in No. 6 room the crosscut had not been cut thru on the first cut of the machine and instead

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of having the place out again, the balance of the coal from the crosscut was being mined from the solid by the loader and in violation of the company rules, according to the statements of the Mine Officials.

It was very apparent that some of the coal had been taken from the solid from the top of slate parting to the roof and that two holes had been drilled to within a few inches of No. 5, the adjacent room and that both of these holes had been loaded with Pallet powder and tamped with lug dust, altho the tamping in all other holes in the various places had been done with clay and evidences of clay in quantity was found in several of the places. After the holes had been drilled and loaded it was further noted that the fuse in the hole on the right or outby side of the crosscut extended some 14 inches from the mouth of the hole, while the fuse had been cut off at the mouth of the hole on the Left or inby side of crosscut. The depth of the hole on the right from the mouth thru to the adjacent room was 23 inches while the depth of the hole on the left side thru to the adjacent room was 27 inches.

It was plainly evident that the holes had both been lighted at the same time, the loader, then, no doubt, went out to the entry, which was some 32 feet from the crosscut but on account of the small amount of coal between the holes and the rib of the adjacent room, the powder had practically no work to do and shot immediately out into the gob in No. 5 room. We assume that the first shot (the one on the left side) created a great vibration and threw all available particles of coal dust into the air, while the second shot (the one on the right side) the fuse being approximately a few inches longer went off a short space of time after the first shot and as the first one had thrown all available particles of coal dust in the air, the force from the second shot as it burst thru the thin piece of coal and the flame in connection with such a shot of black powder only added to the damage already started by the first shot.

Practically all of the Kentucky mines contain some dust and as a great quantity of Pallet powder and keg powder is used in some of the various mines, a pop shot, or short shot such as mentioned above sometimes occur. You can, therefore, readily see the danger connected with such procedure. This is especially true where workmen are allowed to do their own shooting.

The main entries of this mine had been rock-dusted some months back and while not much of this dust was noticeable there is a possibility that it may have checked the explosion somewhat after it reached the Main Headings and started toward the outside.

It should be mentioned, also, that the flame from the explosion traveled at least one-half mile and kindled a prop in a break-thru between the Main Heading and air course at this distance.

The fact that the fan had not been disturbed altho all the brattices (wood) had been demolished on the 1st Left entry, in the Main Headings

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and back down the Main Headings for some distance. A large volume of air was available which expedited the recovery work to a great extent and as there were no falls to contend with, the work of advancing into the trouble area was carried forward rapidly and efficiently.

It would be well, also, to advise that the Zero was connected with No. 2 mine thru the ten face headings and while both mines were ventilated from the same fan, still each mine was on a separate split of air.

The explosion was heard in the No. 2 mine by the foreman in charge of same, for the trap door at the connection between the two mines was blown open. The door was immediately closed and the foreman went to a nearby telephone and called the General Superintendent, who was on the outside and who had figured that an explosion had occurred by the violent movement of leaves and other light material at the entrance of Zero mine. The General Superintendent then ordered all men from the No. 2 mine, without delay, altho none of the gases or any of the effects of the explosion entered the No. 2 mine.

In order that as much as possible be done to eliminate such occurrences and so that all mines be made as safe as possible from explosions, the Department of Mines will hereafter recommend in all mines as follows:

That all blasting in mines be done AT NIGHT by regularly employed shot-firers and with PERMISSIBLE EXPLOSIVES ONLY. Also, that any explosives not used in the regular blasting at night be brought to the outside and stored in a safe place by the regular shooting crews, so that no explosives whatsoever be allowed in the mines during the day. Further, that all explosives be taken into the mines in a properly insulated explosive car.

That either clay or rock-dust be used for stemming.

That close supervision be given the working faces at all times and the method of mining the various places be closely observed.

That shooting from the solid be absolutely forbidden.

That the gobbing of fine coal or bug dust that does not contain sufficient inert material be discontinued and said fine coal or bug dust either be loaded out with the other coal or loaded out and dumped as refuse.

That rock dust be applied where it is deemed necessary.

In conclusion, it is the opinion of the writer that what occurred in the mine of the Harlan Fuel Company at Yancey, is liable to happen in most of our mines.

The officials of the above mentioned company are of the highest type and a group of persons who cooperate fully. This should be fully understood by all and this group of officials have been foremost advocates of safety for sometime past, and this disaster was very disturbing to them, to say

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To all Officials

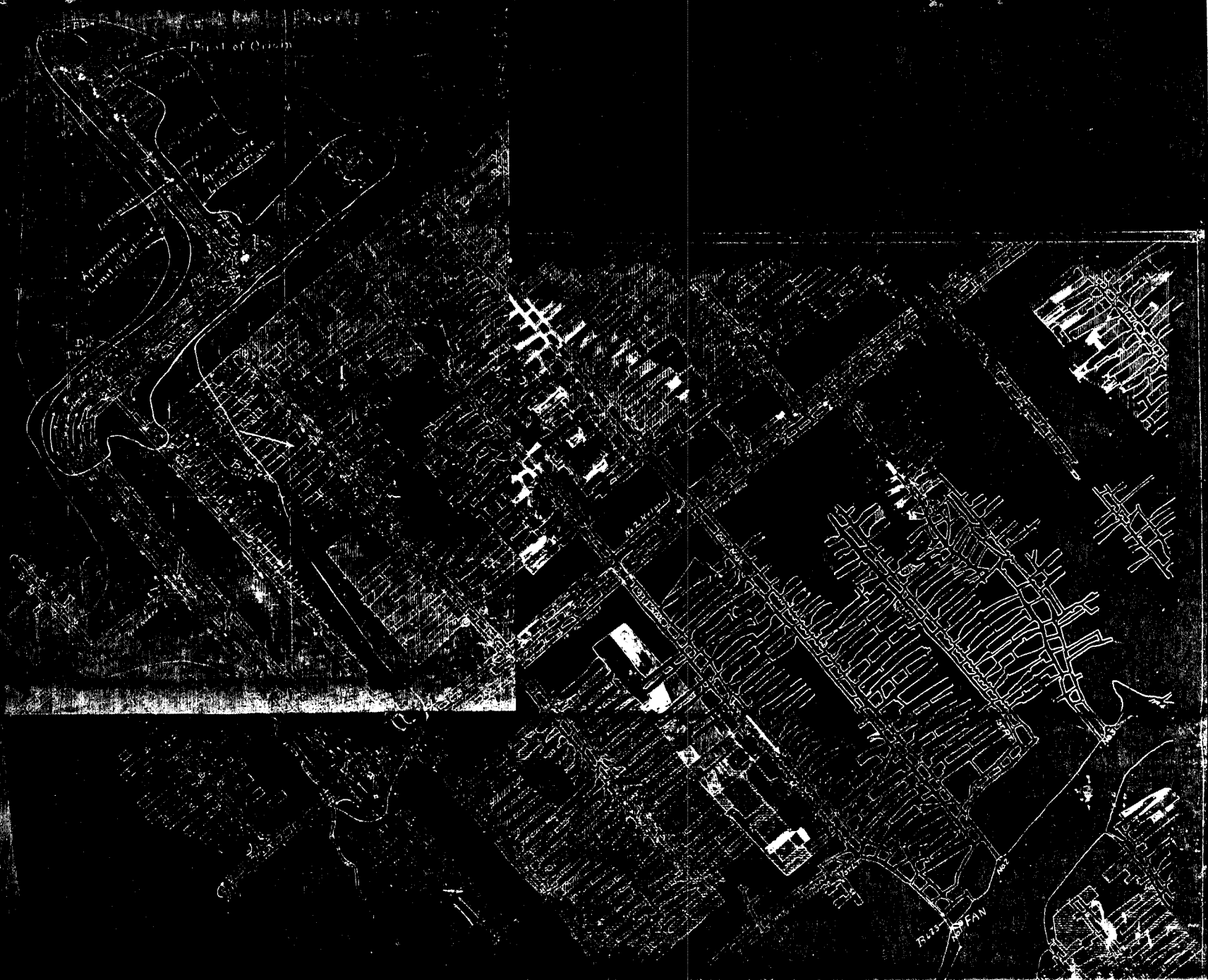
12/15/32

the least. More so, because the workmen who lost their lives had been in their employ for a considerable period of time and they knew each of them exceedingly well individually.

It has now been very clearly demonstrated what can happen in anybody's coal mine and you officials of other companies owe it to your company, your workmen, and yourselves to take an immediate check of your situation, for the Harlan Fuel Company mine was in good condition and what happened in their mine can without question happen your mine.

Very respectfully yours,

JOHN F. DANIEL



Point of Origin

Trip  
29 Empty Cars

Approximate  
Limit of Flame

Approximate  
Limit of Violence

Bodies  
20-21

D<sup>15</sup>  
D<sup>16</sup>  
D<sup>17</sup>

N. 2500 FT

N. 2500 FT

Room 6

DRILL HOLES

← 82' to room neck.

SKETCH OF CROSSCUT  
WITH BORE HOLES OF  
SHOTS WHICH CAUSED  
THE EXPLOSION

Scale- 1' to  $\frac{1}{2}$ "

41' to face  
Room 5

37"

43"

28"

35"