FINAL REPORT OF MINE EXPLOSION
NELLIS NO. 3 MINE, THE AMERICAN ROLLING MILL COMPANY
NELLIS, BOONE COUNTY, WEST VIRGINIA

November 6, 1943

By

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

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INTRODUCTION

A local mine explosion occurred about 7:00 p.m., November 6, 1943, at the Nellis No. 3 mine of the American Rolling Mill Company, Nellis, Boone County, West Virginia.

Forty men were in the mine at the time of the explosion, and eleven of these lost their lives. Nine men were killed by violence, burns, and after-damp, and two others died in the hospital several hours later. Twenty-nine men escaped unassisted. None of these was injured, but some suffered slightly from the effects of carbon monoxide.

The explosion was caused by an ignition of methane, in room 38 off 24 north entry, either by an arc from the locomotive cable nip, or by the open-type cutting machine. The most probable source of ignition appears to have been the locomotive, the controller of which was on the second point. The methane was released when the cutting machine cut through into 25 south, an entry which was abandoned about 1935. This entry had not been ventilated or inspected.

The explosion was confined to five rooms that were being driven from 24 north; about 800 feet of the 23 and 24 north entries; and the 25 and 26 south entries off 11 west.

Some rock-dusting by hand had been done in working places on the affected section and on the haulageways. It is believed that this played little or no part in stopping the explosion, but that it was limited by the wetness of the 23 and 24 north entries. Water is not used for wetting or allaying coal dust in mining operations on this section, but there did not appear to be any accumulation of dust.

The Bureau of Mines at Mount Hope, West Virginia, was first informed that an explosion had occurred by a radio news broadcast at 11:45 p.m., November 6, 1943. M. C. McCall, supervising engineer, called Eric H. Brown, Frank J. Furin, R. B. Jones, J. S. Ferraro, and R. E. Barr. These six Bureau of Mines employees proceeded immediately to Nellis, arriving at 2:45 a.m., November 7, 1943. Mr. McCall offered C. W. Connor, general manager of mines, the assistance of the Bureau of Mines, but was informed that the last body had been removed from the mine at 1:40 a.m.

A joint preliminary investigation by State, Bureau of Mines, and company representatives was made after the bodies had been removed; the party entered the mine at 3:40 a.m.

GENERAL INFORMATION

Location and Operating Officials

The Nellis No. 3 mine is at Nellis, Boone County, West Virginia, about 16 miles north of Madison. It is owned and operated by the American Rolling Mill Company, and is served by the Chesapeake and Ohio Railway. The officials of the company are:

Charles R. Hook	President	Middletown, Ohio
C. W. Connor	General Manager	Montcoal, W. Va.
Paul R. Maxey	Chief Engineer	Montcoal, W. Va.
Alva E. Oakeley	Superintendent	Nellis, W. Va.
Campbell Allen	Safety Engineer	Middletown, Ohio
D. D. Baldwin	Mine Foreman	Nellis, W. Va.

Employment and Production

A total of 259 men is employed at the mine, and of this number 221 are employed underground on three shifts.

The average daily production is 1,050 tons, and the total production for 1942 was 418,166 tons of coal.

Openings and Nature of Coal Bed

The mine is opened by eight drifts and one slope in the No. 2 Gas coal bed, which averages 46 inches in thickness in this mine, and dips slightly to the northwest. The slope is driven on a 30-degree pitch from the surface to the coal bed, a distance of 600 feet. The maximum cover is about 1,000 feet. The coal is high-volatile bituminous. The immediate roof is soft, fossiliferous shale containing many kettle bottoms. The floor is hard, smooth shale.

An analysis of the coal as furnished by the company is as follows:

	Percent
Moisture	2.30
Ash	5.80
Volatile matter	37.50
Fixed carbon	54.40
Total	100.00

Experiments by the Bureau of Mines have shown that coal dust having a volatile matter to total combustible matter ratio in excess of 0.12 is explosive, and that the explosibility of the coal dust increases as this ratio increases. The volatile ratio of the coal dust at this mine is 0.40.

MINING METHODS, CONDITIONS, AND EQUIPMENT

Methods of Mining

A room-and-pillar system of mining is used. Pillars are not removed and approximately 82 percent of the coal bed is recovered. The main entries are

driven 2, 3, or 5 abreast, and the cross entries are turned in pairs at 300- to 600-foot intervals. Coal is loaded either by mobile-loading machines or by hand onto chain conveyors, which are driven by open-type electric motors operated with 250-volt direct current from the trolley wire.

Ventilation and Gas

The mine ventilation is induced by a well-installed centrifugal fan, which is exhausting approximately 112,700 cubic feet of air a minute from the mine. Air enters the mine through the two haulage drifts and several other drift openings. It is distributed through the mine by two major and several secondary splits; part of the main haulageway is in return air.

The fan installation is provided with necessary safety devices.

The mine is rated gassy by the West Virginia Department of Mines. Preshift examinations are made by a fire boss, and the foremen make tests for gas several times during the shifts. Permissible-type flame safety lamps are carried by the fire boss and foremen in the performance of their duties.

The mine ventilation was not disturbed as a result of the explosion, with the exception of E and H sections. Air was short-circuited from E section, following the explosion, when the door at 23 north entry was left open by an excited haulage crew. This door was closed on the day following the inspection and a careful examination was made in E section. The ventilation on H section was not normal after the explosion, but was considered satisfactory. Air measurements were made in the main intakes, and main return, and are shown in table 1.

Table 1
Air Measurements

Location	Cu. Ft. of Air a Minute
Intake No. 1 drift	14,350
Intake No. 2 drift	32,226
Intake No. 3 drift	26,376
Intake No. 4 drift	9,120
Main return at slope	112,700
2 northwest split	51,240
Intake No. 6 drift	12,840

Air samples were collected in the faces of the section H rooms, at the main return, and at the return of the sections E and H. The results of the analyses, the quantity of air, and the location where the samples were taken are shown in table 2 of this report.

Table 2
Analyses of Air Samples

Bottle Number	Location	Location					Cu. Ft. Air a Minute	Cu. Ft. Methane 24 hrs.
		CO_2	O_2	CO	CH_4	N_2		
534	Face 37 rm 23 N	0.05	20.93	0.00	0.03	78.99		
833	Face 40 rm off 23 N	0.16	20.73	0.00	0.03	79.08		
834	Face 36 rm 23 N	0.14	20.75	0.00	0.06	79.05		
857	Face 39 rm 23 N	0.10	20.85	0.00	0.04	79.01		
858	29 N at 9 rm return from explosion area	0.06	20.87	0.00	0.04	79.03	20,000	11,520
859	75 ft. from bottom of slope	0.21	20.61	*	0.05	79.13	112,700	81,144

*Possible trace, less than 0.005

Drainage

The working places in the explosion area are relatively dry; however, the roadway, immediately outby the rooms, is damp to wet.

Dust

The mine, in general, is relatively free of coal-dust accumulations. Water or wetting solutions are not used to allay the dust during the mining operations on the section affected by the explosion. Water sprays are not provided for the empty and loaded trips during transportation. Rock dust is applied by hand in the working places, and by a high-pressure rock-dusting machine on the haulageways.

Six samples of roof, rib, and floor dusts were collected in the affected area during the investigation. Two dust samples were collected in other parts of the mine. The samples were analyzed at the coal laboratory of the Bureau of Mines, Pittsburgh, Pennsylvania, and the results of the analyses are shown in table 3.

It will be noted from table 3 that none of eight samples collected contained the required 65 percent incombustible matter necessary to render the dust inexplosive.

Table 3
Analyses of Dust Samples

Can No.	Location	Kind of Sample	PERCENT			Remarks
			Combustible VM / FC	Incombustible moisture / ash	Through 20-mesh	
C-544	23 N at 45 to 28 rm left	Rib, Road	51.4	48.6	78.0	Explosion area Rock-dusted
H-846	39 rm at 1st 45 rt.	Road	54.8	45.2	73.4	Do
E-286	do	Rib	61.3	38.7	67.2	Do
V-750	40 rm at 1st cross-cut inby 1st 45	Rib, Road	39.5	60.5	78.1	Do

Table 3 (Cont'd)
Analyses of Dust Samples

Can No.	Location	Kind of Sample	PERCENT: Combustible VM / FC	PERCENT: Incombustible moisture / ash	Through 20-mesh	Remarks
L-902	38 rm at 2nd 45 lt.	Road	58.0	42.0	74.4	Explosion area Rock-dusted
T-892	36 rm, 60 ft. outby face	Road	51.0	49.0	85.8	Do
M-344	29 N No. 9 rm	Road	50.3	49.7	60.7	No Rock Dust
M-19	20 N, 2nd lt.	Road	36.2	63.8	66.3	Rock-Dusted

Haulage

Trolley-pole locomotives are used for main-line haulage, and cable-reel locomotives are used for gathering purposes.

Clearance along the haulageways, in general, is inadequate. It is obstructed by timbers and projecting ribs. Clearance in the working places is considered adequate.

Lighting

Underground employees are provided with permissible-type electric cap lamps. The fire boss and section foremen carry flame safety lamps in the performance of their duties. Electric trip lights are used where needed.

Smoking is prohibited underground and employees are searched occasionally before going underground.

Machinery and Electricity Underground

Underground electrical equipment is of nonpermissible type. It is maintained in good operating condition, and is operated on 250 volts direct current from the trolley system. Power and feeder wires are well installed on the side of the haulageway opposite the clearance side. Trailing cables are attached to the trolley wire by hook-type nips which are equipped with fuses. Substations underground are in incombustible housings, but the housings are not equipped with fire doors that close automatically in the event of fire. Track rails and an auxiliary cable on the floor of the clearance side of the haulageways are used for the return circuit.

Explosives and Blasting

Permissible explosives, fired electrically with permissible-type shot-firing batteries, are used for blasting coal and rock. Shot holes are drilled by hand-held electric drills. Rock dust, in paper dummies, is used for stemming. The shots are fired during the operating shifts by a shot-firer. Tests for gas are not made before and after blasting.

Explosives and detonators are transported underground in a suitably constructed explosives car. The explosives and detonators are stored in separate locked box-type magazines at suitable locations.

First Aid and Mine Rescue

Employees are trained in first-aid annually, and 12 employees have received training in mine rescue operations

Mine rescue equipment is available at the mine, and the nearest State-owned mine rescue station is at Charleston, West Virginia.

About 50 percent of the employees carry self-rescuers while underground.

Safety Organization

The company maintains a safety organization and employs a safety engineer. Safety meetings include employees and officials, and are held regularly. A bulletin board and safety bulletins are provided. There appears to be an excellent spirit of cooperation between the employees and officials relative to accident prevention.

Supervision and Discipline

There are four operating sections in the mine, and they are operated either two or three shifts. Section H is operated three shifts. A section foreman is on a section each shift. A maximum of 10 men is supervised by a foreman who has ample time to inspect each place several times a shift. A fire boss inspects the working places before the day shift enters the mine. The section foremen inspect the working places for the oncoming shifts; however, some of the underground officials are not certified by the State Department of Mines.

Locally adopted safety rules and standards are furnished the employees in booklet form.

Fire Protection Underground

Fire-fighting equipment underground consists of water lines, rock dust, fire hose, and brattice cloth. Suitable fire extinguishers are provided at the substation installations. A track-mounted tank is also available for fire-fighting purposes. Fire extinguishers are not available on the portable electrical equipment. Rock dust, for fire-fighting purposes, is not available on both sides of doors.

PREVIOUS EXPLOSIONS IN THIS AND NEARBY MINES

Previous explosions or serious fires, in which loss of life was involved, have not occurred at this mine. A local gas explosion, in the nearby Point Lick No. 4 mine, operated by the Hatfield Campbells Creek Coal Company, at Rensford, West Virginia, which is developed in the same coal bed, caused the death of two men in 1941.

MINE CONDITIONS IMMEDIATELY PRIOR TO THE DISASTER

The weather for 24 hours prior to the explosion was clear and slightly warmer than is usual for the season. Barometric pressure readings prior to the explosion could not be obtained.

The mine had been operated normally up to the time of the explosion, except for a shortage of certain workers. Gas was not reported in the fire-boss' report for the day.

STORY OF THE EXPLOSION AND RECOVERY OPERATIONS

The first evidence of the explosion was noted about 7:00 p.m., when a sudden rush of air was felt by the supply crew at a door near the lower end of 23 north entry, while on their way to the surface, to get a flame safety lamp for the foreman in section H. However, at that time they did not realize that an explosion occurred and attributed the rush of air to a heavy slate fall. The supply crew continued on their way to the surface. In the meantime, the motor crew on section E also noted a sudden rush of air, which they, too, thought was due to a heavy slate fall. A few minutes later they proceeded with a loaded trip to a point near the door on 23 north, where the supply crew experienced the rush of air. The loaded trip was left in the mouth of the "pick up" to section E, and an empty trip was being headed toward section H. The haulage crew encountered dense smoke when they opened the afore-mentioned door on 23 north entry. Realizing that something serious had happened, they uncoupled the locomotive from the empty trip and left hurriedly toward the surface. However, being somewhat affected by the smoke and fumes and being excited, they forgot to close the door, thus short-circuiting the air from section E, which was ventilated with air returning from section H.

A short distance inby the drift portal, the haulage crew met the supply crew returning to the mine, with the flame safety lamp requested by the section H foreman. The two crews discussed the presence of smoke encountered by the tram crew, and returned to the surface and notified Mr. Oakeley, superintendent, and Mr. Baldwin, mine foreman.

In the meantime, some of the men working on section E noticed a peculiar odor unlike the odor of "powdersmoke", and reported this to the section E foreman. The foreman, upon investigation, discovered dense smoke back of two doors and decided to remove the men from the section. The 11 men, including the section foreman, left the section in mine cars drawn by the locomotive used for gathering and proceeded to the point at the "pick up" for section E where they found the haulageway blocked by the loaded trip left there by the tram crew.

Ordinarily, section E and the haulageway from this section is in return air; however, on this occasion the travel here was possible in relatively good air, due to the unintentional short-circuiting of the air by the tram crew. The 11 men walked from the "pick up", in air returning from the explosion area, a distance of approximately 600 feet, to the entrance to 22 north, where they encountered good air. The foreman had instructed the 10 men to remain at this point, but he proceeded to walk along 20 south entry toward the surface.

The superintendent and the mine foreman, after being notified by the operator of the supply motor that something unusual had occurred in the mine, proceeded to the mine at once, and on arrival there, Mr. Oakeley instructed the supply crew and others to notify the doctor and the first-aid crews to report to the mine. They started into the mine with three all-service gas masks on a locomotive, and some distance inby the drift portal met the foreman of section E, who on inquiry was unable to tell what had occurred in the mine. The superintendent continued to 22 north where he met the men from section E, and arranged to have them transported to the surface. One man of the section E group volunteered to accompany the superintendent and mine foreman toward section H, but after traveling only a short distance, they encountered smoke and fumes which made it necessary for them to put on gas masks. The superintendent and party closed the open door near the lower end of 23 north entry, but after traveling only a short distance they returned and opened it again, and continued to travel up 23 north entry until they came to some dislodged timbers and roof falls in the vicinity of 26 room. They crossed over into 24 north because of poor visibility caused by heavy smoke, and proceeded along this entry to 38 room, where it is believed the explosion originated.

Mr. Oakeley, the superintendent, stated that the air, in the five rooms affected by the explosion, was relatively good and practically free of smoke when they reached the area, and they were able to remove their gas masks.

The three men located two bodies (the motorman and brakeman) and proceeded toward the face of 38 room, and found one of the injured men in the last breakthrough between 38 and 39 rooms. While administering first aid to this man, they heard groans coming from the direction of 39 room, and on investigation they located the other injured man near the face of 39 room.

The doctor, together with a number of other men, arrived with first-aid supplies shortly after this, and gave additional first-aid treatment, which included the administration of blood plasma to one of the injured men. The injured men were transported to the surface and then to the hospital.

No difficulty was encountered during recovery operations and by 1:40 a.m. on the 7th, or approximately 6-1/2 hours after the explosion occurred, all of the bodies had been removed from the mine. M. C. McCall, acting district supervising engineer, learned of the explosion by a radio news broadcast at 11:45 p.m., and notified E. H. Brown, F. J. Furin, R. B. Jones, and J. S. Ferraro, by telephone. The party left district headquarters at Mt. Hope about 12:30 a.m., and arrived at Nellis at 2:45 a.m., November 7, 1943. The representatives of the Bureau of Mines did not participate in the rescue and recovery operations. On arrival at the mine, they were advised that all the bodies had been removed, and that the State and company officials were in the mine making a preliminary investigation. The Bureau men entered the mine at 3:40 a.m., and joined the State and company representatives in the explosion area.

Later in the day, Messrs. Brown, Furin, and Jones, of the Bureau of Mines, Humphries of the West Virginia Department of Mines, and a company official again entered the mine, restored the ventilation which was disrupted by the door left open near the lower end of 23 north entry.

Investigation of Cause of Explosion

A preliminary investigation as to the cause of the explosion was made jointly by representatives of the West Virginia Department of Mines, company officials, and the U. S. Bureau of Mines, after the bodies were recovered. The official investigation, however, was made on November 8, 1943, after the return of Mr. Jesse Redyard, Chief of the West Virginia Department of Mines, who was out of the State when the explosion occurred. The party consisted of Chief Redyard, Messrs. C. L. Milligan, Walter Pelter, C. O. Martin, and C. R. Humphreys, representing the West Virginia Department of Mines; Messrs. M. C. McCall, Eric H. Brown, Frank J. Furin, and R. B. Jones, representing the U. S. Bureau of Mines; Mr. Paul Reed, representing the United Mine Workers of America; and Messrs. C. W. Connor and Campbell Allen, representing the company.

The property damage was limited to the destruction of one door, several wooden stoppings, and several gob stoppings; also, damage to a second door, the dislodging of a number of timbers, and the tearing down of some trolley wire on 23 north entry. The mine was ready to be operated the day following the investigation.

Detail of Evidence

Two of the eleven men who were killed lived for a short time after the explosion, but their condition was such that they could not be questioned. Therefore, the cause of the explosion had to be deducted from observation and the statements of employees who worked in that part of the mine.

The explosion originated in room 38 off 24 north entry. Room 38 is one of five being driven toward 25 south entry, which had been abandoned in 1935. The mining machine in this room had cut through when sumping, and the cut had been continued across the face. The room was about 30 feet wide. The machine controller was in the "on" position, and roof jacks were set in position for cutting, but the machine was almost ready to pull out. The bodies of the machinemen, and the gear shield from the machine were blown into 25 south entry from 38 room, approximately 70 feet toward the face. A non-permissible hand-held electric drill, equipped with a trigger-type switch, was on the mine floor near the machine truck in room 38, but an auger was not attached.

Room 38 was used as a haulageway from which coal was gathered from section H. It was apparent, from the surrounding evidence, that a car was being changed for the mobile-loading machine in room 36 at the time of the ignition. The combination trolley and cable-reel gathering locomotive was found off the track about 330 feet from the face of room 38. One loaded and four empty cars were attached, with the last empty and the loaded cars wrecked. It is believed that the force of the explosion caused the wrecks. The trip of cars was stretched; the locomotive controller was on second point, and the reversing

lever was in "forward" position. The reel cable was taut, and the cable nip was lying under the locomotive bumper. The body of the motorman was found about 6 feet outby the locomotive bumper, and it was stated that he was face down in a kneeling position. The brakeman's body was found about 14 feet inby the end of the trip. Fragments of his clothing were caught by the coupling pin on the last car, thus indicating that he was riding on the drawbar. The nearest trolley wire hanger on which the cable could have been hooked was about 8 feet from the seat on the locomotive. This distance, compared with the distances of the bodies from the trip, may indicate that the trip had drifted about 6 to 8 feet after removal of the cable nip and ignition of the methane.

The shot-firer was injured and found in a breakthrough about 150 feet from the face of room 38. The blasting cable was coiled nearby, but neither the explosives nor detonators were found in these rooms. Two shot holes, one 5 feet 2 inches and the other 6 feet 1 inch in depth, were found drilled on the right side of the face. Another hole, 3 feet from the left rib, was 4 feet 11 inches in depth.

Two bodies were found near the face in room 36, with a nonpermissible-type loading machine. The operator's body was lying near the controls, and the helper's body was on the opposite side of the machine. The positions of these two bodies indicated that neither man moved following the ignition.

Two dead men and one live man were found at the face of room 39 which was being timbered. Neither men nor equipment were in rooms 37 and 40.

A nonpermissible-type loading machine in room 36 had loaded two cars. One of these loaded cars had been placed inby the track switch in room 38, and the other one was on the rear of the trip being pulled from the loading machine into room 38. The loading machine had loaded coal to the face through the middle of the prepared coal. It had been backed from the face, the clutch was found in neutral position, the loading head was lowered, and the loading machine conveyors were empty of coal. The machine was in position to be shifted to load from either rib side.

A watch was found under the rear conveyor of the loading machine. The hands of the watch indicated that they had stopped at 6:54.

Testimony disclosed that the flame safety lamp of the foreman in charge of section H had been extinguished. He met the supply crew on 24 north entry and requested them to take the lamp outside and return with another. He also stated that room 38 was being cut through, but he was not going to allow it to be blasted until after he received another lamp. A State inspector examined the flame safety lamp which had been sent out and stated that it relighted the first time he tried the igniter, but further attempts to relight it failed.

Forces

In room 38 off 24 north, the force of the explosion travelled toward the face with terrific violence. A hole about 11 feet in width was blown through the face and the coal piled against the chain pillar between 25 and 26 south entries. The depth of the undercut varied from 44 inches to approximately 7 feet. The force divided in both directions in 24 south entry. Force also

travelled from the locomotive through the mouth of room 38 into 23 and 24 north entries. Some debris was blown against the side of the trip in room 38, on the side opposite the trolley wire.

Forces generally were in directions away from room 38 except in room 40 where one wooden stopping was blown toward room 39.

Evidence of Heat and Flame

Flame extended over most of the described area. Long soot stringers were evident in the vicinity of the locomotive and in the breakthroughs between rooms 38, 39, and 40. This evidence also was particularly heavy in room 40 for a distance of approximately 300 feet from the face. Flame was evident throughout 25 and 26 south entries and on the 23 and 24 north entries to the vicinity of room 19. The entries in this vicinity are under a creek and are very wet.

Deposits of coke were observed on the floor and timbers in room 40 for a distance of about 300 feet from the face. This was the only place in which coal dust appeared to enter into the explosion.

Point of Origin

The Bureau of Mines investigators and the West Virginia Department of Mines investigators agree that the locomotive in room 38 off 24 north was the most probable source of ignition. This is based on the following reasons, most of which have been previously mentioned:

1. Direction of forces.
2. Lack of violence nearby the locomotive.
3. The position of the motorman's body.
4. The locomotive controller was on second point.
5. Evidence that the cable nip had just been removed from the wire.

The cutting machine in room 38 was another possible source of ignition, but because of the evidence of terrific violence at the face, this source has been given secondary consideration. It is believed that the concentration of methane near the mining machine was too great to ignite and that this concentration of methane extinguished the section foreman's flame safety lamp. Although it is known that the igniter in the safety lamp was not in good repair, it was relighted once by a State mine inspector.

The lack of an auger in the drill, found in 38 room, and the fact that the machinemen were operating the cutting machine, excludes the possibility that ignition occurred from the drill.

In room 36, the direction of forces, the locations of bodies of the crew members, and the evidence of flame makes ignition by the loading machine unlikely.

Source of Gas

There is no question concerning the source of gas. The investigators agree that this was impounded in the 25 and 26 south entries and was released as room 38 was cut through.

From statements made at the investigation, it would appear that a misunderstanding existed among the local mine officials regarding the cutting through of room 38 into 25 south. The superintendent stated that he had no intention of driving any rooms through until after the 11 west entries had been unwatered sufficiently to allow inspection of 25 south. He had, however, discussed plans to drive room 40 through about 12 feet in width for the purpose of building a dam in it.

The mine foremen and the section foreman in charge of section H on the day shift both stated that they were under the impression that the room farthest advanced would be driven through. It can reasonably be assumed that the section foreman on the night shift was under the same impression, as he allowed the machine to continue cutting after it sumped through.

A progress map of the section had been drawn and posted October 1, 1943, by the engineer at the mine. This map shows a proposed 12-1/2-foot barrier pillar to be left between the rooms off 24 north and the 25 south entry. It is evident that although the plans for the extension of these rooms had been discussed by the operating officials, orders regarding these plans were indefinite.

Ventilation of Section H Prior to the Explosion

Prior to the explosion, air used to ventilate the area affected by the explosion was coursed through 23 and 24 north entries and into No. 40 room. There are six breakthroughs between No. 39 and 40 rooms. Four of them were closed by wooden stoppings, and a check curtain was erected in the fifth one. The breakthrough nearest the face was left open. The breakthroughs between 38, 37, and 36 rooms were left open, and neither check curtains nor doors were maintained in these rooms to provide ventilation at the faces. The face of No. 36 room was approximately 115 feet from the inby rib of the last breakthrough.

A company report shows 8,250 cubic feet of air entering room No. 40 on the day of the explosion; however, due to lack of check curtains or doors to deflect the air to the faces, the major portion of the air could have short-circuited through the open breakthroughs between the rooms.

Summary of Evidence

1. Evidence shows that the forces radiated from the locomotive in room 38 off 24 north.

2. The locomotive controller was on second point and the position of the cable nip indicated it had just been removed from the trolley wire.

3. It is reasonable to assume that gas caused the extinguishing of the foreman's flame safety lamp.

4. The terrific violence at the face of room 38 off 24 north makes the cutting machine an improbable source of ignition.

5. The presence of heavy soot stringers near the locomotive and in rooms 39 and 40, together with coke deposition in room 40, is indicative of combustion of coal dust in a relatively quiet zone immediately following the gas explosion.

6. It was definitely known by the section foreman and the cutting-machine crew that room 38 was cut through to 25 south.

7. All underground workers wear permissible electric cap lamps; hence, there was no ignition from miners' lights.

8. Evidence of smoking or smokers' articles was not found.

9. Evidence of explosives having been fired was lacking.

10. Evidence indicates that the explosion was stopped by water.

Probable Cause of the Explosion in the Opinion of the Bureau of Mines Investigators

It is the opinion of the Bureau of Mines investigators that the explosion originated in room 38 off 24 north entry, by the ignition of methane. The gas was liberated from the abandoned 25 and 26 south entries when the cutting machine cut through. The gas was ignited by an arc when the cable nip was removed from the trolley or by "nipping". The explosion was propagated by methane, although some coal dust was ignited in room 40 off 24 north entry.

Lessons to be Learned from The Conditions as they Relate to the Explosion

1. Abandoned workings which cannot be ventilated or inspected are likely to contain dangerous quantities of gas or water and extra precautions should be taken when approaching such regions.

2. Distances should be frequently and accurately checked when workings are approaching abandoned regions.

3. Test holes should be maintained well in advance and to each side when approaching abandoned workings.

4. When approaching workings that cannot be inspected, boreholes should be kept at least 20 feet in advance of the face, as well as to each side.

5. Cutting-machine crews should carry permissible flame safety lamps and make frequent tests for gas, after having been carefully instructed in the use and limitations of the flame safety lamp.

6. Nonpermissible mining equipment should be used only where an ample volume of intake air is in circulation.

7. Officials and workers should have self-rescuers available for use.

8. Haulageways should be kept on intake air.

RECOMMENDATIONS

The following recommendations are made in the belief that their adoption will lessen chances of a future disaster at this mine. Because a Federal mine reinspection was made of this mine on September 20 to 25, 1943, only recommendations as apply to the explosion are made in this report.

Ventilation and Gas

1. Main haulageways should be in intake air.

2. Flame safety lamps should be maintained by a competent authorized person and tested in an explosive atmosphere before they are taken into the mine.

3. The shot firers and machine crews should carry and use permissible flame safety lamps, after having been carefully instructed in the use and the limitations of the lamps.

4. Tests for gas should be made before and during cutting operations, and before and after blasting.

5. Nonpermissible electrical equipment should not be operated in air that is likely to contain methane.

6. Doors should not be provided with latches or other devices to hold them open, and doors supposed to be closed should not be held open by blocking of otherwise awaiting return of cars, trips or persons.

7. Doors should be installed in pairs to form air locks or, where this is not feasible, tight check curtains, well maintained, should be hung in connection with single doors.

8. All room crosscuts, except the one nearest the face, should be closed with stoppings, preferably of gob wall, dirt, or tight board.

9. Crosscuts should be made in rooms at distances not exceeding 80 feet.

10. Check curtains or doors should be used to deflect air to the working faces.

11. Line brattices should be provided to conduct the ventilation from the last open crosscut to the working faces to remove and render harmless any explosive gas, noxious fumes, or dust.

Dust

1. Water should be used on the cutter bar of all cutting machines; on the coal face before and after blasting; on the loose coal during loading; on all loaded and empty trips; in the face regions and back to the last application of rock dust.

2. The surfaces of all accessible openings in dry sections of the mine, also, where there is a possibility of wet sections drying out seasonally, should be thoroughly rock-dusted to within 40 feet of the faces. The rock dust should be distributed and maintained in sufficient quantity to assure an incombustible content of the mixed dusts of not less than 65 percent.

Haulage

1. The practice of "nipping" should not be permitted.

Machinery and Electricity Underground

1. Open-type electrical equipment should be replaced by permissible-type equipment as replacements are made.

First Aid and Mine Rescue

1. At least 18 men should be trained in mine rescue and recovery work and should be given additional training monthly.

2. Self-rescuers should be readily available to all underground employees and they should be trained in their use.

Supervision and Discipline

1. All underground officials should possess certificates of competency issued by the West Virginia Department of Mines.

Fire Protection Underground

1. Suitable fire-fighting equipment should be placed on all portable electrical equipment.

2. Rock dust should be maintained near both sides of all doors.

General

1. When approaching abandoned workings that cannot be inspected, boreholes should be kept at least 20 feet in advance of the face, and similar 45-degree angle holes 25 feet deep should be made in each side.

2. An accurate and frequent check should be maintained of distances in the workings approaching abandoned or worked-out regions.

3. Definite instructions should be issued to section foremen, as to the limit of approach toward abandoned or worked-out areas, regardless of whether these areas can be inspected or not.

4. Only permissible electrical equipment maintained in permissible condition should be allowed to be operated in a region where a connection is to be made into old workings that cannot be inspected. When a "break-through" to old workings is imminent the work should be under the constant supervision of a foreman. Frequent tests for explosive gas should be made at the working face and extra precaution should be taken to ventilate the region with an adequate quantity of intake air.

5. After cutting or drilling into an abandoned or worked-out region the electric power should be cut off, and no electrical equipment should be operated in the place, or any part of the section on the return side of such a place, until it is definitely determined that the abandoned or worked-out region does not contain explosive gas.

ACKNOWLEDGMENT

The authors herewith acknowledge the courtesies extended, and the cooperation given by the officials of the American Rolling Mill Company during the investigation.

The cooperation of Chief Jesse Redyard and the mine inspectors of the West Virginia Department of Mines who were present is also hereby acknowledged.

The authors also wish to express their admiration of the courageous work of Dr. J. Paul Aliff of the American Rolling Mill Company, who performed tasks which might be considered as beyond the call of duty.

Respectfully sumbitted,

Eric H. Brown,
Mining Engineer

Frank J. Furin,
Coal-Mine Inspector

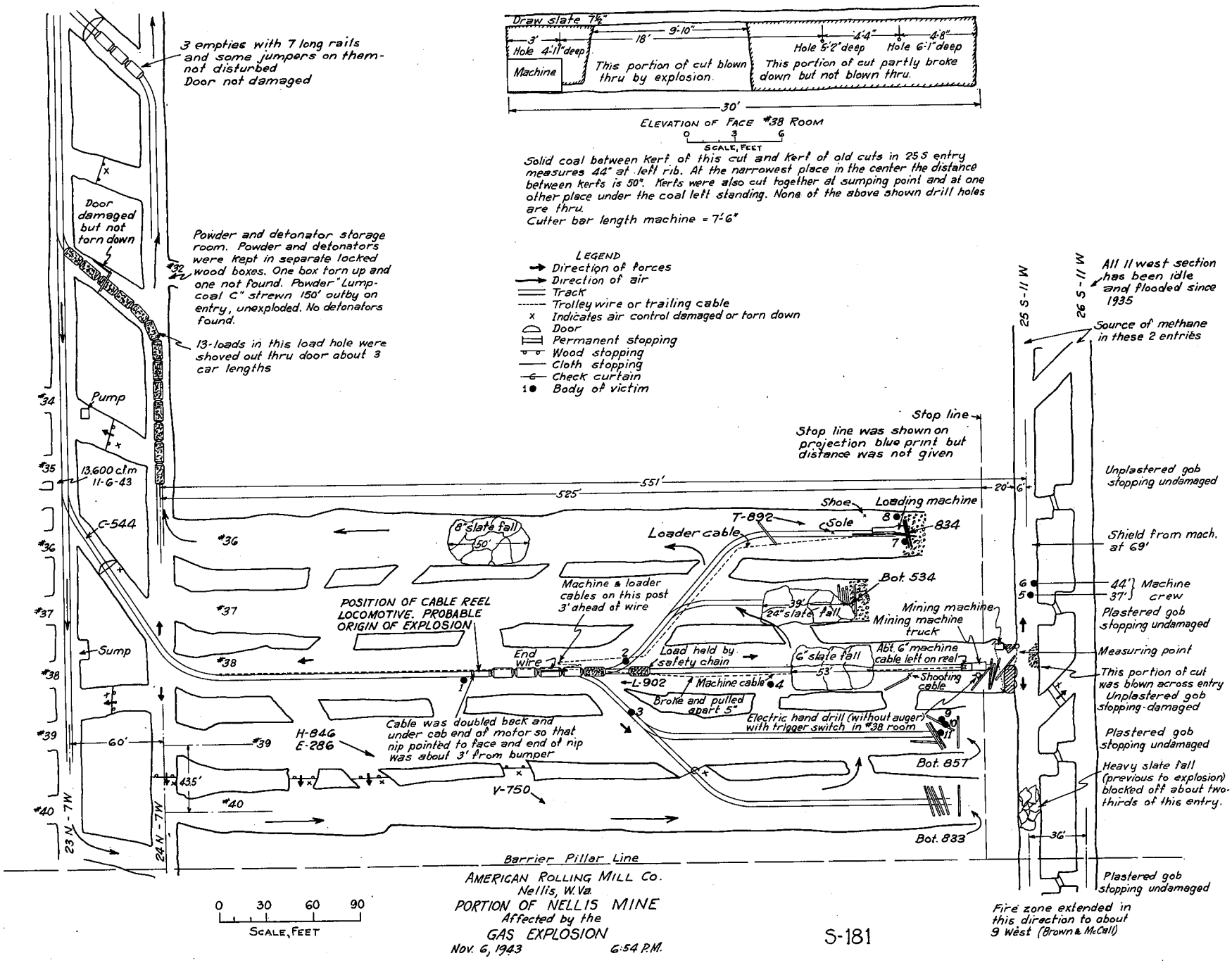
Ralph B. Jones,
Coal-Mine Inspector

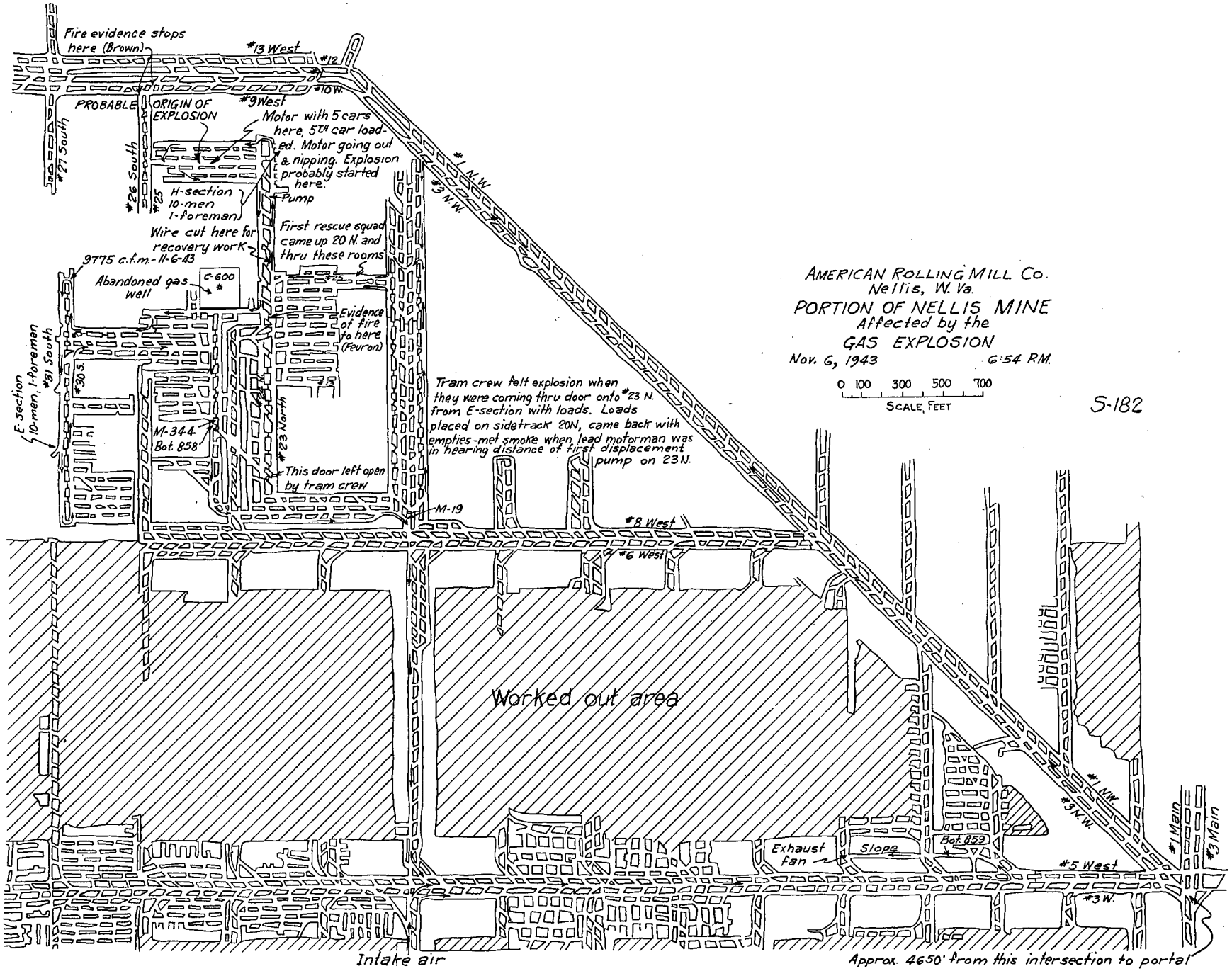
APPROVED:

D. Harrington, Chief,
Health and Safety Service

LIST OF DECEASED MINERS

	Name	Occupation	Age	Remarks
1.	W. O. Workman	Motorman	43	
2.	Onal Miller	Brakeman	28	
3.	W. H. Gunnoe	Foreman	48	
4.	W. C. Barker	Shot-firer	59	Died later
5.	Lester Gunnoe	Machineman helper	37	
6.	Julius Domokes	Machine runner	34	
7.	Odell Linville	Loader operator	37	
8.	Steve Turkovich	Loading machine helper	48	
9.	John Williams	Trackman	60	
10.	John Setliff	Timberman	49	
11.	Lawrence Vincent	Timberman	23	Died later


Draw slate 7½"
3'
Hole 4'-11" deep
9'-10"
18'
4'-4"
4'-8"
Hole 5'-2" deep
Hole 6'-1" deep
Machine
This portion of cut blown thru by explosion.
This portion of cut partly broke down but not blown thru.
30'
ELEVATION OF FACE #38 ROOM
0 3 6
SCALE, FEET
Solid coal between kerf of this cut and kerf of old cuts in 25 S entry measures 44" at left rib. At the narrowest place in the center the distance between kerfs is 50". Kerfs were also cut together at sumping point and at one other place under the coal left standing. None of the above shown drill holes are thru.
Cutter bar length machine = 7'-6"
3 empties with 7 long rails and some jumpers on them- not disturbed
Door not damaged
Door damaged but not torn down
Powder and detonator storage room. Powder and detonators were kept in separate locked wood boxes. One box torn up and one not found. Powder "Lump-coal C" strewn 150' outby on entry, unexploded. No detonators found.
13-loads in this load hole were shoved out thru door about 3 car lengths
LEGEND
Direction of forces
Direction of air
Track
Trolley wire or trailing cable
Indicates air control damaged or torn down
Door
Permanent stopping
Wood stopping
Cloth stopping
Check curtain
Body of victim
Pump
#34
#35
13,600 cfm 11-6-43
C-544
#36
#37
Sump
#38
#39
#40
60'
435'
23 N - 7W
24 N - 7W
#32
551'
525'
20'
6'
Stop line
Stop line was shown on projection blue print but distance was not given
Shoe
Loading machine
T-892
Sole
834
8
7
Loader cable
8' slate fall
50'
Machine & loader cables on this post 3' ahead of wire
POSITION OF CABLE REEL LOCOMOTIVE. PROBABLE ORIGIN OF EXPLOSION
End wire
Load held by safety chain
Bot. 534
39'
24" slate fall
Mining machine
Mining machine truck
Abt. 6" machine cable left on reel
6' slate fall
53'
Shooting cable
L-902
Machine cable
Broke and pulled apart 5"
Electric hand drill (without auger) with trigger switch in #38 room
Cable was doubled back and under cab end of motor so that nip pointed to face and end of nip was about 3' from bumper
H-846
E-286
V-750
Bot. 857
Bot. 833
Barrier Pillar Line
All 11 west section has been idle and flooded since 1935
Source of methane in these 2 entries
Unplastered gob stopping undamaged
Shield from mach. at 69'
44' Machine
37' crew
Plastered gob stopping undamaged
Measuring point
This portion of cut was blown across entry
Unplastered gob stopping-damaged
Plastered gob stopping undamaged
Heavy slate fall (previous to explosion) blocked off about two-thirds of this entry.
36'
Plastered gob stopping undamaged
Fire zone extended in this direction to about 9 West (Brown & McCall)
0 30 60 90
SCALE, FEET
AMERICAN ROLLING MILL CO.
Nellis, W. Va.
PORTION OF NELLIS MINE
Affected by the
GAS EXPLOSION
Nov. 6, 1943 6:54 P.M.
S-181


Fire evidence stops here (Brown)
#13 West
#12
#10 W.
#9 West
PROBABLE ORIGIN OF EXPLOSION
Motor with 5 cars here, 5th car loaded. Motor going out & nipping. Explosion probably started here.
#27 South
#26 South
#25
H-section 10-men 1-foreman
Pump
Wire cut here for recovery work
First rescue squad came up 20 N. and thru these rooms
#1 N.W.
#3 N.W.
9775 c.f.m.-11-6-43
Abandoned gas well
C-600
Evidence of fire to here (Peuron)
E section 10-men, 1-foreman
#31 South
#30 S.
M-344 Bot. 858
#23 North
This door left open by tram crew
Tram crew felt explosion when they were coming thru door onto #23 N. from E-section with loads. Loads placed on sidetrack 20N, came back with empties-met smoke when lead motorman was in hearing distance of first displacement pump on 23N.
M-19
#8 West
#6 West
Worked out area
Exhaust Fan
Slope
Bot. 859
#5 West
#3 W.
#1 NW
#3 N.W.
#1 Main
#3 Main
Intake air
Approx. 4650' from this intersection to portal
AMERICAN ROLLING MILL CO.
Nellis, W. Va.
PORTION OF NELLIS MINE
Affected by the
GAS EXPLOSION
Nov. 6, 1943
6:54 P.M.
0 100 300 500 700
SCALE, FEET
S-182

Supplement to Map Showing the Portion of Nellis Mine of the American Rolling Mill Company Affected by the Explosion on November 6, 1943

NOTE: The information was obtained from a map furnished by the American Rolling Mill Company. The map was drawn by Paul R. Maxey, mining engineer; the accuracy of the map has been verified by Bureau of Mines engineers.

Identification of Bodies

(1) W. O. Workman - Motorman
(2) Onal Miller - Brakeman
(3) W. H. Gunnoe - Foreman
(4) W. C. Barker - Shooter - Died 11/9/43
(5) Lester Gunnoe - Machine Runner
(6) Julius Domokos - Machine Helper
(7) Odell Linville - Loader Operator
(8) Steve Turkovich - Loader Helper
(9) John Williams - Trackman
(10) John Setliff - Timberman
(11) Lawrence Vincent - Timberman - Died 11/9/43

Notes

Motor - Controller on 2nd or 3rd point with reverse bar set for coming out of room. Reel switch out, cable picked up. Deck end of motor off track to wire side and marks on bottom indicated it had run about 18" on ground. 4th and 5th cars back were off track to wire side, one side only, with rail looking to have been spread. Wheels of 5th or rear car lacked 18" of having cleared latch points but right wheel or rear load had jumped latch point and was settling on rail of room track.

Machine - Under coal, cut practically completed, controller wide open, bit clutch in, fast feed friction tight, slow feed friction loose and both pipe jacks were in place. Tail rope was loose dead eye having pulled out of drum. Skid, jack handle and shovel blade were on top machine. (Handle for this shovel was found some 50 ft. down 25 S. entry.) Lifting jack and a pick were found just to left of machine. Tamping stick and an auger bit were found to left of machine truck.

Loader - Had been put in position for a new run. Conveyor clutch was out, tram clutch in neutral and control valve was set for lowering the head. Head was down. A glove containing 4 fingers from the operator's hand was found on the right running board. The helper's arm was found 4 ft. ahead of the left digging arm. A watch was found under the loading boom stopped at 6:54.

Shooting box - Two pieces from the end of a powder box, which might have come from the shooter's hand box were found on clearance side of chain pillar between 23 & 24 N. Entries at mouth #38 Room.

Sherman Int. 3529

DEPARTMENT OF THE INTERIOR

INFORMATION SERVICE

BUREAU OF MINES

For Immediate Release SATURDAY, NOVEMBER 20, 1943.

Aroused by a report from the Bureau of Mines that the death of eleven men in the Nellis Coal Mine explosion Nov. 6 near Madison, W. Va., was the result "either of gross carelessness or negligence", Secretary of the Interior Harold L. Ickes has written a letter to Charles R. Hook, president of the American Rolling Mill Company of Middleton, O., owners of the mine, strongly protesting the failure of the Company to take proper safety precautions.

The Secretary said that the accidental killing of working men is tragic at any time, but in the present situation, when every ton of coal is essential to the successful prosecution of the war, such tragedies constitute a threat to our national security.

The Nellis explosion was the eighth major coal mine disaster of 1943, bringing the total fatalities to 174 in the first ten months and six days of the year. In the corresponding period of 1942, there were only five major disasters, with a death toll of 120.

"This is a bad record," the Secretary said, "and I have accordingly instructed the Bureau of Mines to intensify its efforts to insure greater safety in the mines. Carelessness, or failure to comply with safety requirements should not be tolerated and we propose to do everything within our power to reduce this unnecessary death toll."

Secretary Ickes' letter to Mr. Hook follows:

"My dear Mr. Hook:

"The increasing loss of life in the coal mines, which was augmented by the disaster that cost the lives of 11 men on Saturday, November 6, in your Nellis mine, is a matter of deep concern to me as Coal Mines Administrator. The preliminary report of the disaster submitted by the Bureau of Mines indicates that the explosion was the result of gross carelessness or negligence and that the proper precautions for preventing the explosion had not been taken.

"I am informed that a mining machine cut through a pillar of coal into an abandoned entry in which gas was entrapped, thereby releasing the gas into the active workings where it was ignited with explosive force either by a nonpermissible cutting machine or by an electric arc most likely created by the nip from a cable-reel locomotive.

(over)

"It was not made quite clear to me or to the Bureau engineers who investigated the explosion whether the action of cutting through the pillar into an abandoned section was intentional or was done by mistake. In either case, the failure to take the proper precautions was contrary to safe mining practices and therefore was inexcusable. If the action was intentional, then it seems to me that the officials were remiss in their obligations to safeguard the lives of the men. If the act was a mistake, then it indicates that the engineering information in this instance was inaccurate, which reflects adversely on the ability of the supervisory officials.

"The Bureau of Mines records show that for 1942 your mine had a higher accident rate than the national average for the bituminous industry, based on both man-hours worked and the number of tons of coal mined. The Nellis mine had a rate of 134 accidents for each million tons of coal produced, as against 92.5 for the industry. The accident rate of the Nellis mine for each million man-hours was 83.52, as compared with 66.03 for the average bituminous mine.

"The last Federal coal mine inspection report on the Nellis mine credited it with using permissible explosives and permissible cap lamps, the enforcement of the no-smoking rule underground, the wearing of protective clothing by the underground workers, first-aid training for the employees, and many other safe practices. Despite these precautions, it is obvious that some of the most important recommendations made by the Federal inspector in the report were not put into effect, and that the failure to do so had a direct bearing on the explosion. I refer specifically to a recommendation which stated that 'sufficient gas is being liberated to warrant ... keeping all sources of ignition from the face region ...' The report also cited the practice of nipping portable electric equipment along trolley wires and recommended that this practice be prohibited.

"I have directed the Bureau of Mines to send an inspector to the Nellis mine, within the next thirty days, to report on the use of nonpermissible mining machinery, the hazardous practice of nipping, and other possible hazards. I hope that he will notify me that all possible precautions have been taken and that nothing is being left undone to prevent a recurrence of the disaster.

"The accidental killing of working men is tragic and represents a serious loss to the productive power of the Nation at any time, but in the present situation, when every ton of coal is essential to the successful prosecution of the war, such casualties on the home front are doubly tragic and constitute a threat to our national security.

Sincerely yours,

/s/ Harold L. Ickes

Secretary of the Interior."

Seven of the eight disasters in mines in 1943 were explosions, resulting from the ignition of gas, Dr. R. R. Sayers, Director of the Bureau of Mines, reported to Secretary Ickes. These gas explosions, he said, emphasize the necessity of maintaining adequate ventilation in all coal mines to dilute and carry away methane, an explosive gas. The eighth disaster was a mine fire.

By states, Dr. Sayers said, the toll was as follows: Montana, one explosion, 74 miners killed; Alabama, two disasters and 40 deaths; West Virginia, two disasters and 24 deaths; Pennsylvania, one, 14 deaths; Kentucky, one, 12 deaths, and Tennessee, one disaster and ten deaths.

"Coal mine explosions can be prevented," Dr. Sayers stated. "The means of preventing them are well known. All that is necessary is conscientious desire on the part of both employees and management to apply these well-known safety measures.

"Adequate and properly directed ventilation is of primary importance in preventing explosions in coal mines. By providing an adequate amount of fresh air and directing it properly to all parts of the mine, accumulations of explosive gas can be prevented. Although the proper ventilation of a mine involves a vast amount of planning, study, and installation of facilities, fortunately there are definite standards and methods to fit all types of coal mines--methods which have been tested and found adequate for nearly all conditions and circumstances."

Next to effective ventilation, minimizing or eliminating possible sources of ignition is important in preventing coal-mine explosions, Dr. Sayers stated. This is more difficult in mechanized mines, since the use of electricity presents multiple hazards in the form of arcs and sparks. However, there are a number of ways in which ignition sources can be reduced, such as prohibiting smoking underground, banning open-flame lights, using permissible explosives instead of black blasting powder and dynamite, and using permissible electrical equipment and keeping it in a permissible condition.

A recapitulation of the 1943 disasters showed that electric arcs and sparks from nonpermissible mining equipment caused five of the explosions and 75 deaths; that an open-flame lamp was thought to be responsible for the Montana blast in which 74 died; that the mine fire in which 13 men died was caused by electricity.

Commenting upon the use of rock dust to neutralize coal dust and thus limit the spread of an explosion by depriving it of fuel in the form of highly-explosive coal dust, Dr. Sayers said:

"Four of the mines in which major explosions occurred were reported to have used rock dust and three were not rock-dusted. If all of these mines had been rock-dusted adequately, the death toll undoubtedly would have been lower. Failure to rock-dust adequately is inexcusable, as rock-dusting is relatively inexpensive, and, if kept up to standard, is almost certain to prevent widespread explosions. At present, probably not more than two percent of the coal mines in the United States are kept adequately rock-dusted--a condition by no means a credit to the mining industry."