

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES

District H

FINAL REPORT OF MAJOR MINE EXPLOSION DISASTER  
EVAN JONES SLOPE MINE  
EVAN JONES COAL COMPANY  
JONESVILLE, ALASKA

January 18, 1957

By

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INTRODUCTION

A gas and dust explosion occurred in the Evan Jones Slope mine, Evan Jones Coal Company, Jonesville, Third Judicial District, Alaska, at 10:02 a.m., Friday, January 18, 1957. The mine was operating with five men underground on the first shift when the explosion occurred. The five men were killed by flame and forces of the explosion.

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

The Bureau of Mines investigator believes that the initial explosion originated in a pillar pocket in the top pillar being extracted between Nos. 4 and 5 chutes when blasting with permissible-type explosives in a nonpermissible manner and that the explosion was propagated by methane and coal dust. Forces of the explosion traversed the entire mine and found relief on the surface through the slope portal and air shaft.

During the recovery operations which ended approximately 32 hours following the explosion, dangerous accumulations of methane and high concentrations of carbon monoxide were detected at several locations within the immediate area involved in the explosion. The complete destruction of all stoppings underground and partial destruction of the main fan house on the surface necessitated issuance of a joint closure Order, Form A, on January 18, 1957, in conformance with Section 203(a)(1) and Section 202(b) (State plan) of the Federal Coal Mine Safety Act, debarring all persons from the mine, except those needed in exploratory, recovery, and investigation work.

Following completion of the recovery work on Saturday, January 19, 1957, and the final trip underground on January 22, 1957, to investigate the cause of the explosion, the decision to abandon the mine was made by company officials. The slope portal and fan shaft were sealed January 25, 1957.

## GENERAL INFORMATION

The Evan Jones Slope mine is at Jonesville, Third Judicial District, Alaska, in Section 17, Township 19N, Range 3E, approximately 11 air miles northeast of Palmer, Alaska, three miles north of Milepost 61 on the Glenn Highway and is served by the Alaska Railroad.

Work to open the Slope mine was started by the Evan Jones Coal Company in July 1954. The purpose of developing the mine was to explore the possibility of a sizable block of coal between the Jonesville and Eska faults; however, after considerable work and expenditure of funds, management decided in May 1956, that it would not be economically feasible to continue operation of the mine.

Operation of the mine was contracted to a group of miners in June 1956, and this group was working the mine on contract basis when the explosion occurred. The principal officials of the Evan Jones Coal Company are:

Harry Hill	President	Anchorage, Alaska
Don Hill	Manager	Anchorage, Alaska
Claude G. Murphy	Superintendent	Jonesville, Alaska

At the time of the explosion, five men worked underground and one on the surface on each of two shifts, and other employees, including hoistmen, officials and engineers, went underground regularly. The mine was operated two coal producing shifts a day, six days a week. A total of 22,852 tons of coal was produced since June 1956.

The Slope mine was opened by a shaft (intake) 80 feet in depth and a slope (return) driven through rock for a distance of 180 feet on an 18-degree pitch where it leveled off for a distance of 280 feet and intersected the coal bed 460 feet from the portal. A main slope, intake slope, and a counter slope were driven on the pitch of the coal bed for a distance of 660 feet where the coal bed turned over to almost vertical and the slope faces were abandoned.

The mine was developed in the No. 5 coal bed which averaged 15 feet in thickness and dipped from 24 to 51 degrees in a northwesterly direction. The cover over the coal bed ranged up to 800 feet.

The immediate roof was coal, and the main roof varied from a dark gray sandy shale to sandstone of undetermined thickness. The floor was dark bony shale.

The analysis of a tipple sample of 2" x 0" coal (laboratory No. D-92260, Can No. 8017) taken from the No. 5 coal bed of the Evan

Jones mine and analyzed in the Pittsburgh laboratory of the U. S. Bureau of Mines is as follows:

	Percent
Moisture	8.8
Volatile matter	34.0
Fixed carbon	35.1
Ash	22.1
	<u>100.0</u>

The ratio of volatile matter to total combustible matter is as follows:

$$\frac{\text{Volatile matter}}{\text{Volatile matter plus fixed carbon}} = \frac{34.0}{34.0 + 35.1} = 0.492$$

Numerous tests by the Bureau of Mines have shown that coal dust having a volatile ratio of 0.12 is explosive and that the explosibility increases with an increase in the volatile ratio. The volatile ratio of the coal in this mine as determined above is 0.492, indicating that the dust from this coal is highly explosive.

An explosion which caused the death of 14 men occurred in 1937 in the Evan Jones mine, which overlies this mine.

The last Federal inspection of this mine was completed on September 17, 1956.

#### MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods. The mine was developed by a room-and-pillar method and pillars were extracted on the retreat. The gangway was driven 10 feet wide and the counter entry was approximately 8 feet wide. Room chutes were driven up the pitch to variable depths where they encountered a fault. The gangway, counter entry, room chutes, and crosscuts were driven on about 50-foot centers. Significant is the fact that a "blind" crosscut was driven to the fault from No. 4 chute and was above the pillar being mined between Nos. 4 and 5 chutes. Room chutes and crosscuts were 6 to 8 feet in width and 6 feet in height. The gangway was driven 750 feet east from the main slope to where a fault was encountered. Pillars were extracted by an open-end pocket method working from the low side of the pillar and small fenders or stumps were left along the gob to help hold the cave. The coal was loaded onto flat sheets with air-driven scrapers in the room chutes, crosscuts, and pillars, except the entry stumps, where an air-driven mucker was used to load it directly into mine cars. The flat sheets discharged into chutes and then into mine cars on the gangway.

A systematic method of timbering, which required permanent

posts with cap pieces to be set on 6-foot centers and 3-piece timber sets on the slopes and the gangway, appeared to have been followed. Generally the timbers which had been set in the room chutes were not dislodged by the force of the explosion; however, all 3-piece timber sets on the main haulage slope, from the mouth of the counter entry to within 400 feet of the slope portal, were dislodged.

Explosives. The coal was blasted off the solid with permissible-type explosives (Coalite S1 in 1-3/8" x 8" cartridges) fired with numbers 0 to 8 regular delay detonators. Permissible 10-shot blasting units were used. Individual containers of explosives were stored in crosscuts between Nos. 2 and 3 chutes. Detonators were stored in specially constructed containers in crosscuts between Nos. 3 and 4 chutes. Shots were prepared by the miners and fired by certified shotfirers. Sand or rock dust in paper dummies was used for stemming. Shots were charged and fired at any time during the shift. Boreholes were drilled with compressed-air (jackhammer) drills. Generally when driving crosscuts, chutes, and counter entries, seven boreholes were drilled into the solid coal face to a depth of about six feet and charged with four or five cartridges of explosives. The explosives charges were placed so that the center holes near the floor (busters) would detonate first, followed by either of the bottom rib holes (lifters) then the center top hole, followed by the top rib holes. When blasting in pillars or stumps, the number and positions of the boreholes were left to the discretion of the miners.

Samples of explosives used in the mine were collected during the investigation, and analysis thereof by the Bureau proved that they passed the permissibility requirements.

Ventilation and Gases. The mine ventilation was induced by a well-installed electrically driven axial-flow fan installed on the surface. Air measurement records indicated that on January 4, 1957, the fan was blowing 38,920 cubic feet of air a minute into the mine. Since the last Federal inspection, September 17, 1956, the fan had been reversed from exhausting to blowing to help prevent ice from forming along the main haulage slope. The blowing system of ventilating the pillar section could have a tendency to hold gas back on the higher portion of the gob area and to pass gas from the gob area into the chutes and the main haulage slope. The fan was installed in a fireproof housing with fireproof air ducts to and from the collar of the shaft and equipped with explosion doors. The fan was not operated continuously according to pressure gage recording charts. These records show that the fan was put into operation at 7:00 to 7:20 a.m. each day before the first shift. The fire boss entered the mine at about 7:30 a.m. and the fan was stopped at about 11:00 p.m. when the second shift returned to the surface.

The mine was ventilated by a continuous air current which entered through the shaft from the fan, down the intake slope and counter slope to a sub-counter entry, coursed to the gangway at a point in by a door between Nos. 2 and 3 chutes; thence it filtered up Nos. 4 and 5 chutes to the top crosscut between Nos. 4 and 3 chutes, through the crosscut between No. 3 and No. 2 chutes, down No. 2 chute to the counter entry, thence to main haulage slope and to the surface. Bleeder entries

were not provided to maintain a positive movement of air through and/or around the caved areas. No positive ventilation was directed to the face of the "blind" crosscut above the pillar between Nos. 4 and 5 chutes. Air measurements taken on January 4, 1957, by V. E. Wilkinson, fire boss of the Evan Jones mine, indicated that 15,520 cubic feet of air a minute entered the gangway through the sub-counter entry and 3,360 cubic feet of air a minute passed through the No. 6 crosscut between Nos. 3 and 4 chutes. Available evidence indicated that the second shift on January 4, 1957, did not produce coal until repairs were made to stoppings, and not less than 5,000 cubic feet of air a minute was passing through the No. 6 crosscut between Nos. 3 and 4 chutes; however, written records of these air measurements were not made.

A compressed air driven auxiliary blower fan was installed in the last open crosscut (fifth) between Nos. 2 and 3 chutes and 12-inch tubing was used to conduct the air to the face of the top counter entry. Prior approval for the use of auxiliary blower fans had not been obtained from the Joint Industry Safety Committee. Line brattice was not used to conduct the air currents to and across the working faces.

The mine was classed gassy by the Territory of Alaska Department of Mines and by the Bureau of Mines. At the time of this investigation, methane was detected in the area along the fault between Nos. 3 and 4 chutes. Available information indicated that the fan was shut down on December 21, 1956, for the holidays and was started January 2, 1957. The fire boss record for January 2, 1957, indicated that the face areas had accumulations of methane and that the first shift crew withdrew from the mine. The mine superintendent, Claude G. Murphy, would not permit the second shift to enter the mine until he had made a personal examination for methane; however, a written record of this examination was not made. Fire boss records indicated that the fire boss normally entered the mine at about 7:30 a.m., started his examination at about 7:40 a.m., and returned to the surface at 3:15 to 3:20 p.m. There was no fire boss record for January 18, 1957, the day the explosion occurred, as it was customary to make such records when he returned to the surface at the end of the shift. The men entered the mine with the fire boss and reportedly waited in the counter entry until he made an examination of the working faces. After the fire boss completed his examination he worked as a regular miner with the remainder of the crew. Fire boss records were kept at the Evan Jones Slope mine hoist and were not countersigned by the mine superintendent.

Only one permissible flame safety lamp was used underground on each shift. During rescue operations one lamp was found hanging from a nail in the top crosscut near No. 2 chute; extensive examinations and numerous tests made in the Bureau of Mines laboratory, Pittsburgh, Pennsylvania, on this lamp proved it to be in excellent condition and the lamp was not considered a source of ignition. (see Appendix B)

Two samples of the mine atmosphere were collected on Tuesday,

January 22, 1957, during the underground investigation and after partial ventilation had been restored during recovery operations January 19, 1957; however, one of the two samples collected was broken in transit. Sample No. H-7603 was collected in the No. 3 chute between the 5th and 6th crosscut above the counter. This sample was analyzed in the Bureau of Mines laboratory, Denver, Colorado, and the results are shown in Table 1. The sample showed 1.1 percent carbon dioxide, 14.1 percent oxygen, 13.0 percent methane, 71.8 percent nitrogen and no carbon monoxide.

1.1	CO <sub>2</sub>
14.1	O <sub>2</sub>
13.0	CH <sub>4</sub>
71.8	N <sub>2</sub>
0.00	CO
<u>100.00</u>	

This sample is an indication that methane was being emitted.

Oil or gas wells did not penetrate the coal bed on this property.

Dust. The mine was dry and rock dust had been applied; however, fire boss records from January 15, 1957, to January 17, 1957, inclusive, indicated that the No. 2 chute and crosscuts between Nos. 2 and 3 chutes were dusty (coal dust). These daily records also indicated that rock dust had been applied on January 4 and January 16, 1957. Information obtained from Merritt Long, hoistman, who came out of the mine at about 9:55 a.m., prior to the explosion, indicated that rock dust was noticeably suspended in the air current along the main slope and that apparently rock dust was being applied at that time. Evidence obtained during the recovery operations indicated that one man, Glen R. Vore, may have been distributing rock dust by hand when the explosion occurred. Rock dust was applied to the top, bottom, and ribs by hand and by the use of a "bazooka", a hand made device to distribute rock dust with compressed air.

During recovery operations and investigations, dangerous accumulations of fine loose coal and coal dust were observed along each side of the flat sheets from the counter entry to the last crosscut in the No. 2 chute. Water or other methods to allay the coal dust at its source were not used.

A rib and roof sample of the mine dust (floor wet) collected on the gangway side track during the last Federal inspection on September 17, 1956, contained 95 percent incombustible material.

Transportation. A storage-battery locomotive was used on the gangway to push the mine cars, one at a time, from the mouths of the chutes to a side track, a maximum distance of 200 feet. A gasoline-driven hoist on the surface was used for hoisting on the slope.

Electricity. All face area equipment was compressed-air-driven and electricity, 440 volts alternating current, was used on the lower end of the main slope for operating a pump and battery charger for the locomotive. The transmission cable entered the mine through the air shaft and was installed along the intake slope. The cable was a rubber-covered four-conductor-type and all splices were of a permanent, vulcanized type. The transmission cable, pump, and charger was installed in intake air. The pump was disconnected and had not been operated for several months prior to the explosion. The battery charger was operated for short periods of time at different intervals as required to keep the battery locomotive in operation; the charger was frame grounded.

Illumination and Smoking. Permissible cap lamps were used for portable illumination and smoking was not permitted underground. The clothing of each of the victims was searched for smoker's articles by the undertaker in the presence of two Territorial Highway Patrolmen and cigarettes, matches or lighting devices were not found.

Mine Rescue. Fifteen underground employees of the Evan Jones Coal Company have been trained in mine rescue and these men have taken practice training periodically. A fully equipped mine rescue coach (No. 5) is maintained by the Bureau of Mines for use along the railbelt. At the time of the explosion the mine rescue coach was located in the yards of the Alaska Railroad at Anchorage, Alaska, approximately 61 miles from the mine. The Bureau of Mines maintains the only mine rescue equipment in Alaska and all mine rescue training is conducted by the Federal coal-mine inspector. Mine rescue coach No. 5 was delivered to the mine by the Alaska Railroad on the first available regular train after the explosion. Officials of the Alaska Railroad volunteered to call out a special train crew to expedite movement of the coach; however, as ample equipment had been transported to the mine by plane and automobile, special movement of the coach was not required.

Fire-fighting equipment was considered adequate at the time of the last inspection. This equipment consisted of bags of rock dust placed near the ventilation door and at the pump in addition to fire extinguishers on the locomotive and at the battery charger.

#### STORY OF EXPLOSION AND RECOVERY OPERATIONS

Activities of Bureau of Mines Personnel. An explosion occurred in the Evan Jones Slope mine at 10:02 a.m., January 18, 1957; the fan pressure-recording gage was stopped at that time. The Bureau of Mines office in Anchorage was notified at 10:20 a.m. by an official of the Evan Jones Coal Company. Raymond L. Ellis obtained rescue equipment from the mine rescue coach located in the yards of the Alaska Railroad and arrangements were made with the Safeway Airways, Merrill Field, to fly the inspector and equipment to the mine. The plane left Anchorage at 11:20 a.m. and arrived at the mine at 11:50 a.m. A crew of men was

found working in by the first crosscut between the main rock slope and the fan shaft. This crew was withdrawn immediately as they were depending on natural ventilation. A temporary fan was placed in operation at about 1:30 p.m. At 2:00 p.m. Ellis, with a crew of six men, working in fresh air and wearing Chemox apparatus and gas masks when necessary, made their way to the third crosscut, approximately 450 feet from the slope portal, where a large cave was encountered. The underground crew was withdrawn to the surface at which time the main fan was put into operation. After a 2-hour waiting period, the crew again entered the mine. No special attempt was made to recover the bodies until the entire mine was explored; however, the first body was recovered at 10:50 p.m., the second at 3:30 a.m., Saturday, the third and fourth at 5:15 a.m., and the fifth and final body at 5:25 p.m., Saturday, January 19.

Mine Conditions Immediately Prior to Explosion. The mine had been idle since the second shift stopped work at about 11:00 p.m. January 17, or for approximately 8 hours. According to pressure-recording gage charts, the fan was stopped at about 11:15 p.m. on January 17, and started about 7:20 a.m., January 18, 2 hours and 42 minutes prior to the explosion. The weather was clear in the vicinity of the mine and according to barometric pressure readings obtained from fire boss records of the Evan Jones mine, the barometer had dropped from a high of 29.90 at 12 o'clock midnight, January 17, 1957, to 29.66 at 8:00 a.m., January 18, 1957. The ventilating fan and mine operations were normal and the day shift was at work when the explosion occurred. There was no fire boss record for January 18, 1957, as the fire boss made his report on his return to the surface at the end of the day shift; however, available information indicated that the fire boss and the men entered the mine at about 7:25 a.m. According to information obtained from Merritt Long, hoistman on the day shift, he started hoisting coal at about 7:30 a.m. After pulling about 7 or 8 cars of coal from the mine, one car at a time, he called Glen Vore on the telephone and informed him that the coal bin was full and that he would not be able to hoist again until he had delivered the coal to the cleaning plant. After delivering the coal to the cleaning plant, he made several attempts to contact Vore by telephone and failing he went underground to determine why. Long entered the mine about 9:25 a.m. He noticed considerable coal dust in the air along the haulage slope (return), he crossed from the haulage slope to the intake slope through the second crosscut from the portal and traveled down the intake slope because he had been warned by the crew not to permit anyone to travel the haulage slope as they were about to hole through from the top counter. Long crossed from the intake slope into the gangway but did not see Vore. After disconnecting the empty car and connecting the loaded car onto the hoisting rope, he went into the counter entry at the mouth of No. 2 chute and noticed coal coming down the chute and considerable coal dust suspended in the air current. He returned to the intake slope and started toward the surface. When he crossed from the intake slope back to the haulage slope, through the second crosscut from the portal, rock dust suspended in the air was noticed. After throwing a few handfuls of calcium chloride on some ice

in the main slope, he returned to the surface at about 9:55 a.m. He went on to the main shop and did not see the explosion come from the mine; however, he did hear the reports. Two distinct reports were heard by numerous other persons.

Information obtained from the men who worked the second shift on January 17, indicated that some coal had been blasted from the small pillar stump (fender) along the top of the pillar block between Nos. 4 and 5 chutes during the second shift and that it was left to the judgment of the day crew as to whether or not they would attempt to get more coal from the stump (approximately 5 feet in thickness to the blind crosscut) or move down to the next pillar block. Information obtained during the recovery work and the underground investigation indicated that no tools or equipment had been moved from this area and that no preparations had been made to move down to the next block. Inspection of the pillar area during the investigation indicated that a portion of the top stump (fender) was missing and that it appeared to have been blasted prior to the explosion. A cave had occurred extending toward the fault above the pillar.

Recovery Operations. A log of activities maintained by an office clerk at the mine indicated that immediate steps were taken for recovery operations. Mr. Claude G. Murphy, superintendent, dispatched the electrician to investigate the fan and electric service; notified the Bureau of Mines, Territorial Department of Mines, doctors, and Territorial police; withdrew the underground workmen from the Evan Jones mine; rushed an emergency fan to the fan shaft; and organized crews to work 6-hour shifts. Repairmen began work installing the emergency fan and repairing the main fan air ducts. An attempt was made by the superintendent and a few miners to enter the haulage slope following natural ventilation. A temporary stopping was constructed in the first crosscut from the portal between the main slope and air shaft. At the second crosscut, the crew encountered a large fall of roof and were attempting to remove some of it when they were withdrawn from the mine at about 12:05 p.m. by the Federal coal-mine inspector. An emergency fan was placed into operation at 1:30 p.m. A rescue crew of six men wearing respiratory protective equipment when necessary entered the mine a few minutes later and found the main slope completely blocked with timbers, crossbars, lagging, and roof rock. A brattice-cloth stopping was erected in the second crosscut and some air was forced over and through the obstruction; tests for carbon monoxide and methane were made in the return air which indicated less than 0.01 percent carbon monoxide and no methane. However, it appeared that the emergency fan was not capable of producing sufficient ventilation to continue; therefore, this crew returned to the surface. Subsequently a three-man crew equipped with Chemox apparatus erected a brattice-cloth stopping in the third crosscut which extended the air current to the first crosscut in the coal bed. This crew returned to the surface at about 3:30 p.m. and necessary repairs having been made, the main fan was started at 4:00 p.m. It was operated exhausting thus ventilating the main slope with intake air. A

rescue crew of six men plus a crew of men to clear the obstruction from the main slope entered the mine at 6:00 p.m. By making careful and numerous checks for carbon monoxide and methane in the return air and following the intake air, brattice-cloth stoppings were erected in each crosscut along the haulage slope to the counter entry. Here, a brattice-cloth stopping was erected across the main slope just below the counter entry. The air was then coursed up No. 2 chute to the top crosscut. At this point, the air current became very weak and considerable time was spent in repairing and tightening the temporary stoppings. After the air current had been increased, four men wearing Chemox apparatus were sent to explore No. 5 crosscut between Nos. 3 and 4 chutes where the body of Sam Kwamdahl was located. The body of Glen Vore was located in No. 3 chute near the first crosscut above the counter entry, and the bodies of John Fowler and Nick Uzelac were also found in No. 3 chute near the second crosscut above the counter entry. These latter two bodies were found at 5:15 a.m., Saturday, January 19. At 5:25 a.m. the night crew was relieved and it was decided that the day crew would only work in the areas which were ventilated and would not attempt to wear respiratory apparatus or go into the last two open crosscuts (fifth and sixth) between Nos. 3 and 4 chutes which had not been properly ventilated. The day crew was to empty the loose coal and debris from the Nos. 2 and 3 chutes onto the gangway in an attempt to find the fifth man. At 5:25 p.m. the body of Philip V. Doherty was found in the No. 3 chute near No. 5 crosscut. When the last body was brought to the surface recovery operations were completed. Though some of the men had been trained in mine rescue procedure and the use of instruments and apparatus, no men were available who had previous experience in actual recovery work; therefore, it was necessary for the Federal coal-mine inspector, in cooperation with the mine superintendent and Territorial inspector, to lead and direct the recovery operations.

#### INVESTIGATION OF CAUSE OF EXPLOSION

Investigation Committee. The underground investigation of the cause of the explosion was made Tuesday, January 22, 1957. A conference was held in the superintendent's office following the underground investigation. The physical features of the mine and the effects of the explosion were noted but a definite conclusion was not reached as to cause of the disaster. All possible sources of ignition were considered but no conclusion could be reached at least until the flame safety lamp found in the mine could be tested by the Bureau of Mines. A committee report was not made.

The names of the persons who participated in the underground investigation on January 22, 1957, were:

#### Evan Jones Coal Company

Claude G. Murphy

Superintendent

Local Union No. 7901 U.M.W. of A.

Jim Harris  
John (Rip) Harris  
Jim Ord

Shotfirer  
Safety Committee  
Fire boss - Financial  
Secretary

United States Bureau of Mines

Raymond L. Ellis

Federal Coal-Mine Inspector

Methane as a Factor in the Explosion. The mine is classed gassy by the Territorial Department of Mines and by the Bureau of Mines. Methane had been detected on numerous occasions, particularly when the room chutes approached into proximity of the fault. Evidence observed during recovery operations and during the investigation indicated that methane was the primary factor in the origin of this explosion. Methane was detected with a permissible flame safety lamp during the recovery operations and investigation. Soot streamers and discoloration of coal in the top counter being driven from No. 2 chute to the main haulage slope were indicative, more or less, of a slower rate of burning than at other locations in the Nos. 2, 3, and 4 chutes.

Flame. Evidence of heat and flame in the form of coke, soot, partly burned paper, and charred timbers were observed throughout the chutes and connecting crosscuts that were explored. Heavy applications of rock dust in the gangway and counter entry appeared to play a major part in stopping the flame.

Bodies of two of the victims, Sam Kwamdahl recovered in the fifth crosscut above the counter entry between Nos. 3 and 4 chutes and Philip Doherty recovered in No. 3 chute just below No. 5 crosscut, were burned severely. The bodies of the three victims who appeared to be farther down the pitch from the face area at the time of the explosion were burned but to a lesser degree. Explosives cartridges were scattered from the last crosscut to the mouth of No. 3 chute. Some of the explosives cartridges were charred slightly and others showed signs of heat; some of the explosives cartridges were broken and empty.

Samples of the mine dust collected at three locations during the investigation were analyzed in the Bureau of Mines laboratory, Pittsburgh, Pennsylvania. The results of the analyses are shown in Table 2. The incombustible content of Sample No. 1, collected in the fourth crosscut above the counter entry between Nos. 2 and 3 chutes (see map Appendix C), was 62.8 percent. The incombustible content of Sample No. 2, collected in crosscut No. 5 between Nos. 2 and 3 chutes (see map), was 44.1 percent and of Sample No. 3, collected 50 feet from the face of the top counter entry (see map), 32.2 percent. Each of the samples contained less than 65 percent incombustible and indicated that the rock dust applications in these particular areas were not sufficient

to render the coal dust nonexplosive, particularly since methane was present in the mine atmosphere. Statements of miners who worked on the second shift regarding conditions prior to the explosion and visual observation during recovery operations and the investigation revealed that an insufficient amount of rock dust had been applied.

Forces. The forces radiated from the area of the pillar being extracted near the fault between Nos. 4 and 5 chutes (see map, Appendix C). The forces appeared to have traveled through No. 6 crosscut between Nos. 3 and 4 chutes and towards the face of the top counter entry being driven to the haulage slope. At the mouth of this counter entry and in the No. 5 crosscut between Nos. 2 and 3 chutes, the forces were conflicting as explosives stored between the Nos. 2 and 3 chutes were plastered in cracks of the overhead lagging at the intersection of No. 3 chute and the crosscut; however, an unlighted flame safety lamp was found hanging from a nail on the high side of this crosscut five feet in by the corner of the intersection of the crosscut and No. 2 chute. An undisturbed lunch box was found in No. 5 crosscut between Nos. 3 and 4 chutes 19 feet from the corner of the intersection of No. 3 chute and the crosscut; however, a specially constructed detonator box located between the lunch box and the No. 3 chute was demolished and detonators were scattered in the crosscut from the location of the box to No. 4 chute. The body of Sam Kwamdahl appeared to have been blown from an area in the No. 5 crosscut between Nos. 2 and 3 chutes and across the top of No. 3 chute as the battery from his head lamp was found in No. 3 chute wedged between a timber and the rib about four feet down from the No. 5 crosscut. Both legs of this victim had multiple fractures and his trouser legs were torn off almost to the hips. All forces traveled down the Nos. 2 and 3 chutes. The direction of forces in the No. 4 chute could not be ascertained as this chute was completely blocked from the counter entry to the fourth crosscut between Nos. 3 and 4 chutes with timbers and roof material from the pillar cave. It is not known when the batteries (timbers set skin to skin) holding the pillar cave gave way (see map). The batteries could have been dislodged by the forces of the explosion; on the other hand, posts supporting the area from which the coal had been mined could have been dislodged by forces of the explosion permitting a cave which could have dislodged the batteries; further, blasting in the small coal stump which was left as a fender to hold the gob could have permitted the entire mined-out area to cave and move down the pitch dislodging the batteries. The forces were sufficiently violent to demolish wooden stoppings, brattice-cloth stoppings and a door; however, no timbers were dislodged in the Nos. 2 and 3 chutes. The maximum forces appeared to be along the gangway at the entrance to the chutes. The metal cover was blown off the locomotive and was badly twisted and deformed. The locomotive appeared to have been moved in an outward direction for a distance of about 10 feet. A mine car which had been on the sidetrack just outby the locomotive was turned on its side by the forces and the mine car which was attached to the haulage rope and standing on the curve at the mouth of the gangway was also turned on its side and moved up the slope slightly. The three-piece timber sets and

lagging along the haulage slope from the gangway to within 400 feet of the surface were dislodged by the forces traveling outby. The wooden stoppings in the crosscuts between the haulage slope (return) and the intake slopes were blown towards the intake slopes. There was very little evidence of forces along the intake slope other than bits of paper, brattice-cloth, and lumber being turned in an outward direction. A mine car which had been abandoned and left sitting off the track in the second crosscut inby the portal was turned on its side and moved toward the intake slope and the air ducts to the main fan were destroyed by the forces. The forces of the shock wave could be traced without difficulty from the last open crosscuts between the Nos. 2, 3, and 4 chutes to the surface.

Two separate and distinct reports of the explosion were heard by numerous persons on the surface causing them to believe that there had been two explosions. Information obtained from Mrs. Claude Murphy, wife of the mine superintendent who was in her home approximately 1,000 yards from the Evan Jones Slope mine, indicated that she saw smoke and dust come out of the fan shaft followed instantly by smoke and dust from the slope portal.

Evidence of Activities. The hoistman, who had returned to the surface shortly before the explosion occurred, had observed coal sliding down the chute at the mouth of No. 2 chute indicating that the two men working the top counter were operating the slusher. The operating controls on the slusher, used to scrape the coal from the top counter entry, were found in an "on" position, indicating that at least one of the two men who worked the place, Sam Kwamdahl or Philip Doherty, was operating the slusher. Also, the compressed-air connection, common to the slusher and the drill in the face of the top counter, was connected for operation of the slusher. Four holes had been drilled in the face, but it was apparent that drilling had been interrupted in favor of slushing. It is believed that these two men were in the fifth crosscut between the Nos. 2 and 3 chutes when the explosion occurred. Two victims, John Fowler and Nick Uzelac who worked the pillar stump, appeared to have been in No. 3 chute at the fourth crosscut, the blasting station, and could have been blasting when the explosion occurred. Information obtained from the men who worked the second shift indicated that the blasting unit used to blast in the pillar place was kept at this point and that Fowler always put his parka on when blasting. Fowler was the only victim wearing a parka when the explosion occurred. Statements made during the recovery operations regarding the parka and statements made on January 29, 1957, were conflicting as it was stated on January 29, that Fowler would sometimes wear his parka when working at the face. The fifth victim, Glen Vore, appeared to have been rock dusting by hand as indicated by the position of his body and a large bucket containing rock dust.

Assuming that the pillar stump between Nos. 4 and 5 chutes (the most likely point of origin) was being blasted when the explosion occurred, it is unlikely that tests for gas were made before blasting. Only one flame safety lamp was available in the mine, and it was found hanging in the top crosscut off No. 2 chute. If tests for gas had been made immediately before blasting, one would expect the lamp to be in the vicinity of the blasting station.

Probable Point of Origin. From the information obtained during recovery operations, underground investigation, conferences with the mine officials, and miners who worked the second shift, the probable point of origin

was in the area of the pillar being extracted near the fault between Nos. 4 and 5 chutes.

Summary of Evidence. Facts obtained during recovery operations, the investigation that followed, and information given by the mine officials, miners who worked the second shift, and the hoistman who was the last person to leave the mine provided sufficient evidence as to the cause and origin of the explosion. The evidence from which the conclusions are drawn is summarized as follows:

1. Generally blasting was done with permissible-type explosives using regular delay detonators, which produce a quick succession of blasts. Either instantaneous or regular delay blasting could ignite methane if any one of the shots were underburdened; regular delay blasting could raise coal dust into the atmosphere and ignite it if any shot, except the first, were underburdened.

2. The obvious lack of positive ventilation to all sections of the workings, particularly along the gob area, the fault line, and the "blind" crosscut above the pillar being mined was conducive to accumulations of explosive mixtures of methane and air.

3. The drop in barometric pressure of 0.24 inch in eight hours may have been a factor in the liberation of methane from the pillared area along the fault. However, the fact that the fan had not been operated continuously was a definite factor.

4. Forces emanated from the area of the pillar being mined between the Nos. 4 and 5 chutes.

5. The two men who worked the pillar place appeared to have been in a position to blast at the time of the explosion.

6. It is unlikely that a test for gas was made before blasting, in that the only flame safety lamp available underground was hanging near the top of No. 2 chute.

7. The No. 2 chute and crosscuts between the Nos. 2 and 3 chutes were dry and were not rock-dusted.

8. Fire boss records show that rock dust was last applied on January 16, 1957, and on that day and the following day the fire boss reported that No. 2 chute and the crosscuts between Nos. 2 and 3 chutes were dusty (coal).

9. Rock dust applications in the face area were not sufficient to prevent the propagation of an explosion.

10. Only air-driven equipment was used in the face areas, and there was no evidence of electricity contributing to the ignition.

11. Smoking underground was prohibited and there was no evidence to indicate that this rule was broken.

12. A source of ignition was not present in any working place except the pillar between Nos. 4 and 5 chutes.

13. The flame safety lamp was in permissible condition.

Cause of the Explosion. It is the opinion of the Federal investigator that the explosion was initiated by an underburdened shot in the presence of an explosive mixture of methane and air and/or coal dust. The explosion was propagated by methane and coal dust.

Other probable sources of ignition, such as electricity, a flame safety lamp, and smoking, were considered but were ruled out.

#### RECOMMENDATIONS

The following recommendations are made for preventing similar disasters.

1. The use of regular delay detonators should be discontinued. This is not intended to preclude the use of short delay detonators.

2. Tests for gas should be made immediately before each shot or group of multiple shots and after blasting is completed.

3. Boreholes should be charged only by certified shot-firers or under the direct supervision of such shot-firers.

4. All boreholes, particularly in pillar stumps, should be checked by the shot-firer before the boreholes are charged to make certain that each charge has a firm unbroken burden of at least 18 inches in all directions.

5. A system of bleeder entries or openings to assure a positive movement of air through and/or around caved areas should be provided. The movement of air should be of sufficient volume to prevent dangerous accumulations of gas in such areas and to minimize the effect of variations of atmospheric pressure. Such bleeder system should be included in all pillaring plans.

6. The main fan should be operated continuously.

7. Substantially constructed and well-maintained line brattice should be used to conduct the air currents to and across the working faces in sufficient volume and velocity to dilute and sweep away all flammable and harmful gases.

8. The preshift examinations of a mine should conform with the requirements of Section 209(d)(7) of the Federal Coal Mine Safety Act or Article V, Section 10e, of the Federal Mine Safety Code. The superintendent should read and countersign the fire boss record book daily.

9. Coal dust and loose coal should not be permitted to accumulate in dangerous quantities in any active underground workings. The floor along the flat sheets and chute boxes, from rib to rib, should be kept free of loose coal and coal dust.

10. Loose coal and coal dust should be removed before rock dust is applied.

11. All underground mines, except those mines or areas of mines in which the dust is too wet or too high in incombustible content to propagate an explosion, should be rock-dusted to within 40 feet of all faces and, if open crosscuts near such faces are less than 40 feet therefrom, such crosscuts should be rock-dusted.

12. Rock dust should be distributed on the roof, ribs, and floor and maintained in such quantity that the incombustible content of the combined rock dust, coal dust, and other dust will not be less than 65 percent, plus 1 percent for each 0.1 percent of methane present in the ventilating current.

13. Prior approval for the use of auxiliary blower fans should be obtained from the Joint Industry Safety Committee before such fans are used underground.

14. All employees and officials should comply with Territorial laws, Federal laws, and the Federal Mine Safety Code covering mining conditions and practices.

#### ACKNOWLEDGMENT

The writer acknowledges gratefully the courtesies extended and the help given by the officials and employees of the Evan Jones Coal Company, members of the United Mine Workers of America and representatives of the Territorial Department of Mines, who gave freely all information requested in connection with this investigation.

Respectfully submitted,

/s/ Raymond L. Ellis

Raymond L. Ellis  
Coal-Mine Inspector

Approved:

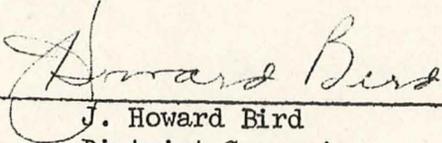
  
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J. Howard Bird  
District Supervisor

TABLE 1 ANALYSES OF AIR SAMPLES COLLECTED January 22, 1957

MINE Slope mine COMPANY Evan Jones Coal Company COLLECTED BY R. L. Ellis

BOTTLE NO.	LABORATORY NO.	LOCATION IN MINE	Carbon Dioxide CO <sub>2</sub>	Oxygen O <sub>2</sub>	Carbon Monoxide CO	Methane CH <sub>4</sub>	Nitrogen N <sub>2</sub>	Cubic Ft. Air Per Minute	Cubic Ft. Methane In 24 hrs.
H-7603	7023	Mine air, following mine explosion, No. 3 chute, between 5th and 6th crosscuts above counter.	1.1	14.1	0.0	13.0	71.8	Still	

TABLE 2

## ANALYSES OF MINE DUST SAMPLES COLLECTED AFTER EXPLOSION

Sample No.	Samples of Dust from	Location in Mine	As Rec'd Percent Incomb.	Alcohol Coke Test Coked Particles Present (Amount)
1	Band	Fourth crosscut above the counter between Nos. 2 and 3 chutes (see map).	62.8	Small
2	Band	Crosscut No. 5. Last crosscut between Nos. 2 and 3 chutes (see map).	44.1	Very large
3	Band	Fifty feet from the face of the top east counter entry (see map).	32.2	None

APPENDIX A  
 VICTIMS OF EXPLOSION, EVAN JONES SLOPE MINE  
 EVAN JONES COAL COMPANY

January 18, 1957						
<u>Name</u>	<u>Age</u>	<u>Marital Status</u>	<u>No. Dependents</u>	<u>Occupation when killed</u>	<u>Experience this job</u>	<u>Experience in mines</u>
Doherty, Philip V.	38	Married	3 (expectant mother)	Miner	7-1/2 mos.	15 yrs.
Fowler, John E.	35	Single	0	Miner	7-1/2 mos.	15 yrs.
Kwamdahl, Sam	56	Single	0	Miner	7-1/2 mos.	40 yrs.
Uzelac, Nick	41	Married	1	Miner	7-1/2 mos.	21 yrs.
Vore, Glen R.	41	Divorced	2 (?)	Miner	7-1/2 mos.	25 yrs.

APPENDIX B

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES

Health and Safety Activity

Branch of  
Electrical-Mechanical Testing

4800 Forbes Street  
Pittsburgh 13, Pennsylvania

February 1, 1957

Memorandum

To: James Westfield, Assistant Director--Health and Safety

From: R. S. James, Acting Chief, Branch of Electrical-Mechanical Testing

Subject: Report of safety tests on flame lamp from Anchorage, Alaska

The following report covers examination and check tests on a flame safety lamp suspected as a source of ignition in an explosion at the Slope Mine of the Evan Jones Coal Company, Jonesville, Alaska. The lamp was submitted, as found hanging from a nail in a face area, by Mr. R. L. Ellis, Subdistrict Supervisor, Anchorage, Alaska. A copy of this report is being sent directly to Mr. Ellis.

External Examination

1. Identification--Wolf aluminum Model No. 100 lamp. Word "Slope" scratched on dome top surface and initial "GM" indented therein.
2. Parts -- Lamp is complete with all genuine Wolf parts: Wolf lined glass chimney; steel gauzes; asbestos washers; magnetic lock in good order; and aluminum fount. The approval plate was missing but this is a common complaint on Wolf lamps. Thirty-eight of one hundred and eighty ventilating louvres in the bonnet were jammed shut.
3. External damage--The dome top was badly bent at one point; bonnet depressed at one point 3/16 inch, at other points slightly. Fount slightly bent at base. Damage not excessive or unusual, no broken parts.
4. General--The lamp was assembled properly and all safety features appeared intact.

### Check Tests in Gas

The lamp was mounted in Gallery 3 and surrounded by explosive mixtures of natural gas and air. The mixture range was 6.2%, 7.7%, 8.5%, 9.5%, and 10%. A gallery mixing fan forced the mixtures into the internal volume of the lamp. The igniter, which was operated externally, initiated an explosion within the lamp. The lamp was not preheated but became quite warm as testing progressed.

Fourteen tests were made, two of which failed to ignite internally. Seven tests were made in still mixtures and five with the mixing fan operating to provide turbulence. Flame did not propagate from the lamp during any test.

### Internal Examination

1. Fount--No scratches, gouges, or imperfections on the top surface; threads perfect; no gasket on filler cap. General condition excellent.
2. Air admission ring--One asbestos gasket in perfect condition; no damaged gauzes; base of ring flat, no imperfections. General condition excellent.
3. Bonnet assembly--Magnetic lock good; no loose parts.
4. Expansion ring--Perfect condition.
5. Glass Chimney--Slight spall on top and bottom edge no effect on safety; dimensional tolerances within limits.
6. Gauze gasket--Good condition.
7. Gauzes--Perfect condition; no excessive heating.

### Conclusion

The lamp parts and assembly were in excellent condition. The check tests in gas produced no evidence of fault. Therefore, the Wolf flame safety lamp in question is judged to be safe for use in explosive mixtures of methane and air.

The complete lamp was shipped to your office, parcel post, special delivery, February 1, 1957.

At the request of Mr. W. Dan Walker, the lamp was examined as carefully as possible before being disassembled in any way. Then the tests in gas in one of our testing galleries were made, and finally the lamp was disassembled for the complete inspection as reported herein.

/s/ R. S. James