United States
Department of Labor
Mine Safety and Health Administration
Office of the Administrator
Coal Mine Safety and Health

Report of Investigation
Underground Coal Mine Explosion
McClure No. 1 Mine - I.D. No. 44-04251
Clinchfield Coal Company
McClure, Dickenson County, Virginia
June 21, 1983

by

Robert A. Elam
Mining Engineer

Gene B. Fuller
Mine Safety and Health Specialist

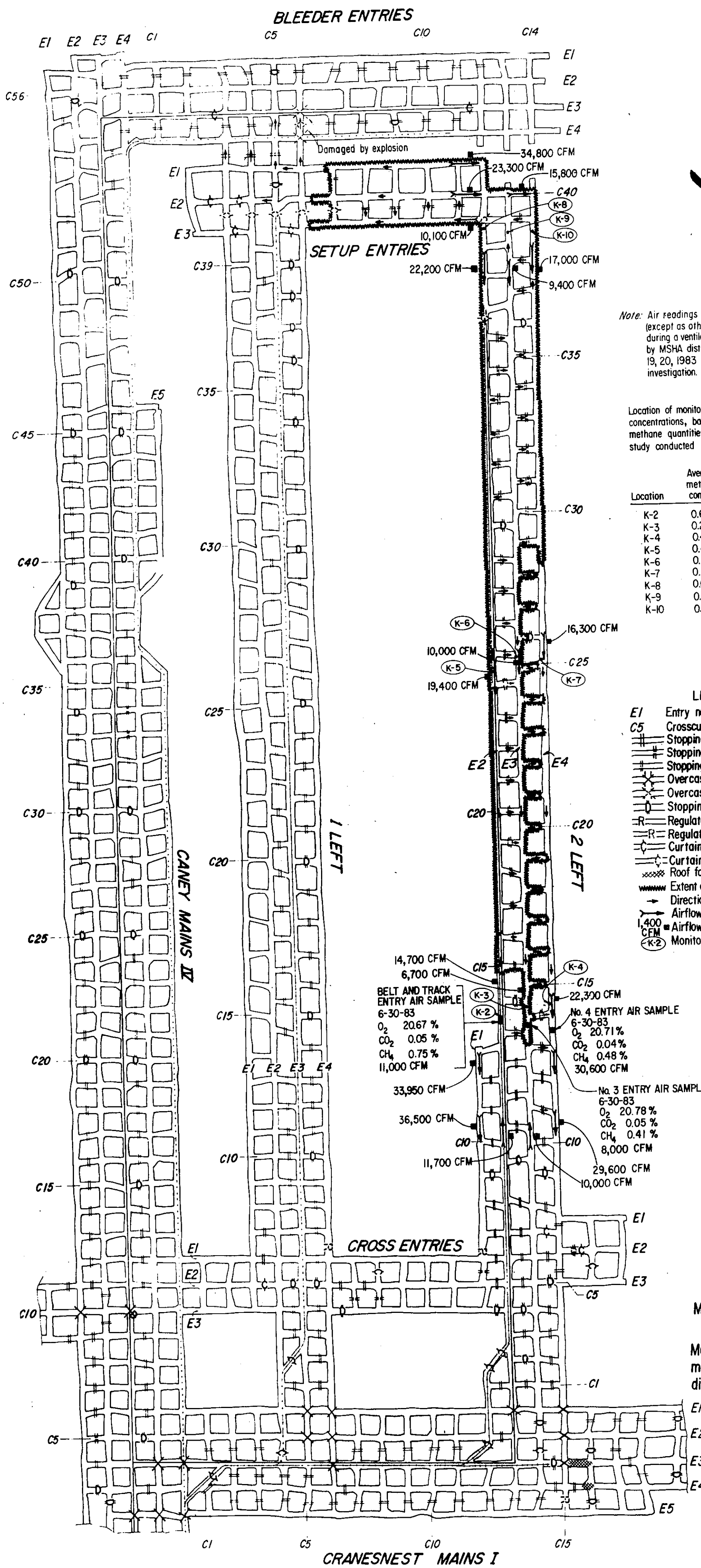
Harry J. Carter
Mine Safety and Health Specialist

Dale R. Cavanaugh
Mechanical Engineer

George M. Fesak
Electrical Engineer

Robert J. Painter
Mine Safety and Health Specialist

Originating Office
Mine Safety and Health Administration
4015 Wilson Boulevard
Arlington, Virginia 22203
Joseph A. Lamonica - Administrator



Note: Air readings taken 7-15-83 (except as otherwise noted.) during a ventilation survey conducted by MSHA district personnel July 15, 18, 19, 20, 1983 in conjunction with the investigation.

Location of monitoring stations, average methane concentrations, balanced air quantities, average methane quantities from pressure-air quantity study conducted 7-11 to 16, 1983

Location	Average methane conc. %	Balanced air quantity (cfm)	Average methane quantity (cfm)
K-2	0.61	10,000	61
K-3	0.24	6,000	14
K-4	0.47	28,000	132
K-5	0.48	18,000	86
K-6	0.27	6,000	16
K-7	0.40	20,000	80
K-8	0.08	25,000	20
K-9	0.13	9,000	12
K-10	0.22	10,000	22

LEGEND

- E1 Entry number
- C5 Crosscut number
- Stopping intact
- Stopping partially out
- Stopping out
- Overcast
- Overcast under construction
- Stopping with mandoor
- Regulator
- Regulator out
- Curtain intact
- Curtain out
- Roof fall
- Extent of flame
- Direction of force
- Airflow direction
- 1,400 CFM Airflow readings
- K-2 Monitoring stations

APPENDIX S

McCLURE NO. 1 MINE, ID 44-04251

CLINCHFIELD COAL COMPANY

Map showing direction and extent of major forces, extent of flame, airflow directions and air quantities after explosion.

0 200 400

Scale, ft

Abstract of Investigation

U.S. Department of Labor
Mine Safety and Health Administration

Authority—This report is based on an investigation made pursuant to the Federal Mine Safety and Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164.

Section A—Identification Data

1. Title of investigation: Underground Coal Mine Explosion	2. Date MSHA investigation started: June 24, 1983
3. Report release date:	4. Mine: McClure No. 1
5. Mine ID number: 44-04251	6. Company: Clinchfield Coal Company
7. Town, County, State: McClure, Dickenson County, Virginia	8. Author(s): R. Elam, G. Fuller, H. Carter, G. Fesak D. Cavanaugh, and R. Painter

Section B—Mine Information

9. Daily production: 2800 tons	10. Surface employment: 22
11. Underground employment: 319	12. Name of coalbed: Jawbone
13. Thickness of coalbed: 84" Average	

Section C—Last Quarter Injury Frequency Rate (HSAC) for:

14. Industry: 10.27	15. This operation: 22.94
16. Training program approved: January 15, 1979	17. Mine Profile Rating: N/A

Section D—Originating Office

18. Mine Safety and Health Administration Coal Mine Health and Safety District No.: Office of the Administrator	Address: 4015 Wilson Boulevard Arlington, Virginia 22203

Section E—Abstract

At approximately 10:15 p.m. EDT, June 21, 1983, an explosion occurred in the 2 Left entries of the McClure No. 1 Mine of Clinchfield Coal Company. Ten miners were present in the 2 Left entries at the time of the explosion, eight in the face area and two in the track entry. Seven miners died as a result of the explosion. Three of the miners at the faces survived the explosion and were rescued. The names of the victims, their ages, job classifications, and mining experience are listed in Appendix A.

About nine hours before the explosion, the No. 40 crosscut of 2 Left was cut through into the longwall setup entries. The failure to install ventilation controls to separate the air split ventilating the setup entries from the air split ventilating the 2 Left entries materially affected the movement of air in the Nos. 2 and 3 entries of 2 Left. The volume and velocity of air became inadequate to dilute, render harmless and to carry away flammable and explosive gases which were liberated in the area. The failure to maintain the airflow in its proper volume and direction in the setup entries, the 2 Left face area and outby in the Nos. 2 and 3 entries of 2 Left allowed an accumulation of an explosive methane-air mixture in the Nos. 2 and 3 entries of 2 Left. These changes in ventilation remained uncorrected for about 9 hours. The explosive methane-air mixture was ignited by electrical arcing created by one of six possible sources identified in this report.

Section F—Mine Organization

Company officials:	Name	Address
19. President:	G. S. Matthis	Dante, Virginia 24237
20. Superintendent:	R. K. Light, Jr.	Dante, Virginia 24237
21. Safety Director:	M. L. West	Dante, Virginia 24237
22. Principle officer—H&S:	R. K. Light, Jr.	Dante, Virginia 24237
23. Labor Organization:	United Mine Workers of America	900 Fifteenth Street, N.W. Washington, D.C. 20005
24. Chairman—H&S Committee:	S. J. Clay	Rt. 1, Box 248-D Clintwood, Virginia 24228

MSHA Form 2000-57, Apr 82 (revised)

TABLE OF CONTENTS

PART IV

FINDINGS OF FACT

PART V

CONCLUSION

APPENDICES

Appendix A - Victim Data Sheets

Appendix B - Persons participating in the underground recovery operations.

Appendix C - List of persons who participated in the investigation.

Appendix D - List of persons providing sworn statements during the investigation.

Appendix E-1 - Discussion and evaluation of potential electrical ignition sources.

Appendix E-2 - Single-line diagram of underground high-voltage circuit supplying the 2 Left section.

Appendix E-3 - Single-line diagram of 2 Left section circuits and equipment at the time of the explosion.

Appendix E-4 - Summary and Findings excerpt from the Report of Analysis of electrical equipment by the Approval and Certification Center.

Appendix E-5 - Report on Temperature Testing on Heat Lamps by the Approval and Certification Center.

Appendix F - Report of tests on Flame Safety Lamp by Technical Support.

Appendix G - Report of Velocity Tests on Personnel Carrier by Technical Support.

Appendix H - Report of testing of 13 SCSRs by the Pittsburgh Research Center.

Appendix I - Analysis of Mine Dust Samples collected by the investigation team.

Appendix J - Report of proximate analysis tests on coal and coke samples.

Appendix K - Summary of Mine Air Samples collected during the investigation.

Appendix L - Investigative Report No. P224-V130 Mine Ventilation Pressure-Air Quantity Distribution Study.

Appendix M - Mine Fan Pressuring Recording Chart.

Appendix N - Copies of citations and orders issued relative to the investigation.

Appendix O - Selected photographs taken by the investigation team.

Appendix P - Mine Map of entire mine.

Appendix Q - Mine Map (affected areas) - Locations of mine dust samples with analysis data, locations of spot coke samples, and locations of coal channel samples collected during the investigation.

Appendix R - Mine Map (affected area) - Ventilation prior to the explosion, air flow directions, air quantities from inspector's notes, testimony and underground observations during the investigation.

Appendix S - Mine Map (affected areas) - Direction and extent of forces, extent of flame, air flow directions, air quantities, and information gathered during the recovery operations and the investigation.

Appendix T - Mine Map (affected area) - Major information gathered by the investigation team.

Appendix U - Mine Map (Detail A) - Detailed information of 2 Left section between crosscuts 33 and 40 and the longwall setup entries gathered by the investigation team.

Appendix V - Mine Map (Detail B) - Detailed information of 2 Left section between crosscuts 13 and 19 as gathered by the investigation team.

PART I

GENERAL INFORMATION

The McClure No. 1 Mine is located on Caney Creek about 2 miles northwest of McClure, Dickenson County, Virginia, off State Route 63. The mine is operated by Clinchfield Coal Company, a division of the Pittston Company. The corporate officers for The Pittston Company and the Clinchfield Coal Company at the time of the explosion were:

<u>The Pittston Company</u>

N. T. Camicia	Chairman of the Board
H. J. Hartong, Jr.	President - Chief Operating Officer
J. M. Davis	Vice President and Treasurer

<u>Pittston Coal Group</u>

G. S. Matthis	President
G. C. Clark	Vice President of Engineering
J. W. Crawford	Vice President of Health and Safety
W. F. LePore	Vice President of Finance
B. M. Swarthout	Vice President of Materials Management

<u>Clinchfield Coal Company</u>

C. M. Bailes	Group Vice President
H. L. Kiser	Vice President of Operations
M. L. West	Manager of Safety Division

The McClure No. 1 Mine management officials at the time of the explosion were:

W. B. Couch	Mine Manager
R. K. Light, Jr.	Mine Superintendent
J. P. Talbert	Assistant Mine Superintendent
J. W. Kiser	General Mine Foreman
H. W. Fields	Mine Safety Inspector
H. E. Young, Jr.	Maintenance Superintendent

The mine, at an elevation of approximately 1,500 feet above sea level, was opened into the Jawbone Coalbed by two shafts and one slope. Slope and shaft sinking contractors, developing the shaft bottom, began limited coal production in early 1979. At the completion of this development work Clinchfield Coal Company took over production operations.

At the time of the explosion, the mine employed 341 miners, 319 working underground, on three coal producing shifts per day, 5 days a week. Production averaged 2,800 tons of coal daily.

Mining Methods

A block system of mining was employed. Multiple entries were developed with the entries and crosscuts approximately 20 feet wide. Parallel main entries were driven from the shaft and slope bottoms, approximately 7,200 feet to the northwest, 4,800 feet to the southwest, and 2,400 feet to the southeast. Mine development was done with continuous mining equipment. Entries in sets of three and four were being driven from the mains to establish blocks for future longwall mining. The entries are numbered for identification from left to right.

The two shafts were approximately 450 feet in depth and the slope was approximately 1,600 feet in length and declined approximately 30 feet in elevation for every 100 feet in length (16° pitch). The shafts and slope were interconnected by four to six entry developments. Eight active sections were being developed in northwest and southwest directions. Normally, six sections produced coal and two sections were idled for maintenance during each shift. The approximate distance from the intake air shaft, number of entries, and direction of development for the active sections were as follows:

Section	Approximate Distance (feet)	No. of Entries	Direction
Cranesnest Mains I	4,800	4-5	Northwest
Cranesnest Mains II	8,400	5	Northwest
Cranesnest Mains III	4,800	4	Northwest
Cranesnest Mains IV	4,200	4	Northwest
Caney Mains I	6,000	4-5	Southwest
Caney Mains IV Bleeder Entries	7,200	4-5	Northwest
2 Left off Cranesnest Mains I	7,000	3-4	Southwest
3 Left off Cranesnest Mains I	4,200	3	Southwest

In addition to the above mining, the Caney Mains II and III, consisting of 5 entries each, had been developed in a southeast direction for a distance of approximately 5,000 feet from the intake air shaft.

The 1 Left set of entries was developed approximately 7,000 feet in a southwest direction and consisted of 4 entries driven on 80-foot centers. Generally, the crosscuts were staggered and driven on approximately 80- and 100-foot centers. The conveyor belt and track were located in the No. 3 entry. The conveyor belt was in the process of being removed. However, the track was left intact to facilitate the installation of a longwall mining system which would utilize the 1 Left entries for the tailgate entries.

The 3 longwall setup entries were developed approximately 550 feet in a northwest direction and connected the top end of 1 Left with 2 Left forming the face of a longwall panel. These entries were also connected into the Caney Mains IV bleeder entries at the top of the 1 Left entries.

The 2 Left entries off Cranesnest Mains 1 entries, which would later be used as the headgate entries for the longwall, were started on about November 8, 1982 and consisted of 4 entries driven on 80-foot centers with crosscuts predominantly staggered and driven on 100-foot centers. After being driven to a depth of about 200 feet, the No. 1 entry was stopped and a 45 degree connecting crosscut was driven into the No. 2 entry. The track was installed in this portion of the No. 1 entry and through the 45 degree crosscut into the No. 2 entry where it was then installed parallel to the conveyor belt up to the section loading point. About 325 feet inby the point where the No. 1 entry was stopped it was picked up and driven for a distance of about 650 feet where it was stopped again.

Mine Inspections

The last Mine Safety and Health Administration (MSHA) inspection of the entire McClure No. 1 Mine was conducted from January 3, 1983 through March 31, 1983. During this inspection 56 citations and 1 notice to provide a safeguard were issued.

An MSHA safety and health inspection was in progress on the day of the explosion. During the day shift of June 21, 1983, a Federal Inspector was on the Caney Mains IV bleeder entries working section performing inspection activities. A total of 47 citations were issued during this inspection which was begun on April 4, 1983 and terminated on June 21, 1983.

A resident inspector was first assigned to the McClure No. 1 Mine on October 1, 1981, and the current resident inspector was assigned in October 1982. Because of methane liberation, the McClure No. 1 Mine was also placed on a 5-day spot inspection schedule on October 3, 1980, pursuant to Section 103(i) of the Federal Mine Safety and Health Act of 1977 (Mine Act). Air samples collected by MSHA showed that the mine was liberating 3.2 million and 2.6 million cubic feet of methane (CH_4) every 24 hours in May and June of 1983, respectively.

Section 103(i) of the Mine Act directs MSHA to conduct a minimum number of spot inspections at mines which liberate certain quantities of methane or other explosive gases. Mines liberating more than 1 million cubic feet of methane during a 24-hour period (cfd) are spot inspected a minimum of once each 5 working days. Mines liberating more than 500,000 cfd are spot inspected a minimum of once each 10 working days and mines liberating more than 200,000 cfd are spot inspected a minimum of once each 15 working days. Nationally as of December 31, 1983, 179 coal mines receive 103(i) spot inspections due to methane liberation. Of the 179 mines, 77 are on a 5-day 103(i) spot inspection schedule, 31 are on a 10-day spot inspection schedule and 71 are on a 15-day 103(i) spot inspection schedule. The methane liberation in these mines varies from slightly more than 200,000 cfd to more than 22 million cfd.

Roof Support

Generally, the immediate roof consisted of 2-3 feet of sandy shale. The main roof consisted of sandstone. The roof was supported throughout most of the mine with 48-inch to 72-inch resin grouted rebar installed on 4-foot centers.

In addition to roof bolts a single row of posts on 4-foot spacings was required as additional roof support in entries containing both the conveyor belt and track.

Ventilation and Examinations

There were three openings into the mine: one intake air shaft, one 2-compartment intake slope and a return air shaft. Mine ventilation was induced by one fan of a dual exhaust fan installation located on the surface at the top of the return air shaft. The installation included automatic closing and explosion relief doors and a monitoring system that would start the idle fan automatically upon stoppage of the operating fan. Each of the fans was a Jeffery Model 8HUA-117 Aerodyne Fan, driven at 889 rpm by a 1,000-horsepower electric motor. Pressure and air quantity measurements made at the fan indicated the fan was operating in the 5B-5S blade position. During an inspection made prior to the explosion, an air measurement made at the fan indicated 690,322 cubic feet per minute (cfm) of air was exhausted from the mine at a pressure of 7.4 inches of water. The methane liberation was 2.2 million cubic feet of methane during a 24-hour period (cfd) during an MSHA ventilation survey conducted in July, 1983 when the mine was not producing coal. During the inspection in May and June of 1983, the methane liberation was 3.2 and 2.6 million cfd, respectively.

Permanent stoppings and overcasts were used to provide the required separation between the various aircourses. The stoppings were constructed of dry-stacked concrete blocks and coated with a sealant on the high-pressure side. Overcasts were constructed using a combination of concrete blocks, metal sheeting and steel beams. A sealant was also used to coat the highpressure sides of the overcasts.

The 2 Left section was being developed with three entries at the time of the explosion. The No. 1 entry was discontinued at the No. 13 crosscut from Cranesnest Mains I, and was ventilated with a small split of air dumped into the return; the No. 2 entry contained the track and belt; the No. 3 entry was the intake aircourse; and the No. 4 entry, was the return aircourse.

Prior to connecting with the setup entries, the 2 Left entries and working section were ventilated as follows: The No. 2 entry was utilized as a track and belt entry and a curtain was installed across the entry at the belt tailpiece to direct the air in the entry to the return aircourse through 16-inch by 32-inch oval-shaped tubing. The No. 3 entry was an intake aircourse and a curtain was installed across the entry just outby the last open crosscut to direct the air into No. 2 entry inby the belt feeder. Line curtains were used to direct the air to the faces of the Nos. 2 and 3 entries and an exhausting auxiliary fan with tubing was used to ventilate the face of the No. 4 entry.

The 1 Left entries and the longwall setup entries were being ventilated by a single split of air. The air was coursed up the Nos. 1 and 2 entries of 1 Left then into the Nos. 1 and 2 longwall setup entries off 1 Left. After ventilating the faces of the setup entries the air was coursed out the No. 3 setup entry to the No. 4 entry of 1 Left. The No. 4 entry of 1 Left was utilized as a return aircourse. The No. 3 entry of 1 Left was utilized as a track and belt entry and although the conveyor belt was not being used and had been partially removed it was still ventilated with a separate current of air. The air was coursed up this entry, then directed to the 1 Left intake entries, and into the Nos. 1 and 2 setup entries.

According to statements of mine officials and miners, the 2 Left entries and the longwall setup entries were first connected at the No. 39 crosscut of 2 Left on the day shift of Tuesday, June 14, 1983, and the two sets of entries were again connected at the No. 40 crosscut on June 21, 1983.

Preshift, onshift, and weekly examinations were made by certified persons. The results of these examinations were recorded in mine record books on the surface.

The Ventilation System and Methane and Dust Control Plan in effect for the mine at the time of the explosion was approved on February 29, 1980. This plan required a minimum of 3,000 cfm of air to be maintained in all working places of the working section except that 5,000 cfm was required where coal was being mined to dilute the methane liberated during mining. In addition, a mean entry air velocity of 60 feet per minute was required where coal was being cut, drilled, mined, or loaded. Line brattice or other approved device(s) were required to be maintained to within 10 feet of the area of deepest penetration to which any portion of the working faces were advanced.

Combustible Material/Rock Dusting

During the investigation, two standard channel samples of coal were taken by MSHA. The first sample was taken from the right rib of the No. 4 entry in the No. 39 crosscut of the 2 Left section at survey station No. 2505, (Sample No. ISB 259). The second sample was taken from the corner of the longwall face in the No. 3 longwall setup entry just to the left of the No. 2 entry of the 2 Left section 25 feet to the left of survey station No. 3503, (Sample No. ISB 260). The locations of the samples are shown on the map in Appendix Q. These samples were analyzed by the MSHA Industrial Safety Division Laboratory, Bruceton Safety Technology Center, Pittsburgh, Pennsylvania. The proximate analyses of these two channel samples were as follows:

	ISB259	ISB260
% Moisture	0.25	0.25
% Volatile Matter	24.80	21.01
% Fixed Carbon	34.52	45.14
% Ash	40.38	33.60

Numerous tests by the Bureau of Mines have established that coal dust having a volatile ratio of 0.12 and higher is explosive. The average volatile ratio of the coal in the face area of 2 Left section at the time of the explosion from analysis of the two samples was 0.37. The volatile ratio (VR) is the ratio of volatile matter (v) to fixed carbon (fc) plus volatile matter:

$$VR = \frac{v}{fc + v}$$

The application of rock dust was the primary means used for inerting coal dust. Rock dust was applied to the underground areas of the mine, and in all working places to within 40 feet of the faces, including all open crosscuts less than 40 feet from the working faces. Rock dust was applied by hand in the immediate face areas. Rock dust machines were used to apply rock dust in the outby areas and to reapply rock dust on the working sections. Trickle dusters were available for use in the immediate section return aircourses.

Dust created by mining in the face areas was controlled by water sprays on the equipment, and by ventilation directed to the working faces by either line curtains or by auxiliary fans.

Water lines were extended to the working section loading points and each section was equipped with sufficient hose to reach each working face. The hose was available for use to abate dust in the working places and, if needed, to reduce dispersibility and to minimize explosion hazards in the faces, particularly in the areas less than 40 feet from the faces.

Dust generated by roof bolting machines was controlled by permissible dust collectors. Dust at conveyor belt transfer points was controlled by water, as needed.

The operator had an established program to prevent the accumulation of combustible materials, such as loose coal, coal dust, float coal dust, and other combustible materials in active workings or on electric equipment. However, during the investigation, accumulations of loose coal and coal dust were found at several locations along conveyor belts and in several other isolated areas of the mine.

Electricity

Three-phase power was purchased from the Appalachian Power Company at 69,000 volts, reduced to 12,470 volts, and transmitted to surface substations near the mine slope entrance and the mine elevator shaft. The substation located near the mine slope entrance contained a bank of three 750 kVA transformers and supplied 12,470-volt 3-phase power to one underground circuit. The substation located near the mine elevator shaft contained two banks of three 750 kVA transformers and supplied 12,470-volt, 3-phase power to two independent underground circuits.

Each transformer bank was connected delta-wye. Each secondary neutral was properly grounded through a 25-ampere current-limiting resistor. Each of the three underground high-voltage circuits contained a grounding circuit, originating at the grounded side of the grounding resistor, to ground the metallic frames and enclosures of all electric equipment receiving power from the circuit.

Each underground high-voltage circuit was protected by an individual 1,200-ampere oil circuit breaker located in the appropriate surface substation. Each circuit breaker was equipped with a ground-check circuit and relays designed to provide overload, short-circuit, grounded-phase, and undervoltage protection for the appropriate underground circuit.

Three sets of single-pole knife-blade switches were provided in the surface substations to allow disconnecting the phase conductors of each underground high-voltage circuit.

The underground high-voltage circuit that originated in the substation near the mine slope entrance was a spare circuit and was not in use when the explosion occurred. One of the underground high-voltage circuits that originated in the surface substation near the mine elevator shaft supplied power to 12 portable power centers which reduced the 12,470-volt, 3-phase power to 480-volt, 3-phase power for utilization by 11 conveyor belt drive units and 1 battery charging station, and to 5 section power centers which reduced the 12,470-volt, 3-phase power to 480-volt and 600-volt, 3-phase power for utilization by the electric equipment on the 3 Left, Cranesnest Mains I, Cranesnest Mains II, Cranesnest Mains III and Cranesnest Mains IV working sections. Since these two high-voltage circuits were not involved in the explosion, they will not be described in detail in this report.

The other underground high-voltage circuit that originated in the surface substation near the mine elevator shaft supplied power to nine 300 kVA portable power centers which reduced the 12,470-volt, 3-phase power to 480-volt, 3-phase power for utilization by 7 conveyor belt drive units and 2 battery charging stations and to three 950 kVA section power centers which reduced the 12,470-volt, 3-phase power to 480-volt and 600-volt, 3-phase power for the operation of the electric equipment on the Caney Mains I, Caney Mains IV bleeder entries and 2 Left working sections. This circuit contained approximately 21,000 feet of shielded, No. 4/0 AWG, 3-conductor, 15 kV mine power cable and approximately 4,300 feet of shielded, No. 2/0 AWG, 3-conductor, 15 kV mine power cable. A vacuum circuit breaker was installed near the elevator shaft bottom and at or near the beginning of each of the 4 branch circuits. Each vacuum circuit breaker was equipped with a ground-check circuit and relays designed to provide overload, short-circuit, grounded-phase and undervoltage protection. Each vacuum circuit breaker contained a visible disconnect for the branch circuit. A single-line diagram of this underground high-voltage circuit is contained in Appendix E-2.

The power center for the 2 Left section contained a dual-wound transformer which provided 600-volt and 480-volt, 3-phase power to the section equipment. The 600-volt equipment consisted of a continuous mining machine, two shuttle cars, a roof bolting machine, a conveyor belt feeder, a scoop battery charger and a trickle duster. The 480-volt equipment consisted of a welder, an auxiliary fan and a personnel carrier battery charger. The 600-volt winding was delta connected with a zig-zag grounding transformer, the neutral of which was grounded through a 15-ampere current-limiting resistor. The 480-volt, 3-phase winding was wye connected and the secondary neutral was grounded through a 15-ampere current-limiting resistor.

The 2 Left section power center contained ten molded-case circuit breakers for the 600-volt circuits and four molded-case circuit breakers for the 480-volt circuits. Each circuit breaker was equipped with devices to provide short-circuit, grounded-phase and undervoltage protection. Ground-check circuits were provided to monitor the continuity of the grounding circuits for the 480-volt and 600-volt, 3-phase circuits originating at the power center. A cable coupler was provided in conjunction with each 3-phase circuit breaker to provide visual evidence that the power was disconnected when the cable plug was withdrawn from the receptacle.

The electric face equipment was of a permissible type and, according to the mine record books, was examined weekly. A record of these examinations was kept in books in the mine office on the surface.

Fire Protection

The operator's program of instruction for the miners included the location and use of fire fighting equipment; the location of escapeways, exits, and routes of travel; and evacuation and fire drill procedures. The program in effect at the time of the explosion was approved by the MSHA District Manager on September 17, 1980.

Fire fighting facilities provided for the underground portion of the mine included a 12-inch main waterline entering the mine through the slope where two 6-inch lines branched off to supply the Caney and Cranesnest sides of the mine. Four-inch branch lines were installed to a point near the face of each working section except in the Caney Mains I entries where a 2-inch line was used. Water outlets were installed at the required intervals along the waterlines. Fire hose was located primarily at the belt drives for outby areas and fire hoses on the working sections were also used to supply water to the continuous mining machines. Rock dust and dry chemical fire extinguishers were available on the working sections in addition to the water supply. Fire extinguishers of adequate size were provided at electrical installations, at oil storage stations and on mobile equipment operated in the outby areas of the mine.

Fire suppression devices installed on mobile electric face equipment using hydraulic fluid that was not fire resistant were of the dry chemical type except for the devices on the continuous mining machines which used water. Conveyor belt drives were provided with water deluge fire suppression systems and the conveyor belts were continuously monitored for fires by a fire detection and warning system utilizing point-type heat sensors.

Designated escapeways were maintained continuously to the surface. The results of escapeway examinations conducted by certified persons were recorded in a book kept on the surface for that purpose. Maps showing the designated escapeways were available on the working sections and on the surface. Fire drills were conducted by the foreman supervising the section crews and a record was kept in a book on the surface.

Explosives

Explosives were not used on the working sections in the production of coal, but were used in outby areas for construction work.

Supplies of permissible type explosives and electric detonators were stored in an approved storage magazine about 1 1/2 miles from the mine site. Explosives and detonators were transported from the storage magazine to surface or underground work sites in approved containers. Some explosives were stored underground in approved containers.

Transportation and Haulage

Personnel were transported into the mine by an automatic elevator. Mine supplies were transported into the mine by means of the mine hoist and rail cars through the slope opening and by means of the automatic elevator. Personnel and materials were transported from the elevator and slope bottoms by track-mounted battery-powered equipment.

Coal was loaded at the face into shuttle cars and transported to the section loading point where it was discharged into a conveyor belt feeder and onto a conveyor belt system. The conveyor belt system transported the coal to a surface storage area and then to a preparation plant. After being cleaned and processed, the coal was loaded into railroad cars.

Communications

Two-way voice communication was provided by a telephone system containing pager telephones located on the surface, on the working sections and at other appropriate locations underground. The telephones located in the Mine Superintendent's office, in the Maintenance Superintendent's office, and in the underground supply house were nonpermissible, 120-volt ac-powered pager telephones. These telephones were not required to be permissible. Reportedly, the other telephones connected to the telephone system were permissible-type battery-powered telephones.

Oil Wells and Gas Wells

There were no oil wells on the mine property. Numerous gas wells were present on the mine property. Mining was arranged to avoid mining through these wells.

In addition to the gas wells, five degassification holes were drilled into the coalbed during a test project conducted by Clinchfield Coal Company, the U.S. Bureau of Mines and subsequently the Department of Energy. These holes were located in what would eventually be the Caney Mains IV area. Some degassification was accomplished, but the project was terminated due to bore hole pumping problems and the fact that mining would reach the area before the problems could be resolved.

Smoking

The search program to prevent smoking articles from being taken into the mine in effect at the time of the explosion was approved on September 17, 1980, by the MSHA District Manager. The plan required a weekly search of all persons before they entered the mine. No smoking materials were found in a search of the lunch buckets on 2 Left nor in the personal effects of the victims.

Mine Rescue Teams and Self-Rescuers

Clinchfield Coal Company maintains four trained mine rescue teams, equipped with Draeger 3- or 4-hour self-contained oxygen breathing apparatuses. In addition to the Draeger apparatuses, a sufficient number of 1-hour Chemox apparatuses are maintained to equip 3 of the mine rescue teams. The company's mine rescue station is located at the training center in South Clinchfield, Virginia. The 4 teams provide services for all of Clinchfield's mines which are located within 2 hours ground travel time from the mine rescue station.

The investigation revealed that filter-type self-rescuers were provided for all underground employees and each employee had been trained in the use of the self-rescuers. Self-contained self-rescuers (SCSRs) were available for the miners and the mine had an approved storage plan.

Identification Check System

A check-in and check-out system was provided at the mine, consisting of a checkboard and a brass tag corresponding to a similar tag worn on the miner's belt.

Illumination

Permissible-type electric cap lamps were used for portable illumination in the mine. Permissible-type light fixtures installed on the electric face equipment provided illumination while the equipment was being operated in the working places of the mine. In addition, nonpermissible incandescent and fluorescent light fixtures, located in intake air, were used to provide area illumination at various outby locations in the mine. These lights were not required to be permissible in these locations.

Training Program and Emergency Medical Assistance

The training and retraining plan that met the requirements of 30 CFR 48 in effect at the time of the explosion was approved by the MSHA District Manager on January 15, 1979. This program for training and retraining certified and qualified persons and for training and retraining selected supervisors in first-aid in effect at the time of the explosion was approved November 14, 1980. Training was conducted at the company operated training center and at the mine.

The operator had made arrangements with the Hanging Rock Clinic of St. Paul, Virginia for emergency medical assistance for the employees at the mine. Emergency transportation for injured persons was provided by a company operated ambulance located at the mine.

PART II

MINE EXPLOSION, RECOVERY AND INVESTIGATION

The Explosion

The information obtained from MSHA's underground observations and the statements of the miners and mine officials during the investigation revealed the following activities and sequence of events. The information about the activities on the 2 Left section on the evening shift (4:00 p.m. to 12:00 midnight) on June 21, 1983, is limited. Three of the 10 persons on the 2 Left section at the time of the explosion survived; however, their recollections of the accident while generally very helpful are unfortunately incomplete.

The section crew included the following individuals:

Ernest A. Hall (Victim)	Section Foreman
Forrest C. Riner, Jr. (Victim)	Section Foreman
Harold J. Boyd (Injured)	Roof Bolting Machine Operator
Mary K. Counts (Victim)	Shuttle Car Operator
Covey J. French (Victim)	Continuous Mining Machine Operator
Emmery A. Howard (Injured)	Continuous Mining Machine Helper
Luther J. McCoy (Victim)	Repairman
Eugene W. Meade (Victim)	Shuttle Car Operator
Dale Stamper, Jr. (Victim)	Utility Man
Miles W. Sutherland (Injured)	Roof Bolting Machine Operator

With the possible exception of Riner, the evening shift crew entered the mine on Tuesday, June 21, 1983, at 4 p.m. Riner's activities prior to 6:30 p.m. could not be determined during the investigation. Upon reaching the elevator shaft bottom the 2 Left section crew was transported to the working section by a battery-powered track-mounted personnel carrier. The miners arrived on the section at approximately 4:20 p.m., and began their assigned duties under the supervision of Hall. Hall had a total of 8 years mining experience and had assumed the duties of section foreman approximately 8 days prior to the accident. Hall had approximately 8 months experience as a section foreman at the McClure No. 1 Mine, but had been laid off for 13 months immediately preceeding his being rehired 12 days prior to the explosion. Hall was replacing Riner who was scheduled to retire at the end of the week in which the explosion occurred. According to John P. Talbert, Assistant Mine Superintendent, Riner was assigned to work with Hall and familiarize him with the section. However, Ronald C. Sluss, Evening Shift Assistant Mine Foreman, stated he did not assign Riner any specific duties on the night of the explosion nor was he aware that anyone else had assigned Riner any duties that night. Sluss was in charge of this shift since Robert J. Jessee, Evening Shift Mine Foreman, was on vacation. Riner arrived on the 2 Left section at about 7:05 p.m.

When Hall and his crew arrived on the section, the second connection between the 2 Left and the longwall setup entries had been made at the No. 40 crosscut between the Nos. 2 and 3 entries of the 2 Left section. The 2 Left day shift crew had completed the connection and had bolted the roof and rock dusted the area. Ventilation controls necessary to maintain a separation of the air currents ventilating the longwall setup entries and the 2 Left entries had not been installed at the No. 40 crosscut.

The No. 2 entry extended one crosscut inby the Nos. 3 and 4 entries due to the previous mining in the setup entries. Therefore, coal was being mined only in the Nos. 3 and 4 entries in the 2 Left section.

Shortly before 5:00 p.m., French and Howard began cutting the face in the No. 3 entry while Boyd and Sutherland started bolting in the face of the No. 4 entry.

At approximately 6:30 p.m., Meade called the supply house and requested rib bolts. Riner was at the supply house and told Meade he would bring them to the section.

The continuous mining machine was then trammed from the No. 3 entry face and the No. 3 entry face area was bolted. While the No. 3 entry roof was being bolted, coal could not be mined from the No. 4 entry face because the roof bolting machine protruded into the shuttle car roadway in the No. 40 crosscut. This was the only haulage road to the No. 4 entry because a permanent stopping had been erected in the No. 39 crosscut between the Nos. 3 and 4 entries.

The conveyor belt feeder broke down at approximately 7:00 p.m. and McCoy went to the feeder to make repairs as Sluss arrived on the section. John C. Steele, Extra Section Foreman, and Riner arrived on the section at approximately 7:05 p.m. with the previously ordered rib bolts and boards. Meade then left for the supply house to pick up a new drive chain for the feeder and Steele left the section shortly before his return. Riner remained on the section and assisted McCoy with the feeder repairs.

Before Sluss left the section at about 7:45 p.m., he walked with Hall to the No. 40 crosscut in the No. 3 entry and talked with Hall about the haulage problem caused by the permanent stopping installed in the No. 39 crosscut between the Nos. 3 and 4 entries. However, Sluss stated he did not go to the face of the No. 3 or 4 entry and was primarily concerned with rib support during his time in 2 Left.

The repairs to the feeder were completed at about 8:00 p.m. Section activities were unclear after the feeder was repaired. According to Hall's notes, mining was done in both the Nos. 3 and 4 entry faces. However, Howard and Sluss indicated that just the face in No. 3 entry was cut after 8:00 p.m.

Soon after the feeder repairs were completed, Sutherland stated that he walked with Riner and Boyd from the conveyor belt feeder up the No. 3 entry to the No. 40 crosscut. Sutherland said Riner left then and walked to the continuous mining machine but he did not know when Riner left the section.

At the time of the explosion, Sutherland and Boyd were preparing to bolt the face of the No. 3 entry; French and Howard were standing on top of the mining machine hanging ventilation tubing; Counts, Stamper and Meade were helping with the tubing near the mining machine; Riner and McCoy were leaving the 2 Left section via a battery-powered personnel carrier. The location of Hall could not be positively determined; however, Howard speculated that Hall may have gone to shut off the auxiliary fan just before the explosion occurred. Hall was found just outby the No. 40 crosscut in the No. 4 entry.

Howard said that he had the last piece of support wire for the tubing in his hand when the explosion occurred and that he saw fire coming through the curtain in the last open crosscut between the Nos. 3 and 4 entries. The force of the explosion knocked him backwards and knocked his cap lamp off. After he was knocked from the top of the continuous mining machine, he said he heard French crawl past him. He did not remember anything else until shortly before being taken to the surface.

Sutherland and Boyd had just taken CH_4 readings and found 0.9 and 0.7 percent. They were at the drilling stations of the roof bolting machine in the face of the No. 3 entry when the explosion occurred. Sutherland stated that he saw the fire when it was almost upon him and was pushed back by the forces of the explosion. Boyd had no recollection of events immediately before, during or after the explosion.

The battery-powered personnel carrier which Riner and McCoy were using was found on the track between the Nos. 2 and 3 crosscuts, approximately 13 crosscuts outby the No. 16 crosscut where McCoy and Riner were found. McCoy's watch was damaged by the explosion and stopped at 10:15 p.m.

The forces of the explosion traversed all three entries of 2 Left damaging all but 4 stoppings between the faces and the No. 13 crosscut. The forces entered the setup entries through the Nos. 39 and 40 crosscuts damaging all 4 permanent stoppings between the Nos. 2 and 3 setup entries and 1 permanent stopping between the Nos. 1 and 2 entries. The forces then entered the Caney Mains IV bleeder entries at the inby end of 1 Left where the 1 Left entries had cut into the Caney Mains IV bleeder entries. The ventilation controls separating 1 Left from Caney Mains IV bleeder entries were destroyed and 1 stopping and 2 partially constructed overcasts in the Caney Mains IV bleeder entries were damaged. The forces also damaged the 2 regulators in 2 Left, the regulator in 1 Left and 3 stoppings in Caney Mains IV near the point where the entries were offset due to a gas well.

Activities of MSHA Personnel

At 11:02 p.m. EDT, June 21, 1983, Monroe L. West, Manager of the Safety Division notified Bill W. Clemons, MSHA Subdistrict Manager, in Norton, Virginia, that there were indications of an explosion at the McClure No. 1 Mine. Clemons in turn contacted Frank C. Mann, Supervisory Mining Engineer; Ray G. Ross, District Manager; and Eugene W. Graham, Coal Mine Inspection Supervisor and asked them to meet him at the Norton District office.

After a short meeting at the Norton office, Clemons and Mann left and arrived at the mine around midnight. Upon entering the mine office they were informed that there had been an explosion with fatalities, that 3 miners in the explosion area had survived and that 2 miners were still unaccounted for. MSHA established a system to record the remaining recovery operations and a surface control center in the mine office at 12:02 a.m., June 22, 1983. After being told that the fan was operating normally and was being monitored Mann assumed direction of MSHA activities on the surface and Clemons traveled underground at 12:41 a.m. with the mine rescue teams.

Ross, Graham and MSHA Coal Mine Inspectors Kenneth F. Owens and Nickie E. Brewer arrived at the mine at 12:48 a.m. Owens immediately checked the fan and found it operating normally. The fan discharge was tested for methane and carbon monoxide content and examined for smoke. The methane content was 0.4 percent, the carbon monoxide (CO) content was 20 parts per million (ppm) and no smoke was observed at this time.

Other MSHA personnel arrived throughout the recovery operations and were assigned various duties. At 3:42 a.m., Alfonzo Castaneda, Jr., Coal Mine Inspector, issued a Section 103(k) order to insure the safety of any person in the mine, and to require the operator to obtain the approval of MSHA for any plan to return the affected areas of the mine to normal. In addition, Castaneda issued a Section 107(a) imminent danger order of withdrawl. Copies of the 103(k) and 107(a) orders are in Appendix N.

Mine Emergency Operations (MEO)

MSHA district officials notified Mr. Herschel H. Potter, Chief Division of Safety, Coal Mine Safety and Health, of the occurrence on June 22, 1983, at about 12:15 a.m. At 12:30 a.m., Robert G. Peluso, Chief, Pittsburgh Health Technology Center (PHTC) was notified by Potter that an explosion had occurred at McClure No. 1 Mine. Peluso, who was staying at the National Mine Health and Safety Academy at the time, immediately notified James L. Banfield, Jr., Chief, Ventilation Division, PHTC; James Moore, Westinghouse Baltimore Operations Support Center; and John J. Mulhern, Assistant Director for Safety, Technical Support. Moore then contacted Ray Rouiller, Engineer in charge, Mine Emergency Operations, PHTC. These support centers were taken off alert at 2:00 a.m., and remained on standby until after all the victims were removed from the mine at approximately 5:15 a.m.

Recovery

The crews working in the Caney Mains IV bleeder entries and 3 Left working sections felt the concussion from the explosion and some dust and smoke entered their escapeways.

Jay M. Rose, 3 Left Section Foreman, was in the process of taking an air reading on his section when the explosion occurred. Although he had never witnessed an explosion, he stated that because of the noise, the pressure buildup on his eardrums and the movement of the curtains in the wrong direction, he was fairly sure that an explosion had occurred. Rose immediately assembled his crew and left for the surface through the Cranesnest Mains II entries because smoke was entering the 3 Left section through the section intake escapeway. The miners reached the elevator shaft bottom without injury.

Albert D. Holbrook, Section Foreman on the Caney Mains IV bleeder entries working section, was alerted that an explosion had occurred by noise, dust in the air, pressure on his eardrums, and by the movement of the temporary ventilation controls on his working section. Holbrook immediately assembled the miners on his section. They boarded the track-mounted personnel carrier and started towards the mouth of the Caney Mains IV entries and the shaft bottom. As the approached the area where the 1 Left entries had cut into Caney Mains IV they observed debris in the track. They had to remove this as they proceeded slowly through the suspended dust. While this was being done, Holbrook looked into the inby end of 1 Left and saw that the dust was also suspended in 1 Left. The dust in the Caney Mains IV track entry decreased in density as they approached the mouth at the section and the miners reached the elevator shaft bottom without injury.

Carson B. Blackstone, Section Foreman, was supervising a 4-person timber crew on Cranesnest Mains IV when the explosion occurred. They felt the pressure on their ears and a short time later dust was raised into suspension. Blackstone said he thought something had run away on the track. Accompanied by one member of his crew he left in a personnel carrier to investigate. They traveled to the location where Nealy mains belt discharges onto Cranesnest Mains II belt without finding the cause of the sudden increase in pressure and the suspended dust. They decided to go up Cranesnest Mains II to 3 Left section and use the telephone to call someone on the surface. As they entered the section they noticed the crew had already left and there was a powder smoke smell in the air. They called the surface and were informed that the 3 Left crew was already out of the mine. Blackstone sent the miner accompanying him back to Cranesnest Mains IV with the personnel carrier to pick up the 3 miners and take them to the elevator shaft bottom. Blackstone then walked to the 2 Left belthead to investigate.

Sluss and Steele were in the underground supply house located near the elevator shaft when they heard what they thought was a large rock fall near the mine fan. Sluss said he felt a little shock and the doors at the supply house blew open. He then called William E. Glovier, Maintenance Foreman, on the surface and asked him to check the mine fan recorder to see if the water gauge reading had changed. W. Glovier reported that the fan had been running close to 8 inches of water and that it dropped down to about 5 inches of water and then quickly went back to 8 inches of water. A copy of the mine fan chart is in Appendix M. Sluss also tried to call the working sections. After contacting Henry Meade, Caney Mains I Section Foreman, he asked him to take an air reading to see if he had lost any ventilation on his section. Meade reported that he had lost about 15,000 cfm on his section. Sluss was in the process of reporting the incident to Richard K. Light, Jr., Mine Superintendent, by commerical telephone, when Kellis C. Barton and Roy D. Glovier, repairmen, came into the supply house. Light told Sluss to contact all the working sections and remove the men from the mine and that he would be there as soon as he could.

Upon reaching the elevator shaft bottom, the Caney Mains IV section crew went to the surface while Holbrook entered the supply house where he met Sluss, Steele, and Barton. Holbrook informed them that there was dust in suspension and debris on the track in the bleeder entries and dust in suspension in Caney Mains IV bleeder entries where 1 Left cut into Caney Mains IV and that something was wrong on the 2 Left section. Steele remained in the supply house and attempted to contact the sections. Sluss and Holbrook checked their SCSRs and left the supply house and went to the mouth of the 2 Left section. They found the personnel carrier that was used by the 2 Left section crew sitting on the track between the Nos. 2 and 3 crosscuts in the No. 2 entry of 2 Left. The personnel carrier's lights were shining in the outby direction and it felt warm when touched. After pausing a short time at the personnel carrier, Sluss and Holbrook walked up the 2 Left track entry. At the No. 12 crosscut they found a miner's leather boot without the laces. They thought a miner had previously discarded the boot, but later it was determined that the boot belonged to Riner. They proceeded up the track entry to approximately the No. 13 crosscut, where they encountered heavy concentrations of dust and smoke, and decided not to proceed any farther without the aid of proper mine rescue equipment. Sluss and Holbrook returned to the mouth of the 2 Left section at about 11:00 p.m. where they met Blackstone who had walked from 3 Left. Instead of returning to the surface the three men decided to travel up the 1 Left track entry and across the longwall setup entries to the working faces of 2 Left.

About the same time that Sluss and Holbrook left the supply house for 2 Left, Barton and R. Glovier deenergized the underground high-voltage power at the two vacuum circuit breakers near the underground supply house. After opening the circuit breakers they operated the emergency stop switches for the input circuits which opened the oil circuit breakers on the surface. Shortly thereafter, W. Glovier opened the high-voltage disconnects at the surface substation near the slope entrance. Barton and R. Glovier took a personnel carrier to pick up a repair crew on the Cranesnest Mains IV section.

Garlan Vance, Jr., Evening Shift Maintenance Foreman, was talking with one of his repairmen on Cranesnest Mains IV when the explosion occurred. He stated that they thought that something was wrong but decided to wait for a short time to find out more information before leaving the section. He and his repairmen started to walk out of the mine when they realized miners in other sections were leaving for the surface. They met R. Glovier and K. Barton who were coming to pick them up. At about this time Herbert Johnson, General Inside Laborer, and the Cranesnest Mains IV crew arrived in a small personnel carrier operated by Johnson. The Cranesnest Mains III and IV crews took the personnel carrier that Barton and R. Glovier were using and went on to the elevator shaft bottom.

After a delay to rerail one of the jeeps, Johnson, Vance, R. Glovier and Barton rode to the mouth of 2 Left and walked up the No. 2 entry to about the No. 13 crosscut. The men did not have any gas detection instruments so Vance sent Barton to a phone to request them. Barton went on to the supply house arriving at about 11:40 p.m. Vance, Johnson and R. Glovier walked out of 2 Left a short time later.

Meanwhile, Sluss, Holbrook and Blackstone had traveled up the 1 Left entries to the setup entries. Sluss, knowing that they had no means to check for CO, asked Holbrook a couple of times if he was all right as they walked through the setup entries. Sluss knew that Holbrook had had some mine rescue training and might recognize dizziness caused by carbon monoxide. They heard Sutherland, call out as they neared the 2 Left section. They entered the No. 3 entry of the 2 Left section through the No. 39 crosscut. Blackstone detected a maximum of 0.2 percent of methane in the 1 Left track entry, the setup entries and on the 2 Left section.

When the three men turned towards the faces of 2 Left section, they discovered French in the roadway between the Nos. 39 and 40 crosscuts of the No. 3 entry. While Holbrook stopped to examine French for signs of life, Sluss and Blackstone went into the No. 40 crosscut where they found Sutherland standing beside the roof bolting machine. Sutherland was standing at the "inch" controls on the left side of the roof bolting machine. Boyd was found lying unconscious in front of the machine near the right drill head.

At approximately the same time that Boyd was found, Sluss saw Howard sitting near the outby rib in the No. 40 crosscut between the Nos. 3 and 4 entries. After examining Boyd and Howard and determining that they were alive, they went to the continuous mining machine where they located three other victims. Hall was found just outby the No. 40 crosscut in the No. 4 entry, Meade was found under the boom of the continuous mining machine and Stamper was found on his knees near the inby corner of the No. 40 crosscut and the No. 4 entry.

A search was then made for Counts, Riner and McCoy. Sluss stated that he and Holbrook searched the section down to the Nos. 37 or 38 crosscut without locating the missing miners. They then decided that Sluss and Blackstone would take Sutherland to the surface on the personnel carrier while Holbrook stayed with Boyd and Howard. Upon reaching the surface, at approximately 11:45 p.m., Sutherland was placed in a waiting ambulance and transported to a hospital in Wise, Virginia. He was transfered to a hospital in Kingsport, Tennessee, and later to the University of Virginia Medical Center in Charlottesville, Virginia.

At approximately 10:30 p.m., Reecy T. Asbury, Assistant Manager of the Safety Division and Captain of the Dante Mine Rescue Team, was notified of the explosion, first by Homer W. Fields, Mine Safety Inspector, and then by West. Asbury called Neal Phillips, Mine Rescue Trainer, and then called J. Edward Rudder, Mine Safety Inspector, and requested that Rudder get the mine rescue truck and contact Danny and Richard Mann, Mine Rescue Team Members. Asbury instructed his wife to call the other members of the Dante and Open Fork Mine Rescue Teams and left for the mine, stopping at Dante to pick up gas detection instruments.

At approximately the same time, Norman R. Lewis, Day Shift Mine Examiner and Captain of the McClure No. 1 Mine Rescue Team, was contacted by James Stapleton, Evening Shift Mobile Equipment Operator. Lewis left immediately for the mine and called his team members from the mine. He contacted Donald Duncan and Marquis R. Neece, Mine Rescue Team Members, at home and called the sheriff's office to help contact three other members. One member, Lee D. Ratliff, worked the evening shift and was already at the mine.

As members of the three mine rescue teams started arriving, they were told that three of the 2 Left section crew were alive and that access to the face could be gained bare-faced through 1 Left and the longwall setup entries. As Sutherland was being taken to the parking lot where the ambulance was waiting, a rescue party comprised of 12 men entered the mine at approximately 11:45 p.m. The rescue party consisted of William B. Couch, Mine Manager; Gary D. Proffitt, Maintenance Foreman; Light, Sluss, Blackstone, Phillips, Barton and Mine Rescue Team Members: David Buchanan, Ratliff, Lewis, Duncan, and Neece. The team traveled to the 2 Left section via 1 Left and the setup entries. When they arrived on the 2 Left section, Holbrook was waiting with Howard in the No. 40 crosscut between the Nos. 3 and 4 entries. Boyd had not regained consciousness and was still lying near the roof bolting machine. Holbrook informed the rescue party that he had remained near the two men except for brief intervals when he left to investigate a noise near the conveyor belt feeder; to reexamine Hall, Meade and Stamper for signs of life; and to dump a bag of rock dust on a smouldering fire in the welder.

The unconscious Boyd was placed on a stretcher and, with two of the rescuers assisting Howard, they began the trip through the setup entries to the personnel carrier at the end of the 1 Left track. The two injured men reached the surface at approximately 12:30 a.m., June 22, 1983.

Other members of the party began to search for the three missing persons who were expected to be on the section at the time of the explosion, Counts, Riner and McCoy. Counts was found a short time later beneath a piece of plastic curtain material that had fallen near the left side of the continuous mining machine. They continued to search the working section for a distance of approximately 4 crosscuts outby the faces without locating Riner and McCoy. According to Light, at approximately 12:45 a.m., the remainder of the rescue party returned to the shaft bottom where they met Clemons, West, Phillips and the Clinchfield's mine rescue teams equipped with proper self-contained mine rescue apparatus.

The mine rescue teams entered the 2 Left entries through the No. 1 entry (track) and stayed together until they reached the personnel carrier at the point where the No. 1 entry joins the No. 2 entry. Four members then left the group to check the Nos. 2 and 3 entries outby the personnel carrier. While this was being done, the remaining members established communication between the mine rescue teams and the base station on the surface.

The Nos. 2 and 3 entries were on intake air at this point (No. 2 crosscut) and the teams advanced in fresh intake air. The teams advanced "open-faced" (without putting on the face masks to their apparatuses) up the Nos. 2 and 3 entries. Team contact was made at each connecting crosscut that contained a door. Progress reports of the advance were relayed by West to the surface base station, where they were entered into a log by Brewer.

As the team traveled up the 2 Left entries, a boot and a miner's hat were found near the Nos. 12 and 13 crosscuts, respectively. The No. 1 entry was on return air inby the No. 4 crosscut and was stopped at the No. 13 crosscut (referred to by company personnel as the "dogleg"). The team discovered that the air ventilating the 2 Left section was coming down all three entries from the face area to the No. 13 crosscut and contained a trace of carbon monoxide and the air was warmer. Up to this point, the air currents were intaking into the 2 Left section in the Nos. 2 and 3 entries and returning through the Nos. 1 and 4 entries as required by the ventilation plan. A discussion was held to determine if they should proceed farther with the air reversal and the trace of carbon monoxide which was found in addition to the apparent increase in air temperature. A decision was made to advance beyond this point using their self-contained breathing apparatuses.

The lead team started inby the No. 13 crosscut at approximately 1:20 a.m. The lead team was divided with Randall Lee and Carroll Green, Mine Rescue Team Members, and Asbury assigned to the No. 2 entry; Vernon Johnson, Mine Rescue Team Member, and George Willis, Repairman and Mine Rescue Team Member, the No. 3 entry; and Lewis and Rudder the No. 4 entry. All stoppings were damaged or contained doors inby this point and team contact was made at each connecting crosscut.

The team, after traveling 3 crosscuts inby the dogleg, found Riner near the left rib of the No. 2 entry between the Nos. 15 and 16 crosscuts. After examining Riner and finding no signs of life and noting his location, the team found McCoy a few feet up the entry just inby the No. 16 crosscut lying near the edge of the conveyor belt between the track and belt. They examined McCoy and found no signs of life. At this time the decision was made to stop using the self-contained breathing apparatuses because only traces of CO were being detected. After marking the location of McCoy and notifying West, the team traveled to the face of the 2 Left section exploring each entry and crosscut as they advanced.

Even though three members of the 2 Left section crew had earlier been rescued through the setup entries and the Caney Mains IV bleeder entries crew had safely evacuated the mine, the mine rescue teams decided to explore the setup entries and the Caney Mains IV bleeder entries. These two areas were examined in the same manner as the 2 Left entries, on a crosscut to crosscut basis with team members in each entry. After exploring these areas, the victims were transported to the surface and to a funeral home by ambulances. Recovery of all the victims was completed at approximately 5:15 a.m., June 22, 1983, and all persons were withdrawn from the mine. The medical examiner's report indicated that the cause of death of 4 of the 5 victims in the 2 Left face area was asphyxiation from smoke (CO) inhalation, and one of the victims died from head and chest injuries. The two victims located outby the face area of the 2 Left entries died from a combination of burn injuries and smoke inhalation.

The location of each victim is shown on the map in Appendix T. The age, job classification and mining experience of each victim is listed in Appendix A.

<u>Reestablishment of 2 Left Ventilation</u>

Clemons stated that after the bodies were brought to the surface, meetings were held to discuss the ventilation of 2 Left. These meetings, according to Clemons, came naturally and were not called by either the Company, United Mine Workers of America (UMWA) or State or Federal Inspection Agencies. All four parties participated and open discussions were held.

It was decided during the meeting that the entire mine, including the explosion area would be patrolled. The full extent of damages to the mine ventilation system was not known at this time. Crews were assigned to the patrol duties and other crews were assigned to examine all the ventilation controls in the mine from the shaft bottom to the working sections. Full participation by the Company, UMWA, and State and Federal Inspection Agencies was encouraged especially in the explosion area. The crews assigned to the explosion area were given strict instructions to remain together and not to disturb anything in the area. Their principal duties were to examine for methane, test for carbon monoxide and search for possible fires.

The affected areas were checked and the damage to ventilation controls was mapped. In addition to the damaged stoppings in 2 Left, three damaged stoppings were discovered in Caney Mains IV between the Nos. 33 and 38 crosscuts. The regulators in 1 Left and 2 Left were also damaged.

Clemons went on to say that during the examinations of the 2 Left section on the 12:01 a.m. to 8:00 a.m. shift on Thursday, June 23, 1983, methane concentrations near 1.0 percent were periodically found in the belt and track entry of 2 Left. The methane was cleared by increasing the opening in the regulator in the No. 1 entry.

Meetings were again held during the day shift with all 4 parties participating. During these meetings, Clinchfield Coal Company officials in general, and Couch in particular, expressed concern over the fact the ventilation in 2 Left was reversed and was traveling outby from the section down the track and belt entry. They suggested restoring the ventilation to its original course.

After this matter was discussed, the Company, UMWA, State and MSHA agreed that the ventilation should be returned to its original course. One of the concerns was that the nonpermissible haulage equipment would be in air returning from the section. A lengthy discussion was then held to discuss the work necessary to reverse the air and the following steps were agreed upon:

1. Install temporary stoppings between the Nos. 3 and 4 entries in 2 Left where permanent stoppings had been blown out.

2. Repair (rebuild) the regulator in the No. 1 entry of 2 Left between the Nos. 6 and 7 crosscuts.

3. Repair (rebuild) the regulator in the No. 4 entry of the 1 Left directly across from the regulator in the No. 1 entry of 2 Left.

4. Install 3 temporary stoppings in the Caney Mains IV entries where permanent stoppings had been blown out. The stoppings were located between the Nos. 1 and 2 entries and the Nos. 3 and 4 entries of Caney Mains IV where the entries were offset due to a gas well.

5. Install 2 or 3 temporary stoppings in the upper end of 2 Left where the 2 Left entries cut into the longwall setup entries.

6. Install check curtains across the Nos. 2 and 3 entries of 2 Left immediately outby where the No. 1 entry of 2 Left was stopped.

The temporary stoppings between Nos. 3 and 4 entries in 2 Left and the 2 stoppings in Caney Mains IV were the first stoppings installed. After this work was completed, another meeting of all four parties was held and the following steps were agreed upon to reverse the direction of air flow on the 2 Left section and put it in its proper course:

1. Repair (rebuild) the regulator in the No. 1 entry of 2 Left.

2. Repair (rebuild) the regulator in the No. 4 entry of 1 Left.

3. Install temporary stoppings in the inby end of 2 Left where 2 Left cut into the longwall setup entries.

4. Remove the check curtains that were installed across the Nos. 2 and 3 entries of 2 Left immediately outby where the No. 1 entry of 2 Left was stopped.

The 4 parties also concluded that all persons, except persons involved in making the changes should be withdrawn from the mine and that all the changes should be made simultaneously. It was also agreed that the persons making the changes would remain and monitor the mine atmosphere to determine the effects of the changes. The crews that were assigned to these tasks entered the mine shortly after 3:35 p.m., Thursday, June 23, 1983, and went to their assigned locations. At precisely 4:15 p.m. the changes were begun and completed within a few minutes.

Prior to the changes, the methane content in the belt and track entry of 2 Left ranged between 0.8 and 0.9 percent at the No. 13 crosscut where the air entered the No. 1 entry (return). The same air at the No. 38 crosscut contained only 0.2 to 0.3 percent methane. Shortly after the changes were made the methane content in the vicinity of the conveyor belt feeder (No. 36 crosscut) reached 2.2 percent but quickly decreased to 1.6 percent and then to 1.0 percent. The air volume at the last open crosscut (No. 40 crosscut) in 2 Left fluctuated from 9,300 cfm to 13,400 cfm with less than 1 percent methane.

Another meeting was held to decide whether additional action should be taken. It was the consensus of the four parties that the direction of the ventilation was as it should be and the remaining problem was to increase the volume of air in the face areas of 2 Left. To do this the permanent stoppings had to be rebuilt using the blocks from the stoppings that had been blown out. Before any blocks were moved the crews were instructed to draw a map showing the direction of the forces. The crews consisted of one representative from the Company, UMWA, State and Federal agencies. The crews were also instructed to continuously monitor all areas of 2 Left. Clemons stated that he and Mann then left the mine and arrived at headquarters in Norton, Virginia at about 9:00 p.m., June 23, 1983.

At approximately 9:45 p.m., Charles F. Reese, MSHA Coal Mine Inspector, detected 1.7 percent methane at the 2 Left conveyor belt feeder (No. 36 crosscut). At 10:20 p.m., Burnis L. Austin, MSHA Coal Mine Inspector, detected methane concentrations ranging between 3 percent at waist level to over 8 percent one foot below the roof just inby survey station No. 2320 (No. 26 crosscut) in the No. 2 entry. Reese and Austin called their findings to the surface and started out of the mine.

At about 10:30 p.m., Merian O'Bryan, MSHA Coal Mine Inspection Supervisor, called Clemons and informed him of the high methane readings in the No. 2 entry at the No. 26 crosscut of 2 Left and that he was withdrawing all persons from the mine. By 11:00 p.m., all persons were out of the mine.

Clemons called Ross and Mann and informed them of the occurrence. The three met in Clemons' office and after a short discussion all three departed for the mine. Upon arrival at the mine, a meeting was held with representatives of all four parties. It was decided and agreed upon that the only course of action available at that time was to reverse the changes which had been made in the ventilation of 2 Left. While the UMWA agreed with the course of action, they declined to participate in making the changes. Crews were assigned and a time established by the four parties to make the changes. The crews entered the mine and made the changes without incident. As soon as the changes were made, the personnel involved were withdrawn from the mine. After a period of two hours the area was examined and found to be ventilated to the extent that the methane content was below 1.0 percent in the No. 2 entry.

The methane remained below 1.0 percent until July 7, 1983, when it increased to 1.1 percent in the track entry at about 7:15 p.m. Persons were withdrawn from the area and baffle curtains were hung in the No. 3 entry to divert more air into the track and belt entry. This sufficiently diluted the methane to less than 1.0 percent.

Investigation

Participants

On June 22 and 23, 1983, MSHA selected and organized their investigation team and developed detailed plans and procedures for investigating the explosion. On June 24, 1983, individuals from the Virginia Division of Mines and Quarries, Clinchfield Coal Company, UMWA and MSHA met at the McClure No. 1 Mine and discussed the procedures for the investigation. The underground investigation began with a limited number of the investigation team members observing and evaluating the conditions of the 2 Left section. The comprehensive underground investigation was started on June 25, 1983, and was completed on August 12, 1983.

Insuring the safety of the participants in the investigation caused occasional delays such as waiting for the entire affected area to be rock dusted before the electric equipment was energized and tested. Much of the initial stages of the investigation were conducted during miners' vacation. A list of the persons who participated in the underground investigation is contained in Appendix C.

Physical Investigations

The investigation began on June 24, 1983. The investigation was conducted in the affected areas of the mine with all existing conditions being evaluated. The conditions observed were recorded by team members either on maps or in notebooks. Maps showing detailed information gathered in the area affected by the explosion are contained in Appendices S through V. Mine dust surveys were conducted according to standard MSHA procedures in the explosion area and other areas in proximity to the explosion. The analytical results of the mine dust surveys are contained in Appendix I. Methane liberations were measured in the 2 Left section by methane recorders and a ventilation survey was conducted. The results of these studies are contained in Appendix L. Photographs and sketches were made of conditions, equipment and articles as were necessary. Several of the photographs appear in Appendix O.

Interviews

During the months of July and August, MSHA investigators and officials from the State of Virginia, Clinchfield Coal Company and United Mine Workers of America took sworn statements from 63 persons who participated in the recovery operations or could have knowledge of the mining conditions in 2 Left prior to the explosion. Officials and employees of Clinchfield Coal Company, including the three survivors of the explosion, MSHA personnel, UMWA personnel, and a State mine inspector provided testimony voluntarily. The names of these persons are in Appendix D.

While the general public was not present when the testimony was taken by the investigators, company officials and UMWA representatives participated in the process. Copies of the sworn statements were made available to all interested parties. The transcripts of all the testimony were released to the general public on September 9, 1983.

PART III

DISCUSSION AND EVALUATION

Factors Affecting the Explosion

Methane, Ventilation and Examinations

Methane Liberation in 2 Left

MSHA investigators conducted a methane liberation study to determine the methane liberation rate in the 2 Left entries between the Nos. 13 and 39 crosscuts. The methane concentrations and air quantities were monitored daily at three locations selected at the beginning, mid-point, and end of the 2 Left entries. Vacuum bottle samples, air velocity measurements, and continuous recorded methane readings were made daily at the 9 monitoring stations. The 9 monitoring stations (K-2 thru K-10), the average methane concentration, the balanced air quantities, and the average methane quantity being liberated are shown on the map in Appendix S.

The results of the study, which are found in Appendix L, show that the average methane quantity in the 3 entries near the face of 2 Left (K-8, K-9, and K-10) was 54 cubic feet of methane (cfm), the average methane quantity near the mid-point of the section (K-5, K-6, and K-7) was 182 cfm, and the average methane quantity near the mouth of 2 Left was 207 cfm of methane. The methane liberation rate into the 3 entries between the monitoring stations located near the face and mouth of 2 Left was approximately 153 cfm. Of the total methane quantity liberated in 2 Left (153 cfm), 84 percent (128 cfm) entered the 3 entries between the stations located near the face and mid-point in the section.

From an analysis of these data through a computer simulation, the methane emissions and air quantities in the affected area of the 2 Left entries can be estimated. The methane emmitted would be 66 cfm in the No. 2 entry and 4 cfm in the No. 3 entry. The disruption of the ventilation following the cut-through at the No. 40 crosscut would cause approximately 60 percent of the methane, or about 42 cfm, to be retained in the area.

These facts combined with the experiences with methane accumulations encountered during the reestablishment of ventilation on June 23, 1983 clearly show that methane would accumulate very easily when the ventilation was reduced in the 2 Left entries.

Ventilation of 2 Left

The 2 Left entries off the Cranesnest Mains I entries were started about November 8, 1982 and consisted of 4 entries driven on 80-foot centers with crosscuts being driven on 100-foot centers. After being driven to a depth of about 200-feet, the No. 1 entry was stopped and a 45 degree connecting crosscut was driven into the No. 2 entry. The track was installed in this portion of the No. 1 entry and through the 45 degree crosscut into the No. 2 entry where it was then installed parallel to the conveyor belt up to the section loading point. About 325 feet inby the point where the No. 1 entry was stopped it was picked up and driven for a distance of about 650 feet where it was stopped again. According to Light, the original plan was to drive the 2 Left entries to a depth of 7,000 feet and he felt that the additional entry would be necessary for ventilating purposes. When the decision was made to stop the entries short of the planned 7,000 feet it was felt that the section could be adequately ventilated without the No. 1 entry. In his statement, Ronald Hamrick, State Mine Inspector, said that Light told him the No. 1 entry was stopped in order to avoid pulling the chain pillars between the Nos. 1 and 2 entries with the longwall face as the face was retreated. Light also indicated in his statement that for this reason he felt that it would be safer if the No. 1 entry was stopped.

The 2 Left entries were ventilated in the following manner. The outby portion of the No. 1 entry was not utilized in the overall ventilation scheme. The inby portion of this entry, from the No. 6 to the No. 13 crosscut, was originally intended to be an intake airway but was converted to a return airway after a decision to stop the entry development was made and after a methane accumulation of 7 percent was detected in a small area in the upper left hand corner of the face. According to statements of company officials, approximately 10,000 cfm of air was directed through the No. 13 crosscut into the No. 1 entry. After ventilating the face of the No. 1 entry, the air was coursed down the No. 1 entry into and through the cross entries to the No. 4 entry of 1 Left which was a return aircourse.

The No. 2 entry was the track and belt entry and the air in this entry, except for the split directed through the No. 13 crosscut into the No. 1 entry, was dumped to the return near the section loading point. A check curtain was installed across the entry outby the belt feeder to direct the air into a 16-inch-by-32-inch oval fiberglass tubing which conducted the air across the No. 3 entry into the No. 4 entry which was a return aircourse. Management personnel indicated that the tubing was normally moved up each time the belt was advanced, typically at 200-foot intervals. The investigation disclosed that the tubing was not moved up each time the belt was advanced because what appeared to be the last installation was found approximately 500 feet outby the belt feeder.

The No. 3 entry was an intake airway and was the intake escapeway for the section. The No. 4 entry was a return airway. On the working section, the intake air in the No. 3 entry was directed into the No. 2 entry by installing a curtain across the No. 3 entry outby the last open crosscut. Line curtains where used to direct the air to the faces of the Nos. 2 and 3 entries and an exhausting auxiliary fan with 16-inch-by-32-inch oval fiberglass tubing was used to ventilate the face of the No. 4 entry. Miners indicated that a curtain was installed across the No. 4 entry (return) at the auxiliary fan to increase the volume of air passing through the fan tubing. The method of installing this curtain varied from section crew to section crew.

Permanent stoppings were used to separate the intake and return aircourses and to isolate the belt entry. The stoppings were constructed by dry-stacking concrete blocks and plastering them with a sealant on the high pressure side. In the 2 Left entries, the permanent stoppings were installed between the Nos. 3 and 4 entries up to and including the No. 39 crosscut which left only one open crosscut between the intake and return aircourse. Permanent stoppings were also installed between the Nos. 2 and 3 entries up to and including the No. 35 crosscut. These stoppings provide separation between the track and belt entry and the intake aircourse for the entire length of the conveyor belt.

Regulators were installed near the mouth of the No. 4 entry and in the No. 1 entry near the cross entries to control the air flow in the 2 splits.

Cut-Through at the No. 39 Crosscut

According to Harold N. Leonard, Jr., 2 Left Day Shift Section Foreman, the first connection between the 2 Left section and the longwall setup entries was made at about 1:30 p.m., on the day shift, Tuesday, June 14, 1983 when the face of the No. 2 entry was cut into the No. 3 setup entry at the No. 39 crosscut. Leonard had a curtain installed in the No. 2 entry of the 2 Left section between the Nos. 38 and 39 crosscuts behind the roof bolting machine while the cut-through was being bolted. Leonard stated that Light had told him to install a curtain board before the mining machine cut-through and to hang a curtain after the roof bolting machine had been moved into the place. Light was on the section on Tuesday, June 14, 1983, just after the first cut-through was made at the No. 39 crosscut and observed a curtain being installed in the No. 2 entry between the Nos. 38 and 39 crosscuts just outby the roof bolting machine. This curtain was later moved to a diagonal position in the intersection of the No. 39 crosscut to facilitate the mining of the crosscut between the Nos. 2 and 3 entries of 2 Left.

Methane Accumulations on June 17, 1983

On Friday, June 17, 1983, the day shift arrived on the 2 Left section at approximately 8:30 a.m. Shortly thereafter, Jimmy L. Honaker, Continuous Mining Machine Helper, energized the continuous mining machine which the previous shift had parked just outby the last open crosscut (No. 39) in the No. 3 entry. The methane monitor warning light immediately came on and the monitor indicated 1.7 percent methane. Honaker said he then started checking the area with a hand held methane detector and detected methane concentrations from 1.0 to 1.5 percent in both the No. 2 and 3 entries. The methane accumulation extended from the run through curtains hung across both entries just outby the No. 39 crosscut, back to the No. 37 crosscut. He said that the curtains that were installed in the Nos. 2 and 3 entries were blocking the ventilation of the section. He went on to say that it took 45 minutes to clear the gas after the run through curtains were removed. Also, Honaker thought that a diagonal curtain was installed in the intersection at the No. 39 crosscut in the No. 2 entry to allow the intake air to flow to the faces. He also stated that on other occasions when the day shift crew arrived on the section they had found the intake aircourse blocked by improperly installed curtains.

According to Leonard, he measured this same body of methane at 1.2 percent. He estimated it to be approximately 40 feet in length and that it was located between the Nos. 38 and 39 crosscuts. He stated that the methane content ranged from about 0.7 percent at the section power center to 1.2 percent at the No. 38 crosscut.

Leonard's further checks in the immediate area revealed 0.6 to 0.8 percent methane in the No. 2 entry near the belt feeder. According to Leonard, the methane accumulation was apparently caused by improperly installed curtains which blocked the intake air current into the section. He stated that the methane was diluted by removing the curtain in the No. 2 entry which permitted the air to flow to the faces and then to the return in the No. 4 entry and by temporarily raising the curtain across the No. 2 entry at the conveyor belt feeder. The methane in the No. 3 entry was removed by temporarily raising a portion of the curtain in the No. 3 entry.

Cut-Through at the No. 40 Crosscut

Three coal producing shifts on 2 Left proceeded without incident on Monday, June 20, 1983. The midnight shift on Tuesday, June 21, 1983, did not produce coal. The section was idled for maintenance and to move the section power center.

On the following shift, Leonard and his crew arrived on the 2 Left section at approximately 8:35 a.m. The shift progressed normally and the No. 40 crosscut was cut through into the setup entries at approximately 1:15 p.m.

Paul D. Owens, Brattice Man (also a certified mine examiner), examined the belt in the No. 2 entry at about 8:20 a.m., on June 21, 1983. Owens stated he examined the belt while riding with the section mantrip. He made a methane check just inby the curtain at the conveyor belt feeder and while the methane is usually about 0.5 to 0.7 percent, he could not remember the results of that particular test. Owens said he then walked into the setup entries, took an air reading, then proceeded into Caney Mains IV bleeder entries and walked that belt entry to its mouth. Owens stated he traveled to the 2 Left belt head and thought he made a test for methane there.

Talbert said he approached the 2 Left section from Caney Mains IV bleeder entries through the longwall setup entries where at the time he could see the lights of the continuous mining machine through the cut-through at the No. 40 crosscut of 2 Left. Before walking to 2 Left, he took a return air reading in the intersection of the No. 4 entry of 1 Left and the No. 3 entry of the setup entries. Talbert recalls measuring 14,000 or 15,000 cfm flowing from the setup entries into the 1 Left return.

After taking this measurement, Talbert walked along the longwall face and entered 2 Left through the diagonal curtain hung in the No. 39 crosscut. He walked up to the last open crosscut in the No. 3 entry where he met Leonard. Talbert said the air was flowing from the setup entries through the cut-through at the No. 40 crosscut into the No. 3 entry. Talbert detected 0.2 percent methane at the face of the No. 3 entry before he and Leonard walked to the face of the No. 4 entry. Talbert took another methane reading beside the roof bolting machine and got 0.7 percent. Then they walked down the No. 4 entry about 5 crosscuts where Talbert took an air measurement. After measuring 32,000 cfm which was about 4,000 cfm more than normal, they walked back to the face of the No. 3 entry where the continuous mining machine had just finished cleaning up the No. 40 crosscut between the Nos. 2 and 3 entries. Talbert said he instructed Leonard to install a curtain behind the roof bolting machine between the Nos. 2 and 3 entries at the No. 40 crosscut after the roof bolting machine had been trammed into the newly opened No. 40 crosscut.

Talbert said he also told Leonard to remove the block fly (check curtain) that was installed in the No. 3 entry between the Nos. 38 and 39 crosscuts and install it in the No. 2 entry between the same crosscuts. Talbert then left the section at about 1:50 p.m.

Leonard stated that he didn't remember Talbert instructing him to hang a curtain in the cut-through at the No. 40 crosscut, although he did recall being told, and did move the curtain from the No. 3 entry over to the No. 2 entry between the Nos. 38 and 39 crosscuts. He also remembers being told to tighten the curtain across the No. 2 entry at the belt feeder which he did before leaving the section.

After the No. 40 crosscut was cut through and cleaned up, the mining machine was moved to the No. 4 entry and the roof bolting machine moved into the newly opened No. 40 crosscut between the Nos. 2 and 3 entries.

Leonard stated that the air was traveling from the setup entries through the No. 40 crosscut towards the No. 4 entry of 2 Left. He had measured the air prior to and after the crosscut was cut through and there was a 4,000 cfm increase in the total volume of air in the return aircourse of 2 Left after cutting through.

The roof bolting crew finished bolting the No. 40 crosscut at approximately 3:10 p.m. and then helped the rest of the section crew clean up and rock dust the faces and last open crosscut. Leonard said the shift ended without a curtain being hung in the No. 40 crosscut.

Talbert met with Riner at about 3:30 p.m. and discussed the need to install rib bolts on the 2 Left section. Talbert said he did not give Riner any instructions concerning the ventilation because at that time he did not know that Leonard did not install a curtain in the No. 40 crosscut.

At the end of the day shift, Leonard met Hall in the lamp room and told him what places were cut, bolted, and cleaned up. Leonard told Hall that the No. 40 crosscut was cut through into the setup entries and that all equipment was running. He didn't mention to Hall that a curtain had not been installed in the No. 40 crosscut connecting the 2 Left section and the setup entries or that one should be installed.

Leonard said he then left the lamp room and walked down to Talbert's office where Talbert asked him if he had hung the curtain in the second cut-through. After his negative response, Talbert sent him to find Hall to tell him to do so. Leonard stated he went on home after telling Talbert he could not find Hall.

According to Talbert, when Leonard entered his office at the end of the shift, he asked Leonard if he had taken care of the curtain work. Leonard said he moved the block fly curtain from the No. 3 entry to the No. 2 entry, but didn't install the curtain in the cut-through at the No. 40 crosscut.

Talbert said he then told Leonard to go find Hall and tell him to install the curtain in the cut-through but, after being gone a few minutes, Leonard returned and told Talbert he had not been able to find Hall. Talbert said he knew Riner had been told where to hang curtains and felt no further instruction was necessary. No other attempt was made to contact Hall or Riner. Talbert left the mine for home at about 5:30 p.m.

Activities of the Evening Shift on June 21, 1983

The evening shift crew arrived on the 2 Left section at about 4:20 p.m. Mining in the No. 40 crosscut had been completed during the day shift so preparations were begun to mine in the Nos. 3 and 4 entries. Since a curtain was not installed in the cut-through, air was still entering the last open crosscut from the setup entries. Shortly before 5:00 p.m., French and Howard began cutting the face in the No. 3 entry while Boyd and Sutherland started bolting in the face of No. 4 entry. Howard stated that the line curtain used to ventilate the No. 3 entry face had to be held down with bags of rock dust and that he had never seen that much air on the section.

Sluss arrived on the 2 Left section just before 7:00 p.m. at approximately the same time the drive chain broke on the conveyor belt feeder. A short time later, Riner and Steele, arrived on the section with a load of conventional roof bolts, plates and boards for rib bolting. Riner's general assignment was to work with and train Hall on the 2 Left section; however, on the night of the accident, Riner's activities were unknown before he left the supply house to go to the section with Steele at approximately 6:30 p.m.

Sluss walked to the last open crosscut in the No. 3 entry with Hall because Hall wanted to show him how the haulage road was blocked by the roof bolter when the roof was being bolted in the face of the No. 3 entry. This was the only haulage road to the No. 4 entry because a permanent stopping had been erected in the No. 39 crosscut between the Nos. 3 and 4 entries. Sluss stated he was only in the intersection for about 10 seconds and that Hall did not mention any other problems on the section except with the haulage road. Sluss stated that he did not know that the No. 40 crosscut was cut into the setup entries and he did not look in that direction. The only thing Sluss could recall about the face ventilation was that he heard the auxiliary fan running in the No. 4 entry. Sluss left the section at approximately 7:45 p.m. enroute to the supply house. The repairs to the feeder were completed at about 8:00 p.m.

James A. Wagner, Belt Examiner, made his examination of the belt in 2 Left at about 8:00 p.m. Wagner said he inspected the No. 2 belt entry while riding in a personnel carrier. He parked the vehicle outby the conveyor belt feeder and detected 0.2 percent methane inby the curtain at the feeder. Wagner stated he then walked up the No. 3 entry to the No. 40 crosscut and made an air measurement in the setup entries but did not take one in the cut-through at the No. 40 crosscut. Wagner stated he then walked down the No. 2 entry toward the feeder and traveled out the 2 Left track entry. He stated he made a test for methane at the belt discharge, but like Owens, he did not take an air reading or make a test for methane in the No. 2 entry between the conveyor belt feeder and the belt discharge. Wagner said he did not detect any unusual conditions while he was in the 2 Left entries.

MSHA investigators concluded that no ventilation controls were installed in the No. 40 crosscut prior to the explosion.

At the time of the explosion, approximately 10:15 p.m., Sutherland and Boyd were preparing to bolt in the No. 3 entry; French and Howard were standing on top of the continuous mining machine hanging ventilation tubing; Counts, Stamper and Meade were helping with the tubing just outby the mining machine; and the location of Hall could not be positively established; however, he was probably in the No. 4 entry just outby the No. 40 crosscut where he was found after the explosion. McCoy was apparently transporting Riner off the section back to the elevator shaft bottom. MSHA investigators could not determine the exact time the two miners left the section nor their exact location in the No. 2 entry when the explosion occurred.

Effects of Cut-Through at the No. 40 Crosscut

The cut-through in the No. 40 crosscut occurred at about 1:15 p.m. From 1:15 p.m. until the time of the explosion at about 10:15 p.m., approximately nine hours passed. The volume and velocity of the air ventilating the Nos. 2 and 3 entries of 2 Left after the cut-through was not sufficient during this nine hours to prevent methane from accumulating.

During the nine hours, the running of the conveyor belt and the trips made by the battery-powered personnel carriers in the No. 2 entry affected the methane body as it accumulated. The conveyor belt was running the majority of the time before the explosion and between 3:30 p.m. and the explosion eleven trips were made by battery-powered personnel carriers in and out of the No. 2 entry. The following is a list of the trips and their approximate times:

1. Day shift crew departs - 3:30 p.m.
2. Evening shift crew arrives - 4:20 p.m.
3. Sluss arrives - 7:00 p.m.
4. Steele and Riner arrive - 7:05 p.m.
5. Meade departs - 7:10 p.m.
6. Steele departs - 7:15 p.m.
7. Meade returns - 7:20 p.m.
8. Sluss departs - 7:45 p.m.
9. Wagner arrives - 8:00 p.m.
10. Wagner departs - 8:15 p.m.
11. Riner and McCoy depart - 10:10 p.m.

The running of the conveyor belt and the numerous trips of the personnel carriers, especially the last trip at the time of the explosion, caused mixing of the methane and air in the No. 2 entry. The investigators concluded that methane layering was not a factor in the explosion.

During the investigation, a ventilation survey was conducted at the mine. Information gathered during this survey was used to produce a digital computer simulation of the ventilation system in the Cranesnest Mains I, 1 Left and 2 Left areas of the mine. This simulation was conducted to determine the air flow directions in this area before and after the cut-through was made in the No. 40 crosscut when no ventilation controls were installed in the cut-through. All other ventilation controls were assumed to be unchanged. The report for this study is contained in Appendix L.

According to this simulation, the cut-through would have the following effect:

1. The air quantity in the two intake entries of the setup entries would increase from 14,000 to 36,000 cfm.

2. An air quantity of 23,000 cfm would flow from the setup entries into the face area of the 2 Left section.

3. The air quantity in the 2 Left No. 3 (intake) entry at about the No. 37 crosscut would decrease from 24,000 to 8,000 cfm.

4. The air quantity in the No. 2 (belt-track) entry near the belt tailpiece would decrease from 5,000 to 2,000 cfm.

5. The return air flow from the face area of 2 Left would increase from 29,000 to 33,000 cfm.

A significant portion (23,000 of the 33,000 cfm) of the air flowing in the immediate return of the 2 Left section would be supplied from the 1 Left entries through the setup entries.

Although the air quantities listed above are computer simulations, they do illustrate the effects of the cut-through on the ventilation in the Nos. 2 and 3 entries of 2 Left and demonstrate how methane could accumulate in this area. The air quantities from the simulation are consistent with the actual air measurements taken in the setup entries and the 2 Left return aircourse by Talbert and Leonard. In addition, the statements of Howard and Sutherland, who said the ventilation increased in the face area after the cut-through, support the simulation.

The requirements of the approved Ventilation System and Methane and Dust Control Plan were not being followed in that the faces of 2 Left were being ventilated with air from the setup entries. The plan requires the 2 Left working faces to be ventilated by air directed from Cranesnest Mains I to the faces through the No. 3 entry of 2 Left.

The investigators concluded that the failure to install ventilation controls to separate the air split ventilating the setup entries from the air split ventilating the 2 Left entries materially affected the movement of air in the Nos. 2 and 3 entries of 2 Left. The volume and velocity of air became inadequate to dilute, render harmless and to carry away flammable and explosive gases which were liberated in the area. The failure to maintain the airflow in its proper volume and direction in the setup entries, the 2 Left face area and outby in the Nos. 2 and 3 entries of 2 Left allowed an accumulation of an explosive methane-air mixture in the Nos. 2 and 3 entries of 2 Left. These changes in ventilation remained uncorrected for about 9 hours.

Cut-Through Ventilation Procedures

Light stated that the normal procedure for separating aircourses that have been connected was to install a curtain immediately after the continuous mining machine mined the place and the roof bolting machine entered. Light also stated that he had given these instructions to all section foremen who worked on the 2 Left section. Because of his earlier instructions, Light said he didn't think it was necessary to repeat the instructions to the section foremen before the second cut-through.

John Kiser, General Mine Foreman, stated he discussed cut-through ventilation procedures with Light and Talbert, but could not remember giving any instructions on these procedures to the section foremen of 2 Left.

Talbert stated that it was the normal procedure to install a curtain behind the roof bolting machine while a new cut-through was being bolted. He stated that he discussed this procedure with Riner and the foremen on the other two shifts, but did not discuss it with Hall.

Bobby D. Stanley, Midnight Shift 2 Left Section Foreman, and Leonard both stated that they had been instructed on how to ventilate the section during the connection with the setup entries. According to Leonard, he was instructed by Light, first at a meeting, and later when Light was present on the 2 Left section. Stanley said he was instructed by Talbert to install a curtain between the 2 Left entries and setup entries before the roof was bolted.

Robert J. Jessee, Evening Shift Mine Foreman, said Talbert instructed him, J. Kiser and possibly Riner to block the air so it would stay in it's proper course. Jessee thought he had discussed these procedures with Riner, but he did not discuss them with Hall or Sluss. On the night of the accident, Jessee was off and Sluss had replaced him.

Sluss stated that he was not aware that the No. 40 crosscut had been cut through and that he had not discussed the cut-through ventilation with the section foremen on his shift prior to the explosion.

It was evident from the statements given by mine management that the higher levels of mine management had discussed procedures for maintaining the separation between air currents when two sets of entries are cut together. Various other levels of mine management had discussed different methods for controlling the ventilation when the 2 Left entries were cut through into the setup entries. These procedures were followed after the first cut-through was made at the No. 39 crosscut of 2 Left while the Mine Superintendent was present. However, it is also evident that the higher levels of mine management failed to insure that the cut-through ventilation procedures were established, fully understood and followed by the persons responsible for carrying them out. Five management personnel, including the Assistant Mine Superintendent, the day shift section foreman, two evening shift section foremen and the mine foreman in charge of the evening shift were in the No. 40 crosscut of 2 Left after the second cut-through was made and failed to implement the cut-through procedures.

Examinations

Near the end of the day shift on June 21, 1983, Leonard conducted a preshift examination of the 2 Left section for the oncoming shift. The regulations governing preshift examinations require in part that tests for methane be made, that tests be made to determine if the ventilating air current is traveling in its proper course and in normal volume and velocity, and that an examination be made of the section for other hazards and for violations of the mandatory safety and health standards. It was standard practice at this mine for the preshift examiner to inform the oncoming section foreman of any hazards observed and to enter the results of the examination in the preshift examiners book upon arrival on the surface.

Leonard stated that on a preshift examination for the evening shift he would make tests for methane and check the air in all the active working places and take an air reading in the last open crosscut. He said he would usually start this examination sometime after 1:00 p.m., and before leaving the section at the end of the shift, he would call the evening shift section foreman and report any unusual or hazardous conditions.

Leonard stated that he made a preshift examination on the day of the explosion and reported the results of his examination by telephone to Hall prior to leaving the section at the end of his shift. After his shift, Leonard talked to Hall on the surface and explained what had been done during the preceding shift. Leonard said he told Hall about the cut-through in the No. 40 crosscut but did not mention the fact that a curtain had not been installed in that cut-through. Leonard stated that he did not recognize any hazardous condition on the section. Consequently, he did not enter in either the preshift or onshift book that a hazard or deviation from the planned ventilation of the 2 Left entries existed when he entered his results in the book.

Mine management failed to insure that adequate preshift and onshift examinations were made in the 2 Left entries during the day shift and evening shift on June 21, 1983. The preshift examination conducted during the day shift on June 21, 1983; the onshift examination conducted during the day shift on June 21, 1983; and the preshift examination of the conveyor belt entry conducted during the evening shift on June 21, 1983, failed to disclose that the air in the Nos. 2 and 3 entries of 2 Left was not traveling in it's normal volume and velocity. These same examinations also failed to disclose that the volume and velocity of air in the Nos. 2 and 3 entries of 2 Left were not sufficient to dilute, render harmless and to carry away the methane gas being liberated in those entries.

Mine management took air measurements in the returns of both the setup entries and 2 Left entries after the cut-through was made, but failed to detect that the air in the setup intake entries and in the Nos. 2 and 3 entries of 2 Left was not traveling in its normal volume and velocity. The air measurements taken by management indicated a 4,000 cfm decrease in the air quantity returning in the setup entries and a 4,000 cfm increase in the air quantity normally returning in 2 Left. Air measurements were not taken in the setup entry intakes or in areas outby the faces of the Nos. 2 and 3 entries to determine if this ventilation had been affected by the cut-through.

Mine management failed to properly evaluate the effects of the cut-through at the No. 40 crosscut on the ventilation of the 2 Left entries and failed to fully recognize the hazards created by the methane liberation in the 2 Left entries when the cut-through occurred and no ventilation controls were installed in the crosscut.

The preshift examinations of the belt entry conducted on the day and evening shifts on June 21, 1983, were inadequate. The examiners did not determine if the air was traveling in its proper course, and in normal volume and velocity. The examiners did not make sufficient tests for methane along the conveyor belt entry.

Belt examiners were not properly trained to conduct adequate preshift examinations of conveyor belt entries. Belt examiners were not instructed to make tests for methane or make air measurements in conveyor belt entries. Belt examiners were not always equipped with anemometers or other approved devices to allow them to take air readings in conveyor belt entries.

Atmospheric Pressure

The weather was mostly cloudy on June 21, 1983, in the Tri-City area of southwestern Virginia. Records of barometric pressure recorded by the National Weather Service for the Tri-City area from 9:46 p.m., June 20 to 9:46 p.m., June 22, were as follows:

Date	Time	Barometric Pressure
June 20	9:46 p.m.	28.50
June 21	7:48 a.m.	28.53
	8:47 a.m.	28.53
	9:46 a.m.	28.53
	10:53 a.m.	28.52
	11:48 a.m.	28.52
	12:47 p.m.	28.50
	1:47 p.m.	28.48
	2:49 p.m.	28.46
	3:49 p.m.	28.45
	4:49 p.m.	28.44
	5:48 p.m.	28.44
	6:47 p.m.	28.45
	7:48 p.m.	28.46
	8:48 p.m.	28.47
	9:47 p.m.	28.48
	10:46 p.m.	28.48
	11:46 p.m.	28.48
June 22	12:46 a.m.	28.47
	1:46 a.m.	28.46
	2:46 a.m.	28.46
	3:46 a.m.	28.47
	4:46 a.m.	28.48
	5:46 a.m.	28.49
	8:47 a.m.	28.53
	10:51 a.m.	28.54
	12:49 p.m.	28.53
	9:46 p.m.	28.55

In the opinion of MSHA investigators, these slight fluctuations of the atmospheric pressure had no bearing on the explosion.

Coal Dust

The explosion was primarily a methane gas explosion; however, the burning of coal dust lengthened the extent of flame. This is supported in part by the coke deposits observed at several locations. Generally, coking occurs on the surface of coal dust deposits and in locations where the incombustible content of the mine dust is less than 50 percent. Research has shown that coal dust in a mine entry, although inerted to 65 percent incombustible, causes an increase in the flame length when methane is burned.

During the regular safety and health inspection being conducted at the time of the explosion, 47 citations were issued throughout the mine. Of the 47 citations, 13 were issued for violations of 30 CFR 75.400 (accumulations of loose coal, coal dust or float coal dust) and 8 were issued for violations of 30 CFR 75.403 (inadequate application of rock dust).

Statements of miners who had worked on the 2 Left section indicated that the working section and belt entry of 2 Left were rock dusted prior to the explosion. Owens stated that the No. 2 belt and track entry had been rock dusted along the entire length of the belt and some rock dust drifted inby the feeder. Owens observed fresh rock dust in the No. 2 entry during his belt examination on Sunday, June 19, 1983 and believed the rock dust was applied the preceding Friday or Saturday.

On the day shift approximately seven hours before the explosion, Leonard had his crew rock dust the No. 40 crosscut and the No. 3 entry between the Nos. 39 and 40 crosscuts. Randy K. Beverly, Timberman, couldn't remember how many bags of rock dust were applied, but said the coating of rock dust was thick.

Howard stated that he applied 10 to 15 bags of rock dust around the intersection of No. 3 entry and No. 40 crosscut while the feeder was being repaired. This was about 3 hours prior to the explosion.

During the investigation, MSHA conducted a mine dust survey of the affected area of the mine. Samples were taken in the 2 Left entries, 1 Left entries, Caney Mains IV entries, Caney Mains IV bleeder entries, the setup entries and in Cranesnest Mains I entries.

A total of 528 samples were taken at varying intervals depending on their proximity to the orgin of the explosion. Entry samples were taken between the intersection of each crosscut in the 2 Left entries, Caney Mains IV bleeder entries, the setup entries and Cranesnest Mains I entries. Entry samples were taken between the intersection of every other crosscut in the 1 Left entries and Caney Mains IV entries. The samples were analyzed for incombustible content and the presence of coke. Coke was detected in 28 percent of the total samples and in 76 percent of the samples collected in the 2 Left and setup entries. The analysis and a map showing the locations of these samples are in Appendices I and Q, respectively.

The incombustible content of the 97 samples collected in the intake entries of 2 Left averaged 65.1 percent. The incombustible content of the 45 samples collected in the return entries averaged 70.1 percent. Fifty-eight percent of the intake samples were below 65 percent incombustible content and 60 percent of the return samples were below 80 percent incombustible content.

The incombustible content of the 32 samples collected in the intake entries of the setup entries averaged 48.9 percent. The incombustible content of the 10 samples collected in the return entry averaged 51.4 percent. Eighty-eight percent of the intake samples were below 65 percent incombustible content and 100 percent of the return samples were below 80 percent incombustible content. A breakdown of the incombustible content and amount of coke (extra large, large, small, and trace) in the mine dust samples taken in the 2 Left entries, setup entries, on other affected entries in the explosion area is as follows:

2 Left Entries

	No. Samples	Average Incombust Content	No. Samples Below 65% (Intake)	No. Samples Below 80% (Return)	No. Samples With Coke	Amount of Coke in Samples XL	L	S	T
No. 1 Entry (return)									
Crosscut Nos. 4-13	11	80.6	-	4	1	0	0	1	0
Total (Crosscut Nos. 0-13)	13	82.6	-	4	1	0	0	1	0
No. 2 Entry (intake)									
Crosscut Nos. 1-14	17	87.7	0	-	2	0	0	1	1
Crosscut Nos. 14-40	29	64.1	16	-	29	14	7	7	1
Total	46	72.8	16	-	31	14	7	8	2
No. 3 Entry (intake)									
Crosscut Nos. 1-14	16	64.3	9	-	12	0	0	1	11
Crosscut Nos. 14-40	33	53.1	31	-	33	18	11	4	0
Total	49	56.8	40	-	45	18	11	5	11
No. 4 Entry (return)									
Crosscut Nos. 1-14	11	84.6	-	1	3	0	0	2	1
Crosscut Nos. 14-40	23	58.2	-	22	23	12	5	5	1
Total	34	66.7	-	23	26	12	5	7	2
All Entries	142	65.1	56	27	103	44	23	21	15

Setup Entries

	No. Samples	Average Incombust Content	No. Samples Below 65% (Intake)	No. Samples Below 80% (Return)	No. Samples With Coke	Amount of Coke in Samples XL	L	S	T
No. 1 Entry (intake)									
Crosscut Nos. 0-6	5	41.8	5	-	3	0	1	1	1
Crosscut Nos. 6-10	4	50.1	4	-	4	3	1	0	0
Total	9	45.5	9		7	3	2	1	1
No. 2 Entry (intake)									
Crosscut Nos. 0-6	10	46.9	9	-	10	1	2	2	5
Crosscut Nos. 6-10	8	55.8	6	-	8	8	0	0	0
Total	18	50.9	15	-	18	9	2	2	5
No. 3 Entry									
Crosscuts 0-4 (intake)	5	48.1	4		3	1	0	0	2
Crosscuts 4-10 (return)	10	51.4	-	10	9	7	1	0	1
Total	15	50.3	4	10	12	8	1	0	3
All Entries	42	49.5	28	10	37	20	5	3	9
Cranesnest Mains I									
All Entries	58	74.9	9	9	0	0	0	0	0
Caney Mains IV Bleeder Entries									
All Entries	62	60.8	32	9	5	0	0	2	3
Caney Mains IV									
All Entries	92	86.1	2	18	0	0	0	0	0
1 Left									
All Entries	126	70.0	40	12	1	0	0	0	1
Spot Samples									
All Entries	6	77.8	1	-	0	0	0	0	0

The incombustible content of the above samples by itself cannot be taken as representative of conditions prior to the explosion because mine dust was dispersed and transported during the explosion. Consequently, MSHA investigators were unable to determine from the analysis whether or not the required incombustible content of the mine dust in the area affected by the explosion was maintained immediately prior to the explosion.

Electric Circuits and Equipment

High-Voltage Circuits and Equipment

The high-voltage circuit which extended into the 2 Left entries originated at a vacuum circuit breaker located near the mouth of the 2 Left entries. The high-voltage circuit extended from the 2 Left vacuum circuit breaker to a 300 kVA belt transformer located near the 2 Left belt drive and from there to a 950 kVA section power center located on the 2 Left working section. The 2 Left vacuum circuit breaker contained a ground-check circuit and relays designed to provide overcurrent, grounded-phase, and undervoltage protection for the 2 Left high-voltage circuit. The 2 Left belt transformer was used to supply 480-volt, 3-phase power and 120-volt, single-phase power to the 2 Left conveyor belt drive installation.

The high-voltage circuit from the 2 Left belt transformer to the 2 Left section power center contained approximately 3,000 feet of No. 4/0 AWG, 15 kV, 3-conductor, type MP-GC mine power cable and approximately 1,000 feet of No. 2/0 AWG, 15 kV, 3-conductor, type MP-GC mine power cable. The high-voltage cable was installed in the No. 3 entry and was supported from the roof on J-hooks and tie wires. Individual 1,000-foot lengths of high-voltage cable were connected together in three high-voltage splice boxes located in the No. 3 entry at the Nos. 8 and 17 right crosscuts and the No. 26 left crosscut.

None of the 2 Left high-voltage equipment was approved by MSHA as permissible. This equipment was not required to be permissible because none of the equipment was located in or inby the last open crosscut, in return air or within 150 feet of pillar workings.

According to Howard, the auxiliary fan on the 2 Left section was running just before the explosion occurred. Based on Howard's statement and on the physical examination of the 2 Left high-voltage circuits and equipment, MSHA investigators concluded that the 2 Left vacuum circuit breaker, belt transformer, high-voltage cable, and section power center were energized when the explosion occurred. Examinations and tests conducted during the investigation also revealed that the 2 Left vacuum circuit breaker tripped and deenergized the 2 Left high-voltage circuits and equipment when the force of the explosion caused the interruption of the ground check circuit at one of the splice boxes installed in the 2 Left high-voltage cable.

After the explosion occurred, Barton and R. Glovier operated the emergency stop switches for the two vacuum circuit breakers located near the bottom of the elevator shaft. This caused the vacuum circuit breakers to trip (open) and removed power from the inby high-voltage circuits. They then operated the emergency stop switches for the input circuits to the two vacuum circuit breakers located near the bottom of the elevator shaft. This caused the two oil circuit breakers located in the surface substation near the elevator shaft to trip (open). Shortly afterwards, W. Glovier went to the surface substation near the elevator shaft and observed that the two oil circuit breakers were already open. W. Glovier then went to the surface substation near the slope entrance and opened the high-voltage disconnects. As a result of R. Glovier's, Barton's, and W. Glovier's actions, all high-voltage power was removed from the underground areas of the mine.

Section Power Center

At the time of the explosion, a nonpermissible 950 kVA section power center was located in the No. 3 entry between the Nos. 36 and 37 left crosscuts on the 2 Left section. The section power center contained ten 600-volt, 3-phase receptacles and four 480-volt, 3-phase receptacles for the operation of the section equipment. At the time of the explosion, the trailing cables for the continuous mining machine, roof bolting machine, conveyor belt feeder, standard-drive shuttle car, off-standard-drive shuttle car, scoop battery charger, and welder were connected to 600-volt receptacles on the section power center; the trailing cable for the auxiliary fan was connected to a 480-volt receptacle on the section power center; and the trailing cables for the personnel carrier onboard battery charger and the trickle duster were not connected to the section power center. A single-line diagram showing the electric equipment that was connected to the 2 Left section power center at the time of the explosion is in Appendix E-3.

Based on the statements of Sutherland and Howard, the trailing cables for the continuous mining machine, roof bolting machine, and auxiliary fan were energized just before the explosion occurred. MSHA investigators could not conclusively determine if the trailing cables for the conveyor belt feeder, shuttle cars, scoop battery charger, and welder were energized when the explosion occurred. However, it is likely that these trailing cables were also energized.

The section power center also contained two 240-volt, single-phase receptacles and two 120-volt, single phase duplex receptacles. These receptacles were supplied from an 8 kVA auxiliary transformer in the power center. The primary fuses for the auxiliary transformer were tested and found to be intact. The two 40-ampere, 2-pole circuit breakers for the 240-volt single-phase receptacles were found in the open (off) positions. The dust caps on the 240-volt, single-phase receptacles were found in the closed positions. Consequently, MSHA investigators concluded that the two 240-volt, single-phase receptacles on the section power center were neither energized nor in use when the explosion occurred. The two 15-ampere, single pole circuit breakers for the 120-volt, single-phase duplex receptacles were found in the closed (on) positions. The top dust cover on the inby duplex receptacle was found in the open position. The bottom dust cover on the same receptacle was found partially open. The top dust cover on the outby duplex receptacle was found in the open position. The bottom dust cover on the same receptacle was found in the closed position. Based on the condition of the auxiliary transformer fuses and on the positions of the circuit breakers, MSHA investigators concluded that both duplex receptacles were energized when the explosion occurred. Based on statements of miners and on tests and examinations conducted during the investigation, MSHA investigators concluded that one of the duplex receptacles was being used to supply 3 incandescent light fixtures installed over the power center when the explosion occurred. Also, there is some evidence to indicate that the other duplex receptacle may have been used to supply 2 fluorescent light fixtures and 6 incandescent light fixtures installed in and near the dinner hole when the explosion occurred. Both of these circuits are discussed in greater detail in the sections on the power center lights and the dinner hole lights.

AC Equipment Connected to the Section Power Center

Continuous Mining Machine. - At the time of the explosion, a permissible-type continuous mining machine was located at the face of the No. 4 entry on the 2 Left section. The machine was connected to a 600-volt receptacle on the section power center with approximately 550 feet of No. 4/0 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable. According to Howard, French trammed the continuous mining machine into the face of the No. 4 entry and opened the gathering head circuit breaker shortly before the explosion occurred. When the explosion occurred, the machine was idle while Howard, French, Counts, Stamper and Meade were installing additional ventilation tubing to ventilate the face of the No. 4 entry.

Howard's statements agree with the physical examination of the continuous mining machine. Accordingly, MSHA investigators concluded that the continuous mining machine was energized but not in operation when the explosion occurred.

Roof Bolting Machine. - At the time of the explosion, a permissible-type roof bolting machine was located near the face of the No. 3 entry on the 2 Left section. The machine was connected to a 600-volt receptacle on the section power center with approximately 650 feet of No. 2 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable. According to Sutherland, the roof-bolting machine was trammed into the face of the No. 3 entry shortly before the explosion occurred. Sutherland and Boyd were standing at the roof-bolting machine drilling stations when the explosion occurred.

Based on Sutherland's statements and on the physical examination of the machine, MSHA investigators concluded that the roof-bolting machine was energized when the explosion occurred. However, the position of the drill heads, stabilizer jacks, drill steels, and drill bits indicated that Sutherland and Boyd had not started drilling when the explosion occurred.

Auxiliary Fan. - At the time of the explosion, a permissible-type auxiliary fan was located in the No. 4 entry just inby the No. 39 crosscut on the 2 Left section. The fan was connected to a 480-volt receptacle on the section power center with approximately 634 feet of No. 6 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable. According to Howard, the auxiliary fan was running just before the explosion occurred. However, Howard speculated that Hall may have gone to shut off the auxiliary fan when the explosion occurred.

Conveyor Belt Feeder. - At the time of the explosion, a permissible-type conveyor belt feeder was located in the No. 2 entry at the No. 36 crosscut on the 2 Left section. The conveyor belt feeder was connected to a 600-volt receptacle on the section power center with approximately 300 feet of No. 2/0 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable. The conveyor belt feeder was connected to a nonpermissible belt sequence switch installed on the 2 Left conveyor belt just outby the tailpiece with a 3-conductor cable. Neither the conveyor belt feeder nor the belt sequence switch were required to be permissible because they were not located in or inby the last open crosscut, in return air or within 150 feet of pillar workings.

The conveyor belt feeder was not being used to feed coal onto the 2 Left conveyor belt when the explosion occurred. No coal was found on the 2 Left conveyor belt. Both shuttle cars had been parked because the roof-bolting machine in the face of the No. 3 entry had the roadway blocked to the continuous mining machine in the face of the No. 4 entry. However, the conveyor belt feeder had been used on the night of the explosion. According to Sluss and Steele, the conveyor drive chain had broken at about 7:00 p.m. The drive chain was replaced and the conveyor belt feeder was returned to service at about 8:00 p.m.

The 100-horsepower motor on the conveyor belt feeder drives the pick breaker and a hydraulic pump for the operation of the conveyor. The hydraulic motor for the conveyor is controlled by the conveyor solenoid valve which is operated by a timer (approximately 148 seconds). The timer is activated by either of 2 footswitches. Due to the configuration of the control circuit, MSHA investigators could not conclusively determine if the conveyor belt feeder motor was running when the explosion occurred. However, for the motor to have been off, a miner would have had to open the main circuit breaker and then return it to the closed position (as found) or a miner would have had to travel to the hydraulic control station and push in the emergency stop switch. Since both of these events are unlikely, MSHA investigators believe that the conveyor belt feeder motor was running with the pick breaker turning when the explosion occurred. Since it was evident that neither footswitch had been operated within 148 seconds of the explosion, MSHA investigators concluded that the feeder conveyor chain was not operating when the explosion occurred.

Shuttle Cars. - One permissible-type standard-drive shuttle car and 1 permissible-type off-standard-drive shuttle car were located on the 2 Left section at the time of the explosion. The standard-drive shuttle car, normally driven by Counts, was located in the No. 39 crosscut between the Nos. 2 and 3 entries. This shuttle car was connected to a 600-volt receptacle on the section power center with approximately 627 feet of No. 6 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable. The off-standard-drive shuttle car, normally driven by Meade, was located in the No. 3 entry between the Nos. 38 and 39 left crosscuts. This shuttle car was connected to a 600-volt receptacle on the section power center with approximately 476 feet of No. 6 AWG, 600-volt, 3-conductor, type G-GC portable power cable. The roof bolting machine in the face of the No. 3 entry had the roadway blocked to the continuous mining machine in the face of the No. 4 entry. According to Howard, entry at the time of the explosion. Both Counts' and Stamper's bodies were found next to the continuous mining machine in the No. 4 entry. Based on the examination of the shuttle cars and on the locations of the miners and section equipment when the explosion occurred, MSHA investigators concluded that both shuttle cars had been parked some time prior to the explosion.

Scoop Battery Charging Station. - At the time of the explosion, a battery charging station was located in the No. 33 crosscut between the Nos. 3 and 4 entries on the 2 Left section. The battery charging station was used to provide charged batteries for the battery-powered scoop used on the section. The charging station consisted of a nonpermissible battery charger located in the No. 33 crosscut between the Nos. 3 and 4 entries and a spare set of scoop batteries located on a charging stand at the intersection of the No. 33 crosscut and the No. 4 entry. The battery charger was connected to a 600-volt receptacle on the section power center with approximately 613 feet of No. 6 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable. The charging cables from the battery charger were not connected to the spare set of batteries and both electrically driven charging timers in the battery charger had timed off (open).

Since the battery charger output cables were not connected and the charging timers had timed off, MSHA investigators concluded that the scoop battery charging station was not in use when the explosion occurred.

Welder. - A nonpermissible dc rectifier arc welder was found in the No. 3 entry approximately 13 feet inby the section power center on the 2 Left section. The welder was connected to a 600-volt receptacle on the section power center with approximately 38 feet of No. 6 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable. There were no miners near the welder when the explosion occurred and the main on-off switch was in the off position. Also, the welding leads were coiled on top of the welder. Consequently, MSHA investigators concluded that the welder was not in use when the explosion occurred.

Power Center Lights. - MSHA investigators found the parts of a string of 3 incandescent light fixtures outby and along side of the off-standard-drive shuttle car approximately 129 and 160 feet inby the section power center in the No. 3 entry on the 2 Left section. A brass check tag marked "POWER CENTER LIGHTS 120 VAC" was attached to the cable for the fixtures near the plug end.

During the investigation, Willis identified the 3 light fixtures as the ones that were hanging over the section power center at the end of the day shift on June 21, 1983. According to Willis and others, the section power center was moved up approximately 1 crosscut on the midnight shift on June 21, 1983. The move crew did not install the lights over the power center at its new location. Willis, however, installed the lights over the power center on the day shift on June 21, 1983. According to Willis, the lights were on at the end of the day shift on June 21, 1983. Also, Howard stated that the lights over the power center were on when he observed them during the evening shift on June 21, 1983.

MSHA investigators found both 15-ampere, single-pole, circuit breakers in the section power center in the closed (on) position. Each circuit breaker supplied a single 120-volt ac duplex receptacle. On the inby receptacle, the top dust cover was found open and the bottom dust cover was found partially open. On the outby receptacle, the top dust cover was found open and the bottom dust cover was found closed. The plug on the cable for the power center lights was compatible with the duplex receptacles on the power center. Based on information provided by Willis and Howard and on the examination of the light cable and the power center, MSHA investigators concluded that the power center lights were energized when the explosion occurred.

Dinner Hole Lights. - According to Willis, there was a fluorescent light fixture hanging from the roof in the intersection of the No. 3 entry and the No. 36 right crosscut on the 2 Left section on the day shift on June 20, 1983. The supply cord for this light fixture was plugged into one of the 120-volt ac duplex receptacles on the section power center. A second fluorescent light fixture was hanging over the table in the dinner hole in the No. 36 right crosscut. The supply cord for the second fixture was plugged into the connector on the feed-through output of the first fixture. There were also 6 incandescent light fixtures hanging over the table in the dinner hole. These 6 fixtures consisted of 2 strings of 3 fixtures each. The connector on the supply cord for the first string of incandescent light fixtures was connected to the connector on the feed-through output of the second fluorescent light fixture. The supply cord for the second string of incandescent light fixtures was connected to the feed-through connector on the first string. According to Willis, the 6 incandescent light fixtures had 250-watt infrared heat lamps in them. Willis also stated that the 2 fluorescent lights and the 6 incandescent lights were operating on the day shift on June 20, 1983.

According to Willis and others, the section power center was moved up one crosscut on the midnight shift on June 21, 1983. When Willis arrived on the 2 Left section on the day shift on June 21, 1983, the dinner hole lights were no longer connected to the section power center because the supply cord for the lights would not reach to the power center at its new location. Willis intended to make an extension cord so that the dinner hole lights could be used. Willis stated that he went to the underground supply house and obtained approximately 125 feet of No. 14 AWG, 3-conductor, type SO cord for that purpose. However, according to Willis, other work prevented him from making the extension cord. Willis stated that he left the cord along the rib where the section personnel carrier was parked at the end of the shift. Willis also stated that the fluorescent light fixture in the dinner hole was hanging horizontally over the table on the day shift on June 21, 1983.

Sutherland and Howard differ on whether the dinner hole lights were operating on the night of the explosion. Sutherland is fairly certain the lights were operating while Howard is fairly certain they were not. It is possible that they are both correct, since Sutherland ate dinner after Howard. McCoy could have connected the lights between the time Howard and Sutherland ate dinner. MSHA investigators concluded that the dinner hole lights could have been energized when the explosion occurred.

AC Equipment Not Connected to a Power Source

At the time of the explosion, a permissible-type trickle duster was located in the No. 38 crosscut between the Nos. 3 and 4 entries on the 2 Left section. The trickle duster was provided with a No. 10 AWG, 5-conductor, 600-volt, flexible cord; however, the cord was not connected to a section power center receptacle when the explosion occurred.

At the time of the explosion, a permissible-type auxiliary fan was located in the No. 32 crosscut between the Nos. 3 and 4 entries on 2 Left. This fan was not provided with a trailing cable and had evidently been abandoned well before the explosion.

The battery-powered personnel carrier was equipped with an onboard, 480-volt, 3-phase battery charger. However, the onboard battery charger was not connected to the section power center when the explosion occurred.

Battery-Powered Personnel Carrier

During the recovery following the explosion, a nonpermissible, track-mounted battery-powered personnel carrier was found on the 2 Left track just inby a curtain that was installed across the track entry near the No. 2 crosscut. The personnel carrier was not required to be permissible because it was not used in or inby the last open crosscut, in return air or within 150 feet of pillar workings. The personnel carrier was the one that was used to transport the 2 Left section crew to the section at the beginning of the shift. When the personnel carrier was first observed during the recovery, it still felt warm to the touch, and the lights were shining in the outby direction. The bodies of McCoy and Riner were found along the 2 Left track. McCoy's body was found just inby the No. 16 crosscut on the conveyor belt side of the track. Riner's body was found on the rib side of the track between the Nos. 15 and 16 crosscuts. Apparently, McCoy was transporting Riner off the 2 Left section when the explosion occurred. MSHA investigators concluded that the personnel carrier was being operated on the 2 Left track when the explosion occurred. McCoy and Riner were apparently blown out, jumped out, or fell out of the personnel carrier. The personnel carrier continued to coast and came to rest where it was found near the No. 2 crosscut.

Battery-Powered Scoop

At the time of the explosion, a permissible-type battery-powered scoop was located in the No. 40 crosscut between the Nos. 2 and 3 entries on the 2 Left section. There were no miners near the scoop when the explosion occurred. Howard stated that the scoop was probably not moved during the evening shift on June 21, 1983. According to Leonard, the scoop was used at the end of the day shift on June 21, 1983, to clean the No. 40 crosscut after the cut-through into the setup entries had been completed. Based on Howard's and Leonard's statements and on the physical examination of the machine, MSHA investigators concluded that the battery-powered scoop had been parked some time before the explosion, possibly near the end of the day shift on June 21, 1983.

Belt Control Cable and Remote Start/Stop Switch

At the time of the explosion, approximately 3,750 feet of No. 14 AWG, 2-conductor, type SO cord was installed along the 2 Left conveyor belt (No. 2 entry) to allow remote control of the 2 Left conveyor belt. The control cable originated at the 2 Left belt controller near the mouth of the 2 Left entries and extended to a nonpermissible remote start/stop switch located at the intersection of the No. 2 entry and the No. 36 crosscut on the 2 Left section near the conveyor belt feeder. Individual 250-foot lengths of cable were connected together by means of 15-ampere, 2-pole with ground, twist-lock connectors. The cable was suspended from timbers on insulated hooks.

The investigation revealed that the 2 Left belt controller was connected to a 480-volt, 3-phase receptacle on the 2 Left belt transformer when the explosion occurred. MSHA investigators found the circuit breaker in the belt transformer in the tripped position. However, testing conducted during the investigation revealed that there were no faults in the 2 Left conveyor belt power circuit which could have caused the circuit breaker to trip. Consequently, MSHA investigators concluded that the circuit breaker tripped due to the undervoltage condition resulting from the loss of high-voltage power when the explosion occurred. Therefore, MSHA investigators concluded that the 2 Left belt controller was energized when the explosion occurred.

MSHA investigators found both the main circuit breaker and the control circuit breaker in the 2 Left belt controller in the closed (on) positions. The hand/off/automatic control switch was found in the automatic position indicating that the operation of the 2 Left conveyor belt was controlled by a remote start/stop switch located near the conveyor belt drive unit, a remote start/stop switch located near the conveyor belt feeder and a sequence switch on the outby conveyor belt. All three switches were found properly connected in series into the 120-volt ac control circuit for the 2 Left belt controller. The investigation revealed that the outby conveyor belt was operating when the explosion occurred. Consequently, the 2 Left belt control cable was energized when the explosion occurred.

The remote start/stop switch located near the conveyor belt feeder was damaged by the explosion so that MSHA investigators could not determine whether the switch contacts were closed (on) or open (off) when the explosion occurred. However, the conveyor belt feeder had been repaired approximately 2 hours before the explosion and there was no evidence to indicate that the 2 Left conveyor belt was not operating when the explosion occurred. Consequently, MSHA investigators concluded that the remote start/stop switch was closed (on) when the explosion occurred. As a result, the switch and the 2 Left belt control cable were carrying the operating current of a control relay and a timer in the 2 Left belt controller when the explosion occurred.

Telephones and Telephone Line

Reportedly, there were two permissible-type telephones located in the explosion area at the time of the explosion. The first telephone was found hanging from a roof bolt plate at the intersection of the No. 2 entry and the No. 36 crosscut near the conveyor belt feeder. Reportedly, the second telephone was located near the intersection of the No. 2 entry of 2 Left and the No. 3 entry of the longwall setup entries. The investigators did not find the second telephone during the investigation.

At the time of the explosion, approximately 4,000 feet of 2-conductor, No. 16 AWG, twisted-pair telephone line was installed on timbers in the No. 2 entry of 2 Left to connect the telephones in the explosion area into the mine telephone system. The telephone line was damaged severely by the explosion. In many locations, the conductor insulation was burned completely off. The telephone line had been pulled apart at several locations where timbers were dislodged. It was not possible for MSHA investigators to determine if all of the breaks in the telephone line were caused by the force of the explosion or if any of the breaks had occurred prior to the explosion.

Belt Fire Detection Circuit

At the time of the explosion, approximately 3,750 feet of heat detection cable, with point-type heat sensors, was installed along the 2 Left conveyor belt (No. 2 entry) from the belt drive unit to near the belt tailpiece. This cable was connected into the mine belt fire detection system. The control unit for the system was approved by MSHA as permissible and was located in the surface breaker building.

Methane Detectors, Cap Lamps and Voltohmmeter

Three permissible-type methane detectors were recovered by MSHA investigators after the explosion. The first methane detector was found on the body of Hall. The second methane detector was found on the body of French. The third methane detector was found near the body of McCoy.

Ten permissible-type electric cap lamps were recovered by MSHA investigators after the explosion. One cap lamp was found on each of the bodies of French, Stamper, Riner, and McCoy. Two cap lamps were found near the face of the No. 3 entry. One cap lamp was found in the No. 40 crosscut between the Nos. 3 and 4 entries. Three cap lamps were found near the face of the No. 4 entry.

A voltohmmeter was found in the No. 3 entry approximately 28 feet inby the section power center on the 2 Left section. There were no miners near the meter when the explosion occurred. Consequently, MSHA investigators concluded that the meter was not in use when the explosion occurred.

Self-Rescuers

The filter-type self-rescuers of all the victims, with the exception of one were found unused either on their belts or near their bodies. The filter-type self-rescuer of one shuttle car driver was found under the seat of the shuttle car approximately 150 feet from the shuttle car operator. The investigators found numerous self-contained self-rescuers (SCSRs) at various locations on the working section. It was determined that some of the SCSRs were brought to the section and left by the rescue parties. Thirteen of the SCSRs were secured by MSHA for testing by the Bureau of Mines, Pittsburgh Research Center. The SCSR's test results appear in Appendix H. Observations made during the investigation indicated that SCSRs were available for all persons on the 2 Left section. None of the filter-type or SCSRs were used by the 2 Left section miners after the explosion. Two of the survivors, Sutherland and Howard, attempted to use their filter-type self-rescuers, but their hands were burned and they were dazed by the explosion and were unable to get the devices off their belts.

Several miners on other sections used their filter-type self-rescuers and one used an SCSR during the evacuation of the mine.

<u>Extent of Flame and Forces</u>

The determination of the extent of flame and forces of the explosion was made primarily from underground observations of the investigation team. The results of the mine dust survey were also used in these determinations.

Flame

The extent of flame travel was determined from melted plastic brattice cloth, melted telephone line, charred paper and coke deposits on the roof, ribs, timbers, cribs, conveyor belt stands and wooden boards used to support the ribs.

In the 2 Left entries, evidence of flame was present in the No. 2 entry from the No. 15 crosscut inby, in the No. 3 entry from the No. 13 right crosscut inby, in the No. 4 entry inby the No. 28 crosscut and in all the crosscuts from the Nos. 14 through 40. There was very little evidence of flame in the No. 4 entry outby the No. 28 crosscut. Consequently, the evidence of flame in the Nos. 14 through 28 right crosscuts indicates that the flame entered these crosscuts from the No. 3 entry. There was little or no evidence of flame in 2 Left outby the No. 13 crosscut indicating that the flame did not enter the Cranesnest Mains I entries.

In the setup entries, evidence of flame was present in all 3 entries and connecting crosscuts between 2 Left and the No. 4 entry of 1 Left. There was little or no evidence of flame extending into the No. 4 entry of 1 Left, indicating that the flame did not enter the 1 Left or Caney Mains IV bleeder entries.

An analysis of the ventilation of the setup entries and the 2 Left entries indicates that explosive concentrations of methane were not present in the setup entries, in or inby the No. 40 crosscut of 2 Left, or in the No. 4 (return) entry of 2 Left immediately before the explosion occurred. Consequently, MSHA investigators concluded that the evidence of flame in these locations resulted from the combustion of methane that was pushed there by the expansion of the gases and the pressure wave that preceded the flame during the explosion.

Some small soot streamers, less than 1/4-inch in length, were observed at random locations in the 2 Left entries, primarily in the No. 1 entry between the Nos. 11 and 13 crosscuts.

Coking was observed in all of the 2 Left entries and in the longwall setup entries. The heaviest visible coke deposits were observed in the Nos. 2, 3, and 4 entries between the No. 35 crosscut and the faces of 2 Left. The coke deposits diminished in size with the distance from these locations. These coke concentrations may have occurred because of a decrease in flame velocity as the flame reached the faces and turned into the setup entries. Coke was observed as far outby as the No. 13 crosscut in the No. 3 entry.

The mine dust samples collected for analysis of incombustible content were also analyzed for coke. Chemical analysis for coke is more sensitive than visual observation, and coking was found by chemical analysis beyond the areas where coke was visually observed. However, the investigators believe that the coke in most areas where it could not be visually observed was carried there by the air movements during the explosion. The amount of coke in the dust samples is shown in Appendix I.

From the observations made in the mine, the extent of flame travel was well defined. Based on these observations, the total length of flame travel in the entries and crosscuts of the 2 Left and setup entries was approximately 12,000 linear feet. The extent of flame travel is shown on a map in Appendix S.

The extent of the explosive gas body immediately prior to the explosion can be estimated from the extent of flame travel, the forces of the explosion, evidence of coke in the area, and by the measured quantities of methane that were being liberated in the Nos. 2 and 3 entries of 2 Left after the explosion. It is evident from the forces of the explosion that the average concentration of methane in the explosive gas body was near the lower explosive limit (i.e. 6 to 6-1/2 percent). Research has shown that the flame expansion for a methane gas explosion of this concentration is approximately 3 times the original volume of the explosive gas body. Research has also shown that coal dust, even when inerted to 65 percent incombustible, causes a significant increase in the flame length when methane is burned. The fact that some coke deposits were observed in the explosion area indicates that the incombustible content of the mine dust at these locations was less than 50 percent or that coke formed on exposed coal surfaces. Coke was also present in many of the mine dust samples collected in the explosion area. Consequently, it is evident that coal dust was burned during the explosion and contributed to the total flame length. It was determined that about 70 cfm of methane was being liberated in the Nos. 2 and 3 entries of 2 Left and about 60 percent of the methane or 42 cfm would be retained because of the reduction in the airflow in these entries.

Based on the estimated methane liberation and the assumption that the mine dust in the explosion area contained 65 percent incombustible material, MSHA investigators estimated that approximately one-third to one-half of the total flame expansion can be attributed to burning coal dust. Since the total length of flame travel in the entries and crosscuts of the 2 Left and setup entries was approximately 12,000 linear feet, MSHA investigators estimated that the total length of the explosive gas body would range from 2,000 to 2,700 linear feet.

Forces

The magnitude and direction of the forces of the explosion were determined from the effects of the forces on equipment, permanent stoppings, timbers, and other materials and from the direction dust, mud, and debris were impacted on timbers, roof bolt plates, rib boards, and equipment. The major forces of the explosion were confined to the 2 Left entries, the setup entries, and the Caney Mains IV bleeder entries. Evidence of minor forces was also observed in the 1 Left entries and the Caney Mains IV entries.

In the No. 2 entry of 2 Left, the major forces of the explosion were in the outby direction from the No. 25 crosscut. Although, the exact location of the personnel carrier at the time of the explosion is not known, dust impacted on the inby end (and not the outby end) indicates that the forces of the explosion approached the vehicle from inby. The major forces of the explosion in the No. 2 entry were in the inby direction from the No. 36 crosscut. The forces of the explosion deposited a thick coating of mud and dust on the outby end of the supply car that was located in the No. 2 entry near the No. 36 crosscut. The forces of the explosion in the No. 2 entry between the Nos. 25 and 36 crosscuts were either weak or bidirectional.

In the No. 3 entry of 2 Left, the major forces of the explosion were in the outby direction from the No. 26 left crosscut. The high-voltage splice box that was originally located in the No. 3 entry near the No. 26 left crosscut was blown outby approximately 140 feet by the forces of the explosion. The lid was also blown off the splice box and came to rest approximately 200 feet outby its original location. The major forces of the explosion in the No. 3 entry were in the inby direction from the No. 36 left crosscut. The inby lid of the section power center that was located in the No. 3 entry between the Nos. 36 and 37 left crosscuts was blown off the power center and came to rest approximately 37 feet inby its original location. The incandescent light fixtures that had been installed over the section power center were moved up to 169 feet inby their original location by the forces of the explosion. The forces of the explosion in the No. 3 entry between the Nos. 26 and 36 left crosscuts were either weak or bidirectional.

In the No. 4 entry of 2 Left, the major forces of the explosion were in the outby direction from the No. 25 crosscut. The major forces of the explosion were in the inby direction from the No. 37 crosscut. The forces of the explosion turned the auxiliary fan that was located in the No. 4 entry just inby the No. 39 crosscut and deposited a thick coating of mud and dust on the outby side. The forces of the explosion in the No. 4 entry between the Nos. 25 and 37 crosscuts were either weak or bidirectional.

All permanent stoppings installed in and inby the Nos. 13 left and right crosscuts of 2 Left were damaged or destroyed by the forces of the explosion, except for 4 permanent stoppings that were provided with mandoors. The undamaged stoppings were located in the Nos. 14 left, 29 left, 26 right, and 36 right crosscuts.

Blocks from the stoppings in the Nos. 13 and 15 through 28 left crosscuts were blown toward the No. 3 entry. Blocks from the stoppings in the Nos. 30 through 33 left crosscuts were blown toward the No. 2 entry. Blocks from the stoppings in the Nos. 34 and 35 left crosscuts were blown toward the No. 3 entry. Blocks from the stoppings in the Nos. 13 through 25 and 27 through 35 right crosscuts were blown toward the No. 4 entry except for the No. 30 crosscut. Blocks from the stoppings in the No. 30 crosscut and in the Nos. 37 through 39 right crosscuts were blown toward the No. 3 entry. The Nos. 36 through 40 left crosscuts and the No. 40 right crosscut did not have permanent stoppings in them.

Two regulators and 2 permanent stoppings outby the No. 13 crosscut in 2 Left were also damaged. The 2 regulators at the mouths of the Nos. 1 and 4 entries were constructed by dry stacking concrete blocks and leaving an area open to attain the desired air flow. It would only require a slight increase in pressure to dislodge these blocks. The 2 stoppings that were partially damaged were evidently weakly constructed or manually removed since adjacent controls in the line of force remained intact.

The major forces of the explosion traveled from the 2 Left entries, through the setup entries, and into the 1 Left and Caney Mains IV bleeder entries. The forces of the explosion destroyed all four permanent stoppings that had been installed between the Nos. 2 and 3 entries of the setup entries. The setup entries were connected to the Caney Mains IV bleeder entries with four connector entries. The forces of the explosion destroyed the three permanent stoppings that had been installed in the connecting entries. There was no ventilation control in the fourth (right) connecting entry at the time of the explosion. However, two overcasts that were under construction in the first two intersections in the Caney Mains IV bleeder entries in line with this entry were damaged.

A regulator in the 1 Left return entry, and 3 permanent stoppings at the gas well offset in the Caney Mains IV entries were also partially damaged. However, adjacent controls remained intact and these controls were evidently weakly constructed.

The direction and extent of forces are shown on the map in Appendix S. The direction of the major forces of an explosion cannot be used to determine the precise point of ignition. Nevertheless, several general conclusions about the point of ignition can be drawn from the directions of the major forces in the explosion area. The directions of the major forces in the setup entries and in the 2 Left entries inby the No. 37 crosscut indicate that the point of ignition was outby the No. 37 crosscut of 2 Left. The direction of the major forces outby the No. 25 crosscut indicate that the point of ignition was inby the No. 25 crosscut of 2 Left.

The physical condition of the survivors at the faces of the 2 Left entries, the minimal physical dislocation of equipment and material in the explosion area, and the condition of the blown out stoppings indicate that the explosion was relatively mild. Based on research into mine explosions, MSHA investigators estimated that a pressure differential of 1 to 1-1/2 pounds per square inch (psi) would be required to induce rupture of the permanent stoppings in the explosion area. The magnitude of the forces observed in the explosion area is consistent with an explosion involving an average methane concentration near the lower explosive limit (i.e. 6 to 6-1/2 percent). Research has shown that a methane gas explosion of this concentration would develop gage pressures of 2 to 5 psi (psig) with a flame velocity of 100 to 200 ft/sec. The actual pressure and flame velocity during the explosion would depend on the volume of the explosive gas body, the degree of mixing of the methane and air, and the point of ignition within the explosive gas body.

The magnitude of the forces observed in the explosion area, the relatively small amounts of visible coke, and the analyses of the mine dust samples from the explosion area indicate that the explosion did not develop into a propagating coal dust explosion. MSHA investigators believe, however, that burning coal dust contributed to the total flame expansion during the explosion. If a propagating coal dust explosion had occurred, then flame speeds in excess of 800 ft/sec. could be encountered. This flame speed corresponds to a static pressure of about 15 psi and a dynamic pressure of about 30 psi. Such pressures would produce considerably more damage than was observed in the explosion area.

Potential Ignition Sources

Electric Circuits and Equipment

During the investigation, the electric circuits and equipment that were located in the 2 Left entries or that supplied power to electric equipment in the 2 Left entries were carefully tested and examined for any evidence that they provided the ignition source for the explosion. The results of these tests and examinations are summarized below. A detailed description of all tests and examinations conducted by MSHA investigators on the electric circuits and equipment that were located in the 2 Left entries or that supplied power to electric equipment in the 2 Left entries is contained in Appendix E-1.

High-Voltage Circuits and Equipment

MSHA investigators did not find any evidence to indicate that the 2 Left high-voltage cable or high-voltage equipment provided the ignition source for the explosion.

Section Power Center: Low-Voltage Portion

The section power center was not of a permissible design. Consequently, arcing caused by a fault within the power center or by the manual or automatic operation of one of the circuit breakers, relays, and switches in the power center would release sufficient energy to ignite an explosive methane-air atmosphere. Careful examination of the power center revealed no evidence of a short circuit or ground fault in the power center. The locations of the miners on the 2 Left section when the explosion occurred indicates that none of the miners was in a position to manually operate any of the switches or circuit breakers in the power center. Tests and examinations of the electric equipment connected to the section power center when the explosion occurred did not reveal any evidence of a fault that could have caused automatic operation of a circuit breaker in the power center. However, tests and examinations of the trailing cables connected to the section power center when the explosion occurred revealed evidence of several faults that could have caused automatic operation of one of the circuit breakers in the power center (See following section on section trailing cables.) Consequently, MSHA investigators concluded that the section power center could have provided the ignition source for the explosion.

Section Trailing Cables

MSHA investigators carefully examined and tested each of the eight trailing cables that were connected to the section power center to determine if a fault in one of the cables could have provided the ignition source for the explosion. A fault in an energized trailing cable could provide the ignition source either directly by electrical arcing at the fault locations or indirectly by causing automatic operation of a circuit breaker in the section power center.

Auxiliary Fan Trailing Cable. - The trailing cable for the auxiliary fan was tested and examined. Insulation resistance measurements revealed phase-to-ground leakage on the black and red phase conductors. The leakage to ground on the red phase conductor (50,000 ohms) was caused by damage to the cable approximately 4 feet (cable length) outby the auxiliary fan. The cable jacket and insulation on the red phase conductor had been cut; however, there was no evidence of electrical arcing at this location. From the location of the damaged place and the absence of any evidence of electrical arcing, MSHA investigators concluded that the damage was caused by the explosion. The leakage to ground on the black phase conductor (12,000 ohms) was caused by a defective splice and a damaged place in the cable located approximately 190 feet and 200 feet (cable lengths), respectively, outby the auxiliary fan. Both the splice and damaged place in the cable were lying in water. MSHA investigators cut open the splice and the damaged place and found no evidence of electrical arcing at either location. However, evidence of electrical arcing would not necessarily be present since the ground-fault current was limited to 15 amperes and the circuit was provided with ground fault protection set at 6.5 amperes. Consequently, MSHA investigators concluded that a ground fault in the auxiliary fan trailing cable could have occurred and could have provided the ignition source for the explosion by causing the circuit breaker in the section power center to trip.

Conveyor Belt Feeder Trailing Cable. - The trailing cable for the conveyor belt feeder was tested and examined. Insulation resistance measurements revealed phase to ground leakage on the black (30,000 ohms) and white (25,000 ohms) phase conductors. MSHA investigators cut into one damaged place and 6 taped repairs in the cable to find the cause of the leakage to ground. The damaged place and repairs were located approximately 5 feet, 16 feet, 25 feet, 47 feet, 157 feet, 166 feet, and 202 feet (cable lengths) from the conveyor belt feeder. At the damaged place in the cable, the outer jacket and insulation on the black phase conductor were cut. Evidence indicated that the damage to the cable may have been caused by a rib fall that occurred during the investigation. There was no evidence of electrical arcing at the damaged place in the cable. Several of the cable repairs were not well insulated and moisture was present within the repairs. One of the cable repairs contained evidence of a ground fault. This repair was located where the trailing cable was lying on the mine floor between the conveyor belt feeder and the rib approximately 5 feet (cable length) from the controller enclosure on the conveyor belt feeder. The taped jacket and the insulation on the white phase conductor were damaged. The distinctive odor of electrical arcing was present in the repair. MSHA investigators could not determine when the ground fault occurred; however, the distinctive odor in the repair indicates that the fault was recent. There was no evidence of electrical arcing in any of the other cable repairs. Based on the evidence of electrical arcing in the cable repair, MSHA investigators concluded that a ground fault in the conveyor belt feeder trailing cable could have provided the ignition source for the explosion either directly by electrical arcing at the fault location or indirectly by causing the circuit breaker in the section power center to trip.

Other Section Trailing Cables. - Tests and examinations did not reveal evidence of a short circuit or ground fault that could have provided the ignition source for the explosion in any of the other trailing cables in the 2 Left section.

Trailing Cable Plugs. - The plugs for the eight trailing cables that were connected to the section power center when the explosion occurred were also examined and tested. There was evidence that an arcing fault had occurred inside the plug on the outby end of the continuous mining machine trailing cable. Copper strands of the phase and grounding conductors had been melted. A small portion of the brass connectors for the phase and grounding conductors had been melted. The grounding conductors had been discolored by heat and carbon had been deposited on the internal surfaces of the plug. Insulation resistance measurements revealed that the plug was free from short circuits and ground faults at the time of the investigation. MSHA investigators could not determine what caused the arcing fault or when the fault occurred. However, there was very little of the distinctive odor of electrical arcing present in the plug, indicating that the fault probably occurred long before the explosion. Nevertheless, the fault was capable of providing the ignition source for the explosion either directly from electrical arcing or indirectly by causing automatic operation of the circuit breaker in the power center. There was no evidence of a fault in any of the other seven trailing cable plugs that were connected to the section power center when the explosion occurred.

AC Equipment Connected to the Section Power Center

Intermachine Arcing. - No two units of electric equipment were located in close proximity to each other at the time of the explosion. Consequently, MSHA investigators concluded that arcing between the frames of two units of electric equipment did not provide the ignition source for the explosion.

Electric Face Equipment. - MSHA investigators did not find any evidence to indicate that the continuous mining machine, roof bolting machine, auxiliary fan, conveyor belt feeder or shuttle cars provided the ignition source for the explosion.

Scoop Battery Charging Station. - MSHA investigators did not find any evidence to indicate that the scoop battery charging station provided the ignition source for the explosion.

Welder. - MSHA investigators did not find any evidence to indicate that the welder provided the ignition source for the explosion.

Power Center Lights. - MSHA investigators did not find any evidence to indicate that the lights installed over the power center provided the ignition source for the explosion.

Dinner Hole Lights. - Each of the two fluorescent light fixtures used in the 2 Left dinner hole light circuit was a Daniel Woodhead Company, Catalog No. 1051, portable fluorescent light fixture. This fixture was designed for use in a 120-volt ac circuit and included an oval plastic tube with two molded rubber end caps. Inside the plastic tube was a metal assembly which contained a wiring trough and supported 2 ballasts and lamp holders for two 40-watt fluorescent lamps. The fixture was designed for feed-through connection to allow several fixtures to be connected together in a string. Originally, the supply cable consisted of approximately 25 feet of No. 16 AWG, 3-conductor, type SJO cord with a 15-ampere, 2-pole with ground, straight-blade, male connector (plug) on the end. The feed-through cable consisted of approximately 6 inches of the same type of cord with a 15-ampere, 2-pole with ground, straight-blade, female connector on the end. Two weatherproof strain-relief connectors were provided (one in each end cap) to attach the supply and feed-through cables to the fixture. The fixture was also provided with a strap to allow it to be suspended.

Each of the 6 incandescent light fixtures in the dinner hole was a Daniel Woodhead Company, Catalog No. 300W, "Protex Safety Yellow" light fixture. Each fixture was made of molded rubber and consisted of a connection compartment and a weatherproof lamp holder that also served as the cover for the connection compartment. The fixture was designed for feed-through connection to allow several fixtures to be connected together in a string. Two weatherproof, strain-relief connectors were provided to attach the supply and feed-through cables to the fixture. The lamp holder was provided with pigtails for connecting the lamp socket to the power conductors in the supply and feed-through cables. A metal plate was provided in the connection compartment for connecting the grounding conductors in the supply and feed-through cables. Originally, each fixture had a plastic-coated, metal wire guard for the lamp and an "S" shaped hook to allow the fixture to be suspended. Each of the incandescent light fixtures in the dinner hole originally had a Westinghouse 250-watt infrared, 115-125-volt, Heat-Ray Lamp™ in it.

The fluorescent light fixture that was originally hanging in the middle of the No. 3 entry was found on the high-voltage cable sled approximately 83 feet inby its original location. The fixture had been severely damaged. The supply cord had been pulled out of the fixture. The plastic lens had been severely burned and melted. One of the fluorescent lamps had been broken; however, the other lamp was intact. The supply cord for the fixture was found along side the off-standard-drive shuttle car in the No. 3 entry inby the No. 38 left crosscut. The cord had a brass check tag attached near the connector end. The tag was marked "DINNER HOLE LIGHTS 120VAC". The connector was a 15-ampere, 2-pole with ground, straight-blade male plug. The plug was compatible with the 120-volt ac duplex receptacles on the section power center. One of the blades on the plug had been bent out away from the opposite blade. The feed-through connector on the fixture was a 15-ampere, 2-pole with ground, twist-lock female connector which was different from the straight-blade female connector originally supplied with the fixture.

The second fluorescent light fixture was found in the dinner hole. One end of the supporting strap had broken and the fixture was hanging vertically with one end resting on the table in the dinner hole. The plastic lens had sagged toward the bottom end indicating that the fixture was in the vertical position when it was subjected to the heat of the explosion. The supply cable for the fixture was still attached to the fixture and was supported from roof bolt plates with twisted wire at 2 locations. The cable jacket had been blistered at numerous locations by the heat of the explosion. The cord had a 15-ampere, 2-pole with ground, straight-blade, male plug on the end. The feed-through connector on the fixture was also a 15-ampere, 2-pole with ground, straight-blade male plug. This male plug was different from the female connector originally supplied with the fixture.

The 6 incandescent light fixtures were found hanging over the table in the dinner hole. The supply cable for the first string of three incandescent fixtures had a 15-ampere, 2-pole with ground, straight-blade, female connector on the end. This connector was compatible with the male feed-through connector on the fluorescent fixture in the dinner hole. However, when found, the connectors were not plugged together. Due to the way the connectors were taped the investigators concluded that at one time the connectors had been plugged together and taped. Close examination of the tape revealed that the tape had been cut prior to the explosion. Consequently, MSHA investigators could not definitely determine whether or not the connectors were plugged together when the explosion occurred.

The feed-through cable on the first string of incandescent light fixtures was terminated in a 15-ampere, 2-pole with ground, straight-blade, female connector. When found, a 15-ampere, 2-pole with ground, straight-blade, male connector for the second string of incandescent light fixtures was plugged into the feed-through connector on the first string of incandescent light fixtures. The 2 connectors were still taped together. There was no feed-through cable attached to the second string of incandescent light fixtures. The unused cable opening in the last fixture was plugged.

The first, second, fifth, and sixth incandescent light fixtures had undamaged 250-watt infrared lamps in them. A 250-watt infrared lamp was still attached to the third fixture. However, the cement that had held the lamp envelope to the lamp base had softened allowing the envelope to drop down. The envelope was supported by the outside filament support wire which was still attached to the base. A 250-watt infrared lamp had been installed in the fourth fixture. However, the envelope had been broken and only the lamp base and filament remained in the fixture.

The first and third incandescent light fixtures were not provided with guards. The other fixtures were provided with guards. The guards had been cut and spread open to accomodate the infrared lamps. Much of the plastic coating on the guards had been burned or melted off.

MSHA investigators could not find the No. 14 AWG, 3-conductor, type SO cord that Willis stated he brought to the section on the day shift on June 21, 1983. However, MSHA investigators did find a piece of No. 14 AWG, 2-conductor, type SO cord approximately 81 1/2 feet long. The cable originated between the left rib and the section power center (near the 120-volt ac duplex receptacles on the power center), extended outby to a location where the cable was suspended from a roof-bolt plate with a twisted wire, and then looped back toward the power center. The end of the cable near the duplex receptacles on the power center was provided with a 15-ampere, 2-pole with ground, straight-blade, male plug which was compatible with the 120-volt ac duplex receptacles on the power center. The jacket had been removed for approximately 1 inch on the other end of the cable. The insulation had been removed for approximately 1/2 inch on the 2 conductors at this end of the cable. This length of cable would reach from the duplex receptacles on the section power center to the inby end of the supply cable for the flourescent light fixture that had been installed at the intersection of the No. 3 entry and the No. 36 right crosscut.

MSHA investigators found another piece of No. 14 AWG, 2-conductor, type SO cord approximately 27 feet long. This length of cable was found at the intersection of the No. 3 entry and the No. 35 left crosscut. There were no connectors installed on the ends of this length of cable. It is relevant to note the sum of the two lengths of cable is approximately 108 1/2 feet. It is possible that this is the same cable that Willis brought on the section on the day shift. Willis could have mistaken 2-conductor, type SO cord for 3-conductor, type SO cord.

MSHA investigators also found a 15-ampere, 2-pole with ground, straight-blade, female connector in the No. 3 entry between the dinner hole and the power center. Approximately 2 1/4 inches of 2-conductor type SO cord was attached to the connector. The conductors in the cord were slightly recessed in the jacket and it appears that the cord had been cut with a blunt object or had been pulled apart. MSHA investigators could not determine whether or not the connector and cord had been installed in the dinner hole light circuit.

There is some evidence to indicate that the dinner hole lights could have been energized when the explosion occurred. Sutherland first stated that he believed they were energized when he ate dinner on the night of the explosion. Both 120-volt ac circuit breakers on the section power center were found in the closed (on) positions. At least one dust cap on each of the two 120-volt ac duplex receptacles on the power center was found open. The plug on the 81 1/2-foot length of No. 14 AWG, 2-conductor cord was compatible with the duplex receptacles on the power center. The cord was the proper length to reach the inby end of the supply cord for the fluorescent light fixture at the intersection of the No. 3 entry and the No. 36 right crosscut and extended in that direction from the section power center. For the dinner hole lights to have been energized, the plug on the 81 1/2 foot cord would have had to have been plugged into one of the 120-volt ac receptacles on the power center. Also, the outby end of this cord would have had to have been connected to the plug on the supply cord for the fluorescent light fixture in the No. 3 entry either with the female connector found in the No. 3 entry or by twisting the conductors in the cord around the blades on the plug for the fluorescent light fixture. Finally, a jumper would have had to have been installed between the incompatible twist-lock female connector for the fluorescent light fixture in the No. 3 entry and the straight-blade male plug on the supply cord for the fluorescent light fixture in the dinner hole. After considering all of the information gathered during the investigation, MSHA investigators could not conclusively determine whether or not the dinner hole lights were energized when the explosion occurred. Nevertheless, MSHA investigators carefully examined the dinner hole lights for any evidence to indicate that they could have provided the ignition source for the explosion.

Both fluorescent light fixtures were carefully examined and tested. There was no evidence of heating or arcing at any of the connections in either fixture. There was no evidence of a short circuit or ground fault in either fixture. Resistance measurements revealed that both fixtures were free from short circuits and ground faults. Aside from minor heat damage, the fluorescent light fixture that had been hanging over the dinner table was not obviously damaged by the explosion. The fixture was extremely clean inside. MSHA investigators energized the fixture for approximately 4 hours and 34 minutes. The fixture operated properly for the entire time. The fluorescent light fixture that had been hanging over the No. 3 entry had been damaged severely by the explosion. Nevertheless, MSHA investigators reconnected the supply cord, replaced the broken fluorescent lamp, and energized the fixture for approximately 4 hours and 38 minutes. Again, the fixture operated properly for the entire time.

The cords for both fluorescent light fixtures were also carefully tested and examined. The outer jacket on the supply cord for the fluorescent light fixture that had been installed in the No. 3 entry had been cut and damaged at several locations. However, the damage was confined to the outer jacket and the insulation on the conductors had not been damaged. The outer jacket on the supply cord for the fluorescent light fixture that had been installed over the dinner table was blistered by the heat of the explosion at numerous locations. However, the damage was confined to the outer jacket and the insulation on the conductors had not been damaged. Resistance measurements confirmed that both supply cords were free from short circuits and ground faults. Neither feed-through cable appeared to have been damaged by the explosion. All connections to the connectors on the supply cords and the feed-through cords for the two fixtures were examined. There was no evidence of heating or arcing at any of the connections.

The six incandescent light fixtures and the six heat lamps were also examined and tested. Two of the six heat lamps had been damaged. The third heat lamp in the first string was still attached to the fixture. However, the cement that held the lamp envelope to the lamp base had softened allowing the envelope to drop down away from the base. The envelope was still supported by the outside filament support wire which was still attached to the base. The filament in this lamp was still continuous. The first heat lamp in the second string had been smashed. The filament was no longer continuous. The filaments in the remaining four heat lamps were continuous. All six lamp bases were still in the lamp sockets. MSHA investigators removed each lamp base. There was no evidence of heating or arcing in any of the six lamp sockets. Although there was coal dust in one of the six sockets, there was no soot in any of the sockets. All connections in the connectors and in the six incandescent light fixtures were examined carefully. There was no evidence of heating or arcing in any of the connections. Also, there was no evidence of a short circuit between any of the conductors in the connectors, cables, or light fixtures. Resistance measurements indicated that both strings of incandescent light fixtures were free from short circuits. MSHA investigators replaced the two damaged heat lamps and energized both strings of incandescent light fixtures. All six heat lamps operated properly. Finally, the MSHA Beckley Electrical Testing Laboratory conducted temperature tests on the four undamaged heat lamps. These tests revealed that the surfaces of the heat lamps did not reach a temperature sufficient to ignite an explosive methane-air mixture. The highest surface temperature measured during the tests was 650°F. The temperature required to ignite the most readily ignitable methane-air mixture is 1120° F. The results of the tests are contained in Appendix E-5.

MSHA investigators found no direct evidence to indicate that the dinner hole lights provided the ignition source for the explosion. However, the possibility exists that the dinner hole lights were energized and that the circuit was interrupted in an explosive methane-air atmosphere. The circuit could have been interrupted when the strap on the fluorescent light fixture that had been hanging over the dinner table broke or when a small piece of rock fell. Either occurrence could have dislodged one of the connections needed to energize the dinner hole lights. Consequently, MSHA investigators concluded that the dinner hole lights could have provided the ignition source for the explosion.

Battery-Powered Personnel Carrier

The personnel carrier was used during the recovery and then moved to a side track near the underground supply house. The personnel carrier was examined by MSHA investigators. Even though the personnel carrier was used during the recovery, this use did not disturb the effects of the explosion on the vehicle.

An examination of the personnel carrier during the investigation revealed the following:

1. The inby end of the personnel carrier had been exposed to more heat than the outby end. Paint on the inby end of the personnel carrier was blistered, while paint on the outby end was not. The two reflectors on the inby end were deformed by the heat and impregnated with dust. The dust could not be wiped off. The two reflectors on the

outby end were not deformed by the heat. Dust on the outby reflectors could be wiped off leaving the reflectors functional.

2. With the exception of the two battery tray covers, all covers and lids on the personnel carrier were in place and bolted down. Neither battery tray cover was bolted down. Both battery tray covers were found pushed toward the right side (facing inby) of the personnel carrier. There was no evidence of electrical arcing on the insides of the battery tray covers, battery cell terminals, or intercell connections.

3. The headlights on the personnel carrier were controlled by the directional control switch. Consequently, when the personnel carrier was first observed after the explosion, the directional control switch was positioned for travel from the 2 Left section to the elevator shaft bottom.

4. The tram control switch was self-centering with a neutral position, four accelerating positions, and three braking positions.

5. The personnel carrier was equipped with a 480-volt, 3-phase onboard battery charger. However, the battery charger could not have been in operation when the explosion occurred.

6. The following electric components produce incendive arcing during the normal operation of the personnel carrier: The directional control switch, the tram control switch, the contactors in the controller, and the two 20-horsepower direct current motors. In addition, the main circuit breaker would produce incendive arcing if it were opened manually while under load or if it were opened automatically as a result of an overcurrent condition. None of the above listed components was installed in an explosion-proof enclosure. The circuit breaker and contactors were enclosed in loosely fitting metal covers. The enclosure for each direct-current motor had four ventilated (open) hand-hole covers. One hand-hole cover was missing from each motor.

Since the arcing components of the personnel carrier were not installed in the explosion-proof enclosures and the personnel carrier was probably in operation when the explosion occurred, MSHA investigators concluded that the personnel carrier could have provided the ignition source for the explosion.

MSHA investigators, with the assistance of Thomas Barkand and Robert Cascio, Engineers with the MSHA Mine Electrical Systems Branch, conducted additional tests to determine some of the operating characteristics of the personnel carrier. The results of the tests indicate that it takes approximately 113 seconds for the personnel carrier to travel from the No. 35 crosscut, where the battery charger plug for the personnel carrier was found, to the No. 16 crosscut where McCoy's body was found. The test also indicated that if the control handle of the mantrip was released 25 feet inby the No. 16 crosscut while the vehicle was traveling at a typical velocity of at least 13.5 miles/

hour, the vehicle would have sufficient momentum to continue to travel to the No. 2 crosscut. The results of the tests are contained in Appendix G.

Battery-Powered Scoop

MSHA investigators did not find any evidence to indicate that the battery-powered scoop provided the ignition source for the explosion.

Belt Control Cable and Remote Start/Stop Switch

The 120-volt ac remote control circuit for the 2 Left belt controller was not intrinsically safe and was capable of releasing sufficient energy to ignite an explosive methane-air atmosphere. Consequently, if the circuit was interrupted in an explosive methane-air atmosphere, an ignition could result.

The remote start/stop switch for the 2 Left conveyor belt was not explosion proof. However, no miners were in a position to operate the switch when the explosion occurred. Consequently, MSHA investigators concluded that the remote start/stop switch for the 2 Left conveyor belt could not have provided the ignition source for the explosion.

It was not possible for MSHA investigators to observe the condition of the belt control cable immediately after the explosion because the mine rescue team used the belt control cable as a telephone line inby the No. 14 crosscut. Mine rescue team members Fields and Robinette cut and spliced the belt control cable at an undetermined number of locations during the recovery. They also spliced the belt control cable at several other locations where the cable had broken or had pulled out of a twist-lock connector. According to Fields, the belt control cable had pulled out of a twist-lock connector at one or two locations. Fields also stated that, "there was evidence of either timbers had fallen over against it and pulled it out or rocks had fallen on it and pulled it out." Robinette remembered two locations where the belt control cable was separated. One location was about 800 or 900 feet outby the face. The other location was farther outby where some timbers had been knocked down. Although Fields and Robinette could not recall the exact locations where the belt control cable had broken or pulled out of a connector, it is apparent that they encountered at least two locations where it had done so.

When MSHA investigators examined the 2 Left belt control cable on July 13 and 14, 1983, they observed the following:

1. There were two locations where the belt control cable had separated outby the No. 14 crosscut. At one location, the inby cable had pulled out of a twist-lock connector. At the other location, two timbers had fallen and had broken the cable.

2. There were seven splices and one taped repair in the belt control cable that apparently had been made by Fields and Robinette.

3. Several timbers had fallen and had broken the belt control cable approximately 40 feet outby the 2 Left conveyor belt tailpiece. This occurred after the recovery operation.

MSHA investigators could not identify the locations where the belt control cable was found separated by Fields and Robinette. MSHA investigators could not determine if the force of the explosion caused the belt control cable to separate at these locations. However, it is evident that a falling timber or rock could have interrupted the belt control circuit by pulling the belt control cable out of a twist-lock connector or by breaking the cable in two. Since the electrical energy released when the belt control circuit is interrupted is sufficient to ignite an explosive methane-air atmosphere, MSHA investigators concluded that the 2 Left belt control cable could have provided the ignition source for the explosion.

Telephones and Telephone Line

The permissible-type telephone that was located at the intersection of the No. 2 entry and the No. 36 crosscut was damaged by the explosion. However, the telephone was sent to the MSHA Approval and Certification Center for testing and evaluation to determine if it could have provided the ignition source for the explosion. A summary of the results of the testing and evaluation of the telephone is contained in Appendix E-4. Based on the results of the testing and evaluation, MSHA investigators concluded that the telephone did not provide the ignition source for the explosion. In addition, MSHA investigators did not find any evidence to indicate that the 2 Left telephone line provided the ignition source for the explosion.

Belt Fire Detection Circuit

MSHA investigators did not find any evidence to indicate that the 2 Left belt fire detection circuit provided the ignition source for the explosion.

Methane Detectors, Cap Lamps and Voltohmmeter

The three permissible-type methane detectors and ten permissible-type electric cap lamps that were recovered from the 2 Left section were sent to the MSHA Approval and Certification Center for testing and evaluation to determine if one of the devices could have provided the ignition source for the explosion. A summary of the results of the testing and evaluation of these devices is contained in Appendix E-4. Based on the results of the Approval and Certification Center's testing and evaluation, MSHA investigators concluded that the methane detectors and cap lamps did not provide the ignition source for the explosion.

MSHA investigators found no evidence to indicate that the voltohmmeter provided the ignition source for the explosion.

2 Left Conveyor Belt

MSHA investigators believe that the 2 Left conveyor belt was operating when the explosion occurred. Consequently, MSHA investigators carefully examined the 2 Left conveyor belt for evidence of overheated bearings or other mechanical defects which could have provided the ignition source for the explosion.

Mine maintenance records and testimony indicated that a tail roller bearing for the 2 Left conveyor belt wore out and was replaced on June 15, 1983. The newly installed bearing cracked and was replaced again on June 18, 1983. MSHA investigators found no evidence of overheating on either tail roller bearing in use when the explosion occurred. In addition, MSHA investigators examined the entire length of the 2 Left conveyor belt while the conveyor belt was in operation. This examination did not disclose any roller bearings that were overheating, although several broken or dislodged return rollers were observed. MSHA investigators concluded that heat from a defective roller bearing did not provide the ignition source for the explosion.

MSHA investigators also observed one location where the conveyor belt was rubbing a belt stand at the No. 22 crosscut. The belt had cut a 1-inch groove into the steel belt stand. This location was observed while the conveyor belt was in operation during the investigation. Heat and smoke were generated as the conveyor belt rubbed the stand. No sparks were observed as the metal belt splices struck the stand. Nevertheless, MSHA investigators concluded that heat or sparks generated by the conveyor belt rubbing the belt stand was capable of providing the ignition source for the explosion.

Flame Safety Lamp

MSHA investigators found a flame safety lamp lying on the mine floor in the No. 38 crosscut between the Nos. 2 and 3 entries. The lamp had a brass tag bearing the inscription "F. C. RINER". A visual examination of the lamp revealed that the locking ring contained a recent crack most likely caused by the explosion. The lamp was sent to the MSHA Approval and Certification Center for testing and evaluation to determine if the lamp could have provided the ignition source for the explosion. The results of the testing and evaluation (See Appendices E-4 and F) indicated that the lamp had been improperly assembled and that a small separation existed between the mesh and the brass ring of the inner gauze. Under test conditions, however, the lamp would not ignite an explosive methane-air mixture. Consequently, MSHA investigators concluded that the flame safety lamp did not provide the ignition source for the explosion.

Smoking Materials

No smoking materials were found in the lunch buckets on the 2 Left section or in the personal effects of the victims. During the investigation, a cigarette butt was found near the track in the Caney Mains IV bleeder entries outby the No. 1 crosscut; however, MSHA investigators believe that the cigarette was transported underground inadvertently with mine supplies and was not used underground. Other than this cigarette butt, MSHA investigators found no evidence to indicate that smoking materials were being taken into or used underground. Consequently, MSHA investigators concluded that the use of smoking materials did not provide the ignition source for the explosion.

Probable Point of Origin

In attempting to determine the probable point of origin of the explosion, MSHA investigators carefully evaluated the following factors:

1. The effects of the open connection between the No. 40 crosscut of 2 Left and the No. 2 entry of the setup entries on the ventilation of the 2 Left entries and the setup entries.

2. The extent of flame in the 2 Left entries and in the setup entries.

3. The magnitude and direction of forces of the explosion in the 2 Left entries and in the setup entries.

4. The locations of the potential ignition sources.

After evaluating these factors, MSHA investigators concluded that the explosion originated either in the No. 2 entry of 2 Left between the Nos. 25 and 36 crosscuts or in the No. 3 entry of 2 Left between the Nos. 26 and 37 Left crosscuts.

MSHA investigators concluded that an explosive methane-air mixture was ignited by electrical arcing created by one of the following possible ignition sources. The listed sources are not in any order of probability.

1. Interruption of the 120-volt ac belt control circuit in the No. 2 entry between the Nos. 25 and 36 crosscuts.

2. A ground fault in the trailing cable for the conveyor belt feeder in the No. 2 entry between the Nos. 35 and 36 crosscuts.

3. The interruption of the dinner hole light circuit in the No. 3 entry between the Nos. 36 and 37 right crosscuts.

4. The normal operation of the nonpermissible personnel carrier in the No. 2 entry between the Nos. 25 and 35 crosscuts.

5. The automatic operation of one of the circuit breakers in the section power center in the No. 3 entry between the Nos. 36 and 37 left crosscuts.

6. A fault in the cable plug for the continuous mining machine trailing cable in the No. 3 entry between the Nos. 36 and 37 left crosscuts.

MSHA investigators concluded that the 2 Left conveyor belt did not provide the ignition source for the explosion because the direction of forces in the No. 2

entry of 2 Left indicates that the explosion originated at least three crosscuts inby the location where the conveyor belt was rubbing a belt stand.

MSHA investigators concluded that the auxiliary fan trailing cable did not provide the ignition source for the explosion because no evidence of electrical arcing at either of the two locations in the cable where tests indicated there was leakage to ground on the black phase conductor. In addition, the trailing cable was located in the No. 4 entry where approximately 32,000 cfm of air was passing over the cable.

PART IV

FINDINGS OF FACT

Findings

1. At approximately 10:15 p.m. EDT, June 21, 1983, an explosion occurred in the 2 Left entries of the McClure No. 1 Mine of the Clinchfield Coal Company. Ten miners were present in the 2 Left entries at the time of the explosion, eight in the face area and two in the track entry. Seven miners died as a result of the explosion. Three of the miners at the faces survived the explosion and were rescued.

2. Recovery of all the victims was completed at approximately 5:15 a.m., June 22, 1983, and all persons were withdrawn from the mine. The medical examiner's report indicated that the cause of death of 4 of the 5 victims in the 2 Left face area was asphyxiation from smoke (CO) inhalation, and one of the victims died from head and chest injuries. The two victims located outby the face area of the 2 Left entries died from a combination of burn injuries and smoke inhalation.

3. An MSHA safety and health inspection was in progress on the day of the explosion. During the day shift of June 21, 1983, a Federal Inspector was on the Caney Mains IV bleeder entries working section performing inspection activities. A total of 47 citations were issued during this inspection which was begun on April 4, 1983 and terminated on June 21, 1983.

4. The 2 Left entries off Cranesnest Mains I entries, which would later be used as the headgate entries for the longwall, were started about November 8, 1982 and consisted of 4 entries driven on 80-foot centers with crosscuts predominantly staggered and driven on 100-foot centers. After being driven to a depth of about 200 feet, the No. 1 entry was stopped and a 45 degree connecting crosscut was driven into the No. 2 entry. The track was installed in this portion of the No. 1 entry and through the 45 degree crosscut into the No. 2 entry where it was then installed parallel to the conveyor belt up to the section loading point. About 325 feet inby the point where the No. 1 entry was stopped it was picked up and driven for a distance of about 650 feet where it was stopped again.

5. Mine ventilation was induced by one fan of a dual exhaust fan installation located on the surface at the top of the return air shaft. During an inspection made prior to the explosion, an air measurement made at the fan indicated 690,322 cubic feet per minute (cfm) of air was exhausted from the mine at a pressure of 7.4 inches of water. The methane liberation was 2.2 million cubic feet of methane during a 24-hour period (cfd) during an MSHA ventilation survey conducted in July, 1983 when the mine was not producing coal. During the inspection in May and June of 1983, the methane liberation was 3.2 and 2.6 million cfd, respectively.

6. The original Ventilation System and Methane and Dust Control Plan for the mine was approved on February 29, 1980. This plan required a minimum of 3,000 cfm of air to be maintained in all working places of the working section except that 5,000 cfm was required where coal was being mined to dilute the methane liberated during mining. In addition, a mean entry air velocity of 60 feet per minute was required where coal was being cut, drilled, mined, or loaded. Line brattice or other approved device(s) were required to be maintained to within 10 feet of the area of deepest penetration to which any portion of the working faces were advanced. The plan also required the 2 Left working faces to be ventilated by air directed from Cranesnest Mains I to the faces through the No. 3 entry of 2 Left.

7. The 2 Left section was being developed with three entries at the time of the explosion. The No. 1 entry was discontinued at the No. 13 crosscut from Cranesnest Mains I, and was ventilated with a small split of air dumped into the return; the No. 2 entry contained the track and belt; the No. 3 entry was the intake aircourse; and No. 4 entry, was the return aircourse.

8. Prior to connecting with the setup entries, the 2 Left entries and working section were ventilated as follows: The No. 2 entry was utilized as a track and belt entry and a curtain was installed across the entry at the belt tailpiece to direct the air in the entry to the return aircourse through 16-inch by 32-inch oval-shaped tubing. The No. 3 entry was an intake aircourse and a curtain was installed across the entry just outby the last open crosscut to direct the air into No. 2 entry inby the belt feeder. Line curtains were used to direct the air to the faces of the Nos. 2 and 3 entries and an exhausting auxiliary fan with tubing was used to ventilate the face of the No. 4 entry.

9. The 1 Left entries and the longwall setup entries were being ventilated by a single split of air. The air was coursed up the Nos. 1 and 2 entries of 1 Left then into the Nos. 1 and 2 longwall setup entries off 1 Left. After ventilating the faces of the setup entries the air was coursed out the No. 3 setup entry to the No. 4 entry of 1 Left. The No. 4 entry of 1 Left was utilized as a return aircourse. The No. 3 entry of 1 Left was utilized as a track and belt entry and although the conveyor belt was not being used and had been partially removed it was still ventilated with a separate current of air. The air was coursed up this entry, then directed to the 1 Left intake entries, and into the Nos. 1 and 2 setup entries.

10. Numerous tests by the Bureau of Mines have established that coal dust having a volatile ratio of 0.12 and higher is explosive. The average volatile ratio of the coal in the face area of 2 Left section at the time of the explosion from analysis of the two samples was 0.37.

11. At approximately 9:45 p.m., on June 23, 1983, during the reestablishment of the 2 Left ventilation, Charles F. Reese, MSHA Coal Mine Inspector, detected 1.7 percent methane at the 2 Left conveyor belt feeder (No. 36 crosscut). At 10:20 p.m., Burnis L. Austin, MSHA Coal Mine Inspector, detected methane concentrations ranging between 3 percent at waist level

to over 8 percent one foot below the roof just inby survey station No. 2320 (No. 26 crosscut) in the No. 2 entry.

12. According to Harold N. Leonard, Jr., 2 Left Day Shift Section Foreman, the first connection between the 2 Left section and the longwall setup entries was made at about 1:30 p.m., on the day shift, Tuesday, June 14, 1983 when the face of the No. 2 entry was cut into the No. 3 setup entry at the No. 39 crosscut. Leonard had a curtain installed in the No. 2 entry of the 2 Left section between the Nos. 38 and 39 crosscuts behind the roof bolting machine while the cut-through was being bolted. Leonard stated that Light had told him to install a curtain board before the mining machine cut-through and to hang a curtain after the roof bolting machine had been moved into the place. Light was on the section on Tuesday, June 14, 1983, just after the first cut-through was made at the No. 39 crosscut and observed a curtain being installed in the No. 2 entry between the Nos. 38 and 39 crosscuts just outby the roof bolting machine. This curtain was later moved to a diagonal position in the intersection of the No. 39 crosscut to facilitate the mining of the crosscut between the Nos. 2 and 3 entries of 2 Left.

13. A second connection between the 2 Left section and the longwall setup entries was made at about 1:15 p.m. on the day shift, Tuesday, June 21, 1983, when the face of the No. 40 crosscut cut through into the setup entries.

14. The failure to install ventilation controls to separate the air split ventilating the setup entries from the air split ventilating the 2 Left entries materially affected the movement of air in the Nos. 2 and 3 entries of 2 Left. The volume and velocity of air became inadequate to dilute, render harmless and to carry away flammable and explosive gases which were liberated in the area. The failure to maintain the airflow in its proper volume and direction in the setup entries, the 2 Left face area and outby in the Nos. 2 and 3 entries of 2 Left allowed an accumulation of an explosive methane-air mixture in the Nos. 2 and 3 entries of 2 Left. These changes in ventilation remained uncorrected for about 9 hours.

15. Talbert made an air measurement after the cut-through was made in the No. 40 crosscut in the intersection of the No. 4 entry of 1 Left and the No. 3 entry of the setup entries and found 14,000 or 15,000 cfm flowing from the setup entries into the 1 Left return. He also measured the air in the No. 4 entry of 2 Left 5 crosscuts from the last open crosscut and found 32,000 cfm which was 4,000 cfm more than normal.

16. After the No. 40 crosscut was cut through and cleaned up, the mining machine was moved to the No. 4 entry and the roof bolting machine moved into the newly opened No. 40 crosscut between the Nos. 2 and 3 entries. Leonard stated that the air was traveling from the setup entries through the No. 40 crosscut towards the No. 4 entry of 2 Left. He had measured the air prior to and after the crosscut was cut through and there was a 4,000 cfm increase in the total volume of air in the return aircourse of 2 Left after cutting through.

17. During the investigation, a ventilation survey was conducted at the mine. Information gathered during this survey was used to produce a digital computer simulation of the ventilation system in the Cranesnest Mains I, 1 Left and 2 Left areas of the mine. According to this simulation, significant portion (23,000 of the 33,000 cfm) of the air flowing in the immediate return of the 2 Left section would be supplied from the 1 Left entries through the setup entries. As a result, the air quantity in the 2 Left No. 3 (intake) entry at about the No. 37 crosscut would decrease from 24,000 to 8,000 cfm and the air quantity in the No. 2 (belt and track) entry near the belt tailpiece would decrease from 5,000 to 2,000 cfm.

18. After the cut-through of the No. 40 crosscut, the requirements of the approved Ventilation System and Methane and Dust Control Plan were not being followed in that the faces of 2 Left were being ventilated with air from the setup entries. The plan requires the 2 Left working faces to be ventilated by air directed from Cranesnest Mains I to the faces through the No. 3 entry of 2 Left.

19. Mine management failed to insure that the cut-through ventilation procedures were established, fully understood and followed by the persons responsible for carrying them out. Five management personnel, including the Assistant Mine Superintendent, the day shift section foreman, two evening shift section foremen and the mine foreman in charge of the evening shift were in the No. 40 crosscut of 2 Left after the second cut-through was made and failed to implement the cut-through procedures.

20. At the end of the shift Talbert said he then told Leonard to go find Hall and tell him to install the curtain in the cut-through but, after being gone a few minutes, Leonard returned and told Talbert he had not been able to find Hall. Talbert said he knew Riner had been told where to hang curtains and felt no further instruction was necessary. No other attempt was made to contact Hall or Riner. Talbert left the mine for home at about 5:30 p.m.

21. Mine management took air measurements in the returns of both the setup entries and 2 Left entries after the cut-through was made, but failed to detect that the air in the setup intake entries and in the Nos. 2 and 3 entries of 2 Left was not traveling in its normal volume and velocity. The air measurements taken by management indicated a 4,000 cfm decrease in the air quantity returning in the setup entries and a 4,000 cfm increase in the air quantity normally returning in 2 Left. Air measurements were not taken in the setup entry intakes or in areas outby the faces of the Nos. 2 and 3 entries to determine if this ventilation had been affected by the cut-through.

22. Mine management failed to properly evaluate the effects of the cut-through at the No. 40 crosscut on the ventilation of the 2 Left entries and failed to fully recognize the hazards created by the methane liberation in the 2 Left entries when the cut-through occurred and no ventilation controls were installed in the crosscut.

23. Mine management failed to insure that adequate preshift and onshift examinations were made in the 2 Left entries during the day shift and evening shift on June 21, 1983. The preshift examination conducted during the day shift on June 21, 1983; the onshift examination conducted during the day shift on June 21, 1983; and the preshift examination of the conveyor belt entry conducted during the evening shift on June 21, 1983, failed to disclose that the air in the Nos. 2 and 3 entries of 2 Left was not traveling in its normal volume and velocity. These same examinations also failed to disclose that the volume and velocity of air in the Nos. 2 and 3 entries of 2 Left were not sufficient to dilute, render harmless and to carry away the methane gas being liberated in those entries.

24. Belt examiners were not properly trained to conduct adequate preshift examinations of conveyor belt entries. Belt examiners were not instructed to make tests for methane or make air measurements in conveyor belt entries. Belt examiners were not always equipped with anemometers or other approved devices to allow them to take air readings in conveyor belt entries.

25. The explosion was primarily a methane gas explosion; however, the burning of coal dust lengthened the extent of flame. MSHA investigators estimated that approximately one-third to one-half of the total flame expansion can be attributed to burning coal dust. The explosion did not develop into a propagating coal dust explosion.

26. MSHA investigators concluded that an explosive methane-air mixture was ignited by electrical arcing created by one of the following possible ignition sources. The listed sources are not in any order of probability.

    a. Interruption of the 120-volt ac belt control circuit in the No. 2 entry between the Nos. 25 and 36 crosscuts.

    b. A ground fault in the trailing cable for the conveyor belt feeder in the No. 2 entry between the Nos. 35 and 36 crosscuts.

    c. The interruption of the dinner hole light circuit in the No. 3 entry between the Nos. 36 and 37 right crosscuts.

    d. The normal operation of the nonpermissible personnel carrier in the No. 2 entry between the Nos. 25 and 35 crosscuts.

    e. The automatic operation of one of the circuit breakers in the section power center in the No. 3 entry between the Nos. 36 and 37 left crosscuts.

    f. A fault in the cable plug for the continuous mining machine trailing cable in the No. 3 entry between the Nos. 36 and 37 left crosscuts.

27. In the 2 Left entries, evidence of flame was present in the No. 2 entry from the No. 15 crosscut inby, in the No. 3 entry from the No. 13 right crosscut inby, in the No. 4 entry inby the No. 28 crosscut and in all the crosscuts from the Nos. 14 through 40. There was very little evidence of

flame in the No. 4 entry outby the No. 28 crosscut. Consequently, the evidence of flame in the Nos. 14 through 28 right crosscuts indicates that the flame entered these crosscuts from the No. 3 entry. There was little or no evidence of flame in 2 Left outby the No. 13 crosscut indicating that the flame did not enter the Cranesnest Mains I entries.

28. In the setup entries, evidence of flame was present in all three entries and connecting crosscuts between 2 Left and the No. 4 entry of 1 Left. There was little or no evidence of flame extending into the No. 4 entry of 1 Left, indicating that the flame did not enter the 1 Left or Caney Mains IV bleeder entries.

29. It is evident from the forces of the explosion that the average concentration of methane in the explosive gas body was near the lower explosive limit (i.e. 6 to 6-1/2 percent).

30. The magnitude and direction of the forces of the explosion were determined from the effects of the forces on equipment, permanent stoppings, timbers, and other materials and from the direction dust, mud, and debris were impacted on timbers, roof bolt plates, rib boards, and equipment. The major forces of the explosion were confined to the 2 Left entries, the setup entries, and the Caney Mains IV bleeder entries. Evidence of minor forces was also observed in the 1 Left entries and the Caney Mains IV entries.

31. In the No. 2 entry of 2 Left, the major forces of the explosion were in the outby direction from the No. 25 crosscut. Although, the exact location of the personnel carrier at the time of the explosion is not known, dust impacted on the inby end (and not the outby end) indicates that the forces of the explosion approached the vehicle from inby. The major forces of the explosion in the No. 2 entry were in the inby direction from the No. 36 crosscut. The forces of the explosion deposited a thick coating of mud and dust on the outby end of the supply car that was located in the No. 2 entry near the No. 36 crosscut. The forces of the explosion in the No. 2 entry between the Nos. 25 and 36 crosscuts were either weak or bidirectional.

32. In the No. 3 entry of 2 Left, the major forces of the explosion were in the outby direction from the No. 26 left crosscut. The high-voltage splice box that was originally located in the No. 3 entry near the No. 26 left crosscut was blown outby approximately 140 feet by the forces of the explosion. The lid was also blown off the splice box and came to rest approximately 200 feet outby its original location. The major forces of the explosion in the No. 3 entry were in the inby direction from the No. 36 left crosscut. The inby lid of the section power center that was located in the No. 3 entry between the Nos. 36 and 37 left crosscuts was blown off the power center and came to rest approximately 37 feet inby its original location. The incandescent light fixtures that had been installed over the section power center were moved up to 169 feet inby their original location by the forces of the explosion. The forces of the explosion in the No. 3 entry between the Nos. 26 and 36 left crosscuts were either weak or bidirectional.

33. In the No. 4 entry of 2 Left, the major forces of the explosion were in the outby direction from the No. 25 crosscut. The major forces of the explosion were in the inby direction from the No. 37 crosscut. The forces of the explosion turned the auxiliary fan that was located in the No. 4 entry just inby the No. 39 crosscut and deposited a thick coating of mud and dust on the outby side. The forces of the explosion in the No. 4 entry between the Nos. 25 and 37 crosscuts were either weak or bidirectional.

34. MSHA investigators concluded that the explosion originated either in the No. 2 entry of 2 Left between the Nos. 25 and 36 crosscuts or in the No. 3 entry of 2 Left between the Nos. 26 and 37 Left crosscuts.

Contributing Violations

Five of the conditions and practices in the Findings of Fact contributed to the explosion and constituted violations of the Federal Mine Safety and Health Act of 1977 and the mandatory standards contained in 30 CFR Part 75. They are listed below:

30 CFR 75.301	The volume and velocity of air ventilating the 2 Left entries off the Cranesnest Mains I on June 21, 1983 was not sufficient to dilute, render harmless and to carry away methane gas that was liberated.
30 CFR 75.303	The preshift examination of the 2 Left section conducted for the oncoming evening shift of June 21, 1983, and the examination of the belt entry conducted after the shift had begun were inadequate. The preshift examiner did not determine the effect on the ventilation system of the active 2 Left section when a ventilation control was not installed in the left crosscut (No. 40) off the No. 3 entry of 2 Left which had cut through into the No. 2 longwall setup entries. The belt examiner neither made methane tests in the belt entry nor took air readings to determine that the air current in the belt entry was traveling in its normal course and velocity. The absence of the ventilation control in the left crosscut off No. 3 entry (No. 40) permitted a significant portion of the ventilating current for the 2 Left section to be coursed through the longwall setup entries thereby reducing the normal volume and velocity of the ventilating currents in the 2 Left belt entry and the 2 Left intake entry outby the last open crosscut of the 2 Left section. This reduced volume and velocity permitted an explosive mixture of methane to accumulate in the 2 Left entries and the methane was subsequently ignited at 10:15 p.m. on June 21, 1983. The explosion resulted in the death of 7 miners and injury to 3 others.
30 CFR 75.304	The onshift examination(s) of the 2 Left section conducted on June 21, 1983 by the designated and certified examiner(s)

was inadequate. The left crosscut off No. 3 entry (No. 40) of 2 Left had been cut through into the No. 2 longwall setup entry and a ventilation control had not been installed in the crosscut. This permitted a significant portion of the ventilating current for the 2 Left section to be coursed from the longwall setup entries through the crosscut instead of traveling in its normal route. This flow of air through the crosscut resulted in a reduced volume and velocity of the ventilating current in the 2 Left intake entries outby the last open crosscut in 2 Left. The onshift examiner(s) did not determine the potential hazards created by the ventilation change made when the ventilation control was not installed and did not detect the hazardous conditions that developed after the ventilation change was made. The ventilation permitted an explosive mixture of methane to accumulate and the methane was subsequently ignited at 10:15 p.m. on June 21, 1983. The explosion resulted in the death of 7 miners and injury to 3 others.

30 CFR 75.316

The approved ventilation system and methane and dust control plan for the mine was not being complied with. Ventilation of the 2 Left section and the longwall setup entries off 1 Left was changed when the left crosscut (No. 40) off No. 3 entry of 2 Left was cut through into the No. 2 longwall setup entry and a ventilation control was not installed to separate the ventilating currents. A significant portion of the ventilating current in the longwall setup entries left its designated and approved route of travel and entered the 2 Left section through the No. 40 crosscut. This ventilating current was then directed to the faces of the Nos. 3 and 4 entries of 2 Left and then into the 2 Left section return. The approved ventilation system and methane and dust control plan required the ventilating currents to be separated. This change in the ventilation system resulted in a reduction in the normal volume and velocity of the ventilating currents in the 2 Left belt entry and the 2 Left intake entry outby the last open crosscut of the 2 Left section. This reduced volume and velocity permitted an explosive mixture of methane to accumulate and the methane was subsequently ignited at 10:15 p.m. on June 21, 1983. The explosion resulted in the death of 7 miners and injury to 3 others.

30 CFR 75.322

A change in ventilation which materially affected the splits of air used to ventilate the active 2 Left section and the longwall setup entries was made during the day shift of June 21, 1983, while miners were in the mine carrying out routine activities and the electrical equipment in the area was energized. A ventilation control was not installed in the left crosscut (No. 40) off No. 3 entry of 2 Left which had been cut through into the No. 2 longwall setup entry.

The absence of the ventilation control permitted a significant portion of the ventilating current for the 2 Left section to be coursed through the longwall setup entries instead of traveling up the 2 Left intake entries. Management did not conduct sufficient examination to ascertain the effects of the chanage. The ventilation change resulted in an explosive accumulation of methane in the 2 Left entries which was subsequently ignited at 10:15 p.m. on June 21, 1983. The explosion resulted in the death of 7 miners and injury to 3 others.

PART V

CONCLUSION

MSHA investigators concluded that the failure to install ventilation controls to separate the air split ventilating the setup entries from the air split ventilating the 2 Left entries materially affected the movement of air in the Nos. 2 and 3 entries of 2 Left. The volume and velocity of air became inadequate to dilute, render harmless and to carry away flammable and explosive gases which were liberated in the area. The failure to maintain the airflow in its proper volume and direction in the setup entries, the 2 Left face area and outby in the Nos. 2 and 3 entries of 2 Left allowed an accumulation of an explosive methane-air mixture in the Nos. 2 and 3 entries of 2 Left. These changes in ventilation remained uncorrected for about 9 hours. The explosive methane-air mixture was ignited by electrical arcing created by one of the following ignition sources which are not listed in any order of probability:

1. Interruption of the belt control circuit.

2. A ground fault in the trailing cable for the conveyor belt feeder.

3. Interruption of the dinner hole light circuit.

4. Normal operation of the nonpermissible personnel carrier.

5. Automatic operation of one of the circuit breakers in the section power center.

6. A fault in the cable plug for the continuous mining machine trailing cable.

The primary cause of the explosion was the failure of mine management to maintain a sufficient volume and velocity of air in the Nos. 2 and 3 entries of 2 Left to dilute, render harmless and to carry away the methane gas being liberated in those entries. The following factors contributed to the occurrence of the explosion:

1. The failure to follow the approved ventilation plan and maintain the separation between the air current ventilating the setup entries and the air current ventilating the 2 Left entries after the two sets of entries were connected at the No. 40 crosscut of 2 Left.

2. The failure to fully recognize the potential consequences of failing to maintain the separation between the air current ventilating the setup entries and the air current ventilating the 2 Left entries.

3. The failure to properly evaluate the effects of the open connection at the No. 40 crosscut on the ventilation of the 2 Left entries.

4. The failure to insure that procedures for maintaining the separation between the air currents ventilating two sets of entries were established, fully understood and followed by the persons responsible for carrying them out when the sets of entries were connected.

5. The failure to insure that adequate preshift and onshift examinations were made in the 2 Left entries during the day shift and evening shift on June 21, 1983.

6. The failure to train certified persons making belt examinations in the proper procedures for conducting preshift examinations of the conveyor belt and conveyor belt entries.

Respectfully submitted,

Robert A. Elam
Mining Engineer

Gene B. Fuller
Mine Safety and Health Specialist

Harry J. Carter
Mine Safety and Health Specialist

Dale R. Cavanaugh
Mechanical Engineer

George M. Fesak
Electrical Engineer

Robert J. Painter
Mine Safety and Health Specialist

HHP

Approved by:

Joseph A. Lamonica
Administrator
for Coal Mine Safety and Health

APPENDIXES

APPENDIX A

Data Sheet

U.S. Department of Labor
Mine Safety and Health Administration

Section A—Victim Data

1. Name: Harold Joseph Boyd (Injured)
2. Sex: ☒ Male ☐ Female
3. Social Security Number: 226-96-7499
4. Age: 25
5. Job Classification: Roof Bolting Machine Operator
6. Experience at this Classification: 4 years
7. Total Mining Experience: 4½ years
8. What activity was being performed at time of accident? Roof Bolting
9. Victim's Experience at this Activity: 4 years
10. Was victim trained in this task? Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*

		Date Received
11.	Annual Refresher Training (Including Hazard Recognition, Self	12/82
12.	Rescue Devices, Mine Gases and Ventilation)	
13.		
14.		

Section C—Supervisor Data *(supervisor of victim)*

15. Name: Ernest Hall
16. Certified: ☒ Yes ☐ No
17. Experience as Supervisor: 8 months at McClure No. 1 Mine
18. Total Mining Experience: 8 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*

		Date Received
19.	Annual Certified Persons Training	6/83
20.		
21.		
22.		

23. When was the supervisor last present at accident scene prior to the accident? -Present at time of accident
24. What did he do when he was there? Unknown (he was killed in the explosion).
25. When was he last in contact with the victim? Unknown
26. Did he issue instructions relative to the accident? N/A
27. Was he aware of or did he express an awareness of any unsafe practice or condition? N/A

MSHA Form 2000-58, June 83 (Revised)

Data Sheet

U.S. Department of Labor APPENDIX A
Mine Safety and Health Administration

Section A—Victim Data

1. Name: Mary Kathleen Counts
2. Sex: ☐ Male ☒ Female
3. Social Security Number: 212-30-7658
4. Age: 51
5. Job Classification: Shuttle Car Operator
6. Experience at this Classification: 1-3/4 months
7. Total Mining Experience: 2½ years
8. What activity was being performed at time of accident? Installing auxiliary fan tubing
9. Victim's Experience at this Activity: 1-3/4 months
10. Was victim trained in this task? Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*

		Date Received
11.	Annual Refresher Training (Including Hazard Recognition, Self	12/82
12.	Rescue Devices, Mine Gases and Ventilation)	
13.		
14.		

Section C—Supervisor Data *(supervisor of victim)*

15. Name: Ernest Hall
16. Certified: ☒ Yes ☐ No
17. Experience as Supervisor: 8 months at McClure No. 1 Mine
18. Total Mining Experience: 8 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*

		Date Received
19.	Annual Certified Persons Training	6/83
20.		
21.		
22.		

23. When was the supervisor last present at accident scene prior to the accident? Present at time of accident
24. What did he do when he was there? Unknown (he was killed in the explosion)
25. When was he last in contact with the victim? Unknown
26. Did he issue instructions relative to the accident? N/A
27. Was he aware of or did he express an awareness of any unsafe practice or condition? N/A

Data Sheet

U.S. Department of Labor APPENDIX A

Mine Safety and Health Administration

Section A—Victim Data

1. Name Covey Jack French	2. Sex ☒ Male ☐ Female	3. Social Security Number 230-46-5062
4. Age 45	5. Job Classification Continuous Mining Machine Operator	
6. Experience at this Classification 16 years	7. Total Mining Experience 19 years	
8. What activity was being performed at time of accident? Installing auxiliary fan tubing	9. Victim's Experience at this Activity 16 years	10. Was victim trained in this task? Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
11. Annual Refresher (Including Hazard Recognition, Self Rescue	12/82
12. Devices, Mine Gases and Ventilation)	
13.	
14.	

Section C—Supervisor Data *(supervisor of victim)*

15. Name Ernest Hall	16. Certified ☒ Yes ☐ No
17. Experience as Supervisor 8 months at McClure No. 1 Mine	18. Total Mining Experience 8 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
19. Annual Certified Persons Training	6/83
20.	
21.	
22.	

23. When was the supervisor last present at accident scene prior to the accident? Present at time of accident	24. What did he do when he was there? Unknown (he was killed in explosion).
25. When was he last in contact with the victim? Unknown	26. Did he issue instructions relative to the accident? N/A

27. Was he aware of or did he express an awareness of any unsafe practice or condition?

N/A

Data Sheet

U.S. Department of Labor APPENDIX A 4
Mine Safety and Health Administration

Section A—Victim Data

1. Name: Ernest Avery Hall
2. Sex: ☒ Male ☐ Female
3. Social Security Number: 226-78-6010
4. Age: 30
5. Job Classification: Section Foreman
6. Experience at this Classification: 8 months at McClure No. 1 Mine
7. Total Mining Experience: 8 years
8. What activity was being performed at time of accident? Supervising Section
9. Victim's Experience at this Activity: 8 months at the McClure No. 1 Mine
10. Was victim trained in this task? Yes

Section B—Victim Data for Health and Safety Courses/Training Received ***(related to accident)***

	Date Received
11. Annual Certified Persons Training	6/9/83
12.	
13.	
14.	

Section C—Supervisor Data ***(supervisor of victim)***

15. Name: Ronald Sluss
16. Certified: ☒ Yes ☐ No
17. Experience as Supervisor: 4½ years
18. Total Mining Experience: 10 years

Section D—Supervisor Data for Health and Safety Courses/Training Received ***(related to accident)***

	Date Received
19. Annual Certified Persons Training	12/82
20.	
21.	
22.	

23. When was the supervisor last present at accident scene prior to the accident?
6/21/83 - 7:45 p.m.

24. What did he do when he was there?
Assisted Earnest Hall, Forrest Riner, Jr., and Luther McCoy in repairing conveyor belt feeder chain.

25. When was he last in contact with the victim?
6/21/83 - 7:45 p.m.

26. Did he issue instructions relative to the accident?
Informed Hall to have coal rib corners bolted.

27. Was he aware of or did he express an awareness of any unsafe practice or condition?
No

U.S. Department of Labor APPENDIX A

Mine Safety and Health Administration

Section A—Victim Data

1. Name	2. Sex	3. Social Security Number
Emmery Allen Howard (Injured)	☒ Male ☐ Female	230-76-2110

4. Age	5. Job Classification
30	Miner Helper

6. Experience at this Classification	7. Total Mining Experience
1 year	3½ years

8. What activity was being performed at time of accident?	9. Victim's Experience at this Activity	10. Was victim trained in this task?
Miner Helper	1 year	Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
11. Annual Refresher Training (Including Hazard Recognition, Self	12/82
12. Rescue Devices, Mine Gases and Ventilation)	
13.	
14.	

Section C—Supervisor Data *(supervisor of victim)*

15. Name	16. Certified
Ernest Hall	☒ Yes ☐ No

17. Experience as Supervisor	18. Total Mining Experience
8 months at McClure No. 1 Mine	8 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
19. Annual Certified Persons Training	6/83
20.	
21.	
22.	

23. When was the supervisor last present at accident scene prior to the accident?	24. What did he do when he was there?
Present at time of accident.	Unknown (he was killed in the explosion).

25. When was he last in contact with the victim?	26. Did he issue instructions relative to the accident?
Unknown	N/A

27. Was he aware of or did he express an awareness of any unsafe practice or condition?

N/A

Data Sheet

U.S. Department of Labor APPENDIX A 6

Mine Safety and Health Administration

Section A—Victim Data

1. Name: Luther Julian McCoy
2. Sex: ☒ Male ☐ Female
3. Social Security Number: 347-36-6037
4. Age: 37
5. Job Classification: Repairman
6. Experience at this Classification: 14 years
7. Total Mining Experience: 16 years
8. What activity was being performed at time of accident? Departing from the 2 Left Section
9. Victim's Experience at this Activity: 14 years
10. Was victim trained in this task? Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*

	Date Received
11. Newly Employed Experienced Miner Training (Including Hazard	1/10/83
12. Recognition, Self Rescue Devices, Mine Gases and Ventilation)	
13. Electrical Qualification Retraining	6/09/83
14.	

Section C—Supervisor Data *(supervisor of victim)*

15. Name: Ernest Hall
16. Certified: ☒ Yes ☐ No
17. Experience as Supervisor: 8 months at McClure No. 1 Mine
18. Total Mining Experience: 8 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*

	Date Received
19. Annual Certified Persons Training	6/83
20.	
21.	
22.	

23. When was the supervisor last present at accident scene prior to the accident?
Present at time of accident.

24. What did he do when he was there?
Unknown (he was killed in the explosion).

25. When was he last in contact with the victim?
Unknown

26. Did he issue instructions relative to the accident?
N/A

27. Was he aware of or did he express an awareness of any unsafe practice or condition?
N/A

Data Sheet

U.S. Department of Labor APPENDIX A 7

Mine Safety and Health Administration

Section A—Victim Data

1. Name: Eugene Walton Meade
2. Sex: ☒ Male ☐ Female
3. Social Security Number: 230-92-9457
4. Age: 27
5. Job Classification: Shuttle Car Operator
6. Experience at this Classification: 1 year
7. Total Mining Experience: 7 years
8. What activity was being performed at time of accident? Installing auxiliary fan tubing
9. Victim's Experience at this Activity: 1 year
10. Was victim trained in this task? Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*

	Date Received
11. Annual Refresher (Including Hazard Recognition, Self Rescue	12/82
12. Devices, Mine Gases and Ventilation)	
13.	
14.	

Section C—Supervisor Data *(supervisor of victim)*

15. Name: Ernest Hall
16. Certified: ☒ Yes ☐ No
17. Experience as Supervisor: 8 months at McClure No. 1 Mine
18. Total Mining Experience: 8 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*

	Date Received
19. Annual Certified Persons Training	6/83
20.	
21.	
22.	

23. When was the supervisor last present at accident scene prior to the accident?
Present at time of accident

24. What did he do when he was there?
Unknown (he was killed in the explosion)

25. When was he last in contact with the victim?
Unknown

26. Did he issue instructions relative to the accident?
N/A

27. Was he aware of or did he express an awareness of any unsafe practice or condition?
N/A

Data Sheet

U.S. Department of Labor APPENDIX A

Mine Safety and Health Administration

Section A—Victim Data

1. Name	2. Sex	3. Social Security Number
Dale Stamper, Jr.	☒ Male ☐ Female	229-26-2240

4. Age	5. Job Classification
56	Utility Man

6. Experience at this Classification	7. Total Mining Experience
13 years	16 years

8. What activity was being performed at time of accident?	9. Victim's Experience at this Activity	10. Was victim trained in this task?
Utility Man	13 years	Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
11. Annual Refresher Training (Including Hazard Recognition, Self	12/82
12. Rescue Devices, Mine Gases and Ventilation)	
13.	
14.	

Section C—Supervisor Data *(supervisor of victim)*

15. Name	16. Certified
Ernest Hall	☒ Yes ☐ No

17. Experience as Supervisor	18. Total Mining Experience
8 months at McClure No. 1 Mine	8 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
19. Annual Certified Persons Training	6/83
20.	
21.	
22.	

23. When was the supervisor last present at accident scene prior to the accident?	24. What did he do when he was there?
Present at time of accident.	Unknown (he was killed in the explosion).

25. When was he last in contact with the victim?	26. Did he issue instructions relative to the accident?
Unknown	N/A

27. Was he aware of or did he express an awareness of any unsafe practice or condition?

N/A

Data Sheet

U.S. Department of Labor APPENDIX A

Mine Safety and Health Administration

Section A—Victim Data

1. Name	2. Sex	3. Social Security Number
Miles Wedden Sutherland (Injured)	☒ Male ☐ Female	230-34-7812

4. Age	5. Job Classification
51	Roof Bolting Machine Operator

6. Experience at this Classification	7. Total Mining Experience
1½ years	27 years

8. What activity was being performed at time of accident?	9. Victim's Experience at this Activity	10. Was victim trained in this task?
Roof Bolting	1½ years	Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
11. Annual Refresher Training - (Including Hazard Recognition, Self	12/82
12. Rescue Devices, Mine Gases and Ventilation)	
13.	
14.	

Section C—Supervisor Data *(supervisor of victim)*

15. Name	16. Certified
Ernest Hall	☒ Yes ☐ No

17. Experience as Supervisor	18. Total Mining Experience
8 months at McClure No. 1 Mine	8 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
19. Annual Certified Persons Training	6/83
20.	
21.	
22.	

23. When was the supervisor last present at accident scene prior to the accident?	24. What did he do when he was there?
Present at time of accident.	Unknown (he was killed in the explosion)

25. When was he last in contact with the victim?	26. Did he issue instructions relative to the accident?
Unknown	N/A

27. Was he aware of or did he express an awareness of any unsafe practice or condition?

N/A

Section A—Victim Data

1. Name	2. Sex	3. Social Security Number
Forrest C. Riner, Jr.	☒ Male ☐ Female	226-22-9494

4. Age	5. Job Classification
58	Foreman

6. Experience at this Classification	7. Total Mining Experience
17 years	38 years

8. What activity was being performed at time of accident?	9. Victim's Experience at this Activity	10. Was victim trained in this task?
Departing from the 2 Left Section	17 years	Yes

Section B—Victim Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
11. Annual Certified Persons Training	12/82
12.	
13.	
14.	

Section C—Supervisor Data *(supervisor of victim)*

15. Name	16. Certified
Ronald Sluss	☒ Yes ☐ No

17. Experience as Supervisor	18. Total Mining Experience
4½ years	10 years

Section D—Supervisor Data for Health and Safety Courses/Training Received *(related to accident)*	Date Received
19. Annual Certified Persons Training	12/82
20.	
21.	
22.	

23. When was the supervisor last present at accident scene prior to the accident?	24. What did he do when he was there?
6/21/83 - 7:45 p.m.	Assisted Ernest Hall, Forrest Riner, Jr., and Luther McCoy in repairing conveyor belt feeder chain.

25. When was he last in contact with the victim?	26. Did he issue instructions relative to the accident?
6/21/83 7:45 p.m.	None

27. Was he aware of or did he express an awareness of any unsafe practice or condition?

No

APPENDIX B

APPENDIX B

Persons participating in the underground recovery operations:

McClure No. 1 Mine	Open Fork Team	Dante Team
Norman R. Lewis, Team Captain	Ronald Holbrook, Team Captain	Reecy T. Asbury, Team Captain
John K. Brooks	Carroll R. Green	Homer W. Fields
Donald Duncan	Bobby Hammons	Vernon Johnson
Steve L. Hale	Randall Lee	Danny Mann
Marquis R. Neece	Harold Meade	Ray W. Robinette
Lee D. Ratliff	Richard Mann	J. Edward Rudder
George P. Willis		James Stanley

Neal Phillips, Trainer
David Buchanan, Moss No. 2 Team Member

Clinchfield Coal Company

C. M. Bailes	Vice President
Carson B. Blackstone	Section Foreman
Harold L. Couch	Trainer
Willie B. Couch	Mine Manager
Albert D. Holbrook	Section Foreman
Henry L. Kiser	Vice President of Operations
Richard K. Light, Jr.	Superintendent
Michael Ohlson	Section Foreman
Gary W. Proffitt	Maintenance Foreman
Ronald C. Sluss	Assistant Mine Foreman
Bobby D. Stanley	Section Foreman
Garlan Vance, Jr.	Maintenance Foremn
Monroe L. West	Manager of Safety Division
Michael C. Wright	Shift Foreman

United Mine Workers of America

Kellis C. Barton	Repairman
Roy Glovier	Mechanic
Herbert Johnson	General Inside

Mine Safety and Health Administration

Bill W. Clemons	Subdistrict Manager

APPENDIX C

APPENDIX C

List of Persons Who Participated in the Investigation

Pittston Coal Group

John Crawford	Vice President of Health and Safety
Wayne Myers, Jr.	Coal Group Electrical Engineer

Clinchfield Coal Company

Headquarters

C. Max Bailes	Vice President
Henry L. Kiser	Vice President of Operations
Hershel Bull	Superintendent of Operations
Monroe L. West	Manager of Safety Division
Reece T. Asbury	Assistant Manager of Safety Division
John O'Quin	Underground Surveyor
Rick Stanley	Underground Surveyor

McClure No. 1 Mine

Willie B. Couch	Mine Manager
Richard K. Light, Jr.	Superintendent
John P. Talbert	Assistant Superintendent
John W. Kiser	General Mine Foreman
Homer W. Fields	Mine Safety Inspector
Carson B. Blackstone	Section Foreman
Sidney A. Counts	Maintenance Foreman
Jack B. Jacobs	Chief Electrician
Charles R. Montgomery, Jr.	Section Foreman
Jackie M. Mullins	Assistant Chief Electrician
Jimmy Parks	Section Foreman
Ray W. Robinette	Roof Control Inspector
Joseph M. Sykes	Assistant Mine Foreman
Billy H. Taylor	Dust Safety

United Mine Workers of America

Officials

Cecil Roberts	Vice President
Joe Main	Administrator, Department of Occupational Health and Safety
Danny C. Davidson	Deputy Administrator, Department of Occupational Health and Safety
Robert H. Hartsock	Health and Safety Representative
J. C. Lambert	Health and Safety Representative
David Lawson	Health and Safety Representative
Alonzo Mullins	Health and Safety Representative
C. A. Phillips	Health and Safety Representative
Robert A. Phillips	Health and Safety Representative
Denny Swigart	Health and Safety Representative

McClure No. 1 Mine

Samuel J. Clay	Safety Committee Chairman
Roy B. Glovier	Repairman
George H. Owens	Mine Examiner
David L. Stanley	General Inside
George P. Willis	Repairman

Virginia Division of Mines and Quarries

Harry Childress	Chief, Division of Mines and Quarries
Lewis Wheatley	Technical Assistant
Charles Ray	Electrical Instructor
Clarence Ball	Mine Inspector
Mitchell Fischer	Mine Inspector
Ronald Hamrick	Mine Inspector
D. Harrison	Mine Inspector
Jerald Hileman	Mine Inspector
Lee Hughes	Mine Inspector
Jerry Looney	Mine Inspector
Doyle Roberts	Mine Inspector
John Thomas	Mine Inspector
Phillip Willis	Mine Inspector

Department of Labor

Office of the Solicitor

Edward H. Fitch IV, Esquire	Trial Attorney

Mine Safety and Health Administration

Office of Information

Francis E. O'Gorman	Public Affairs Specialist

Technical Support

James L. Banfield, Jr.	Chief, Ventilation Division
Joseph D. Hadden, Jr.	Senior Mining Engineer
Edward J. Miller	Supervisory Mining Engineer
Thomas Barkand	Electrical Engineer
Kevin R. Burns	Mining Engineer
Robert Cascio	Electrical Engineer
Kevin G. Stricklin	Mining Engineer
R. Keith Younger	Industrial Hygienist

Coal Mine Safety and Health - District 5

Ray G. Ross	District Manager
Frank C. Mann	Supervisory Mining Engineer
Bill W. Clemons	Subdistrict Manager
James V. Bowman	Coal Mine Inspection Supervisor
James S. Hicks, Jr.	Coal Mine Inspection Supervisor
Arnold D. Carico	Mining Engineer
Roy D. Davidson	Electrical Engineer
William W. Hulvey	Mining Engineer
Michael L. Jackson	Electrical Engineer
Cliff Lindsay	Mining Engineer
James H. Saunders	Mining Engineer
Frank C. Young, Jr.	Mining Engineer
Burnis L. Austin	Coal Mine Inspector
Nickie E. Brewer	Coal Mine Inspector
Joseph R. Brown, Sr.	Coal Mine Inspector
Kenneth L. Card	Coal Mine Inspector
Dennis Carter	Coal Mine Inspector
Alfonzo Castaneda, Jr.	Coal Mine Inspector
Larry A. Coeburn	Coal Mine Inspector
Charles D. Cooper	Coal Mine Inspector
Douglas G. Evans	Coal Mine Inspector
Arvil C. Gallihar, Jr.	Coal Mine Inspector
John Godsey	Coal Mine Inspector
Clarence A. Goode	Special Investigator
Vearl R. Hileman	Coal Mine Inspector

Coal Mine Safety and Health - District 5 (cont.)

Allen H. Howell	Coal Mine Inspector
Gary W. Jessee	Coal Mine Inspector
Earl W. Owens	Coal Mine Inspector
Kenneth F. Owens	Coal Mine Inspector
Paul J. Porter	Coal Mine Inspector
Nicholas D. Rasnick	Coal Mine Inspector
Ralph P. Reasor	Coal Mine Inspector
Charles F. Reese	Coal Mine Inspector
Warren Ring	Coal Mine Inspector
Marshall B. Roberson	Coal Mine Inspector
Gary L. Roberts	Coal Mine Inspector
Thomas Slemp	Coal Mine Inspector
Clarence Sloane	Coal Mine Inspector
Donnie H. Stallard	Special Investigator
Charles Strunk	Coal Mine Inspector
Charles E. Upchurch	Coal Mine Inspector
George R. Vass	Coal Mine Inspector
John M. Wampler	Coal Mine Inspector

Coal Mine Safety and Health - Headquarters

Michael Yanak, Jr.	Technical Compliance Specialist
James E. Belcher	Health and Safety Specialist
Robert A. Elam	Mining Engineer
Gene B. Fuller	Mine Safety and Health Specialist
Harry J. Carter	Mine Safety and Health Specialist
Dale R. Cavanaugh	Mechnical Engineer
George M. Fesak	Electrical Engineer
Robert J. Painter	Mine Safety and Health Specialist

APPENDIX D

APPENDIX D

List of Persons Providing Sworn Statement During the Investigation

Clinchfield Coal Company

Reecy T. Asbury	Assistance Manager, Safety Division
Carson B. Blackstone	Section Foreman
Carlyle H. Carter	Maintenance Foreman
Willie B. Couch	Mine Manager
Sidney A. Counts	Maintenance Foreman
Homer W. Fields	Safety Inspector
William E. Glovier	Maintenance Foreman
Albert D. Holbrook	Section Foreman
Jack B. Jacobs	Chief Electrician
Robert J. Jessee	Mine Foreman
John W. Kiser	General Mine Foreman
Harold N. Leonard, Jr.	Section Foreman
Norman R. Lewis	Mine Examiner
Richard K. Light, Jr.	Superintendent
Jackie M. Mullins	Assistant Chief Electrician
Johnnie O'Quin	Underground Surveyor
Gary W. Proffitt	Maintenance Foreman
Ray W. Robinette	Roof Control Inspector
Jay M. Rose	Section Foreman
J. Edward Rudder	Safety Inspector
Ronald C. Sluss	Assistant Mine Foreman
Bobby D. Stanley	Section Foreman
John C. Steele	Section Foreman
Lewis D. Stevens	Outby Foreman
Joseph M. Sykes	Assistant Mine Foreman
John P. Talbert	Assistant Mine Foreman
Garlan Vance, Jr.	Maintenance Foreman
Monroe L. West	Manager of Safety Division
Michael D. Wright	Shift Foreman

United Mine Workers of America

James C. Bartley	General Inside
Kellis C. Barton	Repairman
Randy K. Beverly	Timberman
Harold J. Boyd	Roof Bolting Machine Operator
Lawrence F. Carico	Electrician
Samual J. Clay	Belt Examiner/Safety Committee Chairman

Continued UMWA Personnel

Paris N. Collius	Repairman
Danny C. Davidson	Deputy Administrator - Health and Safety Department
Jerry L. Deel	Shuttle Car Operator
Roy B. Glovier	Repairman
Carroll R. Green	Open Fork Rescue Team Member
James W. Hamilton	Supplyman
Robert H. Hartsock	Health and Safety Representative
Jimmy Lee Honaker	Continuous Mining Machine Helper
Emmery A. Howard	Continuous Mining Machine Helper
William M. Litton	Continuous Mining Machine Operator
Fred A. Mullins	Shuttle Car Operator
George H. Owens	Mine Examiner
Paul D. Owens	Bratticeman
Robert A. Phillips	Safety Inspector
Haskell F. Rasnick	Belt Examiner
Gary P. Souleyrette	Timberman
Kennith Stacy	Roof Bolting Machine Operator
James R. Stevens	Repairman
Miles W. Sutherland	Roof Bolting Machine Operator
Bobby L. Sykes	Utility Man
Hobert S. Taylor	Continuous Mining Machine Operator
Freel J. Vanover	Repairman
James A. Wagner	Mine Examiner
George W. Willis	Electrician
Randy E. Wireman	Roof Bolting Machine Operator

Virginia Division of Mines and Quarries

Ronald H. Hamrick	Mine Inspector

Mine Safety and Health Administration

Bill W. Clemons	Subdistrict Manager
Gerald E. Sloce	Mine Inspector

APPENDIX E-1

APPENDIX E-1

DISCUSSION AND EVALUATION OF POTENTIAL ELECTRICAL IGNITION SOURCES

Introduction

During the investigation, all electric circuits and equipment that were located in the 2 Left entries or that supplied power to electric equipment in the 2 Left entries were carefully tested and examined by MSHA personnel for any evidence that the circuits or equipment provided the ignition source for the explosion. These tests and examinations were conducted by George M. Fesak, Electrical Engineer; James S. Hicks, Jr., Coal Mine Inspection Supervisor (Electrical); Michael L. Jackson, Electrical Engineer; Roy D. Davidson, Electrical Engineer; Joseph R. Brown, Sr., Coal Mine Inspector (Electrical); and Donnie H. Stallard, Coal Mine Inspector (Special Investigations). MSHA personnel were assisted by personnel from the Virginia Division of Mines and Quarries, officials and employees of the Clinchfield Coal Company and an official of the UMWA. A detailed description and analysis of the tests and examinations conducted by MSHA investigators as well as other pertinent information provided by officials and employees of the Clinchfield Coal Company follows.

2 Left High-Voltage Circuits and Equipment

The 12,470-volt, three-phase ac circuit which extended into the 2 Left entries originated at a vacuum circuit breaker located near the mouth of the 2 Left entries. The high-voltage circuit extended from the 2 Left vacuum circuit breaker to a 300 kVA belt transformer located near the 2 Left belt drive and from there to a 950 kVA section power center located on the 2 Left working section.

None of the 2 Left high-voltage equipment was approved by MSHA as permissible. This equipment was not required to be permissible because none of the equipment was located in or inby the last open crosscut, in return air, or within 150 feet of pillar workings.

According to Emmery A. Howard, Continuous Mining Machine Helper, the auxiliary fan on the 2 Left section was running just before the explosion occurred. This indicates that the 2 Left high-voltage circuit was energized just before the explosion occurred. After the explosion occurred, Kellis C. Barton and Roy D. Glovier, Repairmen, operated the emergency stop switches for the 2 vacuum circuit breakers located near the bottom of the elevator shaft. This caused the vacuum circuit breakers to trip (open) and removed power from the inby high-voltage circuits. They then operated the emergency stop switches for the input circuits to the 2 vacuum circuit breakers located near the bottom of the elevator shaft. This caused the 2 oil circuit breakers located in the surface substation near the elevator shaft to trip (open). Shortly afterwards, William E. Glovier, Maintenance Foreman, went to the surface substation near the elevator shaft and observed that the 2 oil circuit breakers were already open. W. Glovier then went to the surface substation near the slope entrance and opened the high-voltage disconnects. As a result of R.Glovier's, Barton's, and W. Glovier's actions, all high-voltage power was removed from the underground areas of the mine.

Vacuum Circuit Breaker

A skid-mounted, vacuum circuit breaker (Ohio Brass Model 22015B, Serial No. 1179136-3598) was located near the mouth of the 2 Left entries. This vacuum circuit breaker contained a ground-check circuit and relays designed to provide overcurrent, grounded-phase, and undervoltage protection for the 2 Left high-voltage circuit.

An examination of the 2 Left vacuum circuit breaker during the investigation revealed the following:

1. The incoming high-voltage cable was connected.

2. No high-voltage cable was connected to the feed-through output.

3. The high-voltage cable extending to the 2 Left belt transformer was connected to the branch circuit output.

4. The manually operated high-voltage disconnect switch was in the closed (on) position.

5. The vacuum circuit breaker was in the open (off) position.

6. The spring loaded emergency stop switch for the output branch circuit was in the open (on) position.

7. The maintained emergency stop switch for the input circuit was in the closed (on) position.

8. The control circuit breaker was in the closed (on) position.

9. The ground-check relay, ground-fault relay and overcurrent relays were properly connected.

10. The ground-check relay for the 2 Left branch circuit showed a flag. No other protective relay showed a flag.

11. There was no evidence of a short circuit or ground fault in the vacuum circuit breaker enclosure.

The presence of a flag on the ground-check relay for the 2 Left vacuum circuit breaker indicates that this relay caused the 2 Left vacuum circuit breaker to

:rip. The absence of flags on the overcurrent and ground-fault relays for the ? Left vacuum circuit breaker indicates that an overcurrent or ground-fault :ondition did not cause the circuit breaker to trip. The fact that the outby ıigh-voltage circuit breakers did not trip until manually tripped by R. Glovier ınd Barton indicates that the circuit breakers did not detect an overcurrent)r ground-fault condition in the 2 Left high-voltage circuit.

Belt Transformer

\ 300 kVA belt transformer (Line Power Manufacturing Company, Model 300 PBC, ;erial No. 7599) was located near the mouth of the 2 Left entries. This trans-ⁱormer was used to supply 480-volt, 3-phase power and 120-volt, single-phase)ower to the 2 Left conveyor belt drive installation.

\n examination of the 2 Left belt transformer during the investigation revealed :he following:

1. The incoming high-voltage cable from the 2 Left vacuum circuit breaker was connected.

2. The high-voltage cable to the 2 Left section power center was connected to the feed-through output.

3. The manually operated high-voltage disconnect switch was in the closed (on) position.

4. The emergency stop switch was in the closed (on) position.

5. The three high-voltage fuses were intact.

6. There was no evidence of a short circuit or ground fault in the transformer enclosure.

7. The circuit breaker for the 480-volt, three-phase circuit to the 2 Left conveyor belt drive controller was in the tripped position.

8. The circuit breaker for the 120-volt, single-phase circuit to the 2 Left conveyor belt drive lights was in the closed position.

High-Voltage Cable

The high-voltage circuit from the 2 Left belt transformer to the 2 Left section power center contained approximately 3,000 feet of Anaconda-Ericsson No. 4/0 AWG, 15 kV, 3-conductor, type MP-GC mine power cable and approximately 1,000 feet of Anaconda-Ericsson No. 2/0 AWG, 15 kV, 3-conductor, type MP-GC mine power cable. The high-voltage cable was installed in the No. 3 entry and had been supported from the roof on J-hooks and tie wires. Individual 1000-foot lengths of high-voltage cable had been connected together in three high-voltage splice boxes located in the No. 3 entry at the Nos. 8 and 17 right crosscuts and the No. 26 left crosscut.

An examination of the 2 Left high-voltage cable during the investigation revealed the following:

1. Portions of cable had been dislodged by the force of the explosion.

2. The outgoing (inby) length of cable and the strain clamp had pulled out of the high-voltage splice box at the No. 26 left crosscut when the splice box was blown outby by the force of the explosion. There was no evidence of electrical arcing on the ends of the cable or in the splice box.

3. The cable had been kinked approximately 12 feet outby the intersection of the No. 3 entry and the No. 27 left crosscut. It appeared that the cable damage occurred when the cable was hurled into a roof bolt plate by the force of the explosion. The cable was cut open and no evidence of electrical arcing was observed.

4. The cable had been damaged approximately 14 feet outby the intersection of the No. 3 entry and the No. 27 left crosscut. A small piece of rock had pierced the outer jacket and the shielding and insulation on one phase conductor. The cable was cut open and no evidence of electrical arcing was observed.

Insulation resistance measurements made during the investigation revealed that one phase conductor in the high-voltage cable was grounded at the location described in item No. 4 above. The absence of any evidence of electrical arcing at this location indicates that the conductor was not energized when the phase became grounded. Insulation resistance measurements also revealed that there were no other faults in the high-voltage cable between the 2 Left belt transformer and the 2 Left section power center.

High-Voltage Splice Boxes

Three nonpermissible Line Power Manufacturing Company Model HVJB high-voltage splice boxes had been installed in the high-voltage cable between the 2 Left belt transformer and the 2 Left section power center.

An examination of the high-voltage splice boxes during the investigation revealed the following:

1. The first and second splice boxes at the Nos. 8 and 17 right crosscuts, respectively, had not been damaged by the explosion. The lid interlock switches were in the closed positions.

2. The incoming and outgoing high-voltage cables were connected in the first and second splice boxes.

3. The third splice box at the No. 26 left crosscut had been damaged severely by the explosion. The lid was blown off the splice box. The box was blown approximately 140 feet outby its original location and was turned upside down. The strain clamp for the incoming (outby) high-voltage cable was broken. All of the high-voltage insulators in the splice box were broken.

4. The incoming (outby) high-voltage cable still entered the third splice box; however, the outgoing (inby) high-voltage cable and the strain clamp had pulled out of the splice box when the splice box was blown outby by the explosion.

5. There was no evidence of electrical arcing, short circuits or ground faults in any of the three splice boxes.

Section Power Center: High-Voltage Portion

A 950 kVA section power center (Pemco Corporation Model K-950, Style J-48209, Serial No. C-104-1179) was located in the No. 3 entry between the Nos. 36 and 37 left crosscuts on the 2 Left section.

An examination of the high-voltage portion of the section power center during the investigation revealed the following:

1. The manually-operated high-voltage disconnect switch was in the closed (on) position. The window for the disconnect switch which was located on the outby end of the power center was blown in.

2. The emergency stop switch was in the open (off) position.

3. The three high-voltage fuses were intact.

4. There was no evidence of a short circuit or ground fault in the high-voltage portion of the power center.

Insulation resistance measurements made during the investigation revealed that there were no short circuits or ground faults in the high-voltage portion of the section power center. As noted in No. 2 above, MSHA investigators found the emergency stop switch on the section power center in the open (off) position. However, George Willis, Repairman, stated that he opened the switch during the recovery.

Conclusions

After analyzing the information gathered during the investigation, MSHA investigators concluded the following:

1. The high-voltage circuit supplying the 2 Left vacuum circuit breaker was energized when the explosion occurred.

2. The 2 Left vacuum circuit breaker was closed when the explosion occurred.

3. The 2 Left high-voltage cable, the high-voltage portion of the 2 Left belt transformer, the high-voltage splice boxes, and the high-voltage portion of the 2 Left section power center were energized when the explosion occurred.

4. The low-voltage portions of the 2 Left belt transformer and the 2 Left section power center were energized when the explosion occurred.

5. The 2 Left vacuum circuit breaker tripped and deenergized the 2 Left high-voltage circuits and equipment when the force of the explosion caused the interruption of the ground check circuit at the high-voltage splice box which was originally located near the intersection of the No. 3 entry and the No. 26 left crosscut.

6. The damage to the 2 Left high-voltage cable and the high-voltage splice box located near the No. 26 left crosscut was caused by the explosion.

7. The grounded-phase condition in the high-voltage cable near the No. 27 left crosscut occurred after the cable had been deenergized by the 2 Left vacuum circuit breaker.

In summary, there was no evidence to indicate that the 2 Left high-voltage cable or high-voltage equipment provided the ignition source for the explosion.

Section Power Center: Low-Voltage Portion

The 2 Left section power center had been damaged by the explosion. The power center originally had seven lids. The inby lid had been blown off of the power center and was found in the No. 3 entry approximately 37 feet inby its original location. This lid was bolted to two mounting brackets that had been welded to the frame of the power center. The force of the explosion broke the mounting brackets from the frame. The middle lid was bolted to the left mounting bracket (facing inby) but was not bolted to the right mounting bracket. The force of the explosion pivoted the lid around the attachment to the left mounting bracket moving the right side of the lid in the inby direction. The inside of the power center was coated with a heavy layer of dust. Several of the electronic ground check circuits in the power center were damaged by the heat of the explosion. There was evidence of heat on the control wiring in the power center, particularly where the inby lid had been blown off.

During the investigation, MSHA investigators decided to energize the electric face equipment in the 2 Left section. In view of the damage to the section power center and to the 2 Left high-voltage cable, all parties in the investigation agreed to install a new power center in the No. 2 entry of the longwall setup entries and the necessary high-voltage cable to supply the power center from the Caney Mains IV high-voltage circuit. The new power center and high-voltage cable were installed by Clinchfield Coal Company personnel and were used to energize the 2 Left section face equipment.

The section power center contained ten 600-volt, 3-phase receptacles and four 480-volt, 3-phase receptacles for the operation of the section equipment. At the time of the explosion, the trailing cables for the continuous mining machine, roof bolting machine, conveyor belt feeder, standard-drive shuttle car, off-standard-drive shuttle car, scoop battery charger, and welder were connected to 600-volt receptacles on the section power center; the trailing cable for the auxiliary fan was connected to a 480-volt receptacle on the section power center; and the trailing cables for the personnel carrier onboard battery charger and the trickle duster were not connected to the section power center. A single-line diagram showing the electric equipment that was connected to the section power center at the time of the explosion is in Appendix E-3.

Based on the statements of Miles W. Sutherland, Roof Bolting Machine Operator, and Howard, the trailing cables for the continuous mining machine, roof bolting machine, and auxiliary fan were energized just before the explosion occurred. MSHA investigators could not conclusively determine if the trailing cables for the conveyor belt feeder, shuttle cars, scoop battery charger, and welder were energized when the explosion occurred. However, it is likely that these trailing cables were also energized.

The section power center also contained two 240-volt, single-phase receptacles and two 120-volt, single-phase duplex receptacles. These receptacles were supplied from an 8 kVA auxillary transformer in the power center. The primary fuses for the auxillary transformer were tested and found to be intact. The two 40-ampere, 2-pole circuit breakers for the 240-volt single-phase receptacles were found in the open (off) positions. The dust caps on the 240-volt, single-phase receptacles were found in the closed positions. Consequently, MSHA investigators concluded that the two 240-volt, single-phase receptacles on the section power center were neither energized nor in use when the explosion occurred. The two 15-ampere, single-pole circuit breakers for the 120-volt, single-phase duplex receptacles were found in the closed (on) positions. The top dust cover on the inby duplex receptacle was found in the open position. The bottom dust cover on the same receptacle was found partially open. The top dust cover on the outby duplex receptacle was found in the open position. The bottom dust cover on the same receptacle was found in the closed position. Based on the condition of the auxiliary transformer fuses and on the positions of the circuit breakers, MSHA investigators concluded that both duplex receptacles were energized when the explosion occurred. Based on statements of miners and on tests and examinations conducted during the investigation, MSHA investigators concluded that one of the duplex receptacles was being used to supply three incandescent light fixtures installed over the power center when the explosion occurred. Also, there is some evidence to indicate that the other duplex receptacle may have been used to supply two fluorescent light fixtures and six incandescent light fixtures installed in and near the dinner hole when the explosion occurred. Both of these circuits are discussed in greater detail in the sections on the power center lights and the dinner hole lights.

The section power center was not of a permissible design. Consequently, arcing caused by a fault within the power center or by the manual or automatic operation of one of the circuit breakers, relays, and switches in the power center would release sufficient energy to ignite an explosive methane-air atmosphere. Careful examination of the power center revealed no evidence of a short circuit or ground fault in the low-voltage portion of the power center. The locations of the miners on the 2 Left section when the explosion occurred indicates that none of the miners was in a position to manually operate any of the switches or circuit breakers in the power center. Tests and examinations of the electric equipment connected to the section power center when the explosion occurred did not reveal any evidence of a fault that could have caused automatic operation of a circuit breaker in the power center. However, tests and examinations of the trailing cables connected to the section power center when the explosion occurred revealed evidence of several faults that could have caused automatic operation of one of the circuit breakers in the power center. (See following section on section trailing cables). Consequently, MSHA investigators concluded that the section power center could have provided the ignition source for the explosion.

Section Trailing Cables

MSHA investigators carefully examined and tested each of the eight trailing cables that were connected to the section power center to determine if a fault in one of the cables could have provided the ignition source for the explosion. A fault in an energized trailing cable could provide the ignition source either directly by electrical arcing at the fault location or indirectly by causing automatic operation of a circuit breaker in the section power center.

Continuous Mining Machine Trailing Cable

The trailing cable for the continuous mining machine was examined and tested. MSHA investigators cut open a permanent splice located approximately 9 feet (cable length) outby the strain clamp on the machine. Although the splice jacket did not exclude moisture from inside the splice, there was no evidence of a short circuit or ground fault at this location. MSHA investigators also cut open a cable repair located approximately 68 feet (cable length) outby the strain clamp on the machine. The repair was properly made and well insulated. There was no evidence of a short circuit or ground fault at this location. Finally, MSHA investigators cut open a repaired permanent splice located approximately 127 feet (cable length) outby the strain clamp on the machine. This repair was also properly made and well insulated. There was no evidence of a short circuit or ground fault at this location. All other splices and repairs in the trailing cable appeared to be in good condition. Insulation resistance measurements also revealed that the trailing cable was free from short circuits and ground faults. MSHA investigators concluded that a short circuit or ground fault in the continuous mining machine trailing cable did not provide the ignition source for the explosion.

Roof Bolting Machine Trailing Cable

The trailing cable for the roof bolting machine was examined and tested. The cable jacket had been damaged approximately 220 feet (cable length) from the section power center. There was no damage to the insulation on the phase conductors and no evidence of a short circuit or ground fault at this location. The cable had also been damaged approximately 480 feet (cable length) from the section power center. The outer jacket had a 1 1/2-inch cut in it and the insulation on the red phase conductor was cut through to the conductor. Insulation resistance measurements indicated that the red phase conductor was grounded at this location. However, earlier insulation resistance measurements indicated that the cable was free from short circuits and ground faults. Consequently, MSHA investigators concluded that the cable damage occurred during the investigation from falling roof or rib material. Two cable repairs located 511 feet and 590 feet (cable lengths) from the section power center were cut open by MSHA investigators. There was no evidence of a short circuit or ground fault at either cable repair. All other splices and repairs in the trailing cable appeared to be in good condition. MSHA investigators concluded that a short circuit or ground fault in the roof bolting machine trailing cable did not provide the ignition source for the explosion.

Auxiliary Fan Trailing Cable

The trailing cable for the auxiliary fan was tested and examined. Insulation resistance measurements revealed phase-to-ground leakage on the black and red phase conductors. The leakage to ground on the red phase conductor (50,000 ohms) was caused by damage to the cable approximately four feet (cable length) outby the auxiliary fan. The cable jacket and insulation on the red phase conductor had been cut; however, there was no evidence of electrical arcing at this location. From the location of the damaged place and the absence of any evidence of electrical arcing, MSHA investigators concluded that the damage was caused by the explosion. The leakage to ground on the black phase conductor (12,000 ohms) was caused by a defective splice and a damaged place in the cable located approximately 190 feet and 200 feet (cable lengths), respectively, outby the auxiliary fan. Both the splice and damaged place in the cable were lying in water. MSHA investigators cut the splice and damaged place open and found no evidence of electrical arcing at either location. However, evidence of electrical arcing would not necessarily be present since the ground fault current was limited to 15 amperes and the circuit was provided with ground fault protection set at 6.5 amperes. Consequently, MSHA investigators concluded that a ground fault in the auxiliary fan trailing cable could have occurred and could have provided the ignition source for the explosion by causing the circuit breaker in the section power center to trip.

APPENDIX E-1

Conveyor Belt Feeder Trailing Cable

The trailing cable for the conveyor belt feeder was tested and examined. Insulation resistance measurements revealed phase to ground leakage on the black (30,000 ohms) and white (25,000 ohms) phase conductors. MSHA investigators cut into one damaged place and six taped repairs in the cable to find the cause of the leakage to ground. The damaged place and repairs were located approximately 5 feet, 16 feet, 25 feet, 47 feet, 157 feet, 166 feet, and 202 feet (cable lengths) from the conveyor belt feeder. At the damaged place in the cable, the outer jacket and insulation on the black phase conductor were cut. Evidence indicated that the damage to the cable may have been caused by a rib fall that occurred during the investigation. There was no evidence of electricl arcing at the damaged place in the cable. Several of the cable repairs were not well insulated and moisture was present within the repairs. One of the cable repairs contined evidence of a ground fault. This repair was located when the trailing cable was lying on the mine floor between the conveyor belt feeder and the rib approximately five feet (cable length) from the controller enclosure on the conveyor belt feeder. The taped jacket and the insulation on the white phase conductor were damaged. The distinctive odor of electrical arcing was present in the repair. MSHA investigators could not determine when the ground fault occurred; however, the distinctive odor in the repair indicates that the fault was recent. There was no evidence of electrical arcing in any of the other cable repairs. Based on the evidence of electrical arcing in the cable repair, MSHA investigators concluded that a ground fault in the conveyor belt feeder trailing cable could have provided the ignition source for the explosion either directly by electrical arcing at the fault location or indirectly by causing the circuit breaker in the section power center to trip.

Standard-Drive Shuttle Car Trailing Cable

The trailing cable for the standard-drive shuttle car was examined and tested. The cable jacket was ruptured at a location approximately 128 feet (cable length) from the section power center. MSHA investigators cut the cable open and observed no evidence of a short circuit or ground fault at this location. The cable jacket was blistered where the cable was imbedded in coke along the right rib at the intersection of the No. 2 entry and the No. 39 crosscut. MSHA investigators also cut the cable open at this location. It was evident that the cable jacket had been blistered from the external heat generated by the coking coal dust. The insulation on the conductors was not damaged and there was no evidence of a short circuit or ground fault at this location. MSHA investigators also examined a permanent splice in the trailing cable. The permanent splice appeared to be in good condition. Insulation resistance measurements revealed that the trailing cable was free from short circuits and ground faults. Consequently, MSHA investigators concluded that a short circuit or ground fault in the standard-drive shuttle car trailing cable did not provide the ignition source for the explosion.

Off-Standard-Drive Shuttle Car Trailing Cable

The trailing cable for the off-standard-drive shuttle car was examined and tested. A poorly made permanent splice located approximately 16 feet from the strain clamp on the cable reel was opened by MSHA investigators. There was no evidence of a short circuit or ground fault within this splice. All other splices and repaired places in the trailing cable appeared to be in good condition. Insulation resistance measurements revealed that the cable was free from short circuits and ground faults. Consequently, MSHA investigators concluded that a short circuit or ground fault in the off-standard-drive shuttle car trailing cable did not provide the ignition source for the explosion.

Scoop Battery Charger Trailing Cable

The trailing cable for the scoop battery charger was examined and tested. A cable repair was found approximately 182 feet (cable length) from the section power center. MSHA investigators cut the cable repair open and found that it was properly made and well insulated. There was no evidence that a short circuit or ground fault occurred at this location. MSHA investigators also examined two other repairs in the trailing cable. Both repairs appeared to be in good condition. Insulation resistance measurements also revealed that the trailing cable was free from short circuits and ground faults. Consequently, MSHA investigators concluded that a short circuit or ground fault in the scoop battery charger trailing cable did not provide the ignition source for the explosion.

Welder Trailing Cable

The trailing cable for the welder was examined and tested. The cable was approximately 38 feet long and contained no splices, jacket repairs, or damaged places. Insulation resistance measurements revealed that the cable was free from short circuits and ground faults. Consequently, MSHA investigators concluded that a short circuit or ground fault in the welder trailing cable did not provide the ignition source for the explosion.

Other Trailing Cables

The investigation revealed that the trailing cables for the trickle duster and the personnel carrier onboard battery charger were not connected to the section power center when the explosion occurred. Consequently, a short circuit or ground fault in either trailing cable could not have provided the ignition source for the explosion.

Grounding Circuit Continuity

MSHA investigators also tested the continuity of the grounding conductors in the 8 trailing cables that were connected to the section power center when the explosion occurred. The grounding conductors in each trailing cable were continuous. Consequently, MSHA investigators concluded that a loss of grounding circuit continuity in one of the 8 trailing cables did not provide the ignition source for the explosion by causing automatic operation of one of the circuit breakers in the section power center.

Trailing Cable Plugs

The plugs for the 8 trailing cables that were connected to the section power center when the explosion occurred were also examined and tested. There was evidence that an arcing fault had occurred inside the plug on the outby end of the continuous mining machine trailing cable. Copper strands of the phase and grounding conductors had been melted. A small portion of the brass connectors for the phase and grounding conductors had been melted. The grounding conductors had been discolored by heat and carbon had been deposited on the internal surfaces of the plug. Insulation resistance measurements revealed that the plug was free from short circuits and ground faults at the time of the investigation. MSHA investigators could not determine what caused the arcing fault or when the fault occurred. However, there was very little of the distinctive odor of electrical arcing present in the plug, indicating that the fault probably occurred long before the explosion. Nevertheless, the fault was capable of providing the ignition source for the explosion either directly from electrical arcing or indirectly by causing automatic operation of the circuit breaker in the power center. There was no evidence of a fault in any of the other seven trailing cable plugs that were connected to the section power center when the explosion occurred.

AC Equipment Connected to the Section Power Center

Intermachine Arcing

No two units of electric equipment were located in close proximity to each other at the time of the explosion. Consequently, MSHA investigators concluded that arcing between the frames of two units of electric equipment did not provide the ignition source for the explosion.

Continuous Mining Machine

At the time of the explosion, a permissible-type continuous mining machine (National Mine Service Company Type 3080 Marietta Drum Miner, Approval No. 2G-3305A-1, Serial No. 7792) was located at the face of the No. 4 entry on the 2 Left section. According to Howard, Covey J. French, Continuous Mining Machine Operator, had trammed the continuous mining machine into the face of the No. 4 entry and opened the gathering head circuit breaker shortly before the explosion occurred. When the explosion occurred, the machine was idle while Howard, French, Mary K. Counts, Shuttle Car Operator, Dale Stamper, Jr., Utility Man, and Eugene W. Meade, Shuttle Car Operator, were installing additional ventilation tubing to ventilate the face of the No. 4 entry.

The examination of the continuous mining machine during the investigation revealed the following:

1. The machine was connected to a 600-volt ac receptacle on the section power center with approximately 550 feet of No. 4/0 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable.

2. The main circuit breaker was in the closed (on) position.

3. The spring-loaded cutter head stop switch was locked in the open (off) position.

4. The tram circuit breaker was in the closed (on) position. The tram control levers were in the centered position.

5. The gathering head circuit breaker was in the open (off) position.

6. The headlight switch was in the closed (on) position.

7. The panic bar emergency stop switch and the off-side emergency stop switch were in the closed (on) positions.

8. The hydraulic control levers were all in the neutral positions with the exception of the gathering head control lever which was in the float detent position.

9. The cutter head and gathering head were in the down positions and the conveyor was empty.

Howard's statements agree with the physical examination of the continuous mining machine. Accordingly, MSHA investigators concluded that the continuous mining machine was energized but not in operation when the explosion occurred. Since the gathering head circuit breaker was in the open (off) position, the lights, motors, control circuit, and methane monitor on the machine were not energized when the explosion occurred.

The continuous mining machine was examined carefully to determine if the machine could have provided the ignition source for the explosion. The following permissibility deficiencies were observed:

1. The headlight on the operator side was not mounted securely to the machine frame; however, the headlight was grounded to the frame of the machine by an internal grounding conductor. The step flange joint on the lens cover of this headlight had an opening in excess of .006 inch. One mounting bolt did not have a lock washer.

2. The connection box between the continuous mining machine main controller and the left hand ripper motor was not mounted securely to the machine frame. There was no clamp on the hose conduit on the motor side of this connection box.

3. The incandescent light located on the left side of the left headlight was not mounted to the machine frame securely. This light was grounded to the machine frame by an internal grounding conductor.

4. The left side headlight was not mounted to the machine frame securely. This light was grounded to the machine frame by an internal grounding conductor.

5. The front fluorescent light on the left side had a broken plastic tube surrounding the lamp. The entrance gland for this light was broken. This may have occurred after the explosion from the falling of loose rib.

6. The back fluorescent light on the left side was not mounted securely to the machine frame. This light was grounded to the machine frame by an internal grounding conductor.

None of the permissibility deficiencies described in item Nos. 1 through 6 above could have provided the ignition source for the explosion since none of the components involved was energized when the explosion occurred.

The interiors of the explosion-proof enclosures on the continuous mining machine were carefully examined. None of the enclosures showed any evidence of an internal methane-air ignition. The onboard cables on the continuous mining machine were also tested and examined. No evidence of a short circuit or ground fault was found.

The continuous mining machine was equipped with a National Mine Service Company, Model 420 methane monitor, MSHA Certification No. 32A-6/MS. The methane monitor was not energized at the time of the explosion since the gathering head circuit breaker was open. However, the methane monitor was properly connected into the control circuitry of the continuous mining machine so as to deenergize all electric motors and light fixtures on the machine. The methane monitor was tested by MSHA investigators with a known test mixture of 2.2 percent methane-air. The test mixture was applied to the sensor assembly with the dust cover in place, and the methane monitor meter reading increased from 0.0 percent methane to 2.4 percent methane. When the meter reading reached 1.0 percent methane, the yellow warning light came on. When the meter reading reached 2.0 percent methane, the red warning light came on and the methane monitor deenergized the motors and lights on the machine. The machine could not be restarted until the methane cleared and the methane monitor was reset. These tests indicate that with the exception of the span adjustment (2.4 percent as compared to the 2.2 percent of the test sample) the methane monitor was properly calibrated.

Finally, MSHA investigators performed a functional test of the continuous mining machine. First, all controls were set as initially found and the trailing cable was energized. The control circuit, methane monitor, and lighting system were not energized because the gathering head circuit breaker was in the open (off) position. No motors could be started since the control circuit was not energized. Next, the machine was run through a full sequence of operation. The machine functioned properly.

In summary, MSHA investigators did not find any evidence to indicate that the continuous mining machine provided the ignition source for the explosion.

Roof Bolting Machine

At the time of the explosion, a permissible-type roof bolting machine (J. H. Fletcher and Company Model No. DDO-15C-D, Serial No. 79123, Approval No. 2G-2701A-9) was located near the face of the No. 3 entry on the 2 Left section. According to Sutherland, the roof bolting machine had been trammed into the face of the No. 3 entry shortly before the explosion occurred. Sutherland and Harold J. Boyd, Roof Bolting Machine Operator, were standing at the roof bolting machine drilling stations when the explosion occurred.

The examination of the roof bolting machine during the investigation revealed the following:

1. The machine was connected to a 600-volt ac receptacle on the section power center with approximately 650 feet of No. 2 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable.

2. The main circuit breaker was in the closed (on) position.

3. The light switch was in the closed (on) position.

4. The two spring-loaded emergency stop switches at the drill controls were in the closed (on) positions.

5. The hydraulic diversion valve was in position for the machine to be operated from the boom control stations.

6. The left drill head was in the proper position to drill, but the left stabilizer jack was not down. A starter drill steel with a new and unused drill bit was in the drill head.

7. The right stabilizer jack was down, but the right drill head was not in the proper position to drill. A starter drill steel with a new drill bit was in the right tray. NOTE: The stabilizer jack may have leaked down.

Based on Sutherland's statements and on the physical examination of the machine, MSHA investigators concluded that the roof bolting machine was energized with the machine mounted lights on when the explosion occurred. MSHA investigators could not determine whether or not the pump motors on the machine were running when the explosion occurred because the pump motor start/stop control switches are spring loaded. However, the position of the drill heads, stabilizer jacks, drill steels, and drill bits indicates that Sutherland and Boyd had not started drilling when the explosion occurred.

The roof bolting machine was examined carefully to determine if the machine could have provided the ignition source for the explosion. The following permissibility deficiencies were observed:

1. One of the packing glands entering the inby side of the main controller enclosure was not secured against loosening; however, the gland was properly packed and tight.

2. The hose conduit was not clamped to one of the packing glands entering the center outby lighting system junction box.

3. The center outby lighting system junction box had an opening in excess of 0.004 inch. A 0.005 inch feeder gauge could be inserted approximately 0.25 inch.

4. The lens cap locking screw on the right inby McJunkin lighting fixture was missing and the lens was loose.

The permissibility deficiencies described in item Nos. 1 and 2 above did not render the machine capable of igniting an explosive methane-air mixture. The permissibility deficiencies described in items Nos. 3 and 4 above did not involve enclosures that contain components that arc during normal operation. Nevertheless, the interiors of these enclosures were examined carefully. No evidence of arcing or of an internal methane-air ignition was observed. In addition, the interior of the main controller enclosure was examined. No evidence of an internal methane-air ignition in this enclosure was observed.

The onboard cables on the machine were examined. No evidence of a short circuit or ground fault was observed. In addition, insulation resistance measurements revealed that the motors and onboard power cables were free from ground faults.

Finally, MSHA investigators performed a functional test of the roof bolting machine. First, all controls were set as initially found and the trailing cable was energized. Except for the left headlight which was burned out, all of the machine lights came on. Neither motor started since the start control switches are spring loaded. Next, the machine was run through a full sequence of operations. The machine functioned properly.

In summary, MSHA investigators did not find any evidence to indicate that the roof bolting machine provided the ignition source for the explosion.

Auxiliary Fan

At the time of the explosion, a permissible-type auxiliary fan (Buffalo Forge Company, Type 25A9-NVF, Approval No. 2G-3102A, Serial No. 79M-1338A1) was located in the No. 4 entry just inby the No. 39 crosscut on the 2 Left section. According to Howard, the auxiliary fan was running just before the explosion occurred. However, Howard speculated that Hall may have gone to shut off the auxiliary fan when the explosion occurred.

The examination of the auxiliary fan during the investigation revealed the following:

1. The fan was connected to a 480-volt ac receptacle on the section power center with approximately 634 feet of No. 6 AWG, 2000-volt, 3-conductor, type G-GC portable power cable.

2. The circuit breaker operating lever was in the on position; however, the circuit breaker was in the open (off) position.

3. The spring loaded push-button start/stop control switches were impacted with mud and debris to the point that they would not operate. Once the mud and debris were removed, the stop switch functioned properly. The start switch remained inoperative because the switch had been broken by the force of the debris striking the push-button.

As noted in item No. 2 above, MSHA investigators found the circuit breaker operating lever on the front of the auxiliary fan controller in the on position. However, when the controller cover was removed, the investigators found the circuit breaker in the open (off) position. The fork of the operating lever had become disengaged from the circuit breaker handle. Scuff marks on the circuit breaker handle indicate that the fork was forcibly disengaged from the circuit breaker handle; possibly by the force of the explosion. Because there was a discrepancy in the positions of the operating lever and the circuit breaker handle and because the start/stop control switches were spring loaded, MSHA investigators could not conclusively determine if the auxiliary fan was operating when the explosion occurred. However, Howard's statement indicates that the fan was operating a short time before the explosion occurred.

The auxiliary fan was examined carefully to determine if it could have provided the ignition source for the explosion. The following permissibility deficiencies were observed:

1. The trailing cable was approximately 84 feet longer than permitted by 30 CFR 18.35(i).

2. The motor cable packing gland entering the controller enclosure was not secured against loosening; however, the gland was properly packed and tight.

3. The trailing cable packing gland entering the controller enclosure was not secured against loosening. The packing gland was loose and contained insufficient packing.

The permissibility deficiencies described in item Nos. 1 and 2 above did not render the auxiliary fan capable of igniting an explosive methane-air mixture.

The packing gland described in item No. 3 above was disassembled and examined carefully. There was no evidence that flame passed through the packing gland. In addition, the inside of the controller enclosure was examined. There was no evidence that an internal methane-air ignition occurred in the enclosure.

The power cable from the controller to the fan motor was examined. No evidence of a short circuit or ground fault was observed. In addition, insulation resistance measurements revealed that the fan motor and fan motor cable were free from ground faults.

Finally, MSHA investigators performed a functional test of the auxiliary fan. The fan functioned properly and the fan blades did not contact the fan housing while the auxiliary fan was running.

In summary, MSHA investigators found no evidence to indicate that the auxiliary fan provided the ignition source for the explosion.

Conveyor Belt Feeder

At the time of the explosion, a permissible-type conveyor belt feeder (W. R. Stamler Corporation, Model BF-17-2-10, Serial No. 11781, Approval No. 2G-2908A-6) was located in the No. 2 entry at the No. 36 crosscut on the 2 Left section. The conveyor belt feeder had been connected to a nonpermissible Mefcor belt sequence switch installed on the 2 Left conveyor belt just outby the tailpiece with a 3-conductor cable. Neither the conveyor belt feeder nor the belt sequence switch were required to be permissible because they were not located in or inby the last open croscut, in return air, or within 150 feet of pillar workings.

The conveyor belt feeder was not being used to feed coal onto the 2 Left conveyor belt when the explosion occurred. No coal was found on the 2 Left conveyor belt. Both shuttle cars had been parked because the roof-bolting machine in the face of the No. 3 entry had the roadway blocked to the continuous mining machine in the face of the No. 4 entry. However, the conveyor belt feeder had been used on the night of the explosion. According to Ronald C. Sluss, Evening Shift Assistant Mine Foreman, and John C. Steele, Extra Section Foreman, the conveyor drive chain had broken at about 7:00 p.m. The drive chain was replaced and the conveyor belt feeder was returned to service at about 8:00 p.m.

An examination of the conveyor belt feeder during the investigation revealed the following:

1. The conveyor belt feeder was connected to a 600-volt ac receptacle on the section power center with approximately 300 feet of No. 2/0 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable.

2. The main circuit breaker was in the closed (on) position.

3. The conveyor control switch was in the automatic position.

4. The spring-loaded reset switch was in the open position.

5. The spring-loaded emergency stop switch (panic bar switch) was in the closed (on) position.

6. Both footswitches were in the open (off) positions.

7. The belt sequence switch was in the open (off) position.

8. The cable connecting the belt sequence switch to the controller had been pulled apart at a splice.

9. The drive belt for the pick breaker speed switch was off and the breaker speed switch had been adjusted so that the contacts were always closed.

10. The oil level and oil temperature switches were in the open positions.

11. The high oil pressure switch was in the open position.

12. The pick breaker drive chain cover had been dislodged and was resting on the pick breaker drive chain.

The 100-horsepower motor on the conveyor belt feeder drives the pick breaker and a hydraulic pump for the operation of the conveyor. The hydraulic motor for the conveyor is controlled by the conveyor solenoid valve which is operated by a timer (approximately 148 seconds). The timer is activated by either of two footswitches. Due to the configuration of the control circuit, MSHA investigators could not conclusively determine if the conveyor belt feeder motor was running when the explosion occurred. However, for the motor to have been off, a miner would have had to open the main circuit breaker and then return it to the closed position (as found) or a miner would have had to travel to the hydraulic control station and push in the emergency stop switch. Since both of these events are unlikely, MSHA investigators believe that the conveyor belt feeder motor was running with the pick breaker turning when the explosion occurred. Since it was evident that neither footswitch had been operated within 148 seconds of the explosion, MSHA investigators concluded that the feeder conveyor chain was not operating when the explosion occurred.

The conveyor belt feeder was examined carefully to determine if it could have provided the ignition source for the explosion. Even though the conveyor belt feeder was not required to be permissible, it was of a permissible design. However, it was not maintained in permissible condition as described below:

APPENDIX E-1

1. The strain clamp for the control cable entering the right footswitch was missing.

2. The control cable for the right footswitch contained a permanent-type splice. The splice was well made.

3. The control cable for the right footswitch contained a taped splice that was defective. The conductors were spliced by twisting them together without using connectors. The individual conductors were well insulated; however, there was moisture inside the taped splice jacket.

4. The control cable for the right footswitch had a cut in the outer jacket; however, the conductor insulation was not damaged.

5. The control cable for the left footswitch contained a taped splice. The splice was well made and dry inside.

6. The control cable for the left footswitch had a cut in the outer jacket; however, the conductor insulation wasn't damaged.

7. The packing gland entering the conveyor solenoid valve enclosure contained insufficient packing.

8. The control cable for the belt sequence switch had pulled apart at a taped splice that was defective. The conductors in the splice had been joined by twisting them together.

The permissibility deficiencies described in items Nos. 1 and 2 above did not render the conveyor belt feeder capable of igniting an explosive methane-air mixture. The splices and damaged places described in items Nos. 3 through 6 above were examined carefully. No evidence of electrical arcing or of a short circuit or ground fault was observed in any of the splices or damaged places. The conveyor solenoid valve described in item No. 7 above was not energized when the explosion occurred and therefore could not have provided the ignition source for the explosion. The control cable for the belt sequence switch described in item No. 8 had pulled apart at a taped splice that was defective. It could not be determined when the splice had pulled apart; although, it appeared that the splice had pulled apart either as a result of the forces of the explosion or a rib roll. Both ends of the spliced cables were examined closely. The tape that had insulated the spliced conductors and the tape that had formed the outer jacket of the splice remained with the inby (controller) cable and there was no evidence of electrical arcing where the conductors separated. There was also no evidence of electrical arcing or of a short circuit or ground fault on the inby cable. The belt sequence switch was of a nonpermissible design. However, the switch contacts were inside of sealed glass mercury tubes. The tubes were not broken. Moreover, the switch contacts were connected in series with the contacts of the conveyor timer relay. Since the conveyor timer relay contacts had been open for some time prior to the explosion, no current could have been flowing through the belt sequence switch contacts or through the control cable when the explosion occurred. MSHA investigators concluded that neither the permissibility deficiency described in item No. 8 above nor the nonpermissible belt sequence switch provided the ignition source for the explosion.

The interiors of the controller enclosure and the control switch enclosures were examined carefully. Evidence of an internal methane-air ignition was not observed in any of the enclosures. One footswitch enclosure; however, did contain moisture and electrical lubricant.

The onboard cables on the conveyor belt feeder were examined. No evidence of a short circuit or ground fault was observed. Insulation resistance measurements confirmed that the onboard power cable and motor were free from ground faults. Insulation resistance measurements revealed that the control circuits were free from ground faults except for the footswitch control circuit which showed leakage to ground. The leakage to ground was due to moisture in the splice in the right footswitch cable.

The large metal cover over the electric motor and pick breaker drive chain was not in its supports and was resting on the pick breaker drive chain. Company maintenance records indicate that the pick breaker bearing on the chain side was changed on the midnight and day shifts on June 18, 1983. The repairs were finished by Sidney A. Counts, day shift Maintenance Foreman, Paris N. Collius, Repairman, and Willis on the day shift on June 18, 1983. Counts and Collius both stated that the metal cover was properly replaced in its supports after the bearing was changed. Consequently, MSHA investigators concluded that the metal cover was dislodged from its supports by the force of the explosion.

After the permissibility deficiencies described in item Nos. 1 through 8 above were repaired, MSHA investigators performed a functional test of the conveyor belt feeder. The reset switch contacts had to be cleaned before the machine would operate. Otherwise the machine functioned properly. The conveyor timer relay functioned properly and allowed the conveyor to run for 148 seconds after either footswitch was actuated. The metal cover was left resting on the pick breaker drive chain. No sparks were observed while the pick breaker was operating.

In summary, MSHA investigators found no evidence to indicate that the conveyor belt feeder provided the ignition source for the explosion.

Shuttle Cars

One permissible-type standard-drive shuttle car and one permissible-type off-standard-drive shuttle car were located on the 2 Left section at the time of the explosion. The standard-drive shuttle car (Joy Manufacturing Company, Model No. 21SC-5613KKE-1, Approval No. 2G-2663A-7, Serial No. ET-145653), normally driven by Counts, was located in the No. 39 crosscut between the Nos. 2 and 3 entries on the 2 Left section. The off-standard-drive shuttle car (Joy Manufacturing Company, Model No. 21SC-56BXKKE-1, Approvel No. 2G-2663A-7, Serial No. ET-14654), normally driven by Meade, was located in the No. 3 entry between the Nos. 38 and 39 left crosscuts on the 2 Left section. The roof bolting machine in the face of the No. 3 entry had the roadway blocked to the continuous mining machine in the face of the No. 4 entry. According to Howard, Counts and Meade were helping install ventilation tubing in the face of the No. 4 entry at the time of the explosion. Both Counts' and Meade's bodies were found next to the continuous mining machine in the No. 4 entry.

The examination of the two shuttle cars revealed the following similiarities:

1. The control and lighting circuit breakers were in the closed (on) positions.

2. The conveyor switches were in the off positions.

3. The spring-loaded emergency stop switches (panic bar switches) were in the closed (on) positions.

4. The headlight switches were in the on positions for the inby direction.

5. The traction switches were in the fast positions.

6. The self-centering tram control switches (footswitches) were in the center (off) positions.

7. The manually-operated parking brakes were not set.

8. The automatic parking brakes were set.

9. The seats and foot pedals were arranged for travel in the inby direction.

10. The conveyors were empty.

The examination of the standard-drive shuttle car also revealed that the shuttle car was connected to a 600-volt ac receptacle on the section power center with approximately 627 feet of No. 6 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable and that the main circuit breaker was in the open (off) position.

The examination of the off-standard-drive shuttle car also revealed that the shuttle car was connected to a 600-volt ac receptacle on the section power center with approximately 476 feet of No. 6 AWG, 600-volt, 3-conductor, type G-GC portable power cable and that the main circuit breaker was in the closed (on) position.

Based on the examination of the shuttle cars and on the locations of the miners and section equipment when the explosion occurred, MSHA investigators concluded that both shuttle cars had been parked some time prior to the explosion.

Since the main circuit breaker on the standard-drive shuttle car was in the open (off) position, the headlights, motors, and control circuit on the shuttle car were not energized when the explosion occurred.

The standard-drive shuttle car was examined carefully to determine if it could have provided the ignition source for the explosion. The following permissibility deficiencies were observed:

1. The trailing cable was approximately 77 feet longer than permitted by 30 CFR 18.35(i).

2. The left rear headlight was not mounted securely to the machine frame; however, the headlight was grounded to the machine frame through a grounding conductor in the supply cable.

Neither of these deficiencies rendered the shuttle car capable of igniting an explosive methane-air mixture.

The interiors of the cable reel and main controller enclosures were examined carefully since these enclosures were energized when the explosion occurred. No evidence of an internal methane-air ignition in either enclosure was observed. Insulation resistance measurements revealed that the onboard cable from the cable reel to the main controller was free from ground faults.

MSHA investigators performed a functional test of the standard-drive shuttle car. First, all controls were set as initially found and the trailing cable was energized. None of the headlights came on and none of the motors started since the main circuit breaker was in the open (off) position. Next, the machine was run through a full sequence of operation. The machine functioned properly.

The position of the controls on the off-standard-drive shuttle car indicated that the control circuit and inby headlights were energized and the conveyor motor was deenergized when the explosion occurred. It was not possible to conclusively determine if the pump motor and traction transformer were energized when the explosion occurred because the emergency stop switch (panic bar switch) was spring loaded. However, it is likely that the operator pushed the emergency stop switch when he parked the shuttle car, in which case the pump motor and traction transformer were not energized when the explosion occurred.

The off-standard-drive shuttle car was examined carefully to determine if it could have provided the ignition source for the explosion. No permissibility deficiencies were observed on this shuttle car.

The interiors of the cable reel, main controller, footswitch, control station, and panic bar switch enclosures were examined. No evidence of an internal methane-air ignition was observed in any of these enclosures. Insulation resistance measurements revealed that the motors, motor cables, the power cable from the cable reel to the main controller, and the control circuits on the off-standard-drive shuttle car were free from ground faults.

Finally, MSHA investigators performed a functional test of the off-standard-drive shuttle car. First, all controls were set as found after the explosion and the trailing cable was energized. No motors started and the inby head-lights came on. Next, the shuttle car was run through a full sequence of operation. The shuttle car functioned properly.

In summary, MSHA investigators found no evidence to indicate that either shuttle car provided the ignition source for the explosion.

Scoop Battery Charging Station

At the time of the explosion, a battery charging station was located in the No. 33 crosscut between the Nos. 3 and 4 entries on the 2 Left section. The battery charging station was used to provide charged batteries for the battery-powered scoop used on the section. The charging station consisted of a non-permissible battery charger (Gould Ferrocharger Motive Power Charger, Model No. GFM32-800T2-G, Serial No. 78CS15137) located in the No. 33 crosscut between the Nos. 3 and 4 entries and a spare set of scoop batteries located on a charging stand at the intersection of the No. 33 crosscut and the No. 4 entry.

An examination of the battery charging station during the investigation revealed the following:

1. The battery charger was connected to a 600-volt ac receptacle on the section power center with approximately 613 feet of No. 6 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable.

2. The charging cables from the charger were not connected to the spare set of batteries.

3. The spare set of batteries were nearly fully charged.

4. The battery-powered scoop was not located at the charging station.

5. Both electrically driven charging timers in the battery charger had timed open (off).

6. Both charging contactors in the battery charger were open.

Since the battery charger output cables were not connected and the charging timers had timed off, MSHA investigators concluded that the scoop battery charging station was not in use when the explosion occurred. Since the charging timers had timed open, the charging transformers, rectifier bridges, and charging cables were not energized when the explosion occurred. However, the control circuit in the battery charger was energized when the explosion occurred.

Since the battery charger was not permissible, it contained several components (i.e., two timers and two contactors) that could ignite an explosive methane-air atmosphere during normal operation. An abnormal condition within the battery charger or charging cables (e.g., short circuit or ground fault) could also ignite an explosive methane-air atmosphere.

Based on the conclusion that the charging timers had timed open (off) prior to the explosion, MSHA investigators concluded that the normal operation of the charging timers and contactors did not provide the ignition source for the explosion. Testing indicated that both timers operated properly. Since the battery charger had timed off sometime prior to the explosion, the charging cables were not energized when the explosion occurred. Consequently, a fault in the charging cables could not have provided the ignition source for the explosion. Careful examination of the electric components of the battery charger revealed no evidence of a short circuit or ground fault. All power fuses and the control circuit fuse in the battery charger were intact.

The spare set of batteries was also examined. The force of the explosion had knocked three of the battery tray covers off the batteries and had moved the fourth one. The battery tray receptacles, battery tray covers, battery cell terminals, and intercell connectors were examined carefully. No evidence of electrical arcing was observed on any of these components.

In summary, MSHA investigators found no evidence to indicate that the electric equipment in the scoop battery charging station provided the ignition source for the explosion.

Welder

At the time of the explosion, an Air Products, Incorporated, nonpermissible rectifier arc welder (Code 0400, Serial No. SG802037) was located in the No. 3 entry inby the section power center on the 2 Left section. There were no miners near the welder when the explosion occurred.

An examination of the welder during the investigation revealed the following:

1. The welder was connected to a 600-volt ac receptacle on the section power center with approximately 38 feet of No. 6 AWG, 2,000-volt, 3-conductor, type G-GC portable power cable.

2. The main on-off switch was in the off position.

3. The current range switch was in the low (55-230 ampere) position.

4. The welding leads were coiled on top of the welder which had turned over.

It is evident that the welder was not in use when the explosion occurred. Since the on/off switch on the welder was in the off position, the welding transformer and rectifier bridge could not have been energized when the explosion occurred.

Since the welder was not permissible, it contained several components that could ignite an explosive methane-air mixture during normal operation. An abnormal condition within the welder (e.g., short circuit or ground fault) could also ignite an explosive methane-air atmosphere. Finally, several persons who participated in the recovery indicated that there was a smoldering fire in the welder after the explosion. Albert D. Holbrook, Section Foreman, stated that he extinguished the fire with a bag of rock dust. Consequently, MSHA investigators considered the possibility that a fire in the welder had initiated the explosion.

The welder had been damaged by the explosion. It had been turned over onto its right side. The left side of the enclosure had been bent open. A small rock (4" x 6" x 1 1/2") had entered the opening in the left side of the welder and had bent several aluminum bus bars, shorting three of them together. The terminal board for the supply cable and transformer taps had also been broken.

Since it was not in use, the normal operation of the welder did not provide the ignition source for the explosion. Careful examination of the electric components of the welder revealed no evidence of electrical arcing in the welder. Consequently, the aluminum bus bars could not have been energized when they were short circuited. Testing indicated that there were no ground faults in the welder and that the control fuse was intact. There was no evidence of an electrical fire in the welder. However, a partially burnt rag was found wrapped around the return welding cable. Also, a piece of charred brattice cloth was found draped across the left side of the welder and another piece of charred brattice cloth was found inside the welder. Most of the rock dust applied by Holbrook was in the vicinity of the piece of brattice cloth inside the welder.

The welder was designed for a maximum input voltage of 480-volts. However, it was connected to a 600-volt ac receptacle on the power center when the explosion occurred. Therefore, after separating the shorted bus bars and cleaning the on/off switch, MSHA investigators energized the welder with 600-volts ac to determine if it would operate properly. The welder operated normally with the exception of the noise filter resistor and the current control rheostat which overheated slightly.

In summary, MSHA investigators found no evidence to indicate that the welder provided the ignition source for the explosion.

Power Center Lights

MSHA investigators found the parts of a string of three incandescent light fixtures outby and along side the off-standard-drive shuttle car approximately 129 and 160 feet inby the section power center in the No. 3 entry on the 2 Left section. A brass check tag marked "POWER CENTER LIGHTS 120 VAC" was attached to the cable for the fixtures near the plug end.

During the investigation, Willis identified the 3 light fixtures as the ones that were hanging over the section power center at the end of the day shift on June 21, 1983. According to Willis and others, the section power center was moved up approximately one crosscut on the midnight shift on June 21, 1983. The move crew did not install the lights over the power center at its new location. Willis, however, installed the lights over the power center on the day shift on June 21, 1983. According to Willis, the lights were on at the end of the day shift on June 21, 1983. Also, Howard stated that the lights over the power center were on when he observed them during the evening shift on June 21, 1983.

MSHA investigators found both 15-ampere, single-pole, circuit breakers in the section power center in the closed (on) positions. Each circuit breaker supplied a single 120-volt ac duplex receptacle. On the inby receptacle, the top dust cover was found open and the bottom dust cover was found partially open. On the outby receptacle, the top dust cover was found open and the bottom dust cover was found closed. The plug on the cable for the power center lights was compatible with the duplex receptacles on the power center. Based on information provided by Willis and Howard and on the examination of the light cable and the power center, MSHA investigators concluded that the power center lights were energized when the explosion occurred.

Each of the three light fixtures was a Daniel Woodhead Company, Catalog No. 300W, "Protex Safety Yellow" light fixture. Each fixture was made of molded rubber and consisted of a connection compartment and a weatherproof lamp holder that also served as the cover for the connection compartment. The fixture was designed for feed-through connection to allow several fixtures to be connected together in a string. Two weatherproof, strain-relief connectors were provided to attach the supply and feed-through cables to the fixture. The lamp holder was provided with pigtails for connecting the lamp socket to the power conductors in the supply and feed-through cables. A metal plate was provided in the connection compartment for connecting the grounding conductors in the supply and feed-through cables. Originally, each fixture had a plastic-coated metal wire guard for the lamp and an "S"-shaped hook to allow the fixture to be suspended. According to Willis, each fixture had a 200-watt incandescent lamp in it.

The supply cable to the first light fixture consisted of approximately 29 feet of No. 14 AWG, 3-conductor cord. The cable was provided with a 15-ampere, 2-pole with ground, straight-blade male connector (plug). The power pins in the plug did not appear to have been damaged. The grounding pin, however, had been bent up between the two power pins.

According to Willis, the first light fixture was the farthest outby of the three. The hook, and more than one-half of the lamp guard were missing. The plastic coating on the guard was entirely burned or melted off. The black pigtail in the fixture, the black conductor from the plug, and the black conductor to the second fixture were twisted together and taped. The white pigtail in the fixture and the white conductor to the second fixture were twisted together and taped. The white conductor from the plug, however, had pulled out of the splice. The green conductor to the second light fixture was still connected to the metal plate. The green conductor from the plug, however, had been pulled loose from the metal plate.

The cable from the first light fixture to the second light fixture was approximately 58 inches (measured from connector to connector) of No. 14 AWG, 3-conductor cord. The hook on the fixture was present, but had been bent open. The entire lamp guard was present but smashed and most of the plastic coating had been burned or melted off. The black pigtail in the fixture, the black conductor from the first fixture and the black conductor to the third fixture were twisted together and taped. The white pigtail in the fixture, the white conductor from the first fixture, and the white conductor to the third fixture were also twisted together and taped. Both grounding conductors were loosely connected to the metal plate in the fixture with crimped terminals.

The cable which had originally extended from the second light fixture to the third light fixture was approximately 55 inches (measured from connector to connector) of No. 14 AWG, 3-conductor cord. The connector had broken off in the third fixture and the cable and part of the connector had pulled out of the fixture. The hook on the fixture was present but had been bent open. The entire lamp guard was present, but smashed and most of the plastic coating had been burned or melted off. The three incoming conductors had all been pulled out of the fixture. Both pigtails in the fixture still had tape on them. A short piece of cable was installed in the inby connector. The piece of cable was not connected inside the fixture and was used only to plug the unused opening in the fixture.

The lamps in all three fixtures were shattered, but the lamp bases were still in the sockets. MSHA investigators removed each lamp base. There was no evidence of heating or arcing between the lamp base and the socket in any of the fixtures. Although there was coal dust in two of the three sockets, there was no evidence of soot in any of the sockets.

All connections in the plug and in the fixtures (including those that had been pulled apart) were carefully examined. There was no evidence of heating or arcing in any of the connections. Also, there was no evidence of a short circuit or ground fault between any of the conductors in the plug, cables, or light fixtures.

There was no evidence of physical damage to any of the cables for the light fixtures. The roof over the power center appeared sound and there was no evidence that a rock fall had caused the damage to the connections in the light fixtures. Consequently, MSHA investigators concluded that the damage to the connections in the light fixture was caused by the force of the explosion.

In summary, MSHA investigators found no evidence to indicate that the lights installed over the power center provided the ignition source for the explosion.

Dinner Hole Lights

According to Willis there was a fluorescent light fixture hanging from the roof in the intersection of the No. 3 entry and the No. 36 right crosscut on the 2 Left section on the day shift on June 20, 1983. The supply cord for this light fixture was plugged into one of the 120-volt ac duplex receptacles on the section power center. A second fluorescent light fixture was hanging over the table in the dinner hole in the No. 36 right crosscut. The supply cord for the second fixture was plugged into the connector on the feed-through output of the first fixture. There were also 6 incandescent light fixtures hanging over the table in the dinner hole. These 6 fixtures consisted of 2 strings of 3 fixtures each. The connector on the supply cord for the first string of incandescent light fixtures was connected to the connector on the feed-through output of the second fluorescent light fixture. The supply cord for the second string of incandescent light fixtures was connected to the feed-through connector on the first string. According to Willis, the 6 incandescent light fixtures had 250-watt infrared heat lamps in them. Willis also stated that the 2 fluorescent lights and the 6 incandescent lights were operating on the day shift on June 20, 1983.

According to Willis and others, the section power center was moved up one crosscut on the midnight shift on June 21, 1983. When Willis arrived on the 2 Left section on the day shift on June 21, 1983, the dinner hole lights were no longer connected to the section power center because the supply cord for the lights would not reach to the power center at its new location. Willis intended to make an extension cord so that the dinner hole lights could be used. Willis stated that he went to the underground supply house and obtained approximately 125 feet of No. 14 AWG, 3-conductor, type SO cord for that purpose. However, according to Willis, other work prevented him from making the extension cord. Willis stated that he left the cord along the rib where the section personnel carrier was parked at the end of the shift. Willis also stated that the fluorescent light fixture in the dinner hole was hanging horizontally over the table on the day shift on June 21, 1983.

Sutherland and Howard differ on whether the dinner hole lights were operating on the night of the explosion. Sutherland is fairly certain the lights were operating while Howard is fairly certain they were not. It is possible that they are both correct, since Sutherland ate dinner after Howard. Luther J. McCoy, Repairman, could have connected the lights between the times Howard and Sutherland ate dinner.

APPENDIX E-1

Each of the 2 fluorescent light fixtures used in the 2 Left dinner hole light circuit was a Daniel Woodhead Company, Catalog No. 1051, portable fluorescent light fixture. This fixture was designed for use in a 120-volt ac circuit and included an oval plastic tube with 2 molded rubber end caps. Inside the plastic tube was a metal assembly which contained a wiring trough and supported 2 ballasts and lamp holders for 2 40-watt fluorescent lamps. The fixture was designed for feed-through connection to allow several fixtures to be connected together in a string. Originally, the supply cable consisted of approximately 25 feet of No. 16 AWG, 3-conductor, type SJO cord with a 15-ampere, 2-pole with ground, straight-blade, male connector (plug) on the end. The feed-through cable consisted of approximately 6 inches of the same type of cord with a 15-ampere, 2-pole with ground, straight-blade, female connector on the end. Two weatherproof, strain-relief connectors were provided (one in each end cap) to attach the supply and feed-through cables to the fixture. The fixture was also provided with a strap to allow it to be suspended.

Each of the 6 incandescent light fixtures in the dinner hole was a Daniel Woodhead Company, Catalog No. 300W, "Protex Safety Yellow" light fixture. This fixture is described in more detail in the preceding section on the power center lights. Each of the incandescent light fixtures in the dinner hole originally had a Westinghouse 250-watt infrared, 115-125-volt, Heat-Ray Lamp™ in it.

The fluorescent light fixture that was originally hanging in the middle of the No. 3 entry was found on the high-voltage cable sled approximately 83 feet inby its original location. The fixture had been severely damaged. The supply cord had been pulled out of the fixture. The plastic lens had been severely burned and melted. One of the fluorescent lamps had been broken; however, the other lamp was intact. The supply cord for the fixture was found along side the off-standard-drive shuttle car in the No. 3 entry inby the No. 38 left crosscut. The cord had a brass check tag attached near the connector end. The tag was marked "DINNER HOLE LIGHTS 120VAC". The connector was a 15-ampere, 2-pole with ground, straight-blade male plug. The plug was compatible with the 120-volt ac duplex receptacles on the section power center. One of the blades on the plug had been bent out away from the opposite blade. The feed-through connector on the fixture was a 15-ampere, 2-pole with ground, twist-lock female connector which was different from the straight-blade female connector originally supplied with the fixture.

The second fluorescent light fixture was found in the dinner hole. One end of the supporting strap had broken and the fixture was hanging vertically with one end resting on the table in the dinner hole. The plastic lens had sagged toward the bottom end indicating that the fixture was in the vertical position when it was subjected to the heat of the explosion. The supply cable for the fixture was still attached to the fixture and was supported from roof bolt plates with twisted wire at two locations. The cable jacket had been blistered at numerous locations by the heat of the explosion. The cord had a 15-ampere, 2-pole with ground, straight-blade, male connector (plug) on the end. The feed-through connector on the fixture was also a 15-ampere, 2-pole with ground, straight-blade male connector. This male plug was different from the female connector originally supplied with the fixture.

The 6 incandescent light fixtures were found hanging over the table in the dinner hole. The supply cable for the first string of 3 incandescent fixtures had a 15-ampere, 2-pole with ground, straight-blade, female connector on the end. This connector was compatible with the male feed-through connector on the fluorescent fixture in the dinner hole. However, when found, the connectors were not plugged together. Due to the way the connectors were taped, MSHA investigators concluded that at one time the connectors had been plugged together and taped. Close examination of the tape revealed that the tape had been cut prior to the explosion. Consequently, MSHA investigators could not definitely determine whether or not the connectors were plugged together when the explosion occurred.

The feed-through cable on the first string of incandescent light fixtures was terminated in a 15-ampere, 2-pole with ground, straight-blade, female connector. When found, a 15-ampere, 2-pole with ground, straight-blade, male connector for the second string of incandescent light fixtures was plugged into the feed-through connector on the first string of incandescent light fixtures. The 2 connectors were still taped together. There was no feed-through cable attached to the second string of incandescent light fixtures. The unused cable opening in the last fixture was plugged.

The first, second, fifth, and sixth incandescent light fixtures had undamaged 250-watt infrared lamps in them. A 250-watt infrared lamp was still attached to the third fixture. However, the cement that had held the lamp envelope to the lamp base had softened allowing the envelope to drop down. The envelope was supported by the outside filament support wire which was still attached to the base. A 250-watt infrared lamp had been installed in the fourth fixture. However, the envelope had been broken and only the lamp base and filament remained in the fixture.

The first and third incandescent light fixtures were not provided with guards. The other fixtures were provided with guards. The guards had been cut and spread open to accomodate the infrared lamps. Much of the plastic coating on the guards had been burned or melted off.

MSHA investigators could not find the No. 14 AWG, 3-conductor, type SO cord that Willis stated he brought to the section on the day shift on June 21, 1983. However, MSHA investigators did find a piece of No. 14 AWG, 2-conductor, type SO cord approximately 81 1/2 feet long. The cable originated between the left rib and the section power center (near the 120-volt ac duplex receptacles on the power center), extended outby to a location where the cable was suspended from a roof-bolt plate with a twisted wire, and then looped back toward the power center. The end of the cable near the duplex receptacles on the power center was provided with a 15-ampere, 2-pole with ground, straight-blade, male plug which was compatible with the 120-volt ac duplex receptacles on the power center. The jacket had been removed for approximately 1 inch on the other end of the cable. The insulation had been removed for approximately 1/2 inch on the two conductors at this end of the cable. This length of cable would reach from the duplex receptacles on the section power center to the inby end of the supply cable for the flourescent light fixture that had been installed at the intersection of the No. 3 entry and the No. 36 right crosscut.

MSHA investigators found another piece of No. 14 AWG, 2-conductor, type SO cord approximately 27 feet long. This length of cable was found at the intersection of the No. 3 entry and the No. 35 left crosscut. There were no connectors installed on the ends of this length of cable. It is relevant to note that the sum of the two lengths of cable is approximately 108 1/2 feet. It is possible that this is the same cable that Willis brought on the section on the day shift. Willis could have mistaken 2-conductor, type SO cord for 3-conductor, type SO cord.

MSHA investigators also found a 15-ampere, 2-pole with ground, straight-blade, female connector in the No. 3 entry between the dinner hole and the power center. Approximately 2 1/4 inches of 2-conductor type SO cord was attached to the connector. The conductors in the cord were slightly recessed in the jacket and it appeared that the cord had been cut with a blunt object or had been pulled apart. MSHA investigators could not determine whether or not the connector and cord had been installed in the dinner hole light circuit.

There is some evidence to indicate that the dinner hole lights could have been energized when the explosion occurred. Sutherland first stated that he believed they were energized when he ate dinner on the night of the explosion. Both 120-volt ac circuit breakers on the section power center were found in the closed (on) positions. At least one dust cap on each of the two 120-volt ac duplex receptacles on the power center was found open. The plug on the 81 1/2-foot length of No. 14 AWG, 2-conductor cord was compatible with the duplex receptacles on the power center. The cord was the proper length to reach the inby end of the supply cord for the fluorescent light fixture at the intersection of the No. 3 entry and the No. 36 right crosscut and extended in that direction from the section power center. For the dinner hole lights to have been energized, the plug on the 81 1/2-foot cord would have had to have been plugged into one of the 120-volt ac receptacles on the power center. Also, the outby end of this cord would have had to have been connected to the plug on the supply cord for the flourescent light fixture in the No. 3 entry either with the female connector found in the No. 3 entry or by twisting the conductors in the cord around the blades on the plug for the flourescent light fixture. Finally, a jumper would have had to have been installed between the incompatible twist-lock female connector for the fluorescent light fixture in the No. 3 entry and the straight-blade male plug on the supply cord for the fluorescent light fixture in the dinner hole. After considering all of the information gathered during the investigation, MSHA investigators could not conclusively determine whether or not the dinner hole lights were energized when the explosion occurred. Nevertheless, MSHA investigators carefully examined the dinner hole lights for any evidence that they provided the ignition source for the explosion.

Both fluorescent light fixtures were carefully examined and tested. There was no evidence of heating or arcing at any of the connections in either fixture. There was no evidence of a short circuit or ground fault in either fixture. Resistance measurements revealed that both fixtures were free from short circuits and ground faults. Aside from minor heat damage, the fluorescent light fixture that had been hanging over the dinner table was not obviously damaged by the explosion. The fixture was extremely clean inside. MSHA investigators energized the fixture for approximately 4 hours and 34 minutes. The fixture operated properly for the entire time. The fluorescent light fixture that had been hanging over the No. 3 entry had been damaged severely by the explosion. Nevertheless, MSHA investigators reconnected the supply cord, replaced the broken fluorescent lamp, and energized the fixture for approximately 4 hours and 38 minutes. The fixture operated properly for the entire time.

The cords for both fluorescent light fixtures were also carefully tested and examined. The outer jacket on the supply cord for the flourescent light fixture that had been installed in the No. 3 entry had been cut and damaged at several locations. However, the damage was confined to the outer jacket and the insulation on the conductors had not been damaged. The outer jacket on the supply cord for the fluorescent light fixture that had been installed over the dinner table was blistered by the heat of the explosion at numerous locations. However, the damage was confined to the outer jacket and the insulation on the conductors had not been damaged. Resistance measurements confirmed that both supply cords were free from short circuits and ground faults. Neither feed-through cable appeared to have been damaged by the explosion. All connections to the connectors on the supply cords and the feed-through cords for the 2 fixtures were examined. There was no evidence of heating or arcing at any of the connections.

The 6 incandescent light fixtures and the 6 heat lamps were also examined and tested. Two of the 6 heat lamps had been damaged. The third heat lamp in the first string was still attached to the fixture. However, the cement that held the lamp envelope to the lamp base had softened allowing the envelope to drop down away from the base. The envelope was still supported by the outside filament support wire which was still attached to the base. The filament in this lamp was still continuous. The first heat lamp in the second string had been smashed. The filament was no longer continuous. The filaments in the remaining 4 heat lamps were continuous. All 6 lamp bases were still in the lamp sockets. MSHA investigators removed each lamp base. There was no evidence of heating or arcing in any of the 6 lamp sockets. Although there was coal dust in one of the 6 sockets, there was no soot in any of the sockets. All connections in the connectors and in the 6 incandescent light fixtures were examined carefully. There was no evidence of heating or arcing in any of the connections. Also, there was no evidence of a short circuit between any of the conductors in the connectors, cables, or light fixtures. Resistance measurements indicated that both strings of incandescent light fixtures were free from short circuits. MSHA investigators replaced the 2 damaged heat lamps and energized both strings of incandescent light fixtures. All 6 heat lamps operated properly. Finally, the MSHA Beckley Electrical Testing Laboratory conducted temperature tests on the 4 undamaged heat lamps. These tests revealed that the surfaces of the heat lamps did not reach a temperature sufficient to ignite an explosive methane-air mixture. The highest surface temperature measured during the tests was 650°F. The temperature required to ignite the most readily ignitable methane-air mixture is 1120°F. The results of the tests are contained in Appendix E-5.

MSHA investigators found no direct evidence to indicate that the dinner hole lights provided the ignition source for the explosion. However, the possibility exists that the dinner hole lights were energized and that the circuit was interrupted in an explosive methane-air atmosphere. The circuit could have been interrupted when the strap on the fluorescent light fixture that had been hanging over the dinner table broke or when a small piece of rock fell. Either occurrence could have dislodged one of the connections needed to energize the dinner hole lights. Consequently, MSHA investigators concluded that the dinner hole lights could have provided the ignition source for the explosion.

AC Equipment Not Connected to a Power Source

Trickle Duster

At the time of the explosion, a permissible trickle duster (Mine Safety Appliances, Model No. 454904, Serial No. TD8226, Approval No. 26-2534A-1) was located in the No. 38 crosscut between the Nos. 3 and 4 entries on the 2 Left section. The trickle duster was provided with a No. 10 AWG, 600-volt, 5-conductor, flexible cord; however, the cord was not connected to a section power center receptacle when the explosion occurred. Consequently, the trickle duster could not have provided the ignition source for the explosion.

Personnel Carrier Onboard Battery Charger

The battery-powered personnel carrier (West Virginia Armature Company, "Rail Runner Type II" Serial No. 200-0668) was equipped with an onboard, 480-volt, 3-phase battery charger. However, the onboard battery charger was not connected to its trailing cable when the explosion occurred. Furthermore, the trailing cable for the onboard battery charger was not connected to the section power center when the explosion occurred. Consequently, the personnel carrier onboard battery charger could not have provided the ignition source for the explosion.

Abandoned Auxiliary Fan

At the time of the explosion, an auxiliary fan was located in the No. 32 crosscut between the Nos. 3 and 4 entries of 2 Left. This fan was not provided with a trailing cable and had evidently been abandoned well before the explosion. Consequently, the abandoned auxiliary fan could not have provided the ignition source for the explosion.

Battery-Powered Personnel Carrier

During the recovery following the explosion, a nonpermissible, track-mounted battery-powered personnel carrier (West Virginia Armature Company, "Rail Runner Type II", Serial No. 200-0668) was found on the 2 Left track just inby a curtain that was installed across the track entry near the No. 2 crosscut. The personnel carrier was not required to be permissible because it was not used in or inby the last open crosscut, in return air, or within 150 feet of pillar workings. The personnel carrier was the one that was used to transport the 2 Left section crew to the section at the beginning of the shift. When the personnel carrier was first observed during the recovery, it still felt warm to the touch and the lights were shining in the outby direction. The bodies of McCoy and Riner were found along the 2 Left track. McCoy's body was found just inby the No. 16 crosscut on the conveyor belt side of the track. Riner's body was found on the rib side of the track between the Nos. 15 and 16 crosscuts. Apparently, McCoy was transporting Riner off the 2 Left section when the explosion occurred. MSHA investigators concluded that the personnel carrier was being operated on the 2 Left track when the explosion occurred. McCoy and Riner were apparently blown out, jumped out, or fell out of the personnel carrier. The personnel carrier continued to coast and came to rest where it was found near the No. 2 crosscut.

The personnel carrier was used during the recovery and then moved to a side track near the underground supply house. The personnel carrier was examined by MSHA investigators. Even though the personnel carrier was used during the recovery, this use did not disturb the effects of the explosion on the vehicle.

An examination of the personnel carrier during the investigation revealed the following:

1. The inby end of the personnel carrier had been exposed to more heat than the outby end. Paint on the inby end of the personnel carrier was blistered, while paint on the outby end was not. The two reflectors on the inby end were deformed by the heat and impregnated with dust. The dust could not be wiped off. The two reflectors on the outby end were not deformed by the heat. Dust on the outby reflectors could be wiped off leaving the reflectors functional.

2. With the exception of the two battery tray covers, all covers and lids on the personnel carrier were in place and bolted down. Neither battery tray cover was bolted down. Both battery tray covers were found pushed toward the right side (facing inby) of the personnel carrier. There was no evidence of electrical arcing on the insides of the battery tray covers, battery cell terminals, or intercell connections.

3. The headlights on the personnel carrier were controlled by the directional control switch. Consequently, when the personnel carrier was first observed after the explosion, the directional control switch

was positioned for travel from the 2 Left section to the elevator shaft bottom.

4. The tram control switch was self centering with a neutral position, 4 accelerating positions, and 3 braking positions.

5. The personnel carrier was equipped with a 480-volt, 3-phase onboard battery charger. However, the battery charger could not have been in operation when the explosion occurred.

6. The following electric components produce incendive arcing during the normal operation of the personnel carrier: the directional control switch, the tram control switch, the contactors in the controller, and the 2 20-horsepower direct current motors. In addition, the main circuit breaker would produce incentive arcing if it were opened manually while under load or if it opened automatically as a result of an overcurrent condition. None of the above listed components was installed in an explosion-proof enclosure. The directional control switch and tram control switch were in a gasketed metal enclosure. The circuit breaker and contactors were enclosed in loosely fitting metal covers. The enclosure for each direct-current motor had 4 ventilated (open) hand-hole covers. One hand-hole cover was missing from each motor.

Since the arcing components of the personnel carrier were not installed in explosion-proof enclosures and the personnel carrier was probably in operation when the explosion occurred, MSHA investigators concluded that the personnel carrier could have provided the ignition source for the explosion.

MSHA investigators, with the assistance of Thomas Barkand and Robert Cascio, Engineers with the MSHA Mine Electrical Systems Branch, conducted additional tests to determine some of the operating characteristics of the personnel carrier. The results of the tests indicate that it takes approximately 113 seconds for the personnel carrier to travel from the No. 35 crosscut where the battery charger plug for the personnel carrier was found to the No. 16 crosscut where McCoy's body was found. The test also indicated that if the control handle of the mantrip was released 25 feet inby the No. 16 crosscut while the vehicle was traveling at a typical velocity of at least 13.5 miles/hour, the vehicle would have sufficient momentum to continue to travel the No. 2 crosscut. The results of the tests are contained in Appendix G.

Battery-Powered Scoop

At the time of the explosion, a permissible-type battery-powered scoop (S & S Corporation, Model No. CX-2, Serial No. CX-2-316, Approval No. 2G-2664-3) was located in the No. 40 crosscut between the Nos. 2 and 3 entries on the 2 Left section. There were no miners near the scoop when the explosion occurred. Howard stated that the scoop was probably not moved during the evening shift on June 21, 1983. According to Leonard, the scoop was used at the end of the day shift on June 21, 1983, to clean the No. 40 crosscut after the cut-through into the setup entries had been completed.

An examination of the battery-powered scoop during the investigation revealed the following:

1. The batteries were connected.
2. The main circuit breaker and the controller disconnect switch were in the closed (on) positions.
3. The tram control switch and the tram footswitch were in the off positions.
4. The panic bar switch was in the closed (on) position.
5. The headlight switch was in the open (off) position.
6. The hydraulic control levers were all in the neutral positions with the exception of the bucket lift control which was in the "float" detent position.
7. The manually-operated parking brake was not set.
8. The automatic parking brake was set.
9. The scoop bucket was in the down position and the bucket ram was all the way forward.
10. The cab door was closed, but not latched.
11. The battery tray and traction motor covers had been blown off by the force of the explosion.

MSHA investigators concluded that the battery-powered scoop had been parked some time before the explosion, possibly near the end of the day shift on June 21, 1983. Since the tram control switch and the headlight switch were in the off positions, the pump motor, tram motor, and headlights were not energized when the explosion occurred. However, portions of the control and power circuits on the scoop were energized when the explosion occurred.

The battery-powered scoop was examined carefully to determine if it could have provided the ignition source for the explosion. The following permissibility deficiencies were observed:

1. The battery cable plugs were not padlocked to the receptacles.
2. The packing glands for the cables entering the battery cable plugs were not secured against loosening.

3. The battery tray covers were not secured to the battery trays.

4. The left front headlight was not mounted securely to the machine frame; however, the headlight was grounded to the machine frame with an external grounding shunt.

5. The jacket on the cable to the left rear headlight was damaged; however, no conductors were exposed.

Although the battery cable plugs were not padlocked to the receptacles, the plugs were properly mated with the receptacles and the threaded rings on the plugs were screwed on to the receptacles. Nevertheless, the battery cable plugs and receptacles were examined carefully and no evidence of arcing was observed.

The permissibility deficiency described in item No. 2 above did not render the scoop capable of igniting an explosive methane-air mixture since both glands were properly packed and tight.

The battery tray covers were not secured and were blown off the scoop batteries by the force of the explosion. The battery tray covers, battery cell terminals, and intercell connections were examined carefully and no evidence of arcing or short circuits was found.

Permissibility deficiencies Nos. 4 and 5 did not involve components of the scoop that were energized when the explosion occurred.

MSHA investigators also examined the interiors of the connection box, controller, and control station enclosures. No evidence of an internal methane-air ignition was observed.

Finally, MSHA investigators performed a functional test of the battery-powered scoop. First, all controls were set as initially found. The headlights did not come on and neither motor started since the tram control switch and the light switch were in the off position. Next, the scoop was run through a full sequence of operations. The machine functioned properly, except for the left rear headlight which was burned out.

In summary, MSHA investigators did not find any evidence to indicate that the battery-powered scoop provided the ignition source for the explosion.

<u>Belt Control Cable and Remote Start/Stop Switch</u>

At the time of the explosion, approximately 3,750 feet of No. 14 AWG, 2-conductor, type SO cord was installed along the 2 Left conveyor belt (No. 2 entry) to allow remote control of the 2 Left conveyor belt. The control cable originated at the 2 Left belt controller near the mouth of the 2 Left entries and extended to a nonpermissible remote start/stop switch located at the intersection of the No. 2 entry and the No. 36 crosscut on the 2 Left section near the conveyor belt feeder. Individual 250-foot lengths of cable were connected together by means of 15-ampere, 2-pole with ground, twist-lock connectors. The cable was suspended from timbers on insulated hooks.

The investigation revealed that the 2 Left belt controller was connected to a 480-volt, 3-phase receptacle on the 2 Left belt transformer when the explosion occurred. MSHA investigators found the circuit breaker in the belt transformer in the tripped position. However, testing conducted during the investigation revealed that there were no faults in the 2 Left conveyor belt power circuit which could have caused the circuit breaker to trip. Consequently, MSHA investigators concluded that the circuit breaker tripped due to the undervoltage resulting from the loss of high-voltage power when the explosion occurred. Therefore, MSHA investigators concluded that the 2 Left belt controller was energized when the explosion occurred.

MSHA investigators found both the main circuit breaker and the control circuit breaker in the 2 Left belt controller in the closed (on) positions. The hand/off/automatic control switch was found in the automatic position indicating that the operation of the 2 Left conveyor belt was controlled by a remote start/stop switch located near the conveyor belt drive unit, a remote start/stop switch located near the conveyor belt feeder and a sequence switch on the outby conveyor belt. All three switches were found properly connected in series into the 120-volt ac control circuit for the 2 Left belt controller. The investigation revealed that the outby conveyor belt was operating when the explosion occurred. Consequently, the 2 Left belt control cable was energized when the explosion occurred.

The remote start/stop switch located near the conveyor belt feeder was damaged by the explosion so that MSHA investigators could not determine whether the switch contacts were closed (on) or open (off) when the explosion occurred. However, the conveyor belt feeder had been repaired approximately two hours before the explosion and there was no evidence to indicate that the 2 Left conveyor belt was not operating when the explosion occurred. Consequently, MSHA investigators concluded that the remote start/stop switch was closed (on) when the explosion occurred. As a result, the switch and the 2 Left belt control cable were carrying the operating current of the control relay "CR" and the timer "TR4" in the 2 Left belt controller when the explosion occurred.

The 120-volt ac remote control circuit for the 2 Left belt controller was not intrinsically safe and was capable of releasing sufficient energy to ignite an explosive methane-air atmosphere. Consequently, if the circuit was interrupted in an explosive methane-air atmosphere, an ignition could result.

The remote start/stop switch for the 2 Left conveyor belt was not explosion proof. However, no miners were in a position to operate the switch when the explosion occurred. Consequently, MSHA investigators concluded that the remote start/stop switch for the 2 Left conveyor belt could not have provided the ignition source for the explosion.

APPENDIX E-1

It was not possible for MSHA investigators to observe the condition of the belt control cable immediately after the explosion because the mine rescue team used the belt control cable as a telephone line inby the No. 14 crosscut. Mine rescue team members Homer W. Fields and Ray W. Robinette cut and spliced the belt control cable at an undetermined number of locations during the recovery. They also spliced the belt control cable at several other locations where the cable had broken or had pulled out of a twist-lock connector. According to Fields, the belt control cable had pulled out of a twist-lock connector at one or two locations. Fields also stated that, "there was evidence of either timbers had fallen over against it and pulled it out or rocks had fallen on it and pulled it out." Robinette remembered two locations where the belt control cable was separated. One location was about 800 or 900 feet outby the face. The other location was farther outby where some timbers had been knocked down. Although Fields and Robinette could not recall the exact locations where the belt control cable had broken or pulled out of a connector, it is apparent that they encountered at least two locations where it had done so.

When MSHA investigators examined the 2 Left belt control cable on July 13 and 14, 1983, they observed the following:

1. There were two locations where the belt control cable had separated outby the No. 14 crosscut. At one location, the inby cable had pulled out of a twist-lock connector. At the other location, two timbers had fallen and had broken the cable.

2. There were seven splices and one taped repair in the belt control cable that apparently had been made by Fields and Robinette.

3. Several timbers had fallen and had broken the belt control cable approximately 40 feet outby the 2 Left conveyor belt tailpiece. This occurred after the recovery operation.

MSHA investigators could not identify the locations where the belt control cable was found separated by Fields and Robinette. MSHA investigators could not determine if the force of the explosion caused the belt control cable to separate at these locations. However, it is evident that a falling timber or rock could have interrupted the belt control circuit by pulling the belt control cable out of a twist-lock connector or by breaking the cable in two. Since the electrical energy released when the belt control circuit is interrupted is sufficient to ignite an explosive methane-air atmosphere, MSHA investigators concluded that the 2 Left belt control cable could have provided the ignition source for the explosion.

Telephones and Telephone Line

Reportedly there were two telephones located in the explosion area at the time of the explosion. The first telephone was a Mine Safety Appliances Company (MSA) "Pager IV" permissible-type mine telephone, Approval No. 9B-120-0, Serial No. 001199. This telephone was found hanging from a roof bolt plate at the intersection of the No. 2 entry and the No. 36 crosscut near the conveyor belt feeder.

Reportedly, the second telephone was located near the intersection of the No. 2 entry of 2 Left and the No. 3 entry of the longwall setup entries. The investigators did not find the second telephone during the investigation.

The MSA telephone was damaged by the explosion. However, the telephone was sent to the MSHA Approval and Certification Center for testing and evaluation to determine if it could have provided the ignition source for the explosion. A summary of the results of the testing and evaluation of the MSA telephone is contained in Appendix E-4. Based on the results of the testing and evaluation, MSHA investigators concluded that the MSA telephone did not provide the ignition source for the explosion.

At the time of the explosion, approximately 4,000 feet of two-conductor, No. 16 AWG, twisted-pair telephone line was installed in the No. 2 entry of 2 Left to connect the telephones in the explosion area into the mine telephone system. The telephone line had been damaged severely by the explosion. In many locations, the conductor insulation was burned completely off. The telephone line had been pulled apart at several locations where timbers were dislodged. It was not possible for MSHA investigators to determine if all of the breaks in the telephone line were caused by the force of the explosion or if any of the breaks had occurred prior to the explosion.

At the time of the explosion, there were three nonpermissible 120-volt ac, line-powered telephones connected into the mine telephone system. One Pyott-Boone, Incorporated, Model 304B nonpermissible telephone was located in the Mine Superintendent's office. One Pyott-Boone, Incorporated, Model 114 nonpermissible telephone was located in the Maintenance Superintendent's office and another Pyott-Boone, Incorporated, Model 114 nonpermissible telephone was located in the underground supply house. In the paging mode each of these telephones was capable of delivering enough electrical energy into the telephone line to ignite an explosive methane-air atmosphere. However, for an ignition to occur, the following events would have to take place:

1. One of the nonpermissible telephones would have to be operating in the paging mode.

2. The telephone line would have to break in an explosive methane-air atmosphere.

3. The telephone line would have to be short-circuited inby the location where it broke.

The simultaneous occurrence of these three events is very unlikely. Moreover, there was no evidence to indicate that any of the three nonpermissible telephones was paging when the explosion occurred. MSHA investigators could not determine if the telephone line had broken immediately before the explosion.

Although the telephone line was severely damaged by the explosion, MSHA investigators found no evidence to indicate that the telephone line was short circuited when the explosion occurred. In summary, MSHA investigators concluded that the 2 Left telephone line did not provide the ignition source for the explosion.

Belt Fire Detection Circuit

At the time of the explosion, approximately 3,750 feet of Pyott-Boone, Incorporated, Model No. K250-2 Heat Detection Cable was installed along the 2 Left conveyor belt (No. 2 entry) from the belt drive unit to near the belt tailpiece. This cable was connected into the mine belt fire detection system. The control unit for the system was a Pyott-Boone, Incorporated, Model 211 Permissible Heat Detection Control Unit (Serial No. 225, Approval No. 9B-36) located in the surface breaker building. As originally approved by MSHA, the entire belt fire detection system (including the heat detection cables connected to the control unit) was incapable of releasing sufficient electrical energy to ignite an explosive methane-air mixture. MSHA investigators observed no evidence to indicate that the system had not been maintained as approved. Consequently, MSHA investigators concluded that the 2 Left belt fire detection circuit could not have provided the ignition source for the explosion.

Methane Detectors, Cap Lamps, and Voltohmmeter

Three CSE, Incorporated, Model No. 102, Approval No. 8C-37-4 permissible-type methane detectors were recovered by MSHA investigators after the explosion. The first methane detector (Serial No. E4831) was found on the body of Hall. The second methane detector (Serial No. E1319) was found on the body of French. The third methane detector (Serial No. E7378) was found near the body of McCoy.

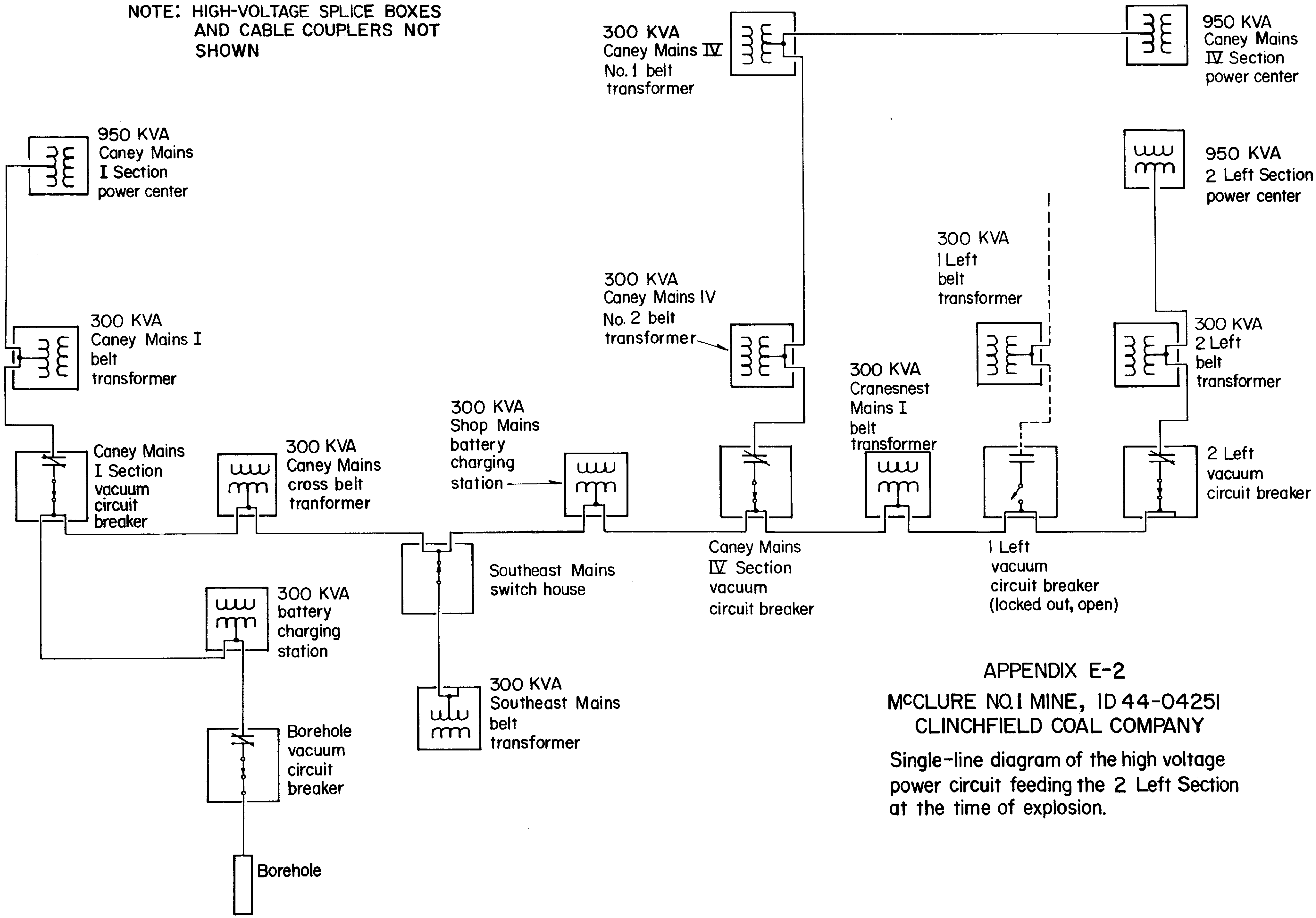
Ten Koehler Manufacturing Company permissible-type electric cap lamps, Approval No. 6D-36, were recovered by MSHA investigators after the explosion. One cap lamp was found on each of the bodies of French, Stamper, Riner, and McCoy. Two cap lamps were found near the face of the No. 3 entry. One cap lamp was found in the No. 40 crosscut between the Nos. 3 and 4 entries. Three cap lamps were found near the face of the No. 4 entry.

The three methane detectors and ten cap lamps were sent to the MSHA Approval and Certification Center for testing and evaluation to determine if one of the devices could have provided the ignition source for the explosion. A summary of the results of the testing and evaluation of these devices is contained in Appendix E-4. Based on the results of the Approval and Certification Center's testing and evaluation, MSHA investigators concluded that the methane detectors and cap lamps did not provide the ignition source for the explosion.

A voltohmmeter was found in the No. 3 entry approximately 28 feet inby the section power center on the 2 Left section. There were no miners near the meter when the explosion occurred. Consequently, MSHA investigators concluded that the meter was not in use and could not have provided the ignition source for the explosion.

APPENDIX E-2

NOTE: HIGH-VOLTAGE SPLICE BOXES AND CABLE COUPLERS NOT SHOWN



APPENDIX E-2

McCLURE NO.1 MINE, ID 44-04251
CLINCHFIELD COAL COMPANY

Single-line diagram of the high voltage power circuit feeding the 2 Left Section at the time of explosion.

APPENDIX E-3

APPENDIX E-4

U. S. Department of Labor

Mine Safety and Health Administration
Industrial Park Boulevard
RR 1, Box 201B
Triadelphia, West Virginia 26059

DEC 14 '83

MEMORANDUM FOR: GENE B. FULLER
Mine Safety and Health Specialist
Coal Mine Safety and Health

THROUGH: ROBERT W. DALZELL
Chief, Approval and Certification Center

ROBERT E. MARSHALL
Chief, Division of Electrical Safety

FROM: KENNETH A. SPROUL
Chief, Intrinsic Safety and Instrumentation Branch

SUBJECT: Report of Investigation on Equipment from the McClure No. 1 Mine Explosion

Enclosed is a copy of the final report on the investigation of equipment recovered from a recent mine explosion at Clinchfield Coal Company's McClure No. 1 Mine. A permanent record of that investigation has been filed at the Approval and Certification Center under Investigation No. X-161. If you need more information or clarification, you may contact Mr. Robert A. Bradburn (FTS 923-1039), the investigator assigned to the project.

APPENDIX E-4
Final Report
BY: RABradburn
TFWetzel
9/7/83

SPECIAL INVESTIGATION X-161

Evaluation of Equipment Recovered From
McClure No. 1 Mine, Clinchfield Coal Co.,
Located in District 5, Norton, VA.

Summary and Findings

Sixteen items of mine equipment, recovered from the area of an explosion that took place at McClure No. 1 Mine (near Norton, Virginia) in June, 1983 were investigated at the Approval and Certification Center. The investigation included preliminary and detailed inspections of each item, comparison with MSHA approval records to determine permissibility of the equipment, performance tests, and circuit evaluations and ignition tests to determine if the equipment was capable of causing ignitions of explosive methane gas concentrations under normal and reasonably assumed fault conditions.

Based on the inspections, evaluations, and tests performed, the findings of this investigation are:

1. None of the equipment evaluated provided an ignition source for explosive concentrations of methane gas.

2. Each item of equipment was identified as either having been approved by MSHA for use in gassy mines or as a part of equipment so approved.

3. Most of the discrepancies uncovered in the inspections could be attributed to damage as a result of the explosion or to normal wear and tear.

4. None of the discrepancies created a potential methane explosion hazard.

5. The three evaluated methane detectors were capable of detecting the presence of methane gas although they were out of calibration.

6. The evaluated flame safety lamp was capable of indicating the presence of methane gas and oxygen deficiency.

7. Five of the eight complete cap lamps that were evaluated were operational, in the received condition, without charging their batteries.

NOTE: COMPLETE REPORT ON FILE.

APPENDIX E-5

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

TECHNICAL INVESTIGATION REPORT

TEMPERATURE TESTING OF HEAT LAMPS

RETRIEVED FROM

MCCLURE NO. 1 MINE

CLINCHFIELD COAL COMPANY

BY

WILLIAM C. BEASLEY
MECHANICAL ENGINEER
ILLUMINATION GROUP
BECKLEY ELECTRICAL TESTING LABORATORY
APPROVAL AND CERTIFICATION CENTER
BECKLEY, WEST VIRGINIA

FEBRUARY 2, 1984

INTRODUCTION

On December 5, 1983, a telephone request for technical assistance was received by Mr. James Oakes, Chief-Illumination Group of the Beckley Electrical Testing Laboratory (BETL), from Mr. George Fesak of the Coal Mine Safety and Health, Arlington, Virginia, office. It was requested that surface temperature tests be performed on lamps that had been recovered from the McClure No. 1 Mine.

As a result, Mr. Dewey Rife delivered to BETL six heat lamps, cables, and fixtures that had been recovered. These lamps had been located at the dinner hole of the 2 Left Section. The lamps were placed in a secured area and a log of activities started.

Messrs. James Oakes, Richard Whitworth, and William Beasley entered the secured area on December 20, 1983, to visually examine the lamps. At this time the test methods, instrumentation requirements and security measures were discussed.

On December 21, 1983, George Fesak requested testing begin as soon as possible. At this time he also asked that splices, plugs and cables of the lamp circuit be checked for faults.

Testing was begun January 16, 1984, to determine maximum surface temperatures for the lamps. This report contains a summary of work performed by the Illumination Branch of the BETL.

PROCEDURES

After photographing and visually examining each lamp, a test station was made by suspending a 10-foot length of pipe from the ceiling of the instrument room. The lamps were hung from this pipe with the mounting hook of the fixtures.

Each lamp's surface temperature was recorded at three points using fine wire thermocouples. Tests were made with input voltages of 120 volts a.c., 130 volts a.c., and 140 volts a.c. Both vertical and horizontal orientations were checked.

The test procedure is detailed in Appendix 1.

RESULTS

The maximum temperatures found with lamps orientated vertically were as follows:

1. 528^{o}F (275^{o}C) at 120 volts a.c.
2. 600^{o}F (316^{o}C) at 130 volts a.c.
3. 646^{o}F (341^{o}C) at 140 volts a.c.

The maximum temperature found with lamps orientated horizontally was 650^{o}F (343^{o}C) at 140 volts a.c.

All temperatures recorded are found in Tables 1 and 2 (Tables of Results).

APPENDIX F

APPENDIX F

U. S. Department of Labor

Mine Safety and Health Administration
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213
Bruceton Safety Technology Center

November 15, 1983

MEMORANDUM FOR: ROBERT A. ELAM
Mining Engineer
Coal Mine Safety and Health

THROUGH : JOSEPH A. LAMONICA
Administrator
Coal Mine Safety ~~and Health~~

MADISON McCULLOCH
Director of Technical Support

JOHN A. McCORMICK
Chief, Bruceton Safety Technology Center

FROM : STEVEN J. LUZIK
Chief, Mine Materials Evaluation Branch
Industrial Safety Division

SUBJECT : Flame safety lamp recovered from McClure No. 1 Mine, Clinchfield Coal Company (Exhibit Number P-26)

As per your request, Division personnel have examined the flame safety lamp recovered from an area of an explosion that took place at the McClure No. 1 Mine (near Norton, Virginia) in June 1983. The lamp was submitted to the Division by Mr. Robert Bradburn of the Approval and Certification Center, Triadelphia, West Virginia. Examination of the lamp by our personnel indicated that it had undergone much external damage due to the forces of the explosion. Conversations with Mr. Bradburn also disclosed that the lamp had been improperly assembled (the asbestos gasket had been incorrectly placed underneath the lower gauze ring) and that a small separation had existed between the mesh and the brass ring of the inner gauze.

Since we were reasonably certain that these two conditions existed prior to the explosion, our efforts focused on attempting to determine if a lamp, in otherwise good condition, assembled with an improperly positioned lower gasket and defective inner gauze, could ignite a flammable mixture of methane in air.

To perform these tests, a separate flame safety lamp was employed. The lamp was disassembled; the lower asbestos gasket was placed under the lower gauze and the inner gauze was replaced with the defective inner gauze from Exhibit P-26. The lamp was then reassembled and tests performed.

A section of the Division's gas gallery was utilized for these tests which were divided into two series. The lamp was suspended in a 420 ft^3 partition of the gallery. Methane gas was metered into the partition and sampled using an infrared analyzer. Video tapes were made of all tests. Series I investigated the effect of subjecting a lighted lamp with a normal working flame to increasing concentrations of methane in air. Series II studied the behavior of the lamp in a simulated re-lighting operation conducted in a flammable methane-air atmosphere. The relighter was removed and replaced with a small electric squib which was remotely activated with a power supply to simulate re-lighting. The gallery was filled with the desired concentrations of methane followed by ignition of the squib. Test results are attached. It was not possible to achieve external ignitions of flammable methane/air mixtures in either of the test series despite the deviations in permissible requirements imposed on the lamp. The lamp flame consistently extinguished at about 5% methane in Series I. Small internal ignitions were observed in Series II but did not propagate to the exterior of the lamp.

I hope this information is beneficial to you. If we can be of any further assistance, please call.

Attachment

UNITED STATES DEPARTMENT OF LABOR
Mine Safety and Health Administration
BRUCETON SAFETY TECHNOLOGY CENTER
Industrial Safety Division

LABORATORY TEST RESULTS

SUBJECT: A Flame Safety Lamp Tests Conducted: 11/8/83

Description: A flame safety lamp assembled with the lower asbestos gasket seated beneath the lower gauze ring in contact with the fuel fount. The inner gauze was taken from EXHIBIT P-26 and had a 1-inch section of mesh separated from the ring with an approximate 1/8-inch opening.

SERIES I - Subjecting a lighted lamp to increasing concentrations of methane in air

Test 1. - Flame elongates as methane is introduced into gallery. Flame extinguishes at 5.2% CH_4. No external ignition of gallery mixture.

Test 2. - Flame elongates as methane is introduced into gallery. Flame extinguishes at 5.4% CH_4. No external ignition of gallery mixture.

Test 3. - Flame elongates as methane is introduced into gallery. Flame extinguishes at 5.2% CH_4. No external ignition of gallery mixture.

SERIES II - Simulated re-lighting of the lamp in a flammable atmosphere of methane in air. Electric squib replaces relighter and is remotely actuated.

Test 1. - Squib ignited and caused internal ignition. No external ignition observed. Gallery methane concentrations = 8.2%.

Test 2. - Squib ignited and caused internal ignition. No external ignition observed. Gallery methane concentration = 8.2%.

Test 3. - Internal ignition observed. No external ignition. Gallery methane concentration = 7.5%.

Test 4. - Internal ignition observed. No external ignition. Gallery methane concentration = 9.5%.

Tests Witnessed by: R. A. Bradburn, A&CC
E. M. Kawenski, MSHA Consultant
G. A. Wancheck, ISD
S. J. Luzik, ISD
C. R. Stephan, ISD
A. Sendek, ISD
T. M. Fircak, ISD

APPENDIX G

U. S. Department of Labor
Mine Safety and Health Administration

APPENDIX G

INVESTIGATIVE REPORT NO.: M-121683-03

VELOCITY TESTS ON THE PERSONNEL CARRIER AT THE McCLURE NO. 1 MINE

by

Thomas D. Barkand

POWER

CONTROLS

COMMUNICATIONS

INSTRUMENTATION

0

—ORIGINATING OFFICE—
MINE ELECTRICAL SYSTEMS DIVISION
BRUCETON SAFETY TECHNOLOGY CENTER
4800 FORBES AVENUE
PITTSBURGH, PENNSYLVANIA 15213
RICHARD L. REYNOLDS, CHIEF

MINE ELECTRICAL SYSTEMS DIVISION
BRUCETON SAFETY TECHNOLOGY CENTER

INVESTIGATIVE REPORT NO.:	M-121683-03
INVESTIGATION DATES:	August 10-11, 1983
LOCATION:	Clinchfield Coal Company, McClure No. 1 Mine Virginia
INVESTIGATORS:	Thomas Barkand - MSHA Technical Support, Pittsburgh, PA
	Robert Cascio - MSHA Technical Support, Pittsburgh, PA
	George Fesak - MSHA CMS&H, Arlington, VA
	Robert Elam - MSHA CMS&H, Arlington, VA
	Dale Cavanaugh - MSHA CMS&H, Arlington, VA
	James Hicks - MSHA CMS&H, District 4
	Roy Davidson - MSHA CMS&H, District 4
ATTENDANCE:	Richard K. Light Clinchfield Coal Company
	Jack Jackobs Clinchfield Coal Company
	Herschel Bull Clinchfield Coal Company
	Jerold Hileman Virginia Department of Mines
	J.C. Lambert United Mine Workers of America
SUBJECT:	Velocity Tests on the Personnel Carrier at the McClure No. 1 Mine

INTRODUCTION

On August 3, 1983, George Fesak of CMS&H requested technical assistance concerning time, velocity and distance measurements on a battery powered, rail mounted personnel carrier at the Clinchfield Coal Company, McClure No. 1 Mine (shown in Figures 1 and 2). Two victims of the McClure No. 1 Mine explosion (Luther McCoy and Forest Riner) were allegedy riding the personnel carrier in the 2 Left section at the time of the mine explosion on June 21, 1983. Tests were conducted on August 11, 1983 to determine the initial velocity necessary to generate sufficient momentum for the personnel carrier to coast from the location where the bodies of McCoy and Riner were found (near crosscut No. 16) to its final stopping location (near crosscut No. 2).

In addition, the average personnel carrier travel times from crosscut numbers 35, 30, 28 and 26 to the location where McCoy's body was found are discussed.

INSTRUMENTATION

A precision tachometer was used to measure the instantaneous velocity of the personnel carrier. The tachometer was strapped to the stationary axle bearing case by adjustable band clamps (Figure 3). Polyurethane foam was inserted between the band clamps and the tachometer to permit mechanical play. The tachometer was mounted in a position that allowed the drive wheel on the tachometer shaft to ride on the rotating personnel carrier axle (Figure 4). The tachometer output voltage was recorded on channel No. 1 of an onboard Brush strip chart recorder.

The run and neutral positions of the controller handle were electronically monitored while the personnel carrier was traveling. This was accomplished by monitoring the voltage across the contacts of the control handle's neutral position switch on channel No. 2 of the Brush recorder. When the control handle is held in the run position, the neutral switch is activated and the contacts are closed. When the spring loaded control handle is released it returns to the neutral position and deactivates the neutral switch causing the contacts to open.

Thus the run and neutral positions of the control handle are indicated on the chart recorder by zero and 120 Vdc respectively. The onboard four channel Brush recorder was energized by a battery powered 12 Vdc/120 Vac inverter (Figure 5).

CALIBRATION

The Brush recorder and a Simpson 360 multimeter were calibrated to the manufacturers' specifications by a source traceable to the National Bureau of Standards.

The mathematical relationship between the tachometer output voltage and the personnel carrier speed was derived experimentally. The empirical data was obtained by elevating the personnel carrier on wooden blocks so the wheels could rotate freely. The tachometer output voltage and the personnel carrier wheel rpm were recorded for each of the three reverse no load speeds. The tachometer voltage was measured by the Simpson 360 multimeter. The wheel rpm was measured by a variable frequency Digistrobe which displayed the wheel speed when the strobe was visually synchronized on the rotating object. The data obtained by this procedure are shown below:

Tachometer Output (Volts)	Wheel Wheel (rpm)	Equivalent Personnel Carrier (mph)
0	0	0
15.3	375	17.7
19.5	472	22.4
21.7	525	24.9

The equivalent personnel carrier speed was calculated by multiplying the wheel rpm by the wheel circumference of 50 inches and then converting the speed into the dimensional units of miles/hour.

The function defining the relationship between the tachometer output and personnel carrier speed was determined by analysis in a linear regression algorithm. The least squares regression algorithm is a statistical method for finding a straight line that best fits a set of data points. The algorithm fits the data to the following equation format.

$$v = mx + b$$

where: v = dependent variable - velocity (miles/hour)
x = independent variable - tachometer output (volts)
m = slope (mph/volt)
b = y intercept-velocity (miles/hour)

The linear equation generated by the algorithm is shown below:

$$v = 1.147x + 0.04 \qquad \text{(miles/hour)} \qquad (1)$$

The algorithm also calculates the coefficient of determination, r^2. This is an indication of how good the calculated straight line fits the data and is a number between 0 and 1. Values closer to 1 indicate better fits than values closer to 0. The coefficient of determination for equation (1) is 0.9999. The tachometers high degree of linear accuracy is evident by this large value of r^2.

The calibration relationship defined in equation (1) was used to convert the tachometer output voltage signal into the appropriate velocity units of miles/hour.

DATA ANALYSIS

The velocity signal from the chart recording was digitized to facilitate computer analysis of the data. Digitizing is a process that selects discrete coördinate pairs of points from the analog velocity signal. The time interval between adjacent points must be small with respect to the rate of change of the velocity signal to insure an accurate digital representation of the analog signal. Velocity changes were moderate due to the inertia of the personnel carrier. Therefore a sampling interval of 1 sec was sufficient to capture the velocity variations. Even small changes in the amplitude of the velocity signal were readily detected due to the 40 points/mm resolution of the digitizer.

Once the velocity signal is digitized, the physically related parameter of distance can readily be derived. The total distance traveled is simply the area underneath the velocity curve. The area is the summation of the sample points multiplied by the sample interval. The relationship is expressed mathematically as:

$$s = \sum v \Delta t$$

where: s = distance traveled

v = velocity amplitude

Δt = sample interval (1 sec.)

The scaled velocity signal and the corresponding distance curve are shown in Figures 8 through 15. A detailed discussion of the test procedures and results is presented in the following sections.

TEST PROCEDURE

The tests were conducted using the same personnel carrier the victims were allegedy riding at the time of the mine explosion. The personnel carrier was the Rail Runner II, serial number 200-0668, manufactured by West Virginia Armature Company. West Virginia Armature is currently a division of Baker Mine Services in Virginia. The weight of the personnel carrier including batteries is 7 tons. An additional 250 pounds of instrumentation and 500 to 750 pounds of personnel were onboard during the testing.

Nine personnel carrier velocity tests were conducted in the track entry of the 2 Left section. Each test is characterized by the following four parameters, starting location, controller release location, stopping location and initial velocity. The initial velocity is the velocity the personnel carrier is traveling when the control handle is released. The entire sequence of tests are summarized in the table shown in Figure 6. The crosscut numbers are approximate locations used to simplify the table presentation. The precise locations are defined on the contour drawing shown in Figure 7 and in the following discussion.

CASE 1

The control handle was released at a marker 25 feet inby crosscut No. 16 for tests 1 through 7 conducted in Case 1. This is the location where McCoy's body was found. The location was marked by a flag hung from a roof bolt directly above the track. The personnel carrier operator, Richard K. Light, was instructed to release the control handle when the leading edge of the personnel carrier passed beneath the marker flag. All of the personnel carrier position and distance measurements discussed hereinafter will be with respect to the outby end of the 21 ft. long personnel carrier.

Test 1

The velocity and distance curves for the first test are shown in Figure 8. The test began at the plug for the personnel carrier's onboard battery charger near crosscut No. 35. Richard K. Light was instructed to tram the personnel carrier at a rate of speed typically traveled when exiting the mine at the end of a working shift. When the control handle was released at the marker flag the personnel carrier was traveling 14.5 miles/hour. Richard K. Light applied the brakes inby the first check curtain near crosscut No. 2 because he was uncertain of what was on the other side of the curtain.

Test 2

The velocity and distance curves for Test 2 are shown in Figure 9. The personnel carrier started at crosscut No. 35 and was trammed outby at a velocity typically traveled when exiting the mine. When the control handle was released near crosscut No. 16 the vehicle was traveling 14.4 miles/hour. The personnel carrier coasted to a point 93 feet outby the intersection of the track and belt and then rolled back 17 feet. The final stopping point was about midway between the first and second check curtain near crosscut No. 2.

Test 3

The personnel carrier started at crosscut No. 35 and was trammed outby at a speed typically traveled when exiting the mine. When the control handle was released near crosscut No. 16 the vehicle was traveling 13.9 miles/hour. The personnel carrier coasted to a point 61.5 feet outby the intersection of the track and belt and then rolled back 40 feet. R. K. Light said the vehicle was at approximately the same location it was found after the explosion. He indicated the actual position may have been a few more feet inby. The velocity curve is omitted due to incomplete data.

Test 4

The velocity and distance curves for Test 4 are shown in Figure 10. R. K. Light was instructed to release the control handle at a speed of approximately 10 miles/hour. The operator was able to observe the vehicle's speed by monitoring the tachometer voltage on a digital multimeter. The personnel carrier started 40 feet inby crosscut No. 23 and the vehicle was traveling 10.8 miles/hour when the control handle was released near crosscut No. 16. The personnel carrier coasted 250 feet to a location 24 feet outby spad No. 2164 (crosscut No. 14).

Test 5

The velocity and distance curves for Test 5 are shown in Figure 11. The personnel carrier started 40 feet outby crosscut No. 24. The vehicle was traveling 13.5 miles/hour when the control handle was released near crosscut No. 16. The personnel carrier stopped 10 feet inby the second check curtain then rolled back 25 feet.

Test 6

The velocity and distance curves for Test 6 are shown in Figure 12. The personnel carrier started at a location 40 feet outby crosscut No. 24. The vehicle was traveling 12.8 miles/hour when the control handle was released at the marker flag near crosscut No. 16. The personnel carrier traveled 400 feet to a location 30 feet inby crosscut No. 12. The vehicle stopped 30 feet inby the crest of a hill, at the No. 12 crosscut, the slopes down to the No. 2 cross-cut area (See Figure 7).

Test 7

The velocity and distance curves for Test 7 are shown in Figure 13. The personnel carrier was located near crosscut No. 24 at the start of the test. The vehicle was traveling 13.9 miles/hour when the control handle was released at the marker flag near crosscut No. 16. The mantrip coasted to a point 15 feet outby the second check curtain then rolled back 40 feet.

CASE 2

Case 2 describes tests 8 and 9 that were conducted to observe the affects of releasing the controller handle at locations inby crosscut No. 16. Richard K. Light was instructed to tram the vehicle at the velocity typically traveled when exiting the mine. Two release points were selected and the results are discussed in the following sections.

Test 8

The velocity and distance curves for Test 8 are shown in Figure 14. A marker flag was attached to a roof bolt 40 feet inby spad No. 2210 (crosscut No. 17). The personnel carrier was located near crosscut No. 24 at the start of the test. The vehicle was traveling 11.5 miles/hour when the control handle was released at the marker flag. The vehicle traveled 367 feet then came to rest 27 feet outby spad No. 2164 (crosscut No. 14).

Test 9

The velocity and distance curves for Test 9 are shown in Figure 15. A marker flag was attached to a roof bolt at crosscut No. 21. This location marked the begining of an severe uphill grade to about crosscut No. 17 (See Figure 7). The personnel carrier was located near crosscut No. 35 at the start of the test. The vehicle was traveling 12 miles/hour when the control handle was released at the marker flag. The steep incline of the slope caused the personnel carrier to coast only 90 feet outby the control handle release point before coming to rest near crosscut No. 20.

DISCUSSION OF RESULTS

One of the objectives of the tests was to determine the minimum initial velocity necessary for the personnel carrier to coast, under its own momentum, from crosscut No. 16 to the intersection of the track and belt near crosscut No. 2. The initial velocity observed in test Numbers 6 and 5 provide the lower and upper limits on this minimum velocity value respectively. The initial velocity of Test No. 6 was 12.8 miles/hour. The personnel carrier came to rest about 30 feet inby the crest of a hill at crosscut No. 12 that sloped down to crosscut No. 2. The initial velocity of Test 5 was 13.5 miles/hour and provided the personnel carrier with sufficient momentum to carry the vehicle over the hill crest at crosscut No. 12 and down to the region of crosscut No. 2. Therefore, it can be concluded that if the personnel carrier is traveling at least 13.5 miles/hour when the control handle is released 25 feet inby crosscut No. 16 then the personnel carrier will have sufficient momentum to coast to the intersection of the track and belt near crosscut No. 2.

The upper limit on the initial velocity may be large if the track slopes uphill outby crosscut No. 2.

Case 2 investigated the impact of the steep slope inby crosscut No. 16 on the momentum of the personnel carrier. Although the vehicle's control handle was in the fastest speed position when traveling up the slope, the vehicle decelerated from the location 50 feet inby crosscut No. 20 to the location 30 feet inby crosscut No. 19. Between the location 30 feet inby crosscut No. 19 and 25 inby crosscut No. 16 the vehicle accelerated.

For Test 8 the control handle was released 40 feet inby crosscut No. 17 when the vehicle was traveling 11.5 miles/hour. This was the fastest speed the personnel carrier could travel at that location. The personnel carrier did not coast to the No. 2 crosscut area since it was traveling less then the minimum initial velocity of 13.5 miles/hour at the No. 16 crosscut, previously discussed.

For Test 9 the control handle was released when the personnel carrier was traveling 12 miles/hour at crosscut No. 21 which is the begining of the steepest portion of the incline. The severe incline of the slope at this point caused the personnel carrier to stop at a location less than one crosscut away from the control handle release point.

As a result of these tests it appears unlikely that the control handle could be released inby crosscut 17 and provide the personnel carrier with sufficient momentum to travel to the No. 2 crosscut region.

Average travel times to the location where McCoy's body was found are shown in the following table.

BEGINNING LOCATION (CROSSCUT NO.)	ENDING LOCATION (CROSSCUT NO.)	AVERAGE TRAVEL TIME (SECONDS)
35	16	114
30	16	78
28	16	68
26	16	55

The tests are numbered in a chronological order. When studying the test data it becomes apparent that lower initial velocities in the later part of the testing produced greater coasting distances. This minor discrepancy may be attributed to the following factors.

Since the personnel carrier had been removed from service for a period of time during the investigation, the petroleum based lubricants in the axle bearing case and motor speed reducer may have increased in viscosity. As the tests progressed, the lubricants became more fluid due to the frictional heating and allowed greater mechanical freedom of movement.

The mine had been idled by a strike prior to the day of the testing. The inactivity in the 2 Left section had allowed the rail surface of the track to become contaminated with ground water and rock dust. The cleaning action of the personnel carrier wheels traveling along the rails may have reduced the coefficient of rolling friction as the testing progressed.

Overall, a high degree of confidence is established concerning the accuracy of the velocity measurements because the intergration of the velocity curve yields a distance measurement which correlates well with the scale drawn mine map of the 2 Left section.

CONCLUSIONS

Two conclusions can be drawn from the test results.

First, if the control handle of the mantrip is released 25 feet inby crosscut No. 16 while traveling at a typical velocity of at least 13.5 miles/hour, the vehicle will have sufficient momentum to continue traveling to the No. 2 crosscut area.

Secondly, under the observed test conditions, the personnel carrier would not travel to the No. 2 crosscut area if the control handle was released inby the No. 17 crosscut.

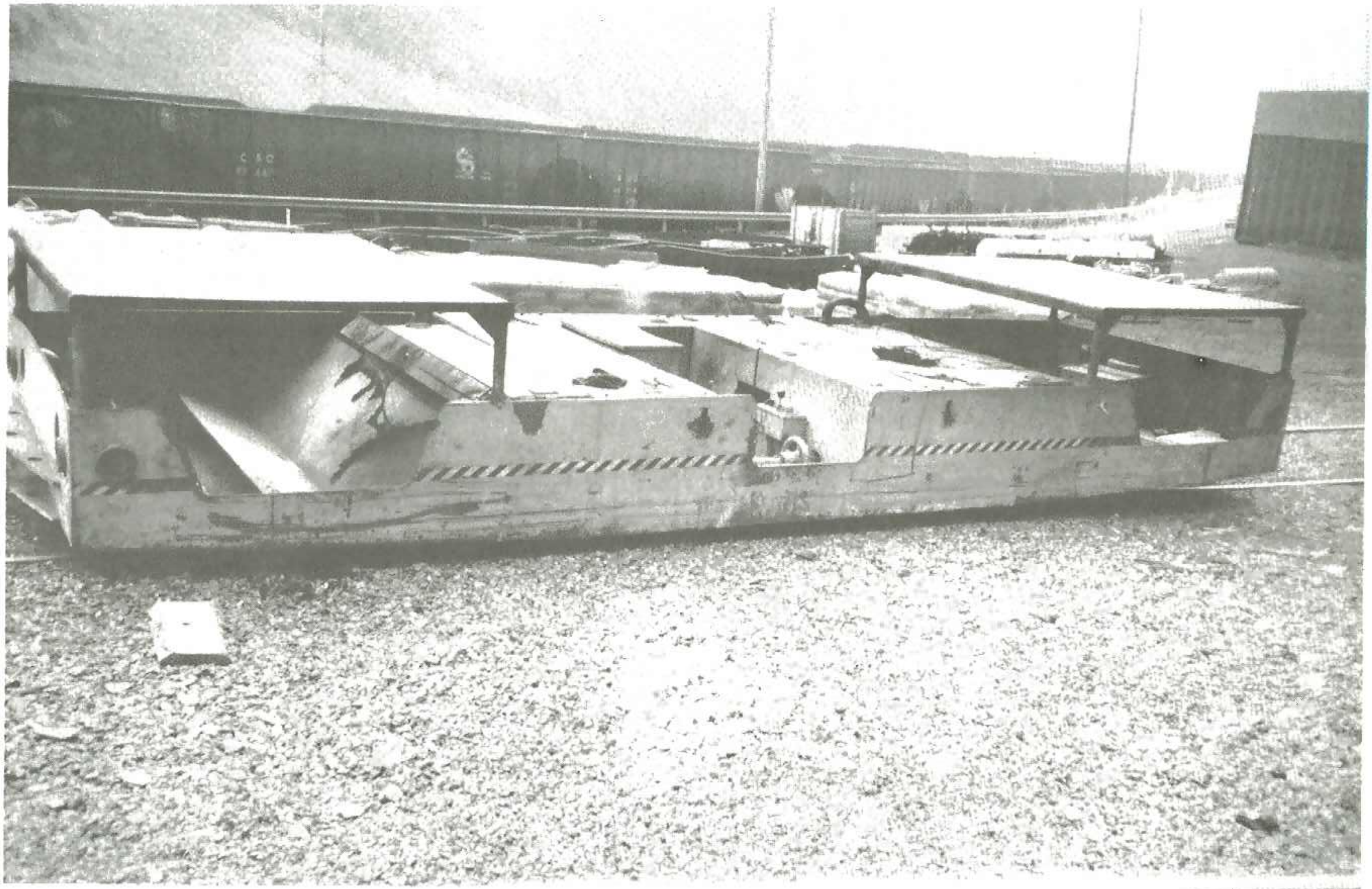


Figure 1: Personnel Carrier, West Virginia Armature Co.
Rail Runner II, Serial Number 200-0668

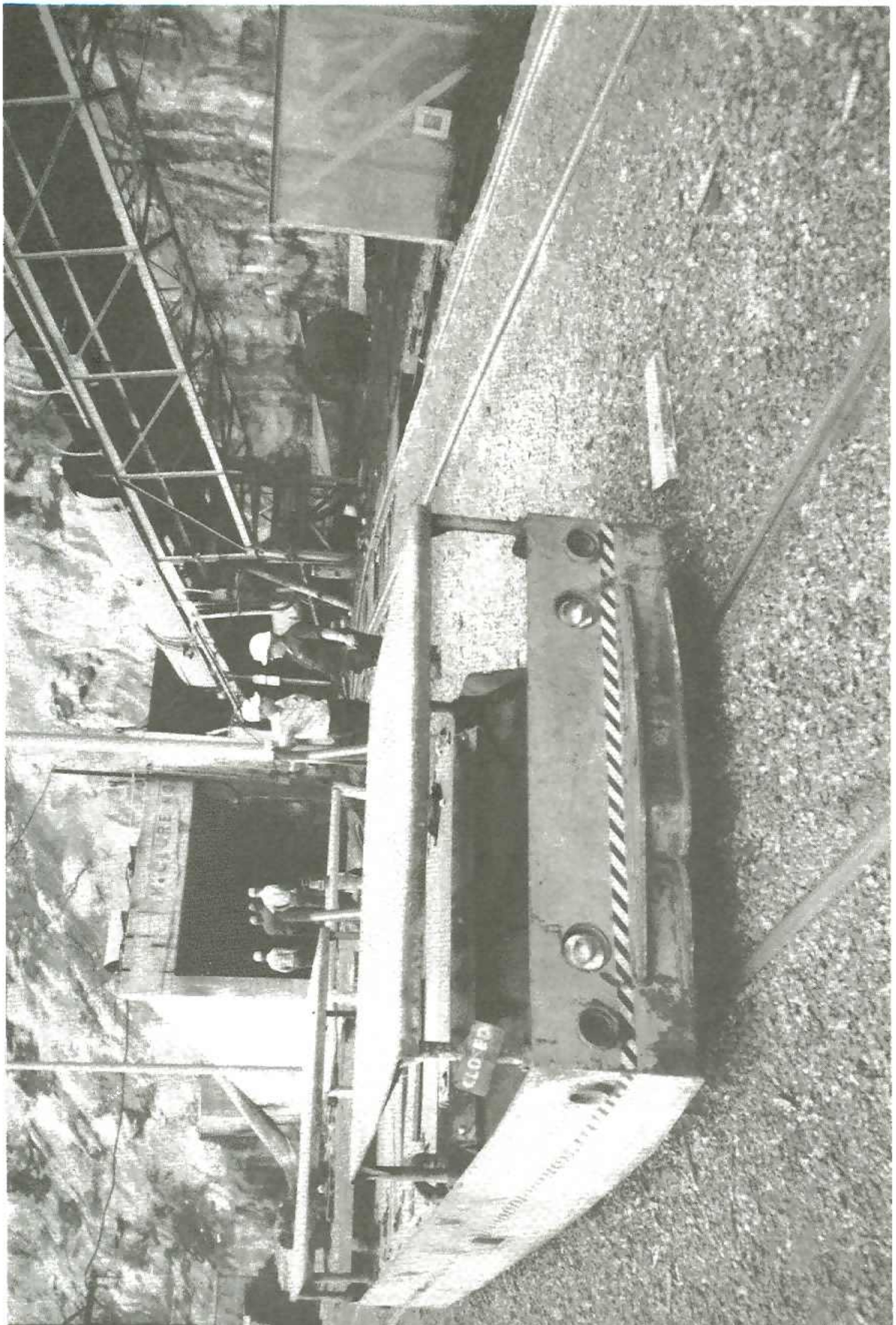


Figure 2: Personnel Carrier, West Virginia Armature Co.
Rail Runner II, Serial Number 200-0668

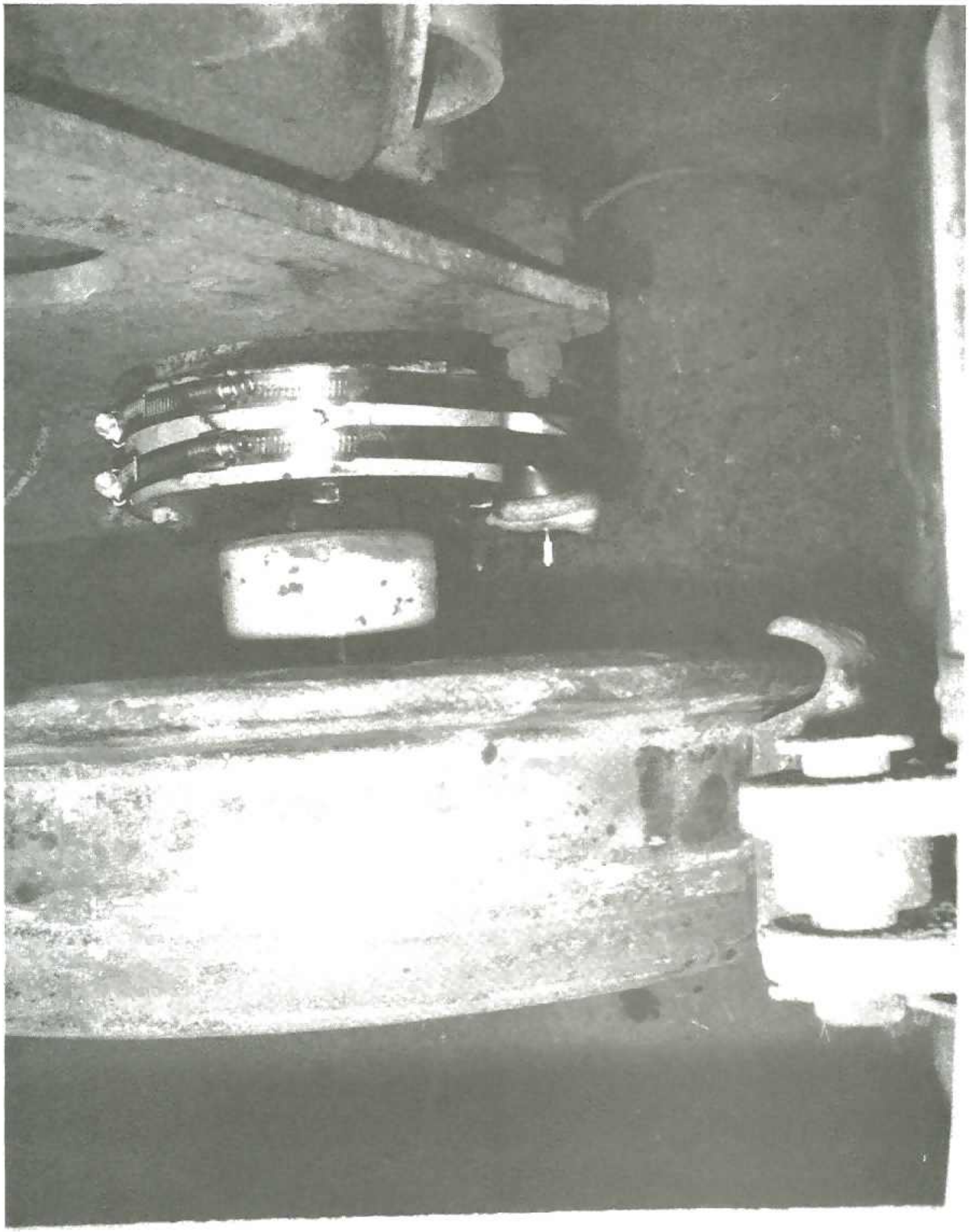


Figure 3: Mounting Position of the Tachometer

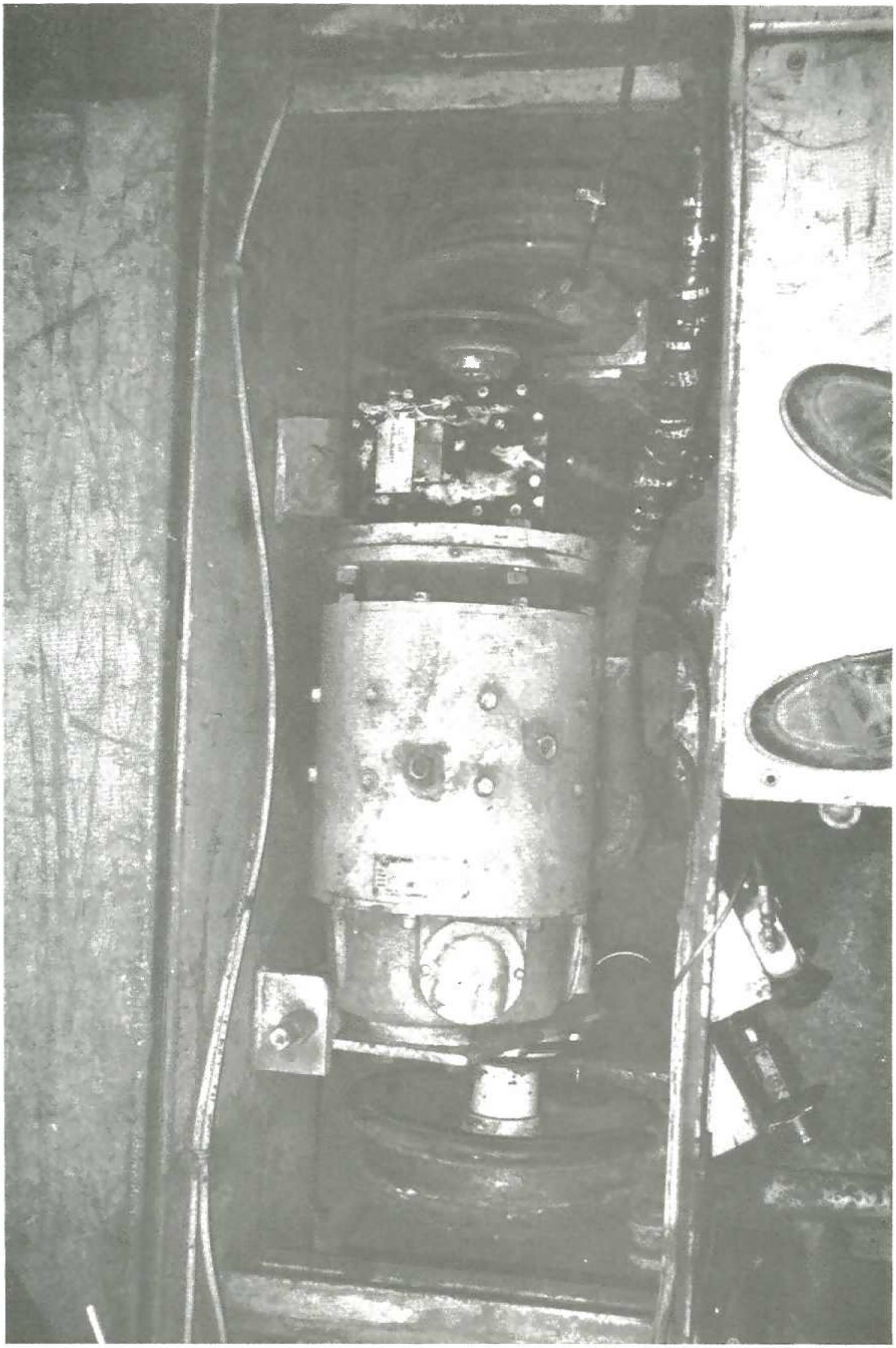


Figure 4: Drive Motor Compartment

Figure 5: Test Instrumentation

TEST NO.	1	2	3	4	5	6	7	8	9
Starting Location (Crosscut No.)	35	35	35	23	24	24	24	24	35
Controller Release Location (Crosscut No.)	16	16	16	16	16	16	16	17	21
Initial Velocity (miles/hour)	14.5	14.4	13.9	10.8	13.5	12.8	13.9	11.5	12
Stopping Location (Crosscut No.)	2	2	2	14	2	12	2	14	20

Figure 6. Summary of Tests

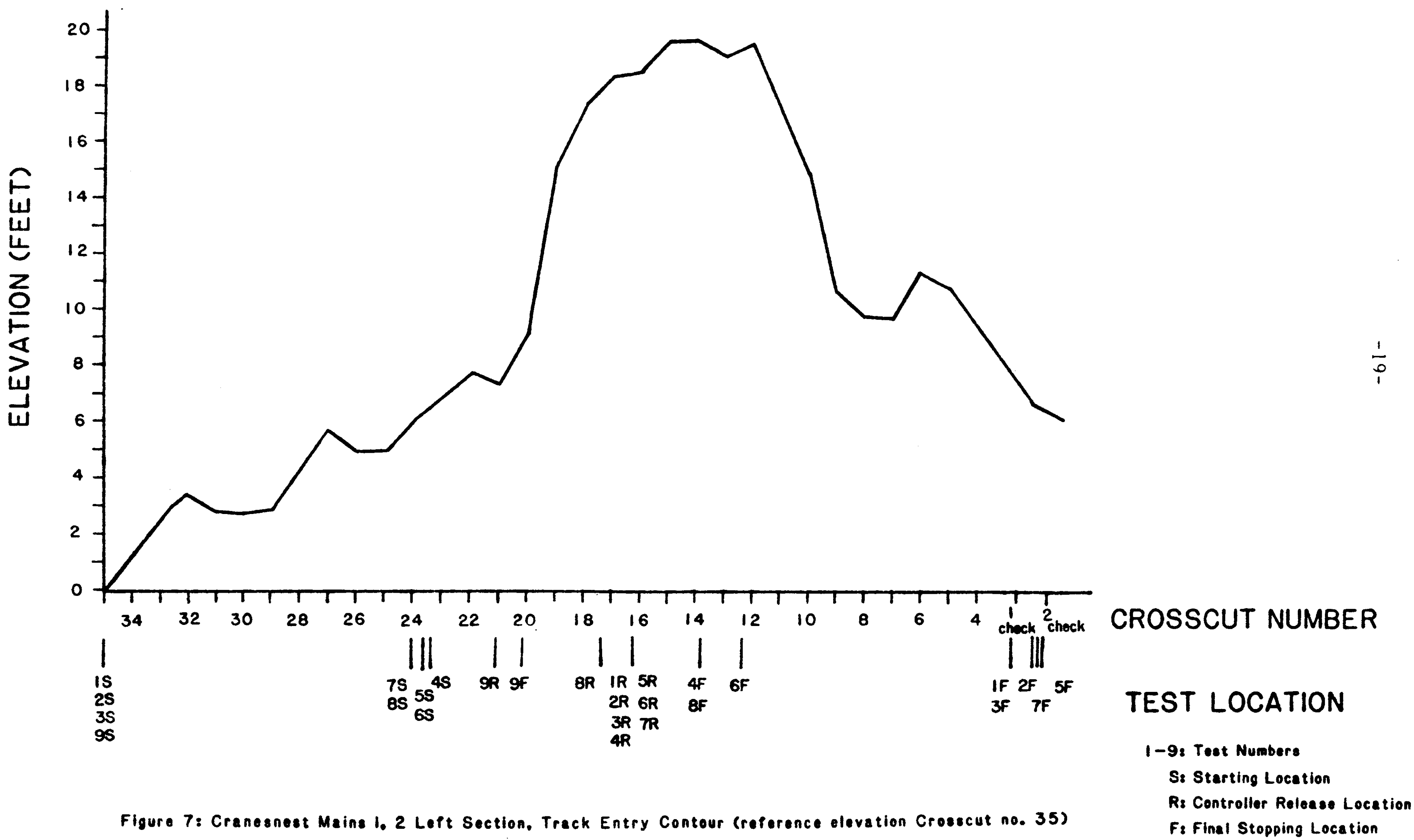


Figure 7: Cranesnest Mains 1, 2 Left Section, Track Entry Contour (reference elevation Crosscut no. 35)

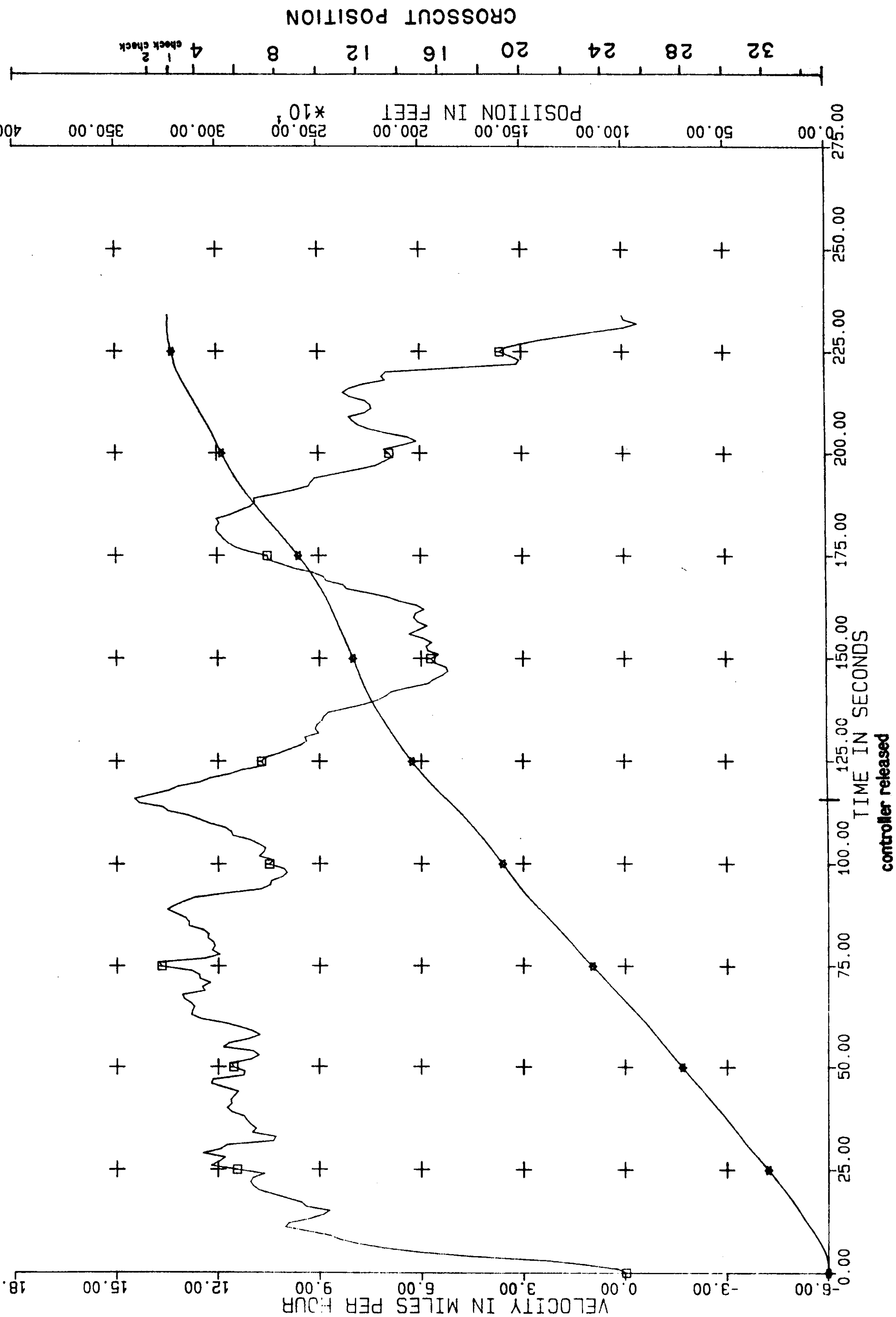


Figure 8: Personnel Carrier Velocity Test I

Velocity = ☆
Position = □

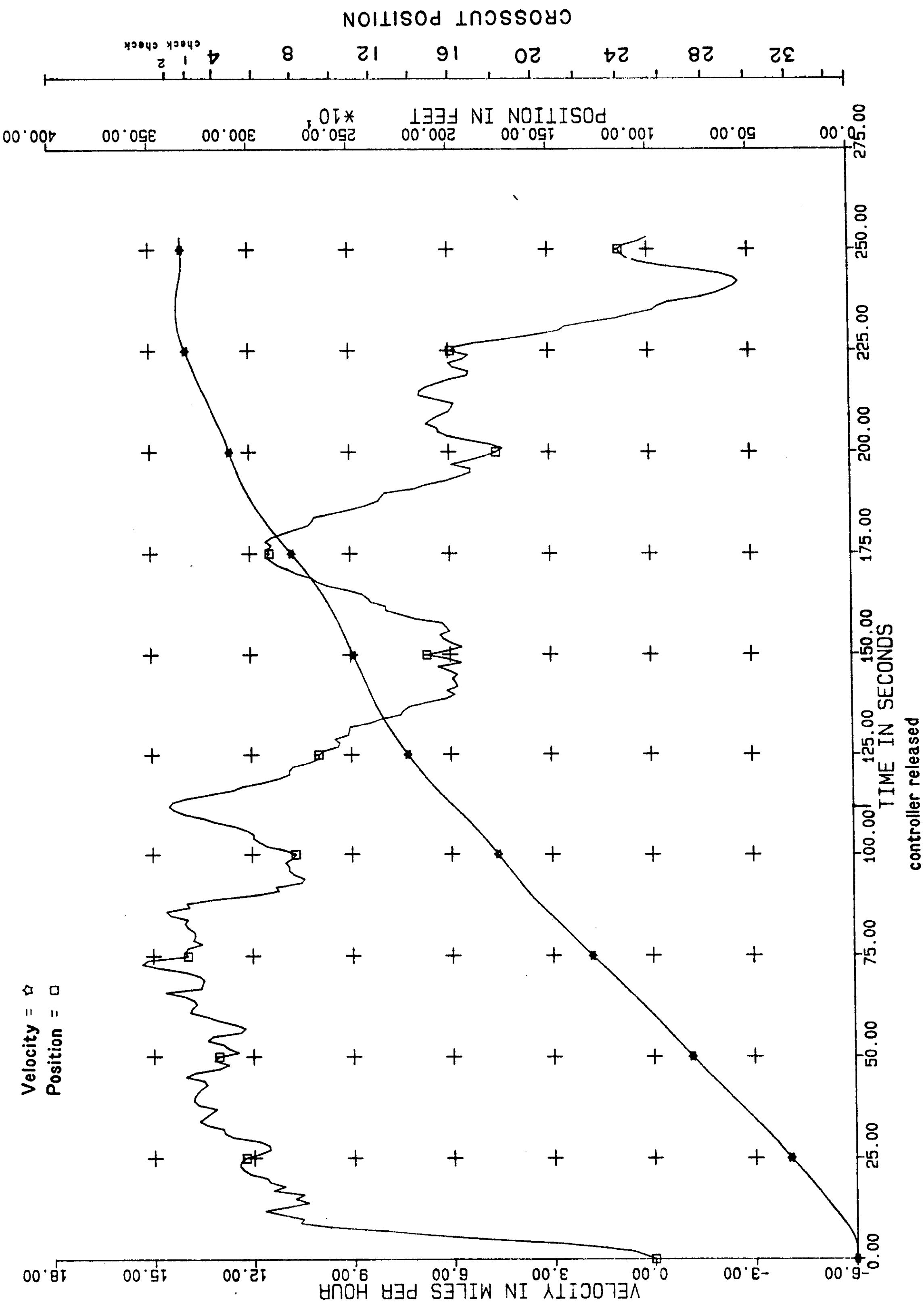


Figure 9: Personnel Carrier Velocity Test 2

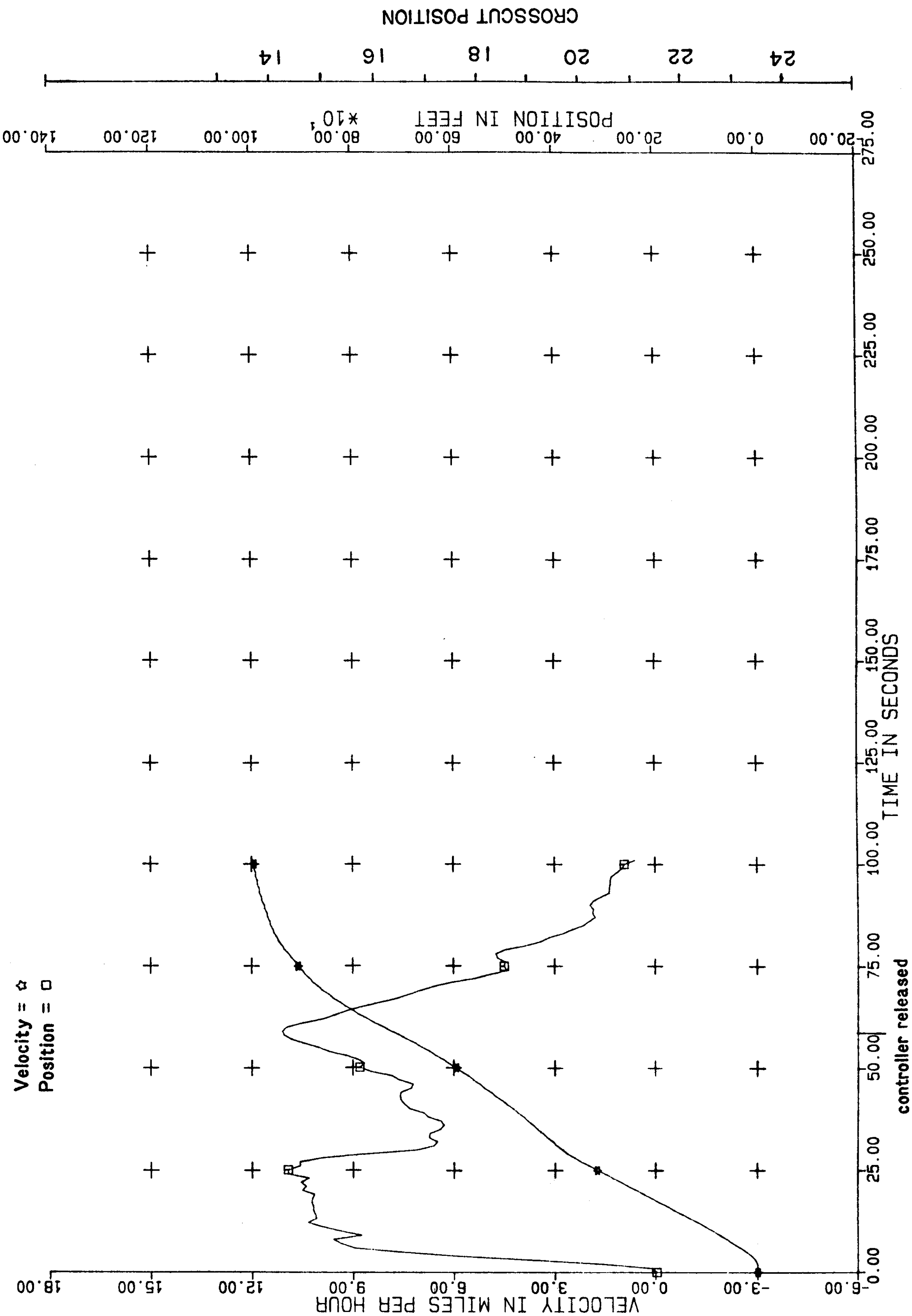


Figure 10: Personnel Carrier Velocity Test 4

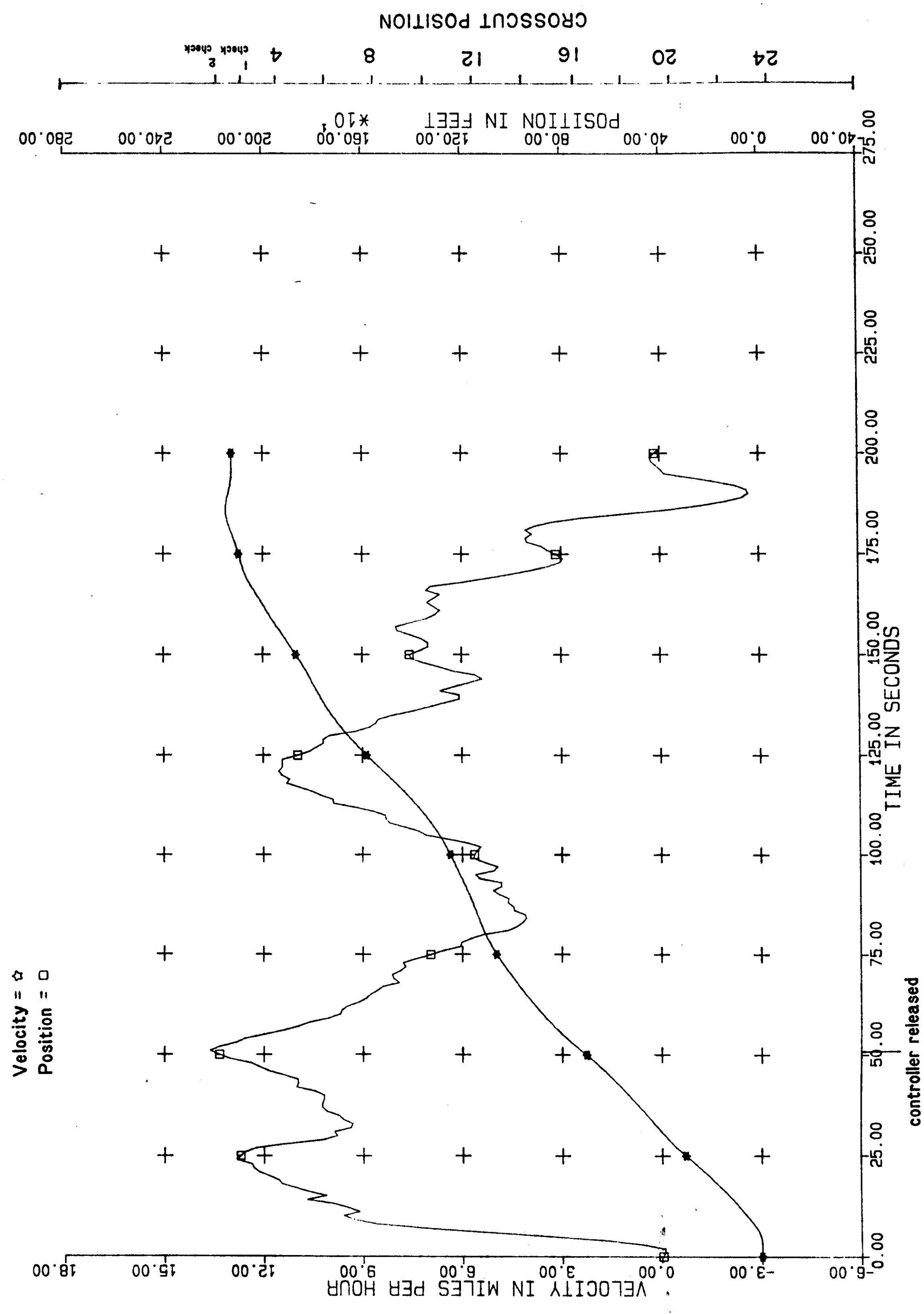


Figure 11: Personnel Carrier Velocity Test 5

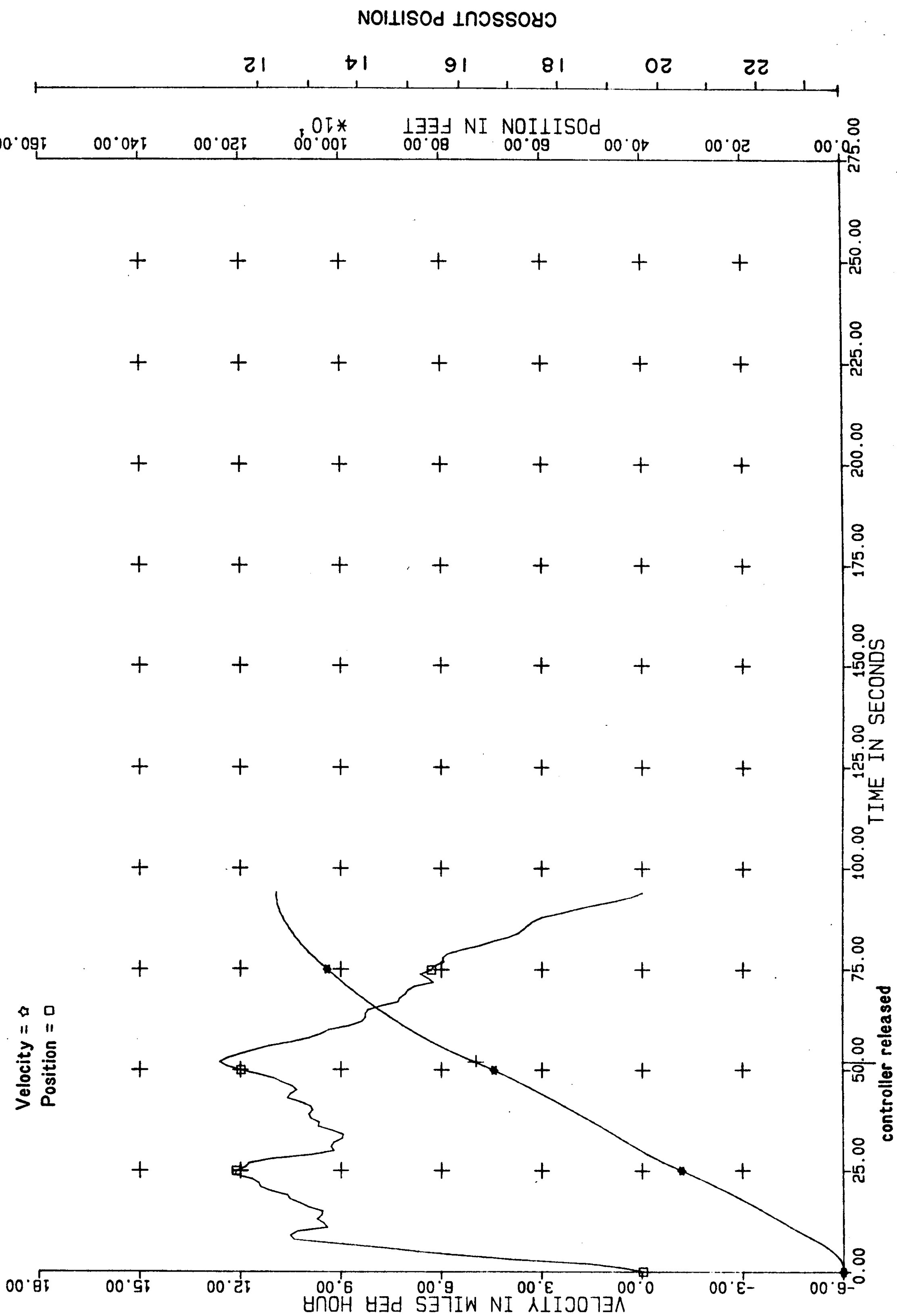


Figure 12: Personnel Carrier Velocity Test 6

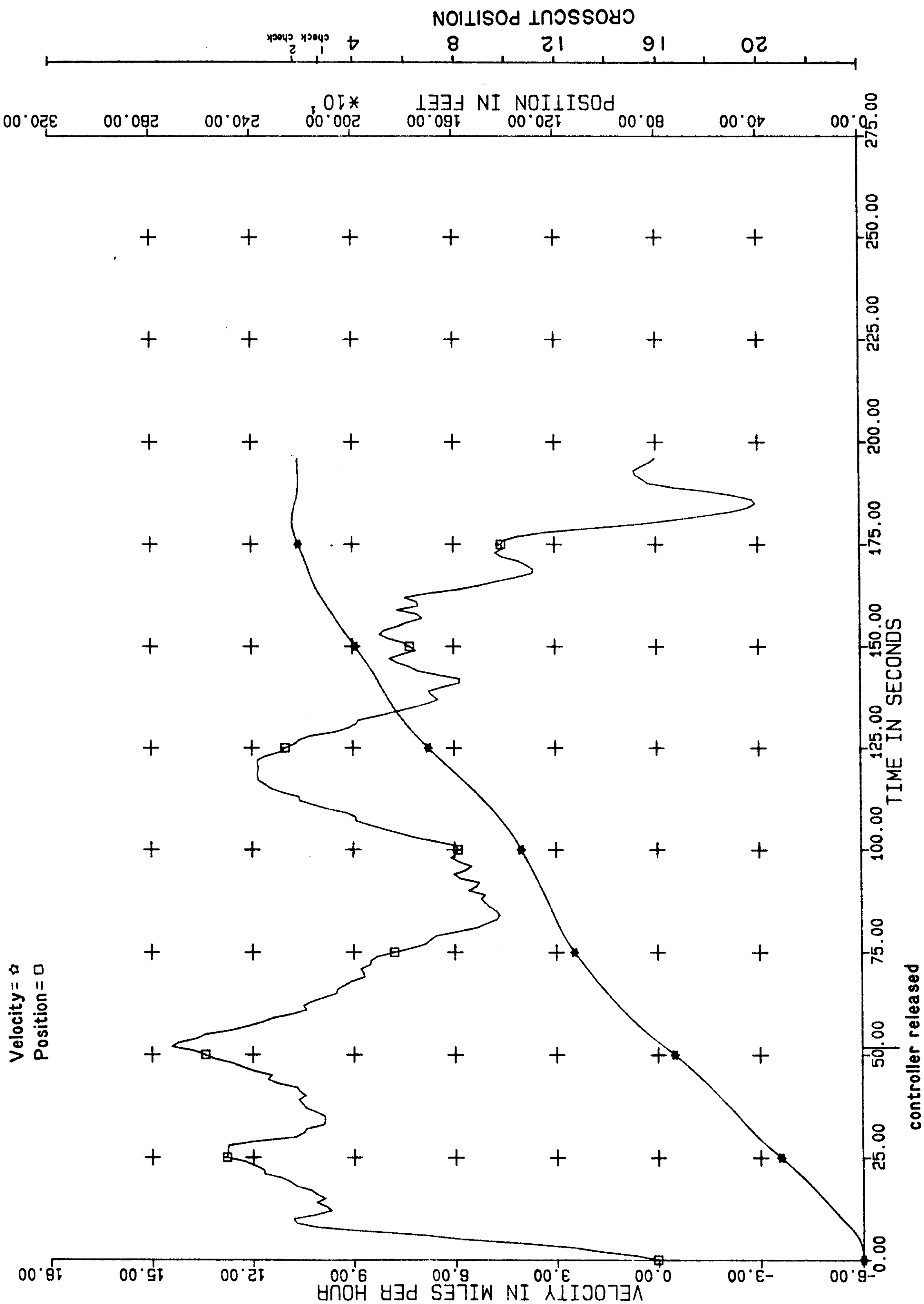


Figure 13: Personnel Carrier Velocity Test 7

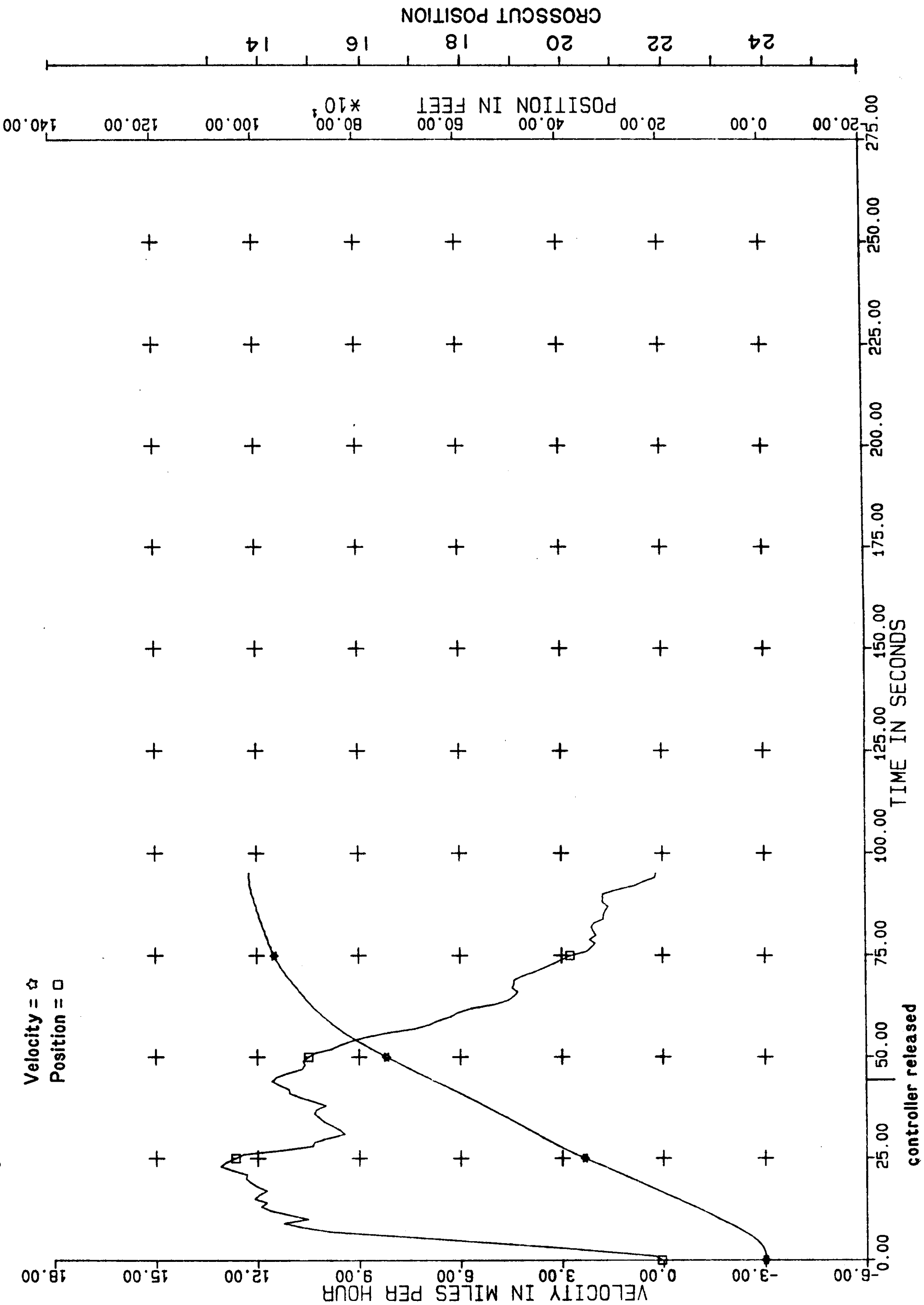


Figure I 4: Personnel Carrier Velocity Test 8

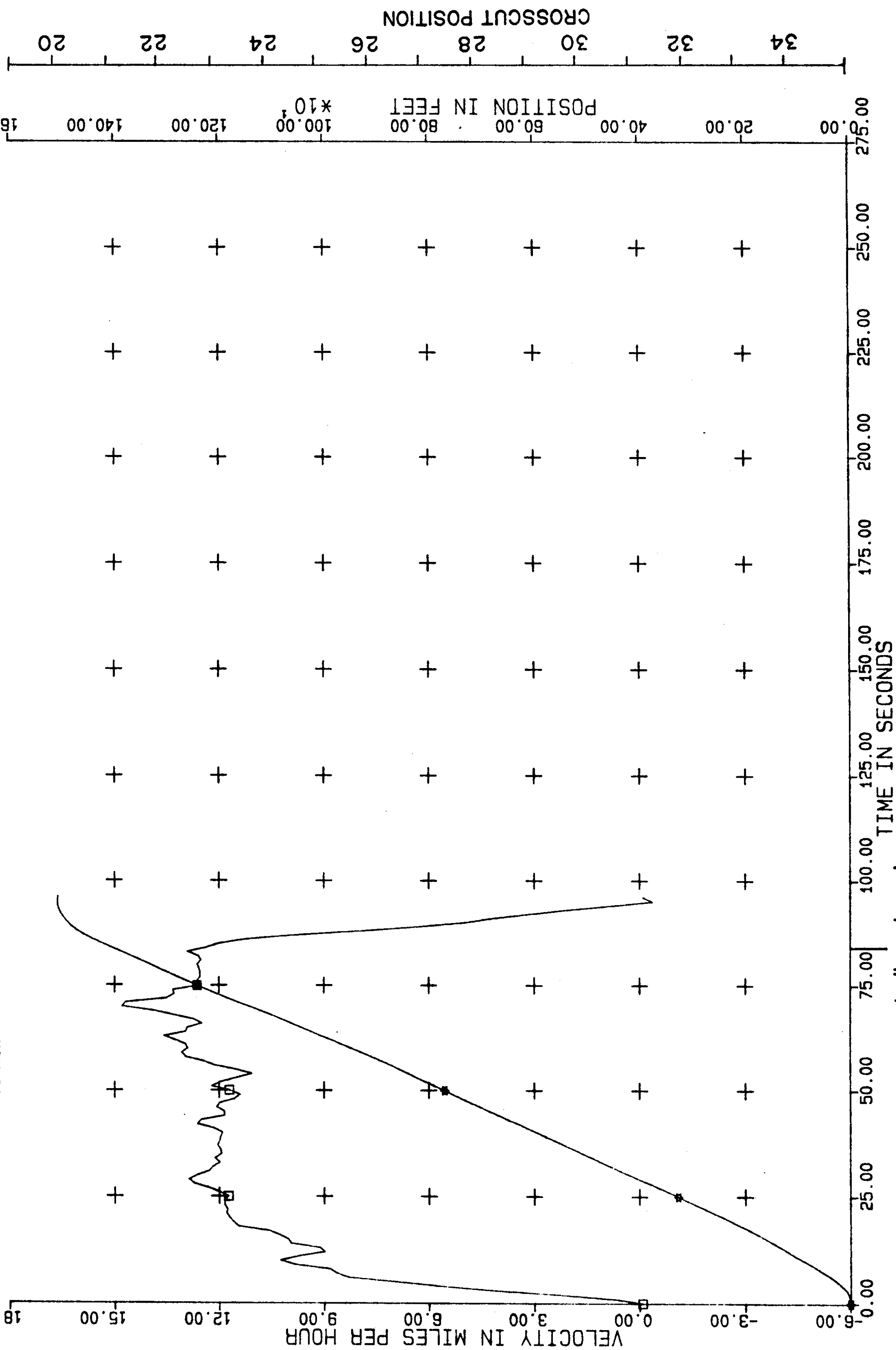


Figure I 5: Personnel Carrier Velocity Test 9

Velocity = ✩
Position = □

APPENDIX H

APPENDIX H

United States Department of the Interior

BUREAU OF MINES

PITTSBURGH RESEARCH CENTER
COCHRANS MILL ROAD
POST OFFICE BOX 18070
PITTSBURGH, PENNSYLVANIA 15236

November 1, 1983

Memorandum

To: J. N. Murphy, Research Director, PRC

Through: G. R. Bockosh, Research Supervisor, IS&TS GRB
J. G. Kovac, Supervisory Mechanical Engineer, IS&TS JGK

From: N. Kyriazi, Biomedical Engineer, IS&TS

Subject: In-house testing of 13 Draeger SCSR's involved in McClure #1 mine explosion

The Life Support Group at the Pittsburgh Research Center was asked by MSHA to assess the condition of 13 Draeger OXY-SR 60B chemical oxygen self-rescuers which had been subjected to various forces in an explosion in the McClure No. 1 mine of the Clinchfield Coal Co. The explosion occurred in late June and killed seven miners. The Bureau received the apparatus in the first half of July.

The apparatus were stored underground and not transported daily to the surface. The locations of the apparatus during the explosion are given in Table 1.

Damage ranged from minimal to serious. Some of the apparatus were simply blackened. Others had heat damage, cracks in the outer case, color indicators obscured or missing, and gashed or crushed outer cases. Eight of the color indicators were a solid blue indicating acceptable condition. Five others were either turning pink or obscured.

Each of the units was first inspected for damage. The case integrity was checked by Draeger's own pressure tester. These descriptions of condition are noted on the data sheet (Table 2).

All of the 13 apparatus were then tested on the Bureau's BMS under the following conditions:

cc: JGKovac
NKyriazi
IS&TS Files

Oxygen Consumption	- 1.35 liters/min.
Carbon Dioxide Addition	- 1.30 liters/min.
Ventilation Rate	- 31.9 liters/min.
Tidal Volume	- 1.21 liters/breath
Respiratory Frequency	- 26.5 breaths/min.

All volumes are listed at STPD. These conditions are the same as those used in our performance comparison testing and environmental testing previously completed.

In the data sheet (Table 2) can be found average values of the following parameters monitored over the entire test: inhaled O_2 and CO_2, inhalation (Pin) and exhalation (Pex) breathing resistance, and inhalation temperature. This data is graphically illustrated in Figures 1-6. The average and standard deviation range is shown shaded. This data was obtained previously using new apparatus (n=5). Factors determining the test termination were low bag volume indicating an expired KO_2 bed, CO_2 values over 4%, or O_2 values under 15%. These criteria were applied to all units except for apparatus number 889A07767, which would have terminated at four minutes due to high CO_2 (4%). It was permitted to continue for informational purposes and terminated at 90 minutes when the KO_2 bed was exhausted (low bag volume).

Eight of the apparatus terminated due to low bag volume, like normal units did in previous testing programs. Three terminated due to high CO_2 and two more had both conditions occur nearly simultaneously.

The most dramatic effect on the apparatus was evidenced in the first self-rescuer tested, witnessed by representatives from National Mine Service Co. and National Draeger. The chlorate candle in this apparatus, serial number 889A07767, worked normally but the KO_2 did not start to function until nearly eight minutes into the test. Oxygen concentration did not fall below 43%, however, because of the functional chlorate candle. Thus, even this apparatus would have permitted a miner to safely escape from the mine if needed. Concentrations of CO_2 were abnormally high during this test but would not have hindered escape to any significant degree. Also, breathing resistance was lower than usual.

No evidence of KO_2 dust was found in the flow loops of any of the apparatus. This was determined mostly by sight but some were inhaled from by a human subject before being tested on the BMS.

The abnormally high exhalation resistance shown by apparatus number 980A07796, (78 mm H_2O) is explained by its case being crushed on the bottom. Other abnormal values, we cannot explain, but we can, nevertheless, conclude that none of the apparatus had performance specifications so extreme that they could not have been used for a successful escape.

Kyriazi

Nicholas Kyriazi

IS&TS:NKyriazi:mdg:11/01/83:723-6478

Table 1

A08590 - No. 3 Heading, 2 Left Section, 30' Outby Face
- Some damage due to heat, hole in bottom, inside cover missing

H02135 - No. 3 Heading, 2 Left Section, 34' Outby Survey Station 2494
- (In a charred plastic carrying case) case cracked

A07796 - No. 3 Heading, 2 Left Section, 30' Outby Face
- Bottom crushed and cracked with hose hanging out

A07792 - No. 3 Heading, Roof Bolting Machine in Face
- In a plastic carrying case

A02115 - 65' Outby Survey Station 2494
- in a plastic carrying case

H08572 - 40' Outby Survey Station 2494 (outby power center)
- Some damage to case due to heat, latch damage-jammed, vinyl cover burnt, case cracked

A02018 - 20'Outby Survey Station 2494 (inby end of power center)
- Part of carrying strap melted, case cracked

A02048 - 20'Outby Survey Station (at power center)

A08581 - 20' Outby Face of No. 3 Heading

A08692 - 65' Outby Survey Station 2494
- Top slightly damaged, color indicator missing

A07556 - 30' Inby Conveyor Belt Feeder, No. 2 Heading, 2 Left
- Release clamp was reversed

A07767 - 72' Inby Survey Station 2494
- Face plate missing

A08704 - 80' Inby Survey Station 2494
- Black and covered with soot
- Top showed damage, cracked, chipped, color indicator pushed in

Table 2

Test Date	Serial #	Color of Indicator	Case Leak Test	Duration (min)	Reason for Termination	Averages of Monitored Parameters: O_2(%)	CO_2(%)	Pex (mmH_2O)	Pin (mmH_2O)	Temp (°C)
July 20	889A07767	Blue	Pass	90	High CO_2*	71	4.8	26	19	37
July 20	080A08704	Blue	Pass	83	Low bag vol.	83	1.0	38	30	38
July 21	180A02135	Turning Pink	Fail	80	Low bag vol.	83	0.9	43	30	41
July 21	980A07796	Turning Pink	Fail	68	Low bag vol.	84	1.5	78	24	41
July 22	180A08692	Missing	Fail	76	Low bag vol.	82	1.4	40	27	39
July 22	180A02018	Turning Pink	Fail	80	Low bag vol.	82	1.2	43	29	40
July 25	980A07556	Blue	Pass	80	Low bag vol.	83	1.0	47	24	40
July 25	880A08581	Blue	Pass	75	High CO_2	80	1.4	31	32	40
July 26	980A07792	Blue	Pass	81	Low bag vol.	85	1.1	40	29	40
July 26	180A02115	Blue	Pass	82	Low bag vol. & High CO_2	82	1.5	42	32	40
July 27	180A02048	Blue	Pass	88	Low bag vol.	90	1.4	44	27	40
July 28	980A08572	Blue	Fail	93	Low bag vol. & High CO_2	74	1.2	59	30	41
August 1	980A08590	Turning Pink	Fail	86	High CO_2	79	1.7	32	30	40

* CO_2 at 4% at 4 minutes but test continued until O_2 bottle was empty.

Average duration for each apparatus

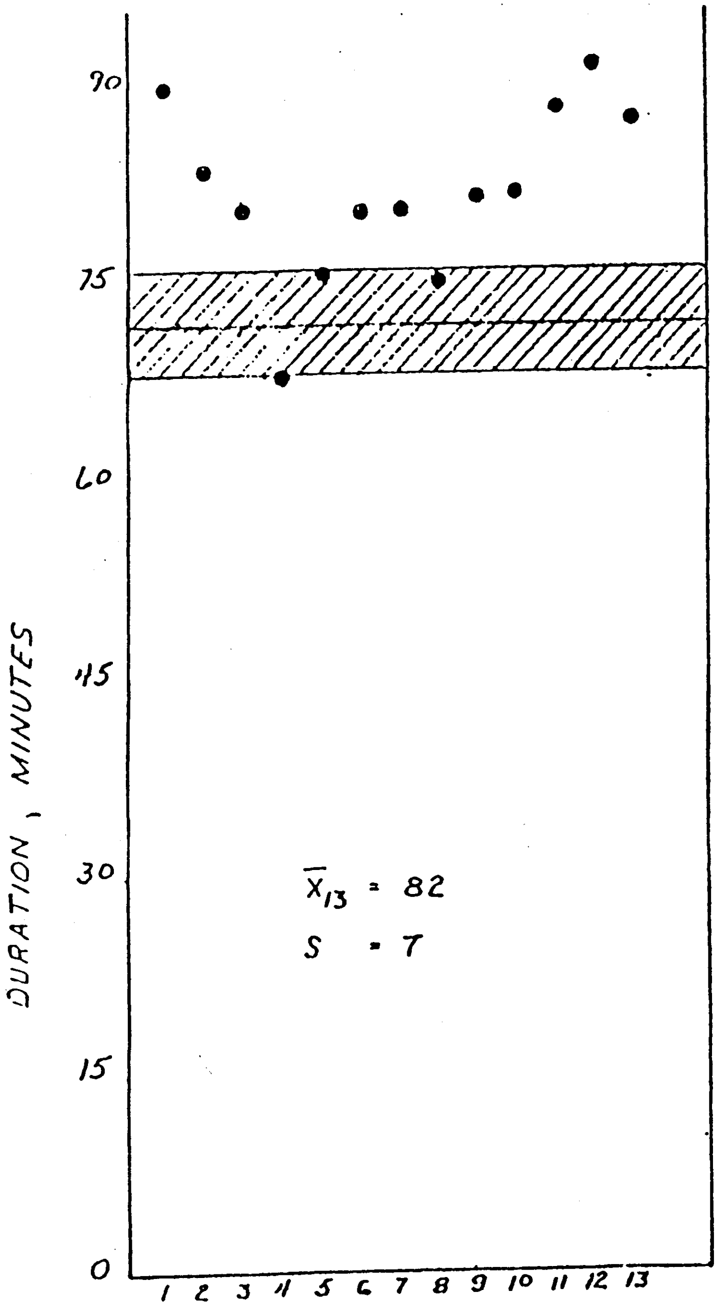


Figure 1.

Average temperature for each apparatus

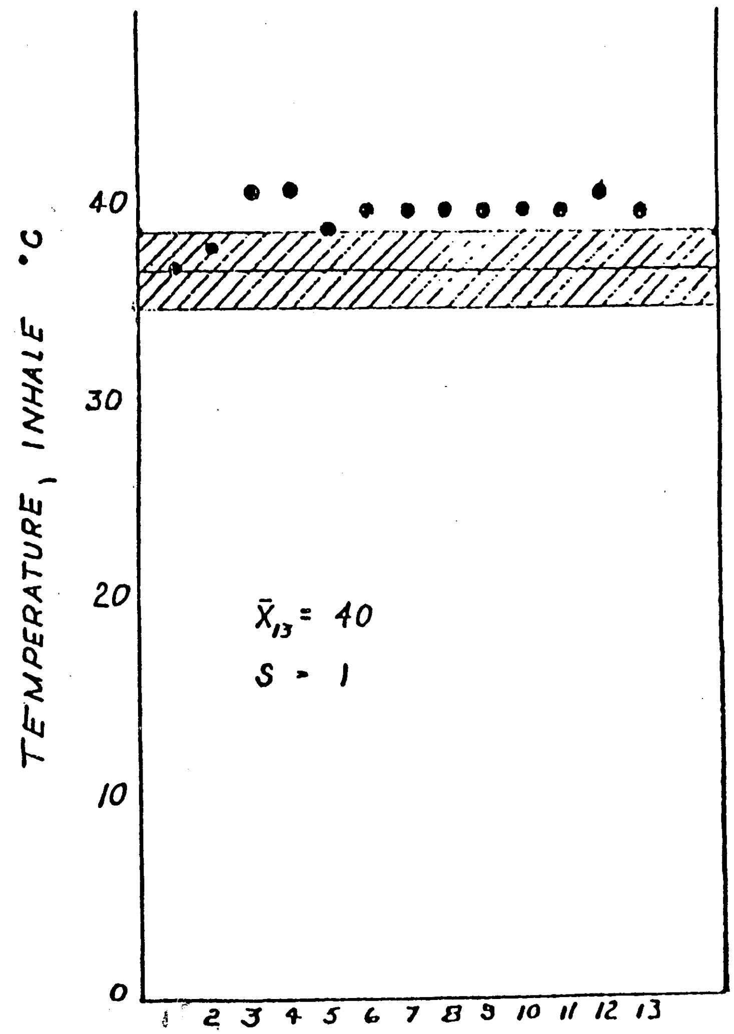


Figure 2

<u>Average O_2 concentration for each apparatus</u>

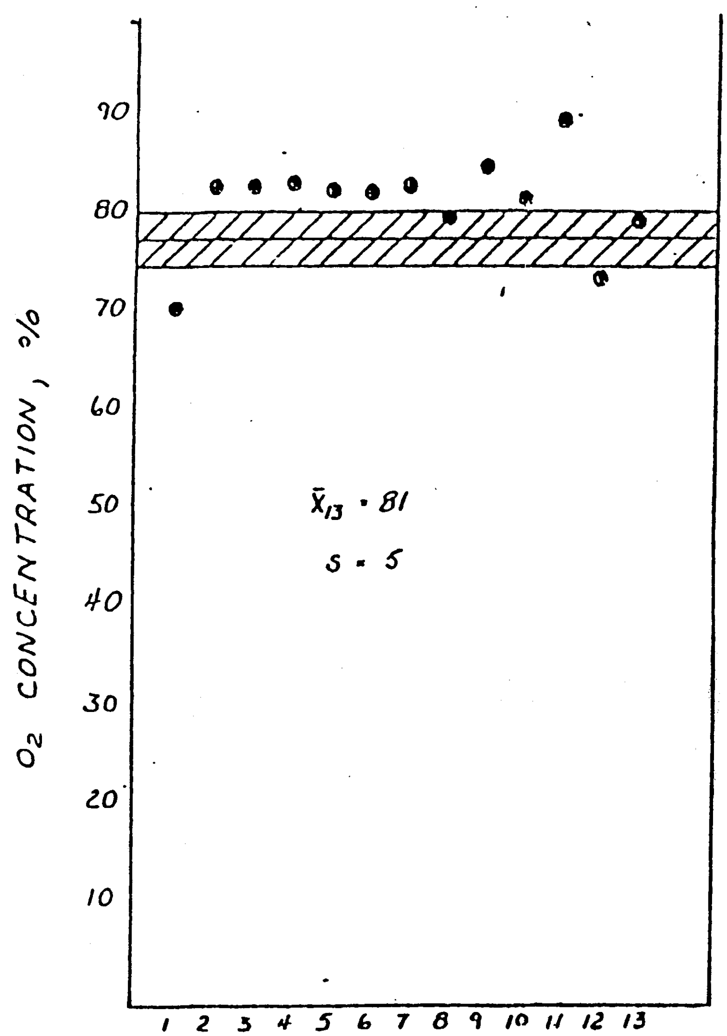


Figure 3

<u>Average CO_2 concentration for each apparatus</u>

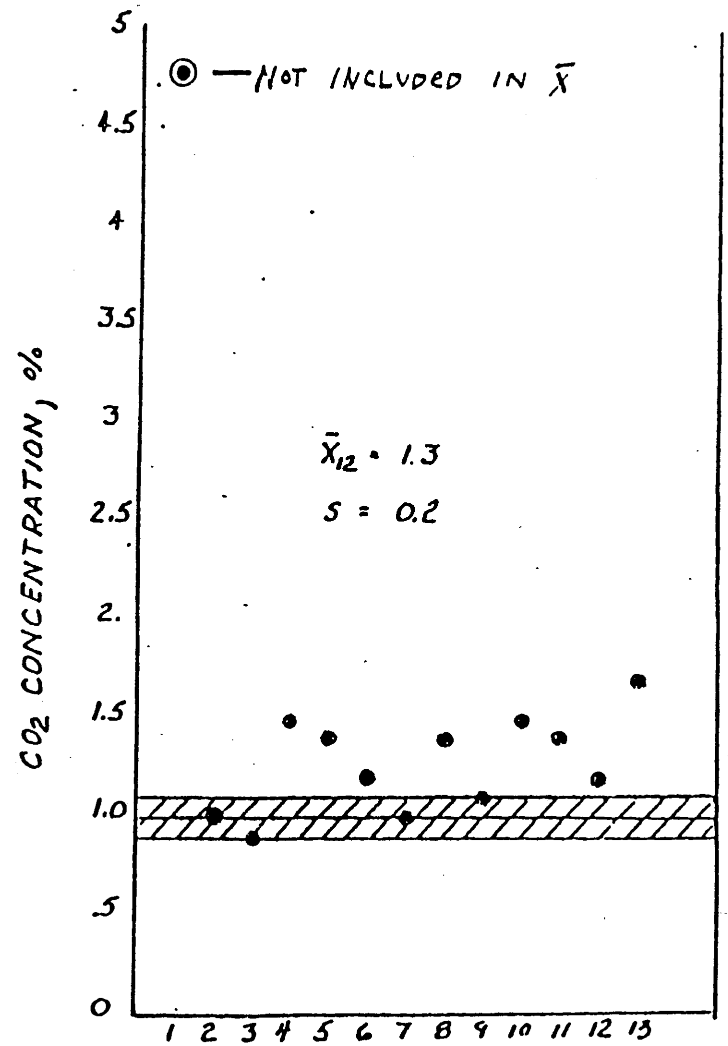


Figure 4

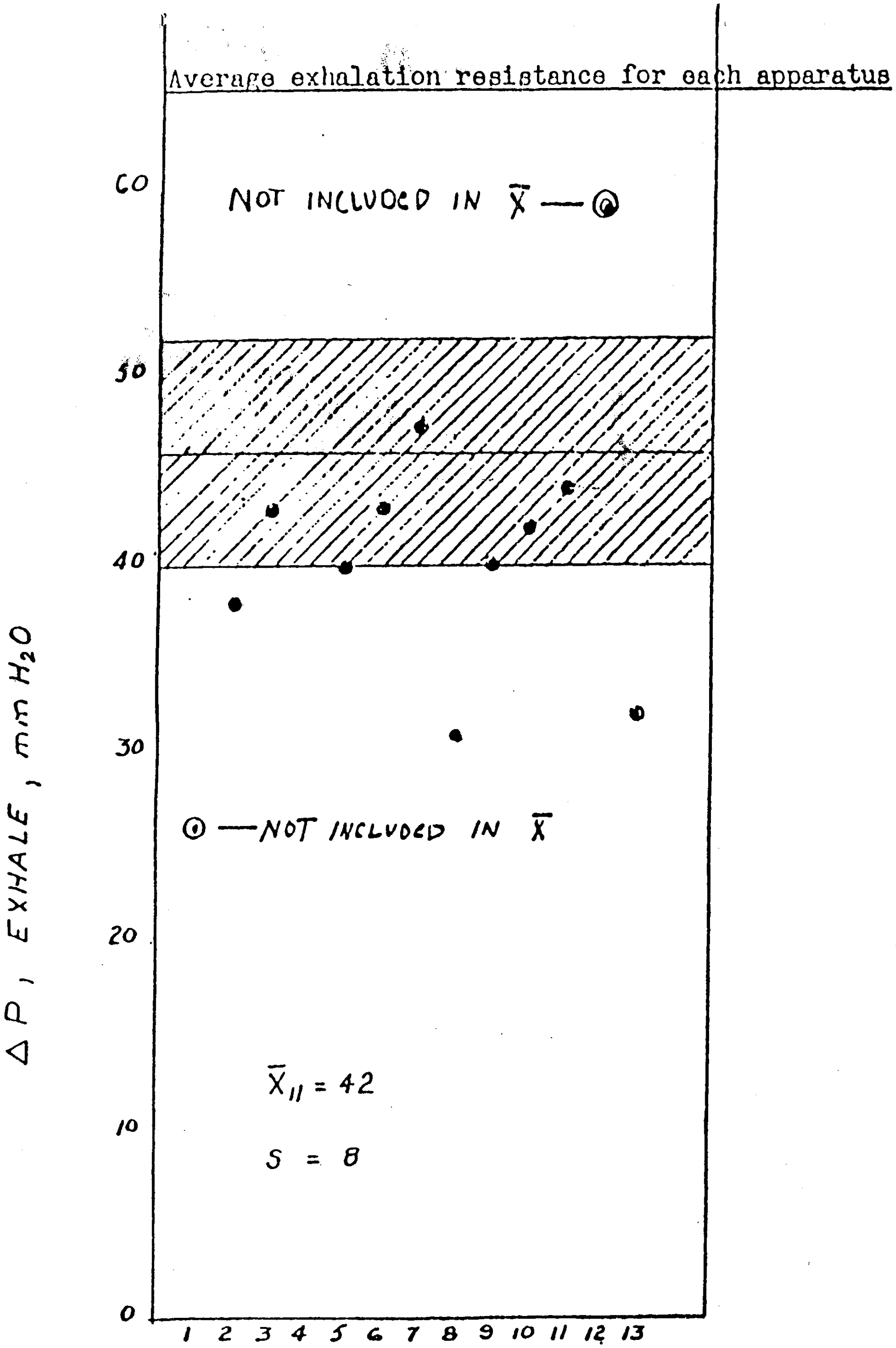


Figure 5

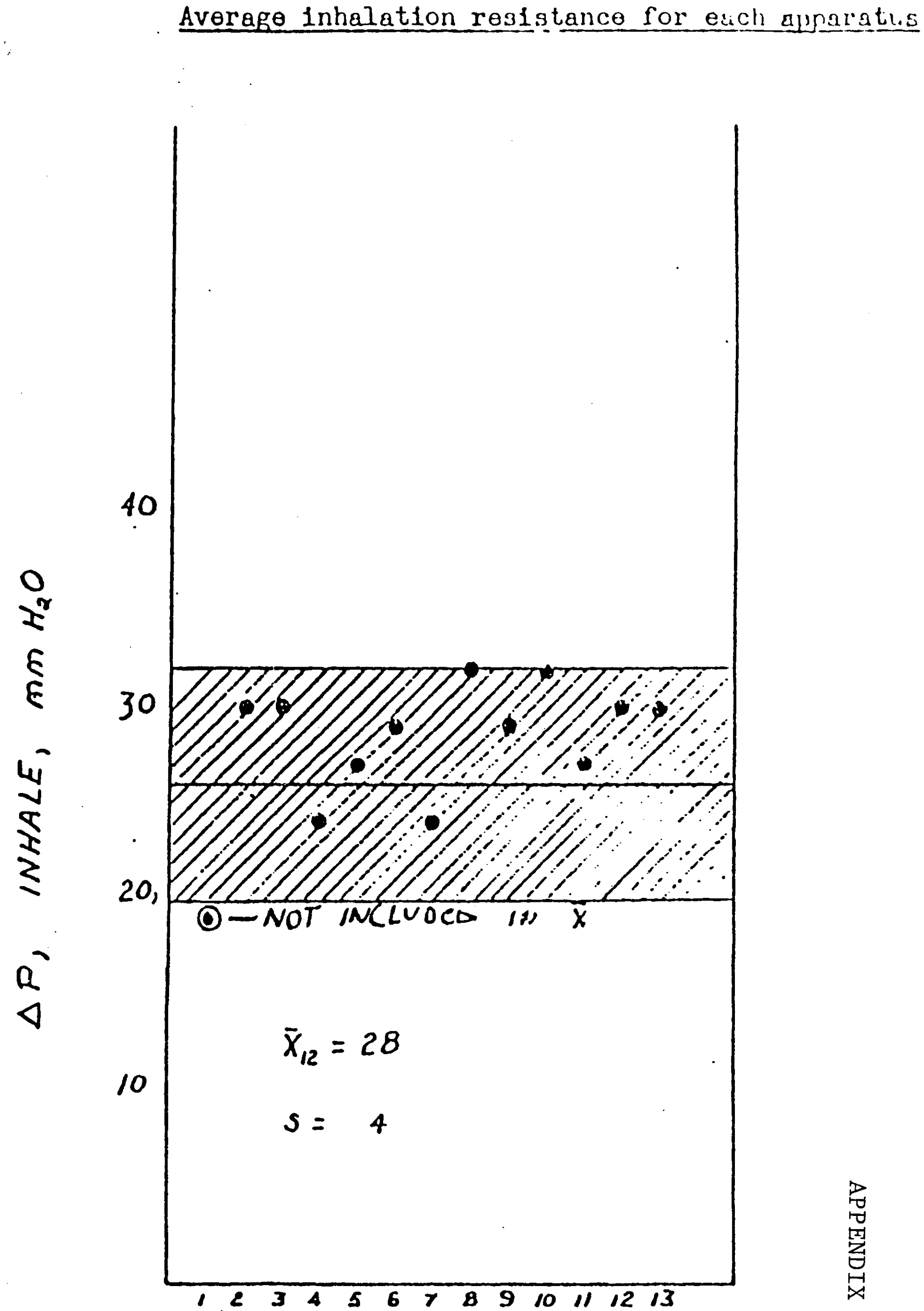


Figure 6

APPENDIX I

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Burnis L. Austin

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		2 Left		
		No. 1 Entry, Return		
1A1	Floor	0 + 00, Intake	None	95
1A2	Rib, Floor	0 + 50, Intake	None	92
1A3		Not Developed		
1A3X		Not Developed		
1A4		Not Developed		
1A5	Band	0 + 300, Return	None	90
1A6	Band	0 + 400, Return	None	52
1A6XR	No Sample	0 + 400, Gob		
1A7	Band	0 + 475, Return	None	67
1A8	Band	0 + 550, Return	None	95
1A9	2 Ribs, Floor	0 + 625, Return	None	90
1A9XR	Band	0 + 675, Return	None	90
1A10	Band	0 + 725, Return	None	99
1A11	Band	0 + 825, Return	None	89
1A12	Band	0 + 925, Return	None	82
1A12XR	Band	0 + 975, Return	None	70
1A13	Band	0 + 1050, Return	Small	62.1
1A14 - 1A40		Not Developed		
		No. 2 Entry, Belt and Track, Intake		
1B1	Floor	0 + 00, Belt, Intake	None	85
1B2	Floor	0 + 75, Belt, Intake	None	87
1B3	Floor	0 + 150, Belt, Intake	None	97
1B3XR	Floor	0 + 200, Belt and Track, Intake	None	87
1B4	Floor	0 + 250, Belt and Track, Intake	None	99
1B5	Floor	0 + 325, Belt and Track, Intake	None	91
1B6	Floor	0 + 400, Belt and Track, Intake	None	99
1B6XR	Floor	0 + 425, Belt and Track, Intake	None	75
1B7	Floor	0 + 475, Belt and Track, Intake	None	70

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1B8	Floor	0 + 550, Belt and Track, Intake	Trace	99
1B9	Floor	0 + 650, Belt and Track, Intake	None	97
1B9XR	1 Rib, Floor	0 + 725, Belt and Track, Intake	None	70
1B10	Floor	0 + 750, Belt and Track, Intake	None	92
1B11	Floor	0 + 875, Belt and Track, Intake	None	92
1B12	Floor	0 + 950, Belt and Track, Intake	None	84
1B12XR	Floor	0 + 1025, Belt and Track, Intake	None	80
1B13	Floor	0 + 1075, Belt and Track, Intake	Small	86
1B14	No Sample	0 + 1175, Belt and Track, Intake, Wet		
1B15	1 Rib, Floor	0 + 1275, Belt and Track, Intake	Trace	82
1B15XR	1 Rib, Floor	0 + 1325, Belt and Track, Intake	Small	53.3
1B16	Band	0 + 1375, Belt and Track, Intake	Small	73
1B17	Band	0 + 1475, Belt and Track, Intake	Large	62.6
1B18	1 Rib, Floor	0 + 1575, Belt and Track, Intake	Small	65
1B18XR	Band	0 + 1625, Belt and Track, Intake	Extra Large	53.6
1B19	Floor	0 + 1675, Belt and Track, Intake	Large	56
1B20	Floor	0 + 1775, Belt and Track, Intake	Large	56.3
1B21	Floor	0 + 1875, Belt and Track, Intake	Large	53
1B21XR	No Sample	0 + 1925, Belt and Track, Intake, Wet		
1B22	Band	0 + 1950, Belt and Track, Intake	Large	60.4
1B23	Band	0 + 2050, Belt and Track, Intake	Small	75
1B24	Band	0 + 2150, Belt and Track, Intake	Large	57.1
1B25	Band	0 + 2250, Belt and Track, Intake	Small	87
1B26	1 Rib, Floor	0 + 2350, Belt and Track, Intake	Small	82
1B27	Band	0 + 2450, Belt and Track, Intake	Small	75
1B27XR	1 Rib, Floor	0 + 2500, Belt and Track, Intake	Extra Large	42.8
1B28	Band	0 + 2550, Belt and Track, Intake	Large	69.7
1B29	Band	0 + 2650, Belt and Track, Intake	Extra Large	68.8
1B30	No Sample	0 + 2750, Belt and Track, Intake, Wet		
1B31	Band	0 + 2825, Belt and Track, Intake	Extra Large	66.4
1B32	Band	0 + 2925, Belt and Track, Intake	Extra Large	67.3
1B33	Band	0 + 3050, Belt and Track, Intake	Extra Large	64.4
1B33XR	Ribs, ½ Floor	0 + 3100, Belt and Track, Intake	Extra Large	60.3
1B34	Ribs	0 + 3125, Belt and Track, Intake	Extra Large	79.2
1B35	No Sample	0 + 3225, Belt and Track, Intake, Wet		

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1B36	Band	0 + 3325, Belt and Track, Intake	Extra Large	74.6
1B36XR	Ribs, ½ Floor	0 + 3375, Belt and Track, Intake	Extra Large	60.7
1B37	Ribs, Floor	0 + 3425, Intake	Extra Large	56.2
1B38	Band	0 + 3525, Intake	Extra Large	54.4
1B39	Ribs, Floor	0 + 3600, Intake	Extra Large	42.4
1B39XR	Ribs, Floor	0 + 3675, Intake	Extra Large	59.1
1B40	No Sample	0 + 3700, Intake, Wet		
		No. 3 Entry, Intake		
1C1	Band	0 + 00, Intake	None	65
1C2	Band	0 + 75, Intake	None	85
1C3	Band	0 + 150, Intake	Trace	58.8
1C3XR	No Sample	0 + 200, Intake, Gob		
1C4	Band	0 + 225, Intake	None	53.1
1C5	Band	0 + 300, Intake	Trace	50
1C6	Band	0 + 375, Intake	Trace	67
1C6XR	Band	0 + 425, Intake	Trace	70
1C7	Band	0 + 475, Intake	Trace	80
1C8	Band	0 + 550, Intake	Trace	77
1C9	Band	0 + 650, Intake	Trace	55
1C9XR	Band	0 + 700, Intake	None	77
1C10	Band	0 + 750, Intake	Trace	62.2
1C11	Band	0 + 850, Intake	Trace	63
1C12	Band	0 + 950, Intake	Trace	53.1
1C12XR	Band	0 + 1000, Intake	Trace	62.1
1C13	Band	0 + 1050, Intake	Small	50
1C14	Band	0 + 1175, Intake	Small	50
1C15	1 Rib, Floor	0 + 1275, Intake	Large	61
1C15XR	1 Rib, Floor	0 + 1275, Intake	Large	61.4
1C16	Band	0 + 1350, Intake	Small	37
1C17	Band	0 + 1450, Intake	Large	41
1C18	Band	0 + 1550, Intake	Small	46
1C18XR	Band	0 + 1575, Intake	Large	55.4

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COLLECTED BY Burnis L. Austin

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1C19	Band	0 + 1650, Intake	Large	37.3
1C20	Band	0 + 1725, Intake	Small	50
1C21	No Sample	0 + 1850, Intake, Wet		
1C21XR	No Sample	0 + 1875, Intake, Wet		
1C22	No Sample	0 + 1950, Intake, Wet		
1C23	Band	0 + 2050, Intake	Large	40.4
1C24	Band	0 + 2150, Intake	Large	42.9
1C24XR	Band	0 + 2175, Intake	Large	45.8
1C25	Band	0 + 2250, Intake	Large	52.9
1C26	Band	0 + 2350, Intake	Large	68.7
1C27	Band	0 + 2425, Intake	Large	49.3
1C27XR	Band	0 + 2450, Intake	Extra Large	57.8
1C28	Band	0 + 2525, Intake	Extra Large	55.1
1C29	Band	0 + 2625, Intake	Extra Large	60.5
1C30	Band	0 + 2725, Intake	Extra Large	48.8
1C30XR	Band	0 + 2750, Intake	Extra Large	62
1C31	Band	0 + 2825, Intake	Extra Large	48.8
1C32	Band	0 + 2925, Intake	Extra Large	68.1
1C33	Band	0 + 3025, Intake	Extra Large	46.6
1C33XR	Band	0 + 3050, Intake	Extra Large	52
1C34	Band	0 + 3125, Intake	Extra Large	55.7
1C35	Band	0 + 3200, Intake	Extra Large	44.4
1C36	Ribs, Floor	0 + 3300, Intake	Extra Large	60.2
1C36XR	Ribs, Floor	0 + 3325, Intake	Extra Large	64.1
1C37	Ribs, Floor	0 + 3450, Intake	Extra Large	53.7
1C38	Ribs, Floor	0 + 3550, Intake	Extra Large	60.9
1C39	Ribs, Floor	0 + 3600, Intake	Extra Large	61.6
1C39XR	1 Rib	0 + 3650, Intake	Extra Large	62.9
1C40	Ribs, Floor	0 + 3700, Intake	Extra Large	49.5
		No. 4 Entry, Return		
1D1	No Sample	0 + 00, Return, Wet		
1D2	No Sample	0 + 75, Return, Wet		

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Burnis L. Austin

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1D3	½ Floor	0 + 150, Return	None	85
1D4	Band	0 + 200, Return	None	87
1D5	1 Rib, ½ Floor	0 + 300, Return	None	100
1D6	Band	0 + 375, Return	None	56.2
1D7	Band	0 + 475, Return	None	85
1D8	½ Floor, 1 Rib	0 + 550, Return	None	92
1D9	1 Rib, ½ Floor	0 + 625, Return	None	85
1D10	1 Rib, Floor	0 + 725, Return	None	90
1D11	1 Rib, Floor	0 + 825, Return	Trace	85
1D12	1 Rib, ½ Floor	0 + 950, Return	Small	85
1D13	1 Rib, ½ Floor	0 + 1025, Return	Small	80
1D14	1 Rib, ½ Floor	0 + 1125, Return	Trace	86
1D15	No Sample	0 + 1250, Return, Wet		
1D16	Ribs, ½ Floor	0 + 1325, Return	Large	77.8
1D17	1 Rib, ½ Floor	0 + 1425, Return	Large	54.3
1D18	1 Rib, ½ Floor	0 + 1525, Return	Small	66.6
1D19	1 Rib, ½ Floor	0 + 1650, Return	Large	55.5
1D20	1 Rib, ½ Floor	0 + 1750, Return	Small	59.7
1D21	No Sample	0 + 1825, Return, Wet		
1D22	1 Rib, ½ Floor	0 + 1950, Return	Small	49.9
1D23	1 Rib, ½ Floor	0 + 2025, Return	Large	54.7
1D24	No Sample	0 + 2125, Return, Wet		
1D25	1 Rib, Floor	0 + 2225, Return	Extra Large	43.6
1D26	Ribs, ½ Floor	0 + 2325, Return	Small	35
1D27	1 Rib, ½ Floor	0 + 2425, Return	Small	45
1D28	1 Rib, ½ Floor	0 + 2525, Return	Large	52.2
1D29	1 Rib, ½ Floor	0 + 2625, Return	Extra Large	53.8
1D30	1 Rib, ½ Floor	0 + 2725, Return	Extra Large	61.3
1D31	Ribs, ½ Floor	0 + 2825, Return	Extra Large	69.5
1D32	Ribs, Floor	0 + 2900, Return	Extra Large	47.2
1D33	Ribs, Floor	0 + 3000, Return	Extra Large	55.3
1D34	Ribs, Floor	0 + 3100, Return	Extra Large	54.1
1D35	Ribs, Floor	0 + 3200, Return	Extra Large	67.4

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Burnis L. Austin

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
1D36	Ribs, Floor	0 + 3300, Return	Extra Large	59.5
1D37	Ribs, Floor	0 + 3400, Return	Extra Large	61.4
1D38	1 Rib, ½ Floor	0 + 3500, Return	Extra Large	59.3
1D39	Ribs, Floor	0 + 3600, Return	Extra Large	68.7
1D40	No Sample	0 + 3700, Return, Wet		

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Larry A. Coeburn

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		1 Left off Cranes Nest Mains 1		
		Number 1 Entry, Intake		
2A-1		0 + 00, Not Developed		
2A-1X		Not Developed		
2A-2		Not Developed		
2A-2X		Not Developed		
2A-3	No Sample	0 + 325, Intake		
2A-3X	Band	0 + 350	None	58.8
2A-4	No Sample	0 + 550, Intake, Wet		
2A-4X	No Sample	0 + 675, Intake, Wet		
2A-5	Band	0 + 700, Intake	None	63.6
2A-5X	Band	0 + 750, Intake	None	60.8
2A-6	Band	0 + 875, Intake	None	56.8
2A-6X	Band	0 + 1000, Intake	None	85
2A-7	Band	0 + 1050, Intake	None	75
2A-7X	No Sample	0 + 1075, Intake, Wet		
2A-8	No Sample	0 + 1125, Intake, Wet		
2A-8X	Band	0 + 1200, Intake	None	92
2A-9	Band	0 + 1250, Intake	None	59.1
2A-9X	Band	0 + 1400, Intake	None	90
2A-10	Band	0 + 1425, Intake	None	50
2A-10X	Band	0 + 1600, Intake	None	80
2A-11	Band	0 + 1625, Intake	None	67
2A-11X	Band	0 + 1800, Intake	None	95
2A-12	Band	0 + 1825, Intake	None	70
2A-12X	Band	0 + 1975, Intake	None	78
2A-13	Band	0 + 2025, Intake	None	66
2A-13X	Band	0 + 2175, Intake	None	50

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Larry A. Coeburn

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
2A-14	Band	0 + 2225, Intake	None	59.4
2A-14X	Band	0 + 2350, Intake	None	70
2A-15	Band	0 + 2425, Intake	None	65
2A-15X	Band	0 + 2550, Intake	None	74
2A-16	Band	0 + 2625, Intake	None	66
2A-16X1	Band	0 + 2675, Intake	None	57.6
2A-16X2	Band	0 + 2750, Intake	None	65
2A-17	Band	0 + 2825, Intake	None	58.2
2A-17X1	Band	0 + 2850, Intake	None	55
2A-17X2	Band	0 + 2950, Intake	None	45
2A-18	Band	0 + 3000, Intake	None	50
2A-18X1	Band	0 + 3050, Intake	None	50
2A-18X2	Band	0 + 3150, Intake	None	77
2A-19	Band	0 + 3200, Intake	None	55
2A-19X1	Band	0 + 3250, Intake	None	47
2A-19X2	Band	0 + 3350, Intake	None	65
2A-20	Band	0 + 3400, Intake	None	53
2A-20X1	No Sample	0 + 3450, Intake, Wet		
2A-20X2	Band	0 + 3550, Intake	None	45
2A-21	Band	0 + 3600, Intake	None	85
		Number 2 Entry, Intake		
2B-1	Band	0 + 0C, Intake	None	82
2B-2	Band	0 + 150, Intake	None	79
2B-2X	Band	0 + 200, Intake	None	82
2B-3	Band	0 + 300, Intake	None	100
2B-3X	Band	0 + 450, Intake	None	61.2
2B-4	Band	0 + 550, Intake	None	75
2B-4X	Band	0 + 675, Intake	None	81

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Larry A. Coeburn

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
2B-5	Band	0 + 700, Intake	None	63.5
2B-5X	Band	0 + 850, Intake	None	66.5
2B-6	No Sample	0 + 850, Intake, Wet		
2B-6X	Band	0 + 1000, Intake	None	77
2B-7	Band	0 + 1025, Intake	None	95
2B-7X		Not Developed		
2B-8	Band	0 + 1125, Intake	None	80
2B-8X	Band	0 + 1250, Intake	None	67
2B-9	Band	0 + 1275, Intake	None	53.5
2B-9X	Band	0 + 1450, Intake	None	65
2B-10	Band	0 + 1475, Intake	None	87
2B-10X	Band	0 + 1650, Intake	None	80
2B-11	Band	0 + 1700, Intake	None	83
2B-11X	Band	0 + 1825, Intake	None	70
2B-12	Band	0 + 1900, Intake	None	65
2B-12X	Band	0 + 2025, Intake	None	70
2B-13	Band	0 + 2100, Intake	None	79
2B-13X	Band	0 + 2225, Intake	None	70
2B-14	Band	0 + 2250, Intake	None	82
2B-14X	Band	0 + 2400, Intake	None	51.6
2B-15	Band	0 + 2425, Intake	None	67
2B-15X	Band	0 + 2600, Intake	None	55
2B-16	Band	0 + 2650, Intake	None	47
2B-16X1	Band	0 + 2700, Intake	None	51
2B-16X2	Band	0 + 2800, Intake	None	65
2B-17	Band	0 + 2825, Intake	None	49.6
2B-17X1	Band	0 + 2900, Intake	None	55.4
2B-17X2	Band	0 + 3000, Intake	None	50
2B-18	Band	0 + 3025, Intake	None	50.5
2B-18X1	Band	0 + 3100, Intake	None	58
2B-18X2	Band	0 + 3200, Intake	None	55

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Larry A. Coeburn

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
2B-19	Band	0 + 3225, Intake	None	57
2B-19X1	Band	0 + 3300, Intake	None	49
2B-19X2	Band	0 + 3400, Intake	None	50
2B-20	Band	0 + 3400, Intake	None	45
2B-20X1	No Sample	0 + 3500, Intake, Wet		
2B-20X2	Band	0 + 3600, Intake	Trace	40
2B-21	Band	0 + 3600, Intake	None	45
		No. 3 Entry, Belt and Track, Intake		
2C-1	Band	0 + 00, Belt and Track, Intake	None	85
2C-2	Band	0 + 150, Belt and Track, Intake	None	100
2C-2X	Band	0 + 200, Belt and Track, Intake	None	51
2C-3	Band	0 + 325, Belt and Track, Intake	None	89
2C-4	Band	0 + 450, Belt and Track, Intake	None	100
2C-4X	No Sample	0 + 525, Belt and Track, Intake, Wet		
2C-5	Band	0 + 625, Belt and Track, Intake	None	87
2C-5X	Band	0 + 675, Belt and Track, Intake	None	90
2C-6	Band	0 + 775, Belt and Track, Intake	None	95
2C-7	Band	0 + 950, Belt and Track, Intake	None	100
2C-7X	Band	0 + 1000, Belt and Track, Intake	None	89
2C-8	Band	0 + 1125, Belt and Track, Intake	None	98
2C-8X	Band	0 + 1200, Belt and Track, Intake	None	65
2C-9	Band	0 + 1325, Belt and Track, Intake	None	100
2C-10	Band	0 + 1500, Belt and Track, Intake	None	95
2C-10X	Band	0 + 1575, Belt and Track, Intake	None	78
2C-11	Band	0 + 1700, Belt and Track, Intake	None	85
2C-11X	Band	0 + 1775, Belt and Track, Intake	None	65
2C-12	Band	0 + 1900, Belt and Track, Intake	None	91
2C-13	Band	0 + 2100, Belt and Track, Intake	None	87
2C-13X	Band	0 + 2175, Belt and Track, Intake	None	70

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Larry A. Coeburn

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
2C-14	Band	0 + 2300, Belt and Track, Intake	None	82
2C-14X	Band	0 + 2375, Belt and Track, Intake	None	55.3
2C-15	Band	0 + 2500, Belt and Track, Intake	None	77
2C-15X	Band	0 + 2650, Belt and Track, Intake	None	65
2C-16	Band	0 + 2675, Belt and Track, Intake	None	92
2C-16X1	Band	0 + 2750, Belt and Track, Intake	None	75
2C-16X2	Band	0 + 2850, Belt and Track, Intake	None	85
2C-17	Band	0 + 2875, Belt and Track, Intake	None	85
2C-17X1	Band	0 + 2950, Belt and Track, Intake	None	73
2C-17X2	No Sample	0 + 3050, Belt and Track, Intake, Wet		
2C-18	Band	0 + 3075, Belt and Track, Intake	None	70
2C-18X1	Band	0 + 3150, Belt and Track, Intake	None	55
2C-18X2	Band	0 + 3225, Belt and Track, Intake	None	85
2C-19	Band	0 + 3275, Belt and Track, Intake	None	78
2C-19X1	No Sample	0 + 3325, Belt and Track, Intake, Wet		
2C-19X2	No Sample	0 + 3425, Belt and Track, Intake, Wet		
2C-20	No Sample	0 + 3450, Belt and Track, Intake, Wet		
2C-20X1	No Sample	0 + 3550, Belt and Track, Intake, Wet		
		No. 4 Entry, Return		
2D-1	Band	0 + 00, Return	None	67
2D-2	Band	0 + 150, Return	None	55
2D-3	Band	0 + 300, Return	None	61
2D-4	Band	0 + 475, Return	None	60
2D-5	Band	0 + 625, Return	None	66
2D-6	Band	0 + 775, Return	None	60
2D-7	Band	0 + 925, Return	None	67
2D-8	Band	0 + 1125, Return	None	87
2D-9	Band	0 + 1300, Return	None	65
2D-10	No Sample	0 + 1500, Return, Wet		
2D-11	Band	0 + 1725, Return	None	67.4

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Larry A. Coeburn

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
2D-12	Band	0 + 1900, Return	None	100
2D-13	Band	0 + 2100, Return	None	65.3
2D-14	Band	0 + 2275, Return	None	54.3
2D-15	No Sample	0 + 2475, Return, Wet		
2D-16	No Sample	0 + 2675, Return, Wet		
2D-17	Band	0 + 2850, Return	None	62
2D-18	No Sample	0 + 3050, Return, Wet		
2D-19	Band	0 + 3250, Return	None	90
2D-20	No Sample	0 + 3450, Return, Wet		

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Gary W. Jessee

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		Caney Mains IV		
		No. 1 Entry, Return		
3A-1	Band	0 + 00, Return	None	85
3A-1X-1	Band	0 + 50, Return	None	82
3A-1X-2	Band	0 + 125, Return	None	60
3A-2	Band	0 + 150, Return	None	89
3A-2X-1	Band	0 + 200, Return	None	59.1
3A-2X-2	Band	0 + 275, Return	None	92
3A-3	Band	0 + 325, Return	None	85
3A-3X-1	Band	0 + 350, Return	None	62
3A-3X-2	Band	0 + 425, Return	None	53
3A-3X-3	Band	0 + 525, Return	None	57
3A-4	Band	0 + 550, Return	None	82
3A-4X-1	Band	0 + 600, Return	None	59.6
3A-4X-2	Band	0 + 675, Return	None	85
3A-5	Band	0 + 725, Return	None	89
3A-5X-1	Band	0 + 750, Return	None	91
3A-5X-2	Band	0 + 825, Return	None	100
3A-6	Band	0 + 950, Return	None	97
3A-6X-1	Band	0 + 1000, Return	None	59.7
3A-6X-2	Band	0 + 1075, Return	None	55
3A-6X-3	Band	0 + 1150, Return	None	52
3A-7	Band	0 + 1175, Return	None	82
3A-7X-1	Band	0 + 1225, Return	None	60.9
3A-7X-2	Band	0 + 1300, Return	None	90
3A-8	Band	0 + 1325, Return	None	87
3A-8X-1	Band	0 + 1450, Return	None	60.9
3A-8X-2	Band	0 + 1525, Return	None	72.3

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Gary W. Jessee

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
3A-9	Band	0 + 1550, Return	None	85
3A-9X-1	Band	0 + 1650, Return	None	72.5
3A-9X-2	Band	0 + 1725, Return	None	97
3A-10	Band	0 + 1750, Return	None	72.6
3A-10X-1	Band	0 + 1800, Return	None	76.7
3A-10X-2	Band	0 + 1925, Return	None	90
3A-11	Band	0 + 1975, Return	None	90
3A-11X-1	Band	0 + 2000, Return	None	80
3A-11X-2	Band	0 + 2125, Return	None	65
3A-12	Band	0 + 2150, Return	None	97
3A-12X-1	Band	0 + 2225, Return	None	87
3A-12X-2	Band	0 + 2300, Return	None	91
		No. 2 Entry, Isolated with Belt, Intake		
3B-1	Band	0 + 00, Isolated with Belt, Intake	None	100
3B-1X-1	Band	0 + 50, Isolated with Belt, Intake	None	75
3B-2	Band	0 + 150, Isolated with Belt, Intake	None	97
3B-3	Band	0 + 325, Isolated with Belt, Intake	None	82
3B-3X-1	Band	0 + 375, Isolated with Belt, Intake	None	97
3B-4	Band	0 + 575, Isolated with Belt, Intake	None	82
3B-5	Band	0 + 750, Isolated with Belt, Intake	None	100
3B-6	Band	0 + 950, Isolated with Belt, Intake	None	99
3B-6X-1	Band	0 + 1000, Isolated with Belt, Intake	None	96
3B-7	Band	0 + 1200, Isolated with Belt, Intake	None	67
3B-8	Band	0 + 1350, Isolated with Belt, Intake	None	85
3B-9	Band	0 + 1575, Isolated with Belt, Intake	None	80
3B-9X-1	Band	0 + 1600, Isolated with Belt, Intake	None	85
3B-10	Band	0 + 1750, Isolated with Belt, Intake	None	80
3B-11	Band	0 + 2000, Isolated with Belt, Intake	None	77
3B-12	Band	0 + 2200, Return	None	58.4
3B-12X-1	Band	0 + 2275, Return	None	72

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Gary W. Jessee

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		No. 3 Entry, Belt, Intake		
3C-1	Band	0 + 00, Belt, Intake	None	100
3C-1X-1	Band	0 + 50, Belt, Intake	None	89
3C-2	Band	0 + 150, Belt, Intake	None	87
3C-3	Band	0 + 325, Belt, Intake	None	95
3C-3X-1	Band	0 + 375, Belt, Intake	None	100
3C-4	Band	0 + 575, Belt, Intake	None	100
3C-5	Band	0 + 750, Belt, Intake	None	97
3C-6	Band	0 + 950, Belt, Intake	None	80
3C-6X-1	Band	0 + 1000, Belt, Intake	None	100
3C-7	Band	0 + 1200, Belt, Intake	None	100
3C-8	Band	0 + 1350, Belt, Intake	None	97
3C-9	Band	0 + 1550, Belt, Intake	None	87
3C-9X-1	Band	0 + 1625, Belt, Intake	None	82
3C-10	Band	0 + 1750, Belt, Intake	None	97
3C-11	Band	0 + 1975, Belt, Intake	None	70
3C-12	Band	0 + 2175, Isolated with Belt, Intake	None	87
3C-12X	Band	0 + 2225, Isolated with Belt, Intake	None	83
		No. 4 Entry, Intake		
3D-1	Band	0 + 00, Intake	None	92
3D-1X-1	Band	0 + 50, Intake	None	92
3D-2	Band	0 + 175, Intake	None	70
3D-3	Band	0 + 325, Intake	None	69
3D-3X-1	Band	0 + 375, Intake	None	83
3D-4	Band	0 + 575, Track, Intake	None	100
3D-5	Band	0 + 750, Track, Intake	None	100
3D-6	Band	0 + 950, Track, Intake	None	96
3D-6X-1	Band	0 + 1000, Track, Intake	None	50
3D-7	Band	0 + 1200, Track, Intake	None	100
3D-8	Band	0 + 1375, Track, Intake	None	77
3D-9	Band	0 + 1575, Track, Intake	None	72

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Gary W. Jessee

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
3D-9X-1		Not Developed		
3D-10	Band	0 + 1750, Track, Intake	None	96
3D-11	Band	0 + 2000, Track, Intake	None	100
3D-12	Band	0 + 2200, Isolated with Belt, Intake	None	80
3D-12X-1	Band	0 + 2225, Isolated with Belt, Intake	None	76
		No. 5 Entry, Intake		
3E-1	Band	0 + 00, Track, Intake	None	89
3E-2	Band	0 + 150, Track, Intake	None	98
3E-3	Band	0 + 325, Track, Intake	None	87
3E-4		Not Developed		
3E-5	No Sample	0 + 725, Intake, Wet		
3E-6	Band	0 + 925, Intake	None	57.3
3E-7	No Sample	0 + 1150, Intake, Wet		
3E-8		Not Developed		
3E-9		Not Developed		
3E-10		Not Developed		
3E-11		Not Developed		
3E-12		Not Developed		

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		1 Right off Caney Mains IV (Bleeder Entries)		
		No. 1 Entry, Return		
4A-1	Band	0 + 00, Return	None	76.5
4A-1X	Band	0 + 50, Isolated with Belt, Intake	None	50
4A-2	Band	0 + 75, Return	None	85
4A-2X	Band	0 + 125, Isolated with Belt, Intake	None	72.6
4A-3	Band	0 + 175, Return	None	85
4A-3X	Band	0 + 250, Isolated with Belt, Intake	None	60
4A-4	Band	0 + 275, Return	None	67
4A-4X	No Sample	0 + 300, Isolated with Belt, Intake, Gob		
4A-5	Band	0 + 350, Return	None	62
4A-5X	Band	0 + 400, Isolated with Belt, Intake	None	50
4A-6	Band	0 + 450, Return	None	99
4A-6X	No Sample	0 + 500, Isolated with Belt, Intake, Cribs		
4A-7	Band	0 + 550, Return	None	47
4A-8	Band	0 + 650, Return	None	90
4A-8X	Band	0 + 675, Isolated with Belt, Intake	None	50
4A-9	Band	0 + 750, Return	None	52
4A-9X	Band	0 + 775, Isolated with Belt, Intake	None	95
		No. 2 Entry, Isolated with Belt, Intake		
4B-1	Band	0 + 00, Isolated with Belt, Intake	None	70
4B-2	Band	0 + 100, Isolated with Belt, Intake	None	56.8
4B-2X	Band	0 + 150, Isolated with Belt, Intake	None	47
4B-3	Band	0 + 225, Isolated with Belt, Intake	None	60
4B-4	Band	0 + 325, Isolated with Belt, Intake	None	58
4B-5	Band	0 + 400, Isolated with Belt, Intake	None	45
4B-5X	Band	0 + 425, Isolated with Belt, Intake	None	40

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
4B-6	Band	0 + 475, Isolated with Belt, Intake	None	47
4B-6X	Band	0 + 525, Isolated with Belt, Intake	None	70
4B-7	Band	0 + 575, Isolated with Belt, Intake	None	54
4B-8	Band	0 + 675, Isolated with Belt, Intake	None	80
4B-8X	Band	0 + 750, Isolated with Belt, Intake	None	72
4B-9	Band	0 + 775, Isolated with Belt, Intake	None	65
4B-10	Band	0 + 875, Isolated with Belt, Intake	None	56.5
4B-11	Band	0 + 925, Isolated with Belt, Intake	None	55.6
4B-12	Band	0 + 1025, Isolated with Belt, Intake	None	47
4B-13	Band	0 + 1125, Isolated with Belt, Intake	None	67
		No. 3 Entry, Belt		
4C-1	Band	0 + 00, Belt, Intake	None	57.9
4C-2	Band	0 + 100, Belt, Intake	None	75
4C-2X	Band	0 + 150, Intake	None	62.3
4C-3	Band	0 + 200, Belt, Intake	None	55.4
4C-4	Band	0 + 300, Belt, Intake	None	47
4C-5	Band	0 + 375, Belt, Intake	None	40
4C-6	Band	0 + 450, Belt, Intake	None	47
4C-6X	Band	0 + 500, Intake	None	48
4C-7	Band	0 + 525, Belt, Intake	None	52
4C-8	Band	0 + 650, Belt, Intake	None	38
4C-9	Band	0 + 750, Belt, Intake	None	69
4C-10	Band	0 + 850, Belt, Intake	None	61.1
4C-10X	Band	0 + 875, Intake	None	62
4C-11	Band	0 + 925, Belt, Intake	None	67
4C-12	Band	0 + 1025, Belt, Intake	None	67
4C-13	Band	0 + 1125, Belt, Intake	None	49
4C-14	Band	0 + 1175, Belt, Intake	None	50

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		No. 4 Entry, Track		
4D-1	Band	0 + 00, Intake	None	52
4D-2	Band	0 + 100, Intake	None	58.9
4D-3	Band	0 + 200, Intake	None	78
4D-4	Band	0 + 300, Intake	Trace	55.6
4D-5	Band	0 + 375, Intake	Small	67
4D-6	Band	0 + 450, Intake	Trace	47.2
4D-7	Band	0 + 525, Intake	Small	50
4D-8	Band	0 + 650, Intake	Trace	50.4
4D-9	Band	0 + 725, Intake	None	48.5
4D-10	Band	0 + 825, Intake	None	75
4D-11	Band	0 + 925, Intake	None	70
4D-12	Band	0 + 1025, Intake	None	51.4
4D-13	Band	0 + 1100, Intake	None	83

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ____ - ANALYSES OF DUST SAMPLES COLLECTED June 28, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		Setup Entries		
		No. 1 Entry, Intake		
5A-1	Band	0 + 00, Intake	None	46
5A-2	Band	0 + 100, Intake	None	38
5A-3	Band	0 + 175, Intake	Trace	40
5A-4	Band	0 + 250, Intake	Small	36
5A-5	Band	0 + 325, Intake	Large	49
5A-6	Band	0 + 425, Intake	Large	47
5A-7	Band	0 + 525, Intake	Extra Large	56.3
5A-8	Band	0 + 625, Intake	Extra Large	54.5
5A-9	Band	0 + 725, Intake	Extra Large	42.7
5A-10	No Sample	0 + 825		
		No. 2 Entry, Intake		
5B-1	Band	0 + 00, Intake	Trace	44.3
5B-1X	Band	0 + 50, Intake	Trace	70
5B-2	Band	0 + 100, Intake	Trace	43
5B-2X	Band	0 + 125, Intake	Trace	52
5B-3	Band	0 + 175, Intake	Small	43
5B-3X	Band	0 + 225, Intake	Trace	52.4
5B-4	Band	0 + 250, Intake	Small	44
5B-4X	Band	0 + 300, Intake	Large	36.4
5B-5	Band	0 + 350, Intake	Large	37
5B-5X	Band	0 + 400, Intake	Extra Large	47
5B-6	Band	0 + 425, Intake	Extra Large	41.8
5B-6X	Band	0 + 500, Intake	Extra Large	55
5B-7	Band	0 + 525, Intake	Extra Large	51.6

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 28, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
5B-7X	Band	0 + 600, Intake	Extra Large	76.4
5B-8	Band	0 + 625, Intake	Extra Large	57.9
5B-8X	Band	0 + 700, Intake	Extra Large	65
5B-9	Band	0 + 725, Intake	Extra Large	48.9
5B-9X	Band	0 + 800, Intake	Extra Large	50.1
		No. 3 Entry, Return		
5C-1	Band	0 + 00, Intake	Trace	66
5C-1X	Band	0 + 75, Intake	Extra Large	35.7
5C-2	Band	0 + 100, Intake	Trace	53
5C-2X	Band	0 + 150, Intake	None	46
5C-3	Band	0 + 175, Belt and Track, Intake	None	40
5C-4	Band	0 + 250, Return	None	39
5C-4X	Band	0 + 300, Return	Trace	54
5C-5	Band	0 + 350, Return	Large	46.6
5C-5X	Band	0 + 400, Return	Extra Large	38
5C-6	Band	0 + 450, Return	Extra Large	61.4
5C-7	Band	0 + 550, Return	Extra Large	51.6
5C-7X	Band	0 + 600, Return	Extra Large	71.7
5C-8	Band	0 + 625, Return	Extra Large	58
5C-9	Band	0 + 725, Return	Extra Large	49.5
5C-10	Band	0 + 800, Return	Extra Large	44.2

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card, Gary W. Jessee, Douglas Evans

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		Cranes Nest 1		
		No. 1 Entry, Intake		
6A-1	No Sample	0 + 00, Intake, Wet		
6A-2	No Sample	0 + 75, Intake, Wet		
6A-3	Band	0 + 175, Intake	None	72
6A-3X	No Sample	0 + 200, Intake, Gob		
6A-4	Band	0 + 250, Intake	None	80
6A-5	Band	0 + 325, Intake	None	91
6A-6	Band	0 + 400, Intake	None	92
6A-6X	No Sample	0 + 450, Overcast		
6A-7	Band	0 + 475, Intake	None	70
6A-8	Band	0 + 555, Intake	None	57.3
6A-9	Band	0 + 625, Intake	None	60.2
6A-9X	No Sample	0 + 675, Intake, Gob		
6A-10	Band	0 + 700, Intake	None	55
6A-11	Band	0 + 775, Intake	None	42
6A-12	No Sample	0 + 875, Intake, Wet		
6A-13	Band	0 + 975, Intake	None	65
6A-14	Band	0 + 1050, Intake	None	81.7
6A-15	Band	0 + 1125, Intake	None	71
6A-15X	No Sample	0 + 1150, Overcast		
6A-16	Band	0 + 1200, Intake	None	77
6A-17	Band	0 + 1275, Intake	None	80
6A-18	Band	0 + 1350, Intake	None	72
6A-18X	No Sample	0 + 1400, Intake, Gob		
6A-19	Band	0 + 1450, Intake	None	65
6A-20	Band	0 + 1525, Intake	None	67

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card, Gary W. Jessee, Douglas Evans

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		No. 2 Entry, Intake		
6B-1	No Sample	0 + 00, Intake, Wet		
6B-2	Band	0 + 100, Intake	None	72
6B-3	No Sample	0 + 175, Intake, Wet		
6B-3X	No Sample	0 + 200, Intake, Wet		
6B-4	No Sample	0 + 250, Intake, Wet		
6B-5	No Sample	0 + 325, Intake, Wet		
6B-6	Band	0 + 400, Intake	None	67
6B-6X	No Sample	0 + 450, Intake, Gob		
6B-7	Band	0 + 500, Intake	None	53.9
6B-8	Band	0 + 575, Intake	None	47.2
6B-9	Band	0 + 650, Intake	None	45
6B-10	Band	0 + 725, Intake	None	52
6B-11	Band	0 + 800, Intake	None	47
6B-12	No Sample	0 + 875, Intake, Wet		
6B-13	No Sample	0 + 975, Intake, Wet		
6B-14	No Sample	0 + 1050, Intake, Wet		
6B-15	Band	0 + 1125, Intake	None	100
6B-15X	Band	0 + 1175, Return	None	90
6B-16	Band	0 + 1200, Intake	None	90
6B-17	Band	0 + 1300, Intake	None	99
6B-18	Band	0 + 1375, Intake	None	100
6B-18X	Band	0 + 1400, Intake	None	67
6B-19	Band	0 + 1450, Intake	None	85
		No. 3 Entry, Belt and Track, Intake		
6C-1	Band	0 + 00, Track, Intake	None	90
6C-2	Band	0 + 100, Belt and Track, Intake	None	80.6
6C-3	Band	0 + 150, Belt and Track, Intake	None	100
6C-3X-1	Band	0 + 200, Belt and Track, Intake	None	70
6C-4	Band	0 + 225, Belt and Track, Intake	None	92

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card, Gary W. Jessee, Douglas Evans

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
6C-5	Band	0 + 325, Belt and Track, Intake	None	95
6C-6	No Sample	0 + 400, Belt and Track, Intake, Wet		
6C-6X	No Sample	0 + 450, Overcast		
6C-7	Band	0 + 475, Belt and Track, Intake	None	72
6C-8	Band	0 + 555, Belt and Track, Intake	None	65
6C-9	Band	0 + 625, Belt and Track, Intake	None	97
6C-9X	No Sample	0 + 675, Belt and Track, Intake, Gob		
6C-10	Band	0 + 700, Belt and Track, Intake	None	96
6C-11	No Sample	0 + 775, Intake, Wet		
6C-12	No Sample	0 + 875, Belt and Track, Intake, Wet		
6C-12X-1	No Sample	0 + 925, Belt and Track, Intake, Wet		
6C-13	Band	0 + 950, Belt and Track, Intake	None	91
6C-14	No Sample	0 + 1075, Track, Intake, Wet		
6C-15	Band	0 + 1100, Track, Intake	None	95
6C-15X-1	No Sample	0 + 1175, Return, Wet		
6C-16	No Sample	0 + 1200, Intake, Gob		
6C-17	No Sample	0 + 1275, Intake, Gob		
		No. 4 Entry, Isolated with Belt and Track, Intake		
6D-1	No Sample	0 + 00, Isolated with Belt and Track, Intake, Wet		
6D-2	Band	0 + 100, Isolated with Belt and Track, Intake	None	95
6D-3	Band	0 + 150, Isolated with Belt and Track, Intake	None	86
6D-3X	Band	0 + 200, Isolated with Belt and Track, Intake	None	90
6D-4	Band	0 + 225, Isolated with Belt and Track, Intake	None	98
6D-5	Band	0 + 300, Isolated with Belt and Track, Intake	None	80
6D-6	No Samples	0 + 400, Isolated with Belt and Track, Intake, Wet		
6D-6X	No Sample	0 + 450, Isolated with Belt and Track, Intake, Wet		
6D-7	No Sample	0 + 475, Isolated with Belt and Track, Intake, Wet		

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE____ - ANALYSES OF DUST SAMPLES COLLECTED June 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card, Gary W. Jessee, Douglas Evans

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
6D-8	No Sample	0 + 550, Isolated with Belt and Track, Intake, Wet		
6D-9	No Sample	0 + 625, Isolated with Belt and Track, Intake, Wet		
6D-9X	No Sample	0 + 675, Isolated with Belt and Track, Intake, Wet		
6D-10	No Sample	0 + 700, Isolated with Belt and Track, Intake, Wet		
6D-11	No Sample	0 + 775, Isolated with Belt and Track, Intake, Wet		
6D-12	No Sample	0 + 875, Isolated with Belt and Track, Intake, Wet		
6D-12X	No Sample	0 + 925, Isolated with Belt and Track, Intake, Wet		
6D-13	No Sample	0 + 975, Isolated with Belt and Track, Intake, Wet		
6D-14	No Sample	0 + 1050, Isolated with Belt and Track, Intake, Wet		
6D-15	No Sample	0 + 1125, Isolated with Belt and Track, Intake, Wet		
6D-15X	No Sample	0 + 1175, Return, Wet		
6D-16	No Sample	0 + 1200, Intake, Wet		
6D-17	No Sample	0 + 1275, Intake, Wet		
6D-18	No Sample	0 + 1375, Intake, Wet		
6D-18X	No Sample	0 + 1410, Intake, Wet		
6D-19	No Sample	0 + 1450, Intake, Wet		
		No. 5 Entry, Return		
6E-1	Band	0 + 00, Return	None	80
6E-2	Band	0 + 100, Return	None	68.8

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Kenneth Card, Gary W. Jessee, Douglas Evans

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
6E-3	Band	0 + 175, Return	None	70
6E-4	Band	0 + 250, Return	None	50
6E-5	No Sample	0 + 325, Return, Wet		
6E-6	No Sample	0 + 400, Return, Wet		
6E-7	No Sample	0 + 500, Return, Wet		
6E-8	No Sample	0 + 575, Return, Wet		
6E-9	No Sample	0 + 650, Return, Wet		
6E-10	No Sample	0 + 725, Return, Wet		
6E-11	No Sample	0 + 800, Return, Wet		
6E-12	No Sample	0 + 875, Return, Wet		
6E-13	No Sample	0 + 975, Return, Wet		
6E-14	Band	0 + 1050, Return	None	69
6E-15	Band	0 + 1125, Return	None	65.1
6E-16	Band	0 + 1200, Return	None	65.9
6E-17	Band	0 + 1275, Return	None	60.9
6E-18	Band	0 + 1375, Return	None	55
6E-19	Band	0 + 1400, Return	None	55

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 28, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Gary W. Jessee

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		Caney Mains IV		
1	Band	Spot Sample 20 feet outby Survey Station 1669, Intake	None	90

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE_____ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Burnis L. Austin

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		2 Left		
No. 1	Band	Spot sample 150 feet Right of Survey Station No. 1924, Return	None	82
No. 2	Band	Spot sample 150 feet Right of Survey Station No. 1859, Return	None	96

UNITED STATES DEPARTMENT OF LABOR
MSHA LABORATORIES - MOUNT HOPE, WEST VIRGINIA

TABLE ___ - ANALYSES OF DUST SAMPLES COLLECTED June 27, 28, and 29, 1983

MINE McClure No. 1 COMPANY Clinchfield Coal Company

COLLECTED BY Larry A. Coeburn

CAN NUMBER	SAMPLE OF DUST FROM	LOCATION IN MINE	ALCOHOL COKE TEST	PERCENT INCOMBUSTIBLE
		EXPLOSION INVESTIGATION		
		Cross Entries		
No. 1	Band	Spot Sample 10 feet inby Survey Station No. 1660 in No. 3 Entry, Intake	None	72
No. 2	Band	Spot Sample 30 feet inby Survey Station No. 1659 in No. 2 Entry, Intake	None	57
No. 3	Band	Spot Sample 100 feet inby Survey Station No. 1661 in No. 1 Entry, Intake	None	70

APPENDIX J

U. S. Department of Labor

Mine Safety and Health Administration
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213
Bruceton Safety Technology Center

August 2, 1983

MEMORANDUM FOR: ROBERT A. ELAM
Mining Engineer
Coal Mine Safety and Health

THROUGH : JOHN A. McCORMICK
Chief, Bruceton Safety Technology Center

for KELVIN K. WU S. J. Luzik
Acting Chief, Industrial Safety Division

FROM : STEVEN J. LUZIK S. J. Luzik
Supervisory Chemical Engineer

SUBJECT : Proximate analysis test results on coal and coke dust samples

As per your request, proximate analysis tests were performed on the 12 coal and coke dust samples taken at the McClure No. 1 Mine, I.D. #44-04251, McClure, Virginia. Test procedures were in accordance with the American Society for Testing and Materials (ASTM) Standard Test Method for Proximate Analysis of Coal and Coke (ASTM D3172-73).

Laboratory test results are attached. Unusually high volatile matter contents observed in Samples ISB 255 and 256 may have been due to the presence of high volatile impurities in the samples such as greases or hydraulic fluids.

A high ash content was observed in the channel samples that were analyzed. This was due to the high rock content of the seam sampled. An additional analysis was performed on small samples of pure coal to get a better idea of the properties of the uncontaminated seam. These values are reported and display a marked reduction in ash as would be expected.

I hope this information is beneficial to you. If I can be of further assistance, please call.

Attachment

UNITED STATES DEPARTMENT OF LABOR
Mine Safety and Health Administration

BRUCETON SAFETY TECHNOLOGY CENTER
Industrial Safety Division

LABORATORY REPORT OF MATERIAL(S) SUBMITTED FOR TESTING

Sample Number: ISB 248-257

Material: Coke

Manufacturer: (or where sample was taken)
Clinchfield Coal Company
McClure No. 1 Mine
McClure, Virginia ID #44-04251

Submitted By:
Robert A. Elam, Mining Engineer
Coal Mine Safety and Health
Ballston Towers #3
Arlington, VA 22203

Description:

Lab No.	Sampling Location
ISB 248	Taken from Right Rib, 30-feet inby, #2465 Deposited on inby faces 15-feet outby dinner hole
ISB 249	Taken from Right Rib, first sign of coke just inby Crosscut 32
ISB 250	Taken on Right corner rib (C-37), 91-feet inby, #2469, 13-feet ROC
ISB 251	GMF 4, coked dust from right outby corner adjacent to SS #2503; 6/30/83; 11:00 a.m.
ISB 252	Coking off timbers and crossbars at SS #2289, set-up entries; 6/25/83; 10:50 a.m.
ISB 253	Dust taken from outby end of supply car, 18-feet outby; #2469
ISB 254	GMF 1, from left inby headlight and reflector on railrunner from 2 south; 6/25/83; 8:52 a.m.
ISB 255	GMF 2, from inby bumper and canopy on railrunner from 2 left; 6/25/83; 8:53 a.m.
ISB 256	GMF 3; from outby bumper of railrunner from 2 left; 6/25/83; 9:00 a.m.
ISB 257	1 MLJ, coke sample 2 left power center; 7/1/83; 12:15 p.m.

ISB Sample No.: 248-257
Date: 8/2/83

Laboratory Tests: PROXIMATE ANALYSIS AS PER ASTM D3172-73

Sample Number	Sample Mass (g)	% Moisture	% Ash	% Volatile Matter	% Fixed Carbon
ISB 248	35.4	1.40	35.10	17.65	45.85
ISB 249	19.1	0.90	35.55	21.85	41.70
ISB 250	41.0	1.05	28.90	20.20	49.85
ISB 251	63.7	1.60	36.65	16.55	45.20
ISB 252	10.6	1.55	35.45	19.45	43.55
ISB 253	59.5	2.75	45.05	27.35	24.85
ISB 254	20.5	0.00	50.25	28.70	21.05
ISB 255	6.0	0.00	51.40	40.05	8.55
ISB 256	14.5	0.25	45.50	38.85	15.40
ISB 257	79.7	1.15	32.15	15.15	51.55

Test Performed by: Steven J. Luzik, Supv. Chemical Engineer
Thomas M. Fircak, Electronics Technician
Anthony Sendek, Mining Engineer

Comments: High volatile matter in ISB 255 and 256 maybe indicative of contamination by hydraulic fluids, greases, or other volatile materials.

Report Prepared by: Steven J. Luzik, Supv. Chemical Engineer

cc: J. A. McCormick
K. K. Wu
S. J. Luzik
Lab Files (2)
ISB Files

UNITED STATES DEPARTMENT OF LABOR
Mine Safety and Health Administration

BRUCETON SAFETY TECHNOLOGY CENTER
Industrial Safety Division

LABORATORY REPORT OF MATERIAL(S) SUBMITTED FOR TESTING

Sample Number: ISB 259 and 260

Material: Coal

Manufacturer: (or where sample was taken) Clinchfield Coal Company
McClure No. 1 Mine
McClure, Virginia ID #44-04251

Submitted By: Robert A. Elam, Mining Engineer
Coal Mine Safety and Health
Ballston Towers #3
Arlington, VA 22203

Description: ISB 259 - Channel sample taken at the McClure No. 1 Mine at Survey Station 2505, right rib; No. 1 Sample; 7/14/83

ISB 260 - Channel sample taken at the McClure No. 1 Mine, 2 left section, No. 1 entry on the longwall face, 25 feet to the left of Survey Station 2503; No. 2 Sample; 7/14/83

ISB 259 (seam composition)

Shale Top

3.5" coal
4.5" rock with coal streaks
8.5" coal with rock streaks
28.5" coal
12.0" bony coal
14.0" coal (with rash streak)
25.5" coal
0.5" rock (sandy shale)
1.0" shale
3.0" coal

Shale bottom

ISB 260 (seam composition)

Shale Top

7.0" rock with coal streaks
4.5" coal with pyrite streaks
5.75" rock with coal streaks
5.0" coal with pyrite streaks
52.5" coal
4.0" coal and rock
9.0" coal
0.75" shale
3.0" coal
0.5" rock
1.0" coal

Shale bottom

Collectors: John Godsey, MSHA
John Wample, MSHA
Grover Meade, Clinchfield Coal Co.

ISB Sample No.: 259-26(
Date: 8/3/83

Laboratory Tests: PROXIMATE ANALYSIS AS PER ASTM D3172-73

	Sample Number	Type of Sample	% Moisture	% Ash	% Volatile Matter	% Fixed Carbon
VR = .42	ISB 259	Representative of entire seam	0.25	40.38	24.80	34.52
	ISB 259	Strictly coal	0.00	10.84	26.30	62.86
VR = .32	ISB 260	Representative of entire seam	0.25	33.60	21.01	45.14
Ave VR = .37	ISB 260	Strictly coal	0.00	8.53	30.47	61.00

Tests Performed by: Anthony Sendek, Mining Engineer
Thomas M. Fircak, Electronics Technician

Comments: Channel sample contained a high percentage of rock and other inert materials resulting in a high ash content. A second analysis was conducted on small samples of pure coal chunks taken from a portion of the overall sample. This analysis showed a marked decrease in ash content, as expected.

Report Prepared by: Steven J. Luzik, Supv. Chemical Engineer

cc: J. A. McCormick
K. K. Wu
S. J. Luzik
Lab Files (2)
ISD Files

APPENDIX K

APPENDIX K

Summary of Mine Air Samples Collected During the Investigation

Date	Location	Air Quantity	CO_2	O_2	CH_4	CH_4/24 Hrs.
6/22/83	Caney I - Immediate Return	42,739	----------Broken in Transit----------			
6/22/83	Caney IV - Last Open Crosscut	16,150	0.05	20.76	0.75	174,000
6/22/83	Caney IV - Immediate Return	29,160	0.05	20.82	0.49	206,000
6/22/83	Cranesnest III - Split Return	46,945	0.04	20.81	0.45	304,000
6/22/83	Cranesnest III - Inby Return Overcast	48,433	0.04	20.80	0.45	314,000
6/22/83	Cranesnest III - Return Regulator	59,724	0.04	20.75	0.29	249,000
6/22/83	Intake From 1 Left to 2 Left	17,622	0.04	20.90	0.04	10,000
6/22/83	2 Left - Return	13,072	0.06	20.82	0.42	79,000
6/22/83	2 Left - Between Return Overcasts	37,080	0.05	20.80	0.38	203,000
6/22/83	2 Left - No. 1 Entry Return	46,240	0.05	20.84	0.39	260,000
6/22/83	Cranesnest III - No. 3 Face	4,631	0.04	20.83	0.32	21,000
6/22/83	Cranesnest III - Immediate Return	47,493	0.04	20.84	0.30	205,000
6/22/83	Cranesnest II - Immediate Return	33,280	0.04	20.83	0.41	196,000
6/22/83	Cranesnest II - Immediate Return	33,280	0.04	20.83	0.42	201,000
6/22/83	Cranesnest II - Intake Air	29,516	0.04	20.88	0.20	85,000
6/24/83	Cranesnest II - Last Open Crosscut	45,600	0.05	20.84	0.38	250,000
6/30/83	2 Left - No. 1 Entry	11,025	0.05	20.67	0.72	114,000
6/30/83	2 Left - No. 2 Entry	8,271	0.05	20.67	0.41	49,000

6/30/83	1 Left - Inby Regulator	170,300	0.06	20.76	0.25	613,000
6/30/83	Caney IV - Inby Regulator	62,856	0.04	20.77	0.23	208,000
6/30/83	Fan Shaft - No. 3 Entry	290,700	0.04	20.73	0.26	1,088,000
6/30/83	Fan Shaft - No. 3 entry	195,000	0.04	20.80	0.38	1,067,000
6/30/83	Fan Shaft - No. 5 Entry	199,103	0.05	20.66	0.53	1,520,000
6/30/83	Caney I - No. 1 Entry	54,760	0.05	20.62	0.55	434,000
7/3/83	Cranesnest III - Outby Feeder No. 2 Entry		0.05	20.90	0.07	
7/9/83	Main Return - Check Point 1	269,280	0.04	20.83	0.15	582,000
7/9/83	Main Return - Check Point 2	273,280	0.04	20.85	0.12	472,000
7/9/83	Main Return - Check Point 3	236,160	0.04	20.84	0.33	1,122,000
7/18/83	007 Section - 100' Outby Face #4	21,476	0.06	20.86	0.26	80,000
7/18/83	Cranesnest I - Regulator	26,565	0.06	20.85	0.30	115,000
7/18/83	2 Left - Regulator	57,460	0.05	20.87	0.26	215,000
7/18/83	2 Left @ CNI Return	46,237	0.05	20.79	0.32	213,000
7/18/83	2 Left - 60' Outby 2503	22,942	0.04	20.90	0.09	30,000
7/18/83	2 Left - No. 2 M.E. Face	8,379	0.04	20.89	0.13	16,000
7/18/83	2 Left - No. 3 M.E. Face	11,016	0.04	20.88	0.20	32,000
7/18/83	1 Left - Longwall Stop Point	38,646	0.06	20.86	0.29	161,000
7/18/83	3 Left - Return	20,400	0.04	20.89	0.17	50,000
7/18/83	Cranesnest 3 - Immediate Return	41,756	0.05	20.87	0.22	132,000
7/18/83	Cranesnest 2 - Immediate Return	40,620	0.04	20.86	0.06	35,000

7/18/83	Cranesnest 2 - No. 1 Entry - Intake	13,572	0.04	20.78	0.30	59,000
7/18/83	Cranesnest 2 - Return	67,262	0.05	20.86	0.30	291,000
7/18/83	Cranesnest 2 - Main Return	70,125	0.04	20.86	0.28	283,000
7/18/83	Shop Mains Return - Overcast Nos. 1 & 2	26,061	0.04	20.92	0.03	11,000
7/18/83	Shop Mains Return - Overcast Nos. 3 & 4	55,304	0.03	20.91	0.08	64,000
7/18/83	Caney I - Regulator	117,648	0.04	20.77	0.49	830,000
7/18/83	Caney I - Immediate Return	56,925	0.04	20.71	0.56	459,000
7/18/83	Cranesnest III - Regulator	45,711	0.06	20.86	0.28	184,000
7/18/83	Caney IV - Immediate Return	40,848	0.05	20.82	0.20	118,000
7/19/83	Bottom Air Shaft - Return-Caney I Side	114,930	0.06	20.82	0.47	778,000
7/19/83	Main Fan - Shop Mains Side	109,824	----------Broken in Transit----------			
7/19/83	Main Fan - Caney I Return	158,920	0.03	20.91	0.06	137,000
7/19/83	Caney III - Return Inby Regulator	32,670	0.05	20.87	0.06	28,000
7/19/83	1 Left - Return Regulator	29,160	0.05	20.79	0.40	168,000
7/19/83	Caney IV - Split Return - 20' Inby #1314	64,800	0.05	20.88	0.21	196,000
7/19/83	Caney IV - Total Return	89,063	0.04	20.85	0.20	257,000
7/20/83	2 Left - Left Return	34,144	0.06	20.89	0.12	59,000
7/20/83	2 Left - Right Return Overcast	46,620	0.05	20.82	0.29	195,000
7/28/83	Return Fan - Checkpoint 1	315,057	0.06	20.84	0.15	681,000
7/28/83	Return Fan - Checkpoint 2	242,368	0.06	20.83	0.42	1,466,000
7/28/83	Return Fan - Checkpoint 3	241,374	0.05	20.87	0.24	834,000

8/3/83	Return Fan - Checkpoint 1	188,863	0.04	20.87	0.15	408,000
8/3/83	Return Fan - Checkpoint 2	168,224	0.04	20.88	0.21	509,000
8/3/83	Return Fan - Checkpoint 3	165,216	0.04	20.86	0.15	357,000
8/3/83	Return Fan - Checkpoint 4	115,400	0.04	20.86	0.30	499,000

APPENDIX L

APPENDIX L

U. S. Department of Labor

Mine Safety and Health Administration
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213
Pittsburgh Health Technology Center
Ventilation Division

October 19, 1983

MEMORANDUM FOR: ROBERT A. ELAM
Mining Engineer, CMS&H, Arlington

FROM: JAMES L. BANFIELD, JR.
Chief, Ventilation Division

SUBJECT: Final report of ventilation survey at McClure No. 1 Mine

Enclosed is a copy of the final report on the ventilation survey conducted at the McClure No. 1 Mine on July 11 - 16, 1983. If you have questions or comments please contact my office.

Attachments (2)

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

Investigative Report No. P224-V130

Mine Ventilation
Pressure-Air Quantity Distribution Study

McClure No. 1 Mine - ID No. 44-04251
Clinchfield Coal Company
McClure, Dickenson County, Virginia

July 11-16, 1983

by

Joseph D. Hadden, Jr., Edward J. Miller,
Kevin R. Burns and R. Keith Younger

Originating Office

Pittsburgh Health Technology Center
Ventilation Division
James L. Banfield, Jr., Chief
Pittsburgh, Pennsylvania

Investigative Report No. P224 - V130

McClure No. 1 Mine
ID No. 44-04251
Clinchfield Coal Company
McClure, Dickenson County, Virginia

July 11-16, 1983

by

Joseph D. Hadden, Jr.[1/], Edward J. Miller[2/],
Kevin R. Burns[3/] and R. Keith Younger[4/]

INTRODUCTION

From July 11 through 16, 1983 a partial mine ventilation pressure-air quantity distribution study was made at Clinchfield Coal Company's McClure No. 1 Mine, McClure, Dickenson County, Virginia, by the Ventilation Division, Pittsburgh Health Technology Center. A List of personnel from the Mine Safety and Health Administration who participated in the survey is contained in the appendix.

The study was requested by the Chairman of the Committee investigating the causes of the explosion at this mine. The purpose was to collect data necessary to describe and analyze the existing ventilation system in a portion of the mine and measure the methane quantity liberated from one section in the mine where an explosion occurred. The data would also provide a base for digital computer simulations of the ventilation system. This report summarizes the results of the study and the computer simulations.

GENERAL

The McClure No. 1 Mine was opened by two shafts and one slope into the Jawbone coalbed which was approximately 60 inches in thickness. The mine employed 295 underground employees on 7 operating sections which normally produced 2800 tons of coal per day. Coal was transported from the operating sections to the surface preparation facilities by a belt conveyor haulage system. A battery-powered track haulage system was used for transporting personnel and supplies underground. The conveyor belt haulage, intake and return entries were separated by masonry stoppings. Based on the analysis of bottle samples collected at the exhaust mine fan, the daily methane liberation from the mine was approximately 2.2 million cubic feet.

1/ Senior Mining Engineer, PHTC, Ventilation Division
2/ Supervisory Mining Engineer, PHTC, Ventilation Division
3/ Mining Engineer, PHTC, Ventilation Division
4/ Industrial Hygienist, PHTC, Ventilation Division

Airflow was induced into the mine by a surfaced mounted exhausting mine fan. The Jeffrey 8HUA - 117 Aerodyne mine fan was connected by suitable ducting to the 20 foot diameter return airshaft which was 402 feet deep. The fan was direct driven by a 4160 vac, 1000 horsepower electric motor at a measured fan speed of 895 rpm. This fan exhausted 670,000 cfm of return air at a density of 0.071 pounds per cubic foot and a fan rated static pressure of -7.1 inches of water. Fan measurements indicated the fan was operating in the 5B - 5S blade position. The fan characteristic curve, the mine resistance curve and the indicated operating point for the fan are shown in Figure 1. A second fan identical to the operating fan was installed to operate in parallel when mine development required additional air quantity.

MINE AIR QUANTITY

Figure 2 is a ventilation schematic illustrating mine airflow direction and quantity for the portion of the mine surveyed. Also shown are the ventilation pressures (inches of water) at various locations throughout the mine. The indicated air quantities have been divided by 100,000 (100,000 cfm is shown as 1.00) and are balanced and suitable for computer simulation of the ventilation system.

The portion of the mine surveyed was in the west bordered by Cranesnest Mains II and Caney Mains IV headings. Figure 3 is a mine map of this area showing the development, ventilation controls and airflow direction at the time of the survey. Air quantity and pressure measurements were made at selected locations in the remaining portion of the mine to permit a computer simulation of the ventilation system in the study area.

PRESSURE GRADIENT

Figure 4 shows the ventilation pressure losses incurred by the ventilating air as it travels to and from the 2 Left Section. The gradient was constructed by plotting the total ventilation pressure measured at key locations against the distance of the location from the intake or return shaft opening. The slope of the line on the gradient indicates the pressure loss to length of airway; therefore a steep slope will indicate an area in the mine with either high resistance to airflow or a high airflow quantity. Steep pressure gradient areas are of primary concern when determining regions of the mine where improvements in terms of reduce mine resistance, would be most beneficial.

The pressure gradient illustrated in Figure 4 shows that the greatest restriction to airflow occurred in the intake aircourse from the bottom of the intake airshaft to the Cranesnest Mains II entries, a distance of approximately 350 ft. The ventilation pressure loss in this aircourse was 2.04 inches of water which was 29 percent of the total ventilation pressure (7.1 inches of water) developed by the mine fan.

METHANE LIBERATION - 2 LEFT

The methane liberation study was conducted in the 2 Left Section to determine the methane quantity, in cubic feet per minute, liberated from 2400 feet of the three entry section. The methane concentration and air quantity was monitored daily at three locations selected at the beginning, mid-point, and end of the 2 Left Section. Three stations were established at each location and each day during a 3-day period a vacuum bottle air sample was collected and an air velocity measurement made at the nine stations. In addition, a continuous recording methane detector was installed at each station to determine if the methane concentration at each location varied from the concentration determined by analysis of vacuum bottle air samples. An examination of the methane recorder strip charts indicated that no significant variation occurred in the daily measured methane concentration at each location. The nine monitoring stations (K-2 thru K-10) are shown in Figure 5 along with the average methane concentration (determined by laboratory analysis of air samples), balanced air quantity and average methane quantity at each station.

The results of the study show that the average methane quantity in the three entries near the face of 2 Left (K-8, K-9 and K-10) was 54 cfm, the average methane quantity near the mid-point of the section (K-5, K-6 and K-7) was 182 cfm, and the average methane quantity near the mouth of 2 Left was 207 cfm of methane. The methane liberation rate into the three entries between the monitoring stations located near the face and mouth of 2 Left was approximately 153 cfm. Of the total methane quantity liberated in 2 Left (153 cfm), 84 percent (128 cfm) entered the 3 entries between the stations located near the face and mid-point in the section.

VENTILATION SIMULATIONS

Figure 6 is a schematic of a simulation of the ventilation system for the 2 Left area before the cut through into the longwall set-up entries. The resistances used for the aircourses were based on values calculated from the data collected during this survey. The air quantities correspond to the reported air quantities that existed in the entries under normal operating conditions.

Figure 7 is a ventilation schematic of the computer simulation of 2 Left at the time of cut through into the longwall set-up entries driven from 1 Left. The computer simulation indicates that without any ventilation controls at the point of cut-through: 1) 23,000 cfm of air would flow from the set-up entries into the face area of the 2 Left Section, 2) the air quantity in the 2 Left intake entry would decrease from 24,000 cfm to 8000 cfm, 3) the air quantity in the belt-track entry near the belt tail-piece would decrease from 5,000 cfm to 2,000 cfm and 4) the return airflow from the face area of 2 Left would increase from 29,000 to 33,000 cfm. This simulation indicates the ventilation changes that would occur after cut-through provided that no changes were made in the systems ventilation controls such as adjusting an air regulator, installing a check curtain; etc.

CONCLUSIONS

1. The Jeffrey 8HUA - 117 Aerodyne mine fan was exhausting 670,000 cfm of air at a fan rated static pressure of -7.1 inches of water. Measurements indicated the fan was operating in the 5B - 5S blade position.

2. The pressure gradient, Figure 4, shows a steep slope from the bottom of the intake airshaft to where this airsplit enters the Cranesnest Mains II entries. Of the 7.1 inches of water developed by the mine fan 2.04 inches of water was consumed in this portion of the intake aircourse.

3. The results of the methane liberation study show that the methane quantity liberated in a portion of the 2 Left Section, 2400 feet in length, averaged 153 cfm.

4. A computer simulation of the mine ventilation system indicates that when the areas were connected 23,000 cfm of air would flow from the longwall set-up entries to the face area of 2 Left; the air quantity in the belt-track entry and intake entry of 2 Left would decrease and; the air quantity in the return entry of 2 Left would increase.

APPENDIX

Mine Safety and Health Administration personnel participating in the ventilation survey at the McClure No.1 Mine - July 11-16, 1983

NAME	TITLE
Coal Mine Safety and Health, District 5	
James V. Bowman	Mine Inspection Supervisor
Frank C. Young, Jr.	Mining Engineer
William W. Hulvey	Mining Engineer
James H. Saunders	Mining Engineer
Coal Mine Safety and Health, Arlington, Virginia	
Dale R. Cavanaugh	Mechanical Engineer
Ventilation Division, Pittsburgh Health Technology Center	
Joseph D. Hadden, Jr.	Senior Mining Engineer
Edward J. Miller	Supervisory Mining Engineer
Kevin R. Burns	Mining Engineer
R. Keith Younger	Industrial Hygienist

ACKNOWLEDGEMENT

The cooperation and courtesies extended by mine management, local union personnel and international union representatives during this survey is greatly appreciated.

Joseph D. Hadden, Jr.
Senior Mining Engineer

Edward J. Miller
Supervisory Mining Engineer

Kevin R. Burns
Mining Engineer

R. Keith Younger
Industrial Hygienist

Approved by:

James L. Banfield, Jr.
Chief, Ventilation Division

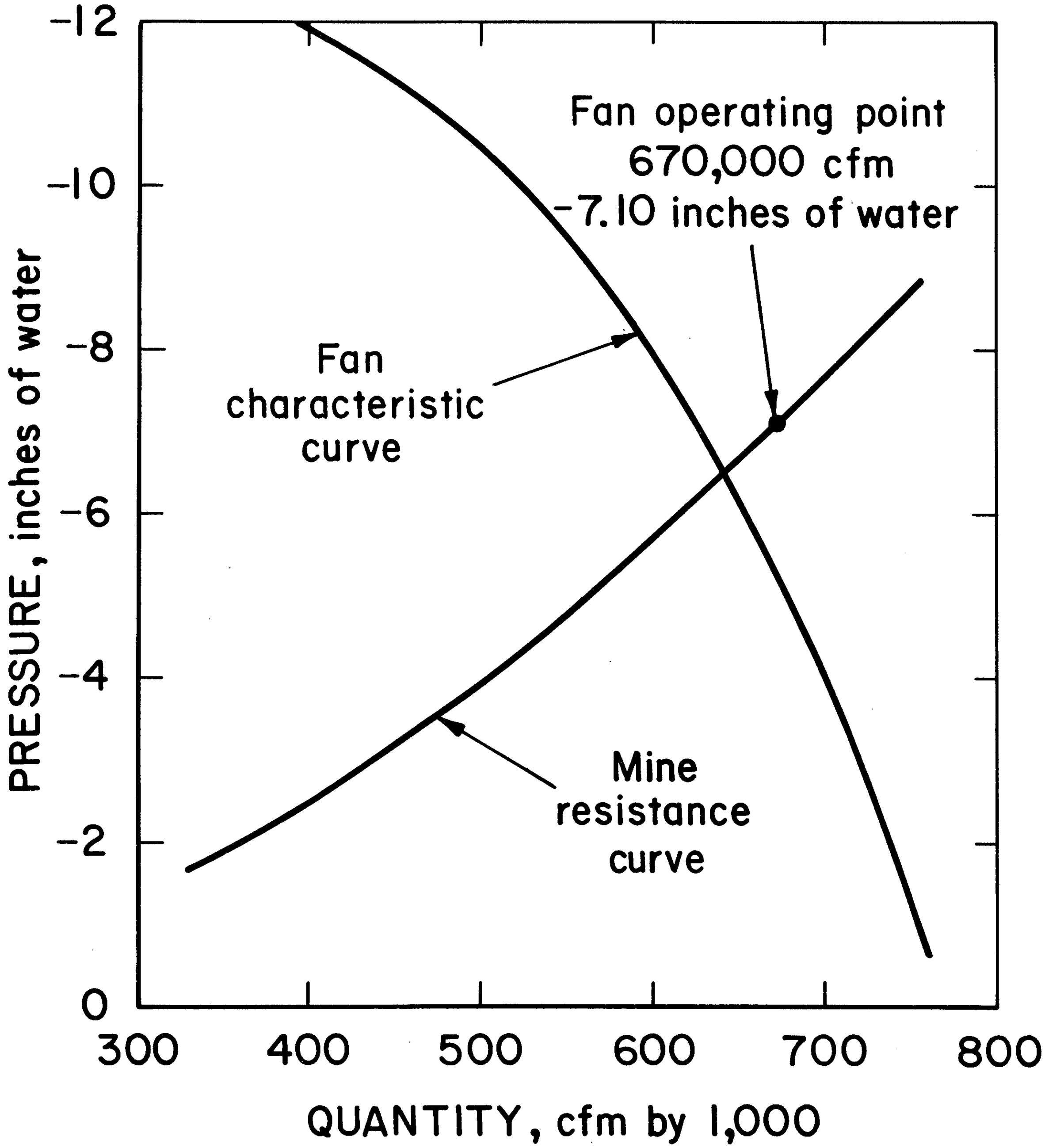


FIGURE 1 - Fan Characteristic Curve, Mine Resistance Curve, and Fan Operating Point, McClure No. 1 Mine, July 1983

PGH-83
1094

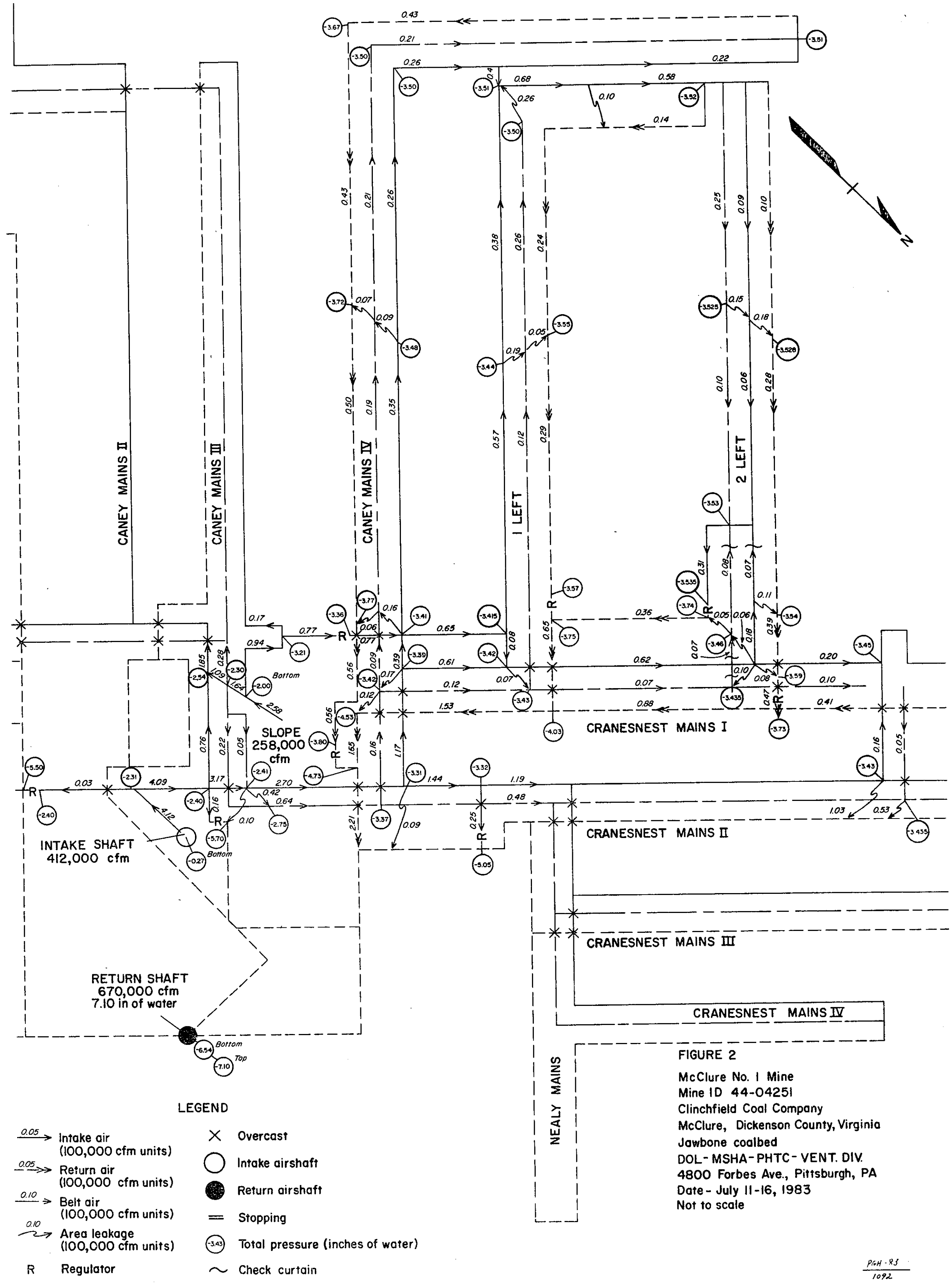


FIGURE 2
McClure No. 1 Mine
Mine ID 44-04251
Clinchfield Coal Company
McClure, Dickenson County, Virginia
Jawbone coalbed
DOL-MSHA-PHTC-VENT. DIV.
4800 Forbes Ave., Pittsburgh, PA
Date- July 11-16, 1983
Not to scale

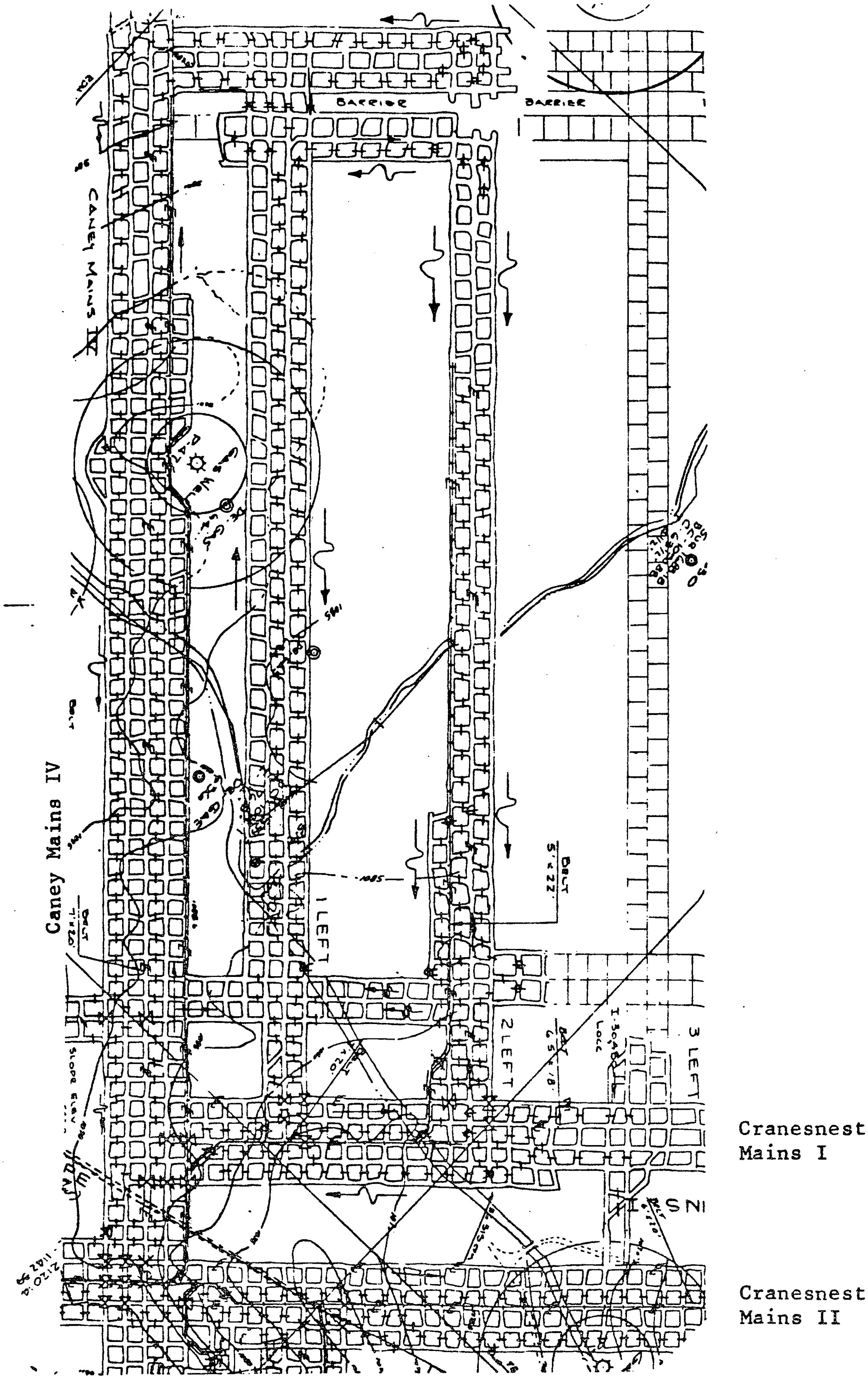


Figure 3 - Survey Area, McClure No. 1 Mine

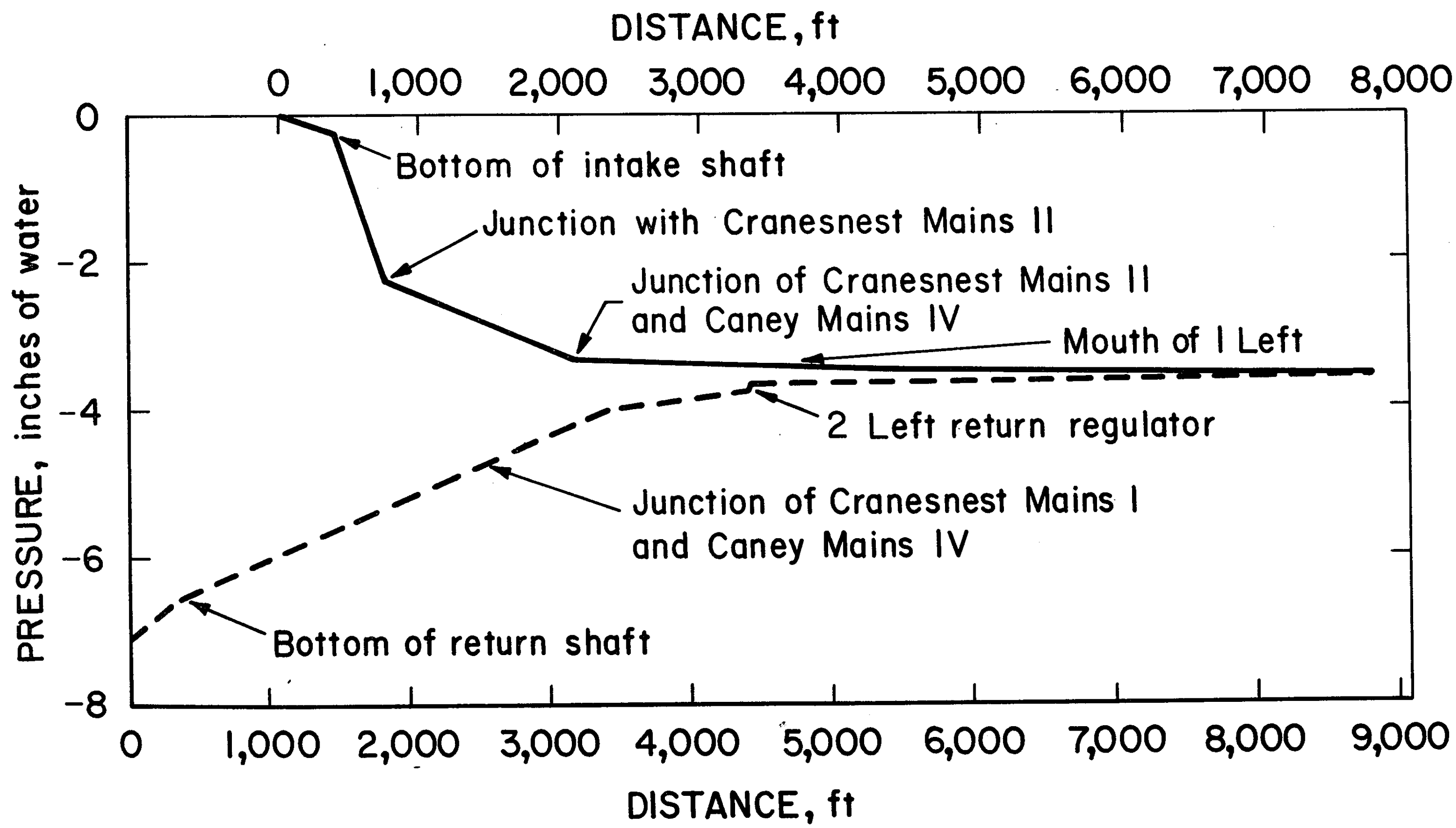
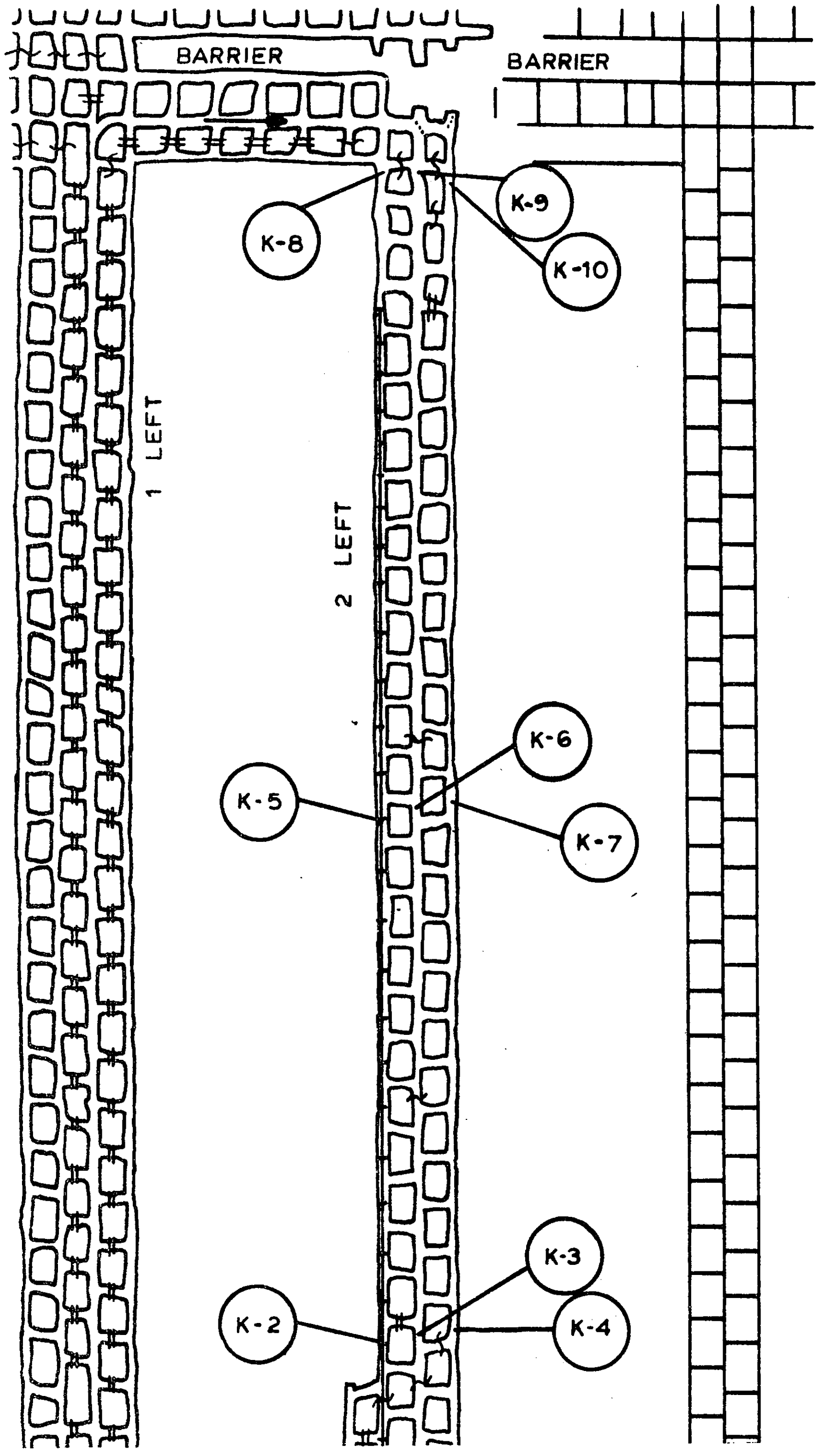


FIGURE 4 - Pressure Gradient of 2 Left Section; McClure No. 1 Mine, July 1983

PGH - 83
1093



Location	Average methane conc. %	Balanced air quantity (cfm)	Average methane quantity (cfm)
K-2	0.61	10,000	61
K-3	0.24	6,000	14
K-4	0.47	28,000	132
K-5	0.48	18,000	86
K-6	0.27	6,000	16
K-7	0.40	20,000	80
K-8	0.08	25,000	20
K-9	0.13	9,000	12
K-10	0.22	10,000	22

Figure 5.- Location of Monitoring Stations, Average Methane Concentrations, Balanced Air Quantities, Average, Methane Quantities

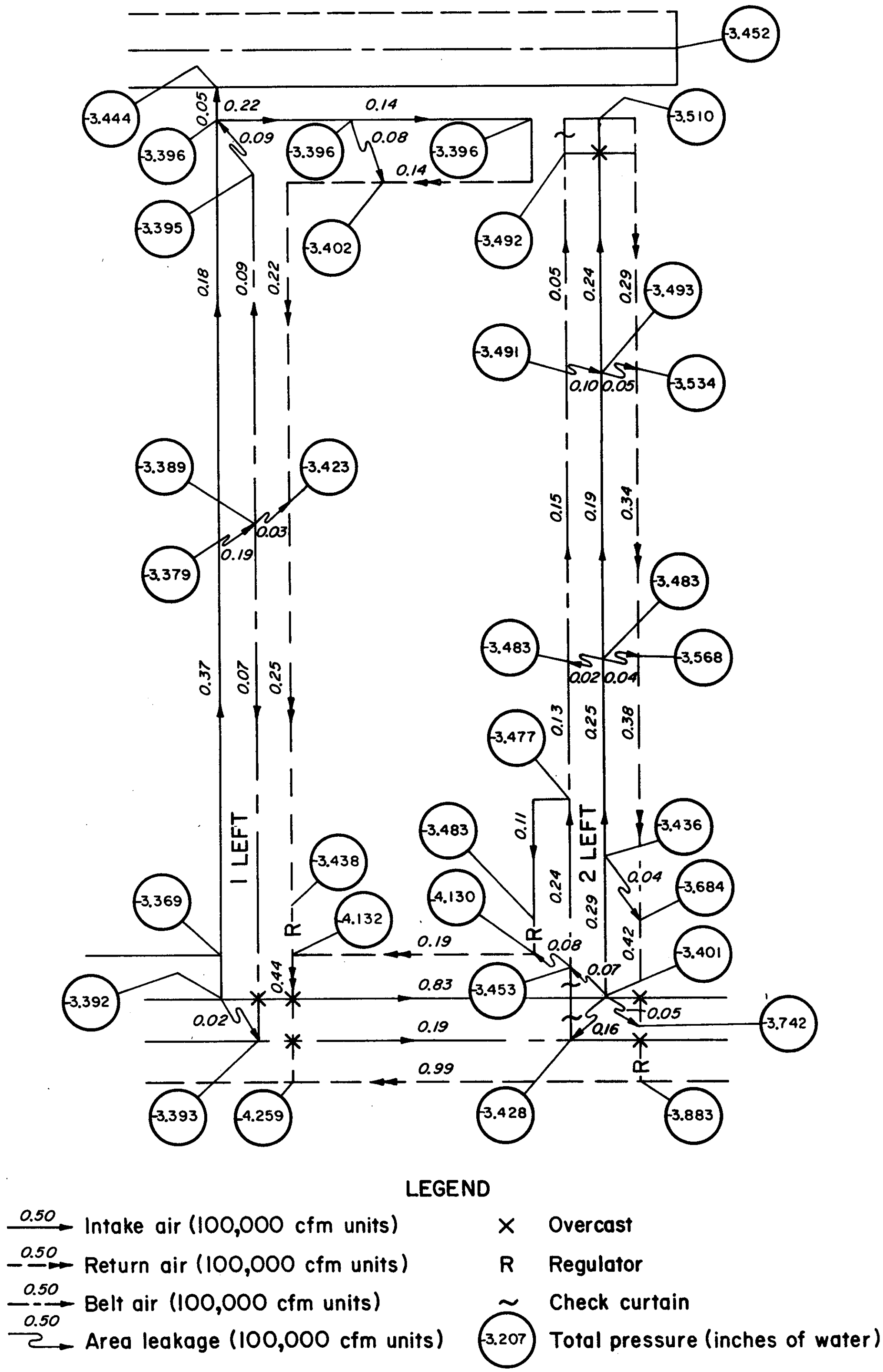
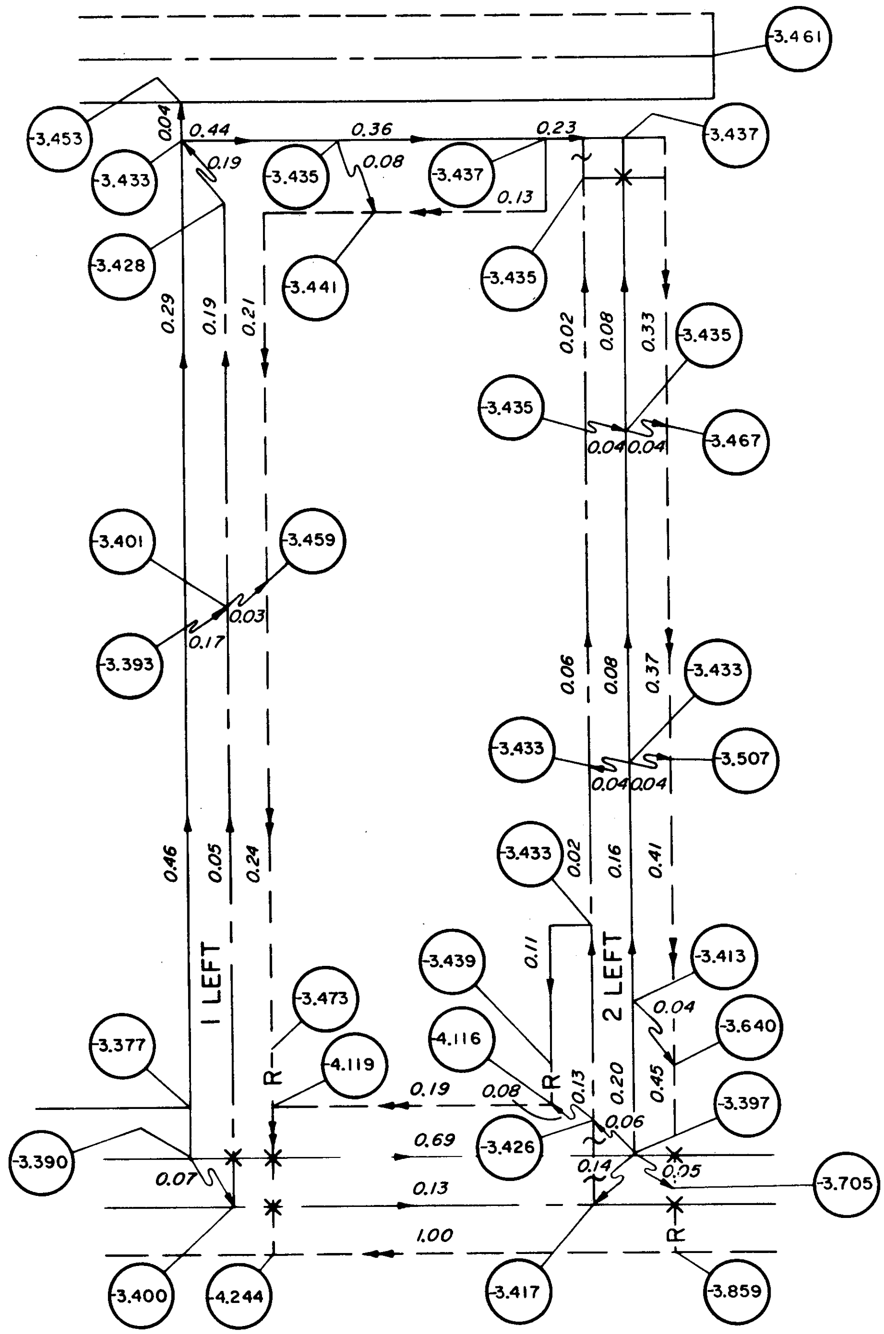


FIGURE 6- Ventilation Schematic of 2 Left Area
Before Cut-through

PGN 83
1095



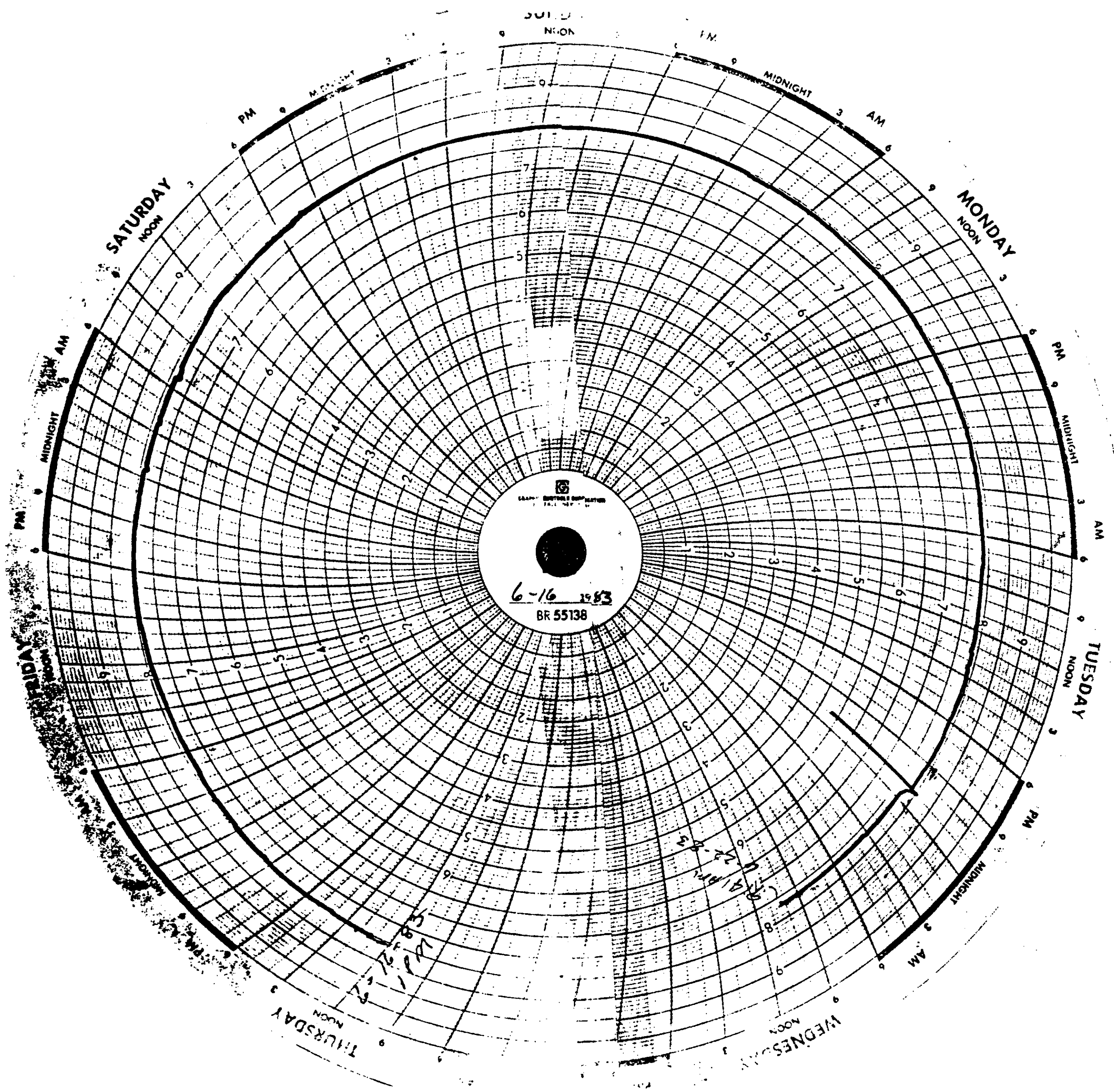
LEGEND

0.50 Intake air (100,000 cfm units)		×	Overcast
0.50 Return air (100,000 cfm units)		R	Regulator
0.50 Belt air (100,000 cfm units)		~	Check curtain
0.50 Area leakage (100,000 cfm units)		(-3.207)	Total pressure (inches of water)

FIGURE 7 - Ventilation Schematic of the Computer Simulation of 2 Left Area After Cut-Through

PGH-83
1096

APPENDIX M



Appendix M

Fan Pressure Recording Chart
6/16/83
Clinchfield Coal Company
McClure No. 1 Mine

APPENDIX N

Mine Citation/Order

U.S. Department of Labor
Mine Safety and Health Administration

Section I—Violation Data

1. Type of issuance (check one) Citation ☐ Order ☑ Safeguard ☐
2. Date Mo. 06 Da. 22 Yr. 83
3. Time (24 hr. clock) 0342
4. Citation/Order Number 2149525
5. Served To: C. M. Bailes
6. Operator: Clinchfield Coal Company
7. Mine: McClure No. 1
8. Mine ID 44-04251 (Contractor)
9. Type of Action 103-k
10. Violation A. Health ☐ Safety ☐ Other ☑ B. Section of Act C. Part/Section of Title 30 CFR
11a Significant and Substantial (see reverse) ☐
11b. Written Notice ☐
12. Condition or Practice

A fatal mine accident has occurred in the 2 left active Section; this order is issued to assure the safety of any person in the coal mine until an examination or investigation is made to determine that the mine is safe to work. Only those persons selected from Company, State, and miners representatives officials and other persons who are deemed by MSHA to have information relevant to the investigation may enter or remain in the affected area

13. Area or Equipment
Entire mine

TERMINAL ENTRY
DATE 6-23-83
Initials [signature]

14. Initial Action: Citation ☐ Order ☐ Safeguard ☐ Written Notice ☐
15. Citation/Order Number
16. Dated Mo. Da. Yr.
17. Termination Due: A. Date Mo. Da. Yr. B. Time (24 hr. clock) C. Signature [signature] Jr. D. AR Number 21413 ☐ See continuation form (MSHA Form 7000-3a)

Section II—Termination Action

18. Action to Terminate

19. Terminated: A. Date Mo. Da. Yr. B. Time (24 hr. clock) C. Signature D. AR Number

Section III—Inspector's Evaluation

20. Negligence (check one) A. None ☐ B. Low ☐ C. Moderate ☐ D. High ☐ E. Reckless Disregard ☐

21. Gravity
A. The occurrence of the event against which the cited standard is directed was:
No Likelihood ☐ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☐
B. The injury resulting from or contemplated by the occurrence of the event could reasonably be expected to be:
No lost workdays ☐ Lost workdays or restricted duty ☐ Permanently Disabling ☐ Fatal ☐
C. Number of persons who would be affected if the event occurred or were to occur.

22. Good Faith
A. Failure to abate within the time period given ☐
B. Signature
C. AR Number

Section IV—Automated System Data

23. Type of Inspection (activity code) AFA
24. Event Number 5106423
25. Primary or Mill

MSHA Form 7000-3, Apr 82, (revised)

Mine Citation/Order

U.S. Department of Labor APPENDIX N 2

Mine Safety and Health Administration

Section I—Violation Data

1. Type of issuance (check one) Citation ☐ Order ☑ Safeguard ☐
2. Date 06 22 83 (Mo. Da. Yr.)
3. Time (24 hr. clock) 0400
4. Citation/Order Number 2149526

5. Served To: C. M. Bailes
6. Operator: Clinchfield Coal Company
7. Mine: McClure No. 1
8. Mine ID: 44-04251 (Contractor)
9. Type of Action: 107-a- ,
10. Violation: A. Health ☐ Safety ☐ Other ☐ B. Section of Act — C. Part/Section of Title 30 CFR

11a Significant and Substantial (see reverse) ☐

11b. Written Notice ☐

12. Condition or Practice

A fatal mine explosion has occurred in the 2 left active section. This order shall remain in effect until all the conditions, practices and causes of the explosion have been corrected.

TERMINAL ENTRY
DATE 6-23-83
Initials [initials]

13. Area or Equipment

Entire mine

14. Initial Action. Citation ☐ Order ☐ Safeguard ☐ Written Notice ☐
15. Citation/Order Number
16. Dated Mo. Da. Yr.
17. Termination Due: A. Date Mo. Da. Yr. B. Time (24 hr. clock) C. Signature [signature] D. AR Number 21413 ☐ See continuation form (MSHA Form 7000-3a)

Section II—Termination Action

18. Action to Terminate

19. Terminated: A. Date Mo. Da. Yr. B. Time (24 hr. clock) C. Signature D. AR Number

Section III—Inspector's Evaluation

20. Negligence (check one) A. None ☐ B. Low ☐ C. Moderate ☐ D. High ☐ E. Reckless Disregard ☐

21. Gravity

A. The occurrence of the event against which the cited standard is directed was: No Likelihood ☐ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☐

B. The injury resulting from or contemplated by the occurrence of the event could reasonably be expected to be: No lost workdays ☐ Lost workdays or restricted duty ☐ Permanently Disabling ☐ Fatal ☐

C. Number of persons who would be affected if the event occurred or were to occur:

22. Good Faith

A. Failure to abate within the time period given ☐

B. C. AR Number

Section IV—Automated System Data

23. Type of Inspection (activity code) DFA
24. Event Number 5106423
25. Primary or Mill

MSHA Form 7000-3, Apr 82 (revised)

Mine Citation/Order

U.S. Department of Labor APPENDIX N 3
Mine Safety and Health Administration

Section I—Violation Data

1. Type of issuance (check one) Citation ☒ Order ☐ Safeguard ☐
2. Date 03 (Mo.) 26 (Da.) 84 (Yr.)
3. Time (24 hr. clock) 1015
4. Citation/Order Number 2352610
5. Served To Monroe West
6. Operator Clinchfield Coal Company
7. Mine McClure No. 1
8. Mine ID 44-04251 (Contractor)
9. Type of Action 104-d-1,
10. Violation A. Health ☐ Safety ☒ Other ☐ B. Section of Act — C. Part/Section of Title 30 CFR 75.316 —

11a Significant and Substantial (see reverse) ☒
11b. Written Notice ☐

12. Condition or Practice

The approved ventilation system and methane and dust control plan for the mine was not being complied with. Ventilation of the 2 left section and the longwall set-up entries off 1 left was changed when the left crosscut (No. 40) off No. 3 entry of 2 left was cut through into the No. 2 longwall set-up entry and a ventilation control was not installed to separate the ventilating currents. A significant portion of the ventilating current in the longwall set-up entries left its designated and approved route of travel and entered the 2 left section through the No. 40 crosscut. This ventilating current was then directed to the faces of the Nos. 3 and 4 entries of 2 left and then into the 2 left section return. The approved ventilation system and methane and dust control plan required the ventilating currents to be separated. This change in the ventilation system resulted in a reduction in the normal volume and velocity of the ventilating currents in the 2 left belt entry and the 2 left intake
[redacted]
entry outby the last open crosscut of the 2 left section. This reduced volume and velocity permitted an explosive mixture of methane to accumulate and the methane was subsequently ignited at 10:15 p.m. on June 21, 1983. The explosion resulted in the death of 7 miners and injury to 3 others.

This violation was determined during an investigation of the explosion.

TERMINAL ENTRY
DATE 3-26-84
Initials

14. Initial Action: Citation ☐ Order ☐ Safeguard ☐ Written Notice ☐
15. Citation/Order Number
16. Dated Mo. Da. Yr.
17. Termination Due: A. Date 03 (Da.) 26 (Yr.) 84 B. Time (24 hr. clock) 1015 C. Signature Nickie E. Brewer / Nicholas Rosnick D. AR Number 21023 / 20448 ☐ See continuation form (MSHA Form 7000-3a)

Section II—Termination Action

18. Action to Terminate

The mine ventilation was reestablished to comply with the approved ventilation and dust control plan.

19. Terminated: A. Date Mo. Da. Yr. B. Time (24 hr. clock) C. Signature Nicholas Rosnick / Nickie E. Brewer 20448 D. AR Number

Section III—Inspector's Evaluation

20. Negligence (check one) A. None ☐ B. Low ☐ C. Moderate ☐ D. High ☒ E. Reckless Disregard ☐

21. Gravity
A. The occurrence of the event against which the cited standard is directed was:
No Likelihood ☐ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☒
B. The injury resulting from or contemplated by the occurrence of the event could reasonably be expected to be:
No lost workdays ☐ Lost workdays or restricted duty ☐ Permanently Disabling ☐ Fatal ☒
C. Number of persons who would be affected if the event occurred or were to occur: 10

22. Good Faith
A. Failure to abate within the time period given ☐
B. Signature Nicholas Rosnick 20448 / Nickie E. Brewer C. AR Number 21023

Section IV—Automated System Data

23. Type of Inspection (activity code) CAA
24. Event Number 5271059
25. Primary or Mill

MSHA Form 7000-3, Apr 82, (revised)

Mine Citation/Order

U.S. Department of Labor APPENDIX N 4

Mine Safety and Health Administration

Section I—Violation Data

1. Type of issuance (check one): Citation ☐ Order ☒ Safeguard ☐

2. Date: 03 26 84 (Mo. Da. Yr.)

3. Time (24 hr. clock): 1008

4. Citation/Order Number: 2352604

5. Served To: Monroe West

6. Operator: Clinchfield Coal Company

7. Mine: McClure No. 1

8. Mine ID: 44-04251 (Contractor)

9. Type of Action: 104-d-1,

10. Violation: A. Health ☐ Safety ☒ Other ☐ B. Section of Act — C. Part/Section of Title 30 CFR: 75.304

11a. Significant and Substantial (see reverse) ☒

11b. Written Notice ☐

12. Condition or Practice

The onshift examination(s) of the 2 left section conducted on June 21, 1983 by the designat and certified examiner(s) was inadequate. The left crosscut off No. 3 entry(No. 40) of 2 left had been cut through into the No. 2 longwall set-up entry and a ventilation control had not been installed in the crosscut. This permitted a significant portion of the ventilating current for the 2 left section to be coursed from the longwall set-up entries through the crosscut instead of traveling in its normal route. This flow of air through the crosscut resulted in a reduced volume and velocity of the ventilating current in the 2 left intake entries outby the last open crosscut in 2 left. The onshift examiner(s) did not determine the potential hazards created by the ventilation change made when the ventilation control was not installed and did not detect the hazardous conditions that developed after the ventilation change was made. The ventilation change permitted an explosive mixture of methane to accumulate and the methane was subsequently ignited at [redacted] 10:15 PM on June 21, 1983. The explosion resulted in the death of 7 miners and injury to 3 others. This violation was determined during the investigation of the explosion.

13. AREA OR EQUIPMENT

The entire mine.

TERMINAL ENTRY
DATE 3-26-84
Initials [signature]

14. Initial Action: Citation ☒ Order ☐ Safeguard ☐ Written Notice ☐

15. Citation/Order Number: 2352601

16. Dated: 03 26 84 (Mo. Da. Yr.)

17. Termination Due: A. Date 03 26 84 (Mo. Da. Yr.) B. Time (24 hr. clock) 1008 C. Signature Nickie E. Brewer / Nicholas Rosnick 20448 D. AR Number 21023

☐ See continuation form (MSHA Form 7000-3a)

Section II—Termination Action

18. Action to Terminate

Prior to the resumption of production, all persons responsible for conducting onshift examination were made aware of the importance of conducting adequate onshift examinations and the manner in which the examination are to be conducted.

19. Terminated: A. Date 03 26 84 (Mo. Da. Yr.) B. Time (24 hr. clock) 1008 C. Signature Nicholas Rosnick / Nickie E. Brewer 20448 D. AR Number 21023

Section III—Inspector's Evaluation

20. Negligence (check one): A. None ☐ B. Low ☐ C. Moderate ☐ D. High ☒ E. Reckless Disregard ☐

21. Gravity

A. The occurrence of the event against which the cited standard is directed was: No Likelihood ☐ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☒

B. The injury resulting from or contemplated by the occurrence of the event could reasonably be expected to be: No lost workdays ☐ Lost workdays or restricted duty ☐ Permanently Disabling ☐ Fatal ☒

C. Number of persons who would be affected if the event occurred or were to occur: 10

22. Good Faith

A. Failure to abate within the time period given ☐

B. Signature Nicholas Rosnick / Nickie E. Brewer 20448 C. AR Number 21023

Section IV—Automated System Data

23. Type of Inspection (activity code): CAA

24. Event Number: 5271059

25. Primary or Mill

MSHA Form 7000-3, Apr 82, (revised)

Mine Citation/Order

U.S. Department of Labor APPENDIX N 5
Mine Safety and Health Administration

Section I—Violation Data

1. Type of issuance (check one) Citation ☐ Order ☒ Safeguard ☐	2. Date Mo. 03 Da. 26 Yr. 84	3. Time (24 hr. clock) 1009	4. Citation/Order Number 2352605
5. Served To Monroe West		6. Operator Clinchfield Coal Company	
7. Mine McClure No. 1		8. Mine ID 44-04251 (Contractor)	
9. Type of Action 104-d-1,			
10. Violation A. Health ☐ Safety ☒ Other ☐	B. Section of Act	C. Part/Section of Title 30 CFR 75.322	
11a Significant and Substantial (see reverse) ☒		11b. Written Notice ☐	

12. Condition or Practice

A change in ventilation which materially affected the splits of air used to ventilate the active 2 left section and the longwall set-up entries was made during the day shift of June 21, 1983, while miners were in the mine carrying out routine activities and the electrical equipment in the areas was energized. A ventilation control was not installed in the left crosscut (No. 40) off No. 3 entry 2 left which had been cut through into the No. 2 longwall set-up entry. The absence of the ventilation control permitted a significant portion of the ventilating current for the 2 left section to be coursed through the longwall set-up entries instead of traveling up the 2 left intake entries. Management did not conduct sufficient examinations to ascertain the effects of the change. The ventilation change resulted in an explosive accumulation of methane in the 2 left entries which was subsequently ignited at 10:15 p.m., on June 21, 1983. The explosion resulted in the death of 7 miners and injury to 3 others.

13. Area or Equipment This violation was observed during an investigation of the explosion.

Entire Mine

TERMINAL ENTRY
DATE 3.26.84
Initials [signature]

14. Initial Action: Citation ☒ Order ☐ Safeguard ☐ Written Notice ☐	15. Citation/Order Number 2352601		16. Dated Mo. 03 Da. 26 Yr. 84	
17. Termination Due: A. Date 03 Da. 26 Yr. 84	B. Time (24 hr. clock) 1009	C. Signature Nickie E. Brewer / Nicholas Rosnick 20448	D. AR Number 21023	☐ See continuation form (MSHA Form 7000-3a)

Section II—Termination Action

18. Action to Terminate

Plans were developed to prevent intermixing of ventilating currents when cut-throughs are made which involve more than one ventilating current. These plans will prevent ventilation changes from occurring when the cut-throughs are made.

19. Terminated: A. Date Mo. 03 Da. 26 Yr. 84	B. Time (24 hr. clock) 1009	C. Signature Nicholas Rosnick / Nickie E. Brewer 20448	D. AR Number 21023

Section III—Inspector's Evaluation

20. Negligence (check one) A. None ☐ B. Low ☐ C. Moderate ☐ D. High ☒ E. Reckless Disregard ☐

21. Gravity

A. The occurrence of the event against which the cited standard is directed was:
No Likelihood ☐ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☒

B. The injury resulting from or contemplated by the occurrence of the event could reasonably be expected to be:
No lost workdays ☐ Lost workdays or restricted duty ☐ Permanently Disabling ☐ Fatal ☒

C. Number of persons who would be affected if the event occurred or were to occur: 10

22. Good Faith A. Failure to abate within the time period given ☐	B. Signature Nicholas Rosnick / Nickie E. Brewer 20448	C. AR Number 21023

Section IV—Automated System Data

23. Type of Inspection (activity code) CAA	24. Event Number 5271059	25. Primary or Mill

MSHA Form 7000-3, Apr 82, (revised)

Mine Citation/Order

U.S. Department of Labor APPENDIX N 6

Mine Safety and Health Administration

Section I—Violation Data

1. Type of issuance (check one): Citation ☐ Order ☒ Safeguard ☐
2. Date: 03 26 84 (Mo. Da. Yr.)
3. Time (24 hr. clock): 1012
4. Citation/Order Number: 2352609
5. Served To: Monroe West
6. Operator: Clinchfield Coal Company
7. Mine: McClure No. 1
8. Mine ID: 44-04251 (Contractor)
9. Type of Action: 104-d-1,
10. Violation: A. Health ☐ Safety ☒ Other ☐ B. Section of Act: — C. Part/Section of Title 30 CFR: 75.301 —

11a. Significant and Substantial (see reverse) ☒

11b. Written Notice ☐

12. Condition or Practice

The volume and velocity of air ventilating the 2 left entries off the Cranesnest I Mains on June 21, 1983, was not sufficient to dilute, render harmless and carry away methane gas that was liberated. A methane gas explosion occurred in the 2 Left entries at about 10:15 p.m. on that date.

This violation was determined during the investigation of an explosion that occurred on June 21, 1983, that resulted in the death of 7 miners and injury to 3 others.

13. Area or Equipment

Entire Mine

TERMINAL ENTRY
DATE 3-26-84
Initials MJW

14. Initial Action: Citation ☒ Order ☐ Safeguard ☐ Written Notice ☐
15. Citation/Order Number: 2352601
16. Dated: 03 26 84 (Mo. Da. Yr.)
17. Termination Due: A. Date 03 26 84 B. Time (24 hr. clock) 1012 C. Signature Nicholas Rosnick / Nickie E. Brewer 20448 D. AR Number 21023 ☐ See continuation form (MSHA Form 7000-3a)

Section II—Termination Action

18. Action to Terminate

Air in sufficient quantities was directed through the 2 left entries to dilute and carry away the methane being liberated.

19. Terminated: A. Date 03 26 84 B. Time (24 hr. clock) 1012 C. Signature Nicholas Rosnick / Nickie E. Brewer 20448 D. AR Number 21023

Section III—Inspector's Evaluation

20. Negligence (check one): A. None ☐ B. Low ☐ C. Moderate ☐ D. High ☒ E. Reckless Disregard ☐

21. Gravity

A. The occurrence of the event against which the cited standard is directed was: No Likelihood ☐ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☒

B. The injury resulting from or contemplated by the occurrence of the event could reasonably be expected to be: No lost workdays ☐ Lost workdays or restricted duty ☐ Permanently Disabling ☐ Fatal ☒

C. Number of persons who would be affected if the event occurred or were to occur: 10

22. Good Faith

A. Failure to abate within the time period given ☐

B. Signature Nicholas Rosnick / Nickie E. Brewer 20448 C. AR Number 21023

Section IV—Automated System Data

23. Type of Inspection (activity code): CAA
24. Event Number: 527059
25. Primary or Mill:

MSHA Form 7000-3, Apr 82, (revised)

Mine Citation/Order

U.S. Department of Labor APPENDIX N 8
Mine Safety and Health Administration

Section I—Violation Data

1. Type of issuance (check one)	Citation ☐ Order ☒ Safeguard ☐
2. Date	03 26 84
3. Time (24 hr. clock)	1020
4. Citation/Order Number	2352608
5. Served To	Monroe West
6. Operator	Clinchfield Coal Company
7. Mine	McClure No. 1
8. Mine ID	44-04251 (Contractor)
9. Type of Action	104-d-1
10. Violation	A. Health ☐ Safety ☒ Other ☐; B. Section of Act; C. Part/Section of Title 30 CFR 75.303
11a	Significant and Substantial (see reverse) ☒
11b.	Written Notice ☐

12. Condition or Practice

The preshift examination of the 2 left section conducted for the oncoming evening shift of June 21, 1983, and the examination of the belt entry conducted after the shift had begun were inadequate. The preshift examiner did not determine the effects on the ventilation system of the active 2 left section when a ventilation control was not installed in the left crosscut (No. 40) off the No. 3 entry of 2 left which had cut through into the No. 2 longwall set-up entries. The belt examiner neither made methane tests in the belt entry nor took air readings to determine that the air current in the belt entry was traveling in its normal course and velocity. The absence of the ventilation control in the left crosscut off No. 3 entry (No. 40) permitted a significant portion of the ventilating current for the 2 left section to be coursed through the longwall set-up entries thereby reducing the normal volume and velocity of the ventilating currents in the 2 left belt entry and the 2 left intake entry outby the last open crosscut of the 2 left section. This reduced volume and ~~[struck-out text]~~ velocity permitted an explosive mixture of methane to accumulate in the 2 left entries and the methane was subsequently ignited at 10:15 p.m. on June 21, 1983. The explosion resulted in the death of 7 miners and injury to 3 others. This violation was determined during an investigation of the explosion.

TERMINAL ENTRY
DATE 3-26-84
Initials [signature]

13. Area or Equipment

Entire Mine

14. Initial Action	Citation ☒ Order ☐ Safeguard ☐ Written Notice ☐
15. Citation/Order Number	2352601
16. Dated	03 26 84
17. Termination Due	A. Date 03 26 84; B. Time (24 hr. clock) 1020; C. Signature Nickie E. Brewer, Nicholas Kosnick; D. AR Number 21023, 20448; ☐ See continuation form (MSHA Form 7000-3a)

Section II—Termination Action

18. Action to Terminate

Prior to the resumption of production, all persons responsible for conducting preshift examinations and all persons responsible for conducting belt examinations were made aware of the importance of conducting adequate preshift examinations and the manner in which the examinations are to be conducted.

19. Terminated	A. Date 03 26 84; B. Time (24 hr. clock) 1020; C. Signature Nicholas Kosnick 20448, Nickie E. Brewer; D. AR Number 21023

Section III—Inspector's Evaluation

20. Negligence (check one): A. None ☐ B. Low ☐ C. Moderate ☐ D. High ☒ E. Reckless Disregard ☐

21. Gravity

A. The occurrence of the event against which the cited standard is directed was:
No Likelihood ☐ Unlikely ☐ Reasonably Likely ☐ Highly Likely ☐ Occurred ☒

B. The injury resulting from or contemplated by the occurrence of the event could reasonably be expected to be:
No lost workdays ☐ Lost workdays or restricted duty ☐ Permanently Disabling ☐ Fatal ☒

C. Number of persons who would be affected if the event occurred or were to occur: 010

22. Good Faith
A. Failure to abate within the time period given ☐
B. Signature Nicholas Kosnick 20448, Nickie E. Brewer
C. AR Number 21023

Section IV—Automated System Data

23. Type of Inspection (activity code): CAA
24. Event Number: 5271059
25. Primary or Mill

MSHA Form 7000-3, Apr 82, (revised)

Mine Citation/Order Continuation

U.S. Department of Labor
Mine Safety and Health Administration

1. Dated (original issue)	03 26 84 (Mo. Da. Yr.)
2. Citation/Order Number	2352610 -
3. Subsequent Action ☒ Continuation ☐	
4. Date	03 26 84 (Mo. Da. Yr.)
5. Time (24 hr. clock)	1230
6. Served To	Certified Mail
7. Operator	Clinchfield Coal Company
Mine	McClure No. 1
8. Mine ID	44-04251-
(Contractor)	

Justification For Action

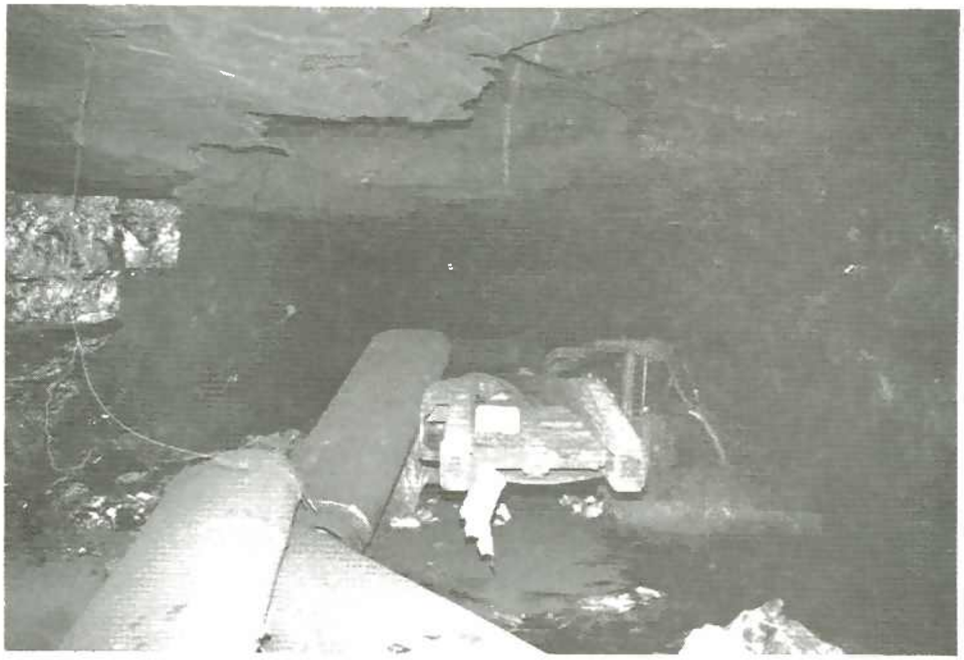
Citation no. 2352610 is modified to show the date and time of termination, line 19, as 3-26-84 and 1015 respectively.

TERMINAL ENTRY
DATE 3-26-84
Initials [illegible]

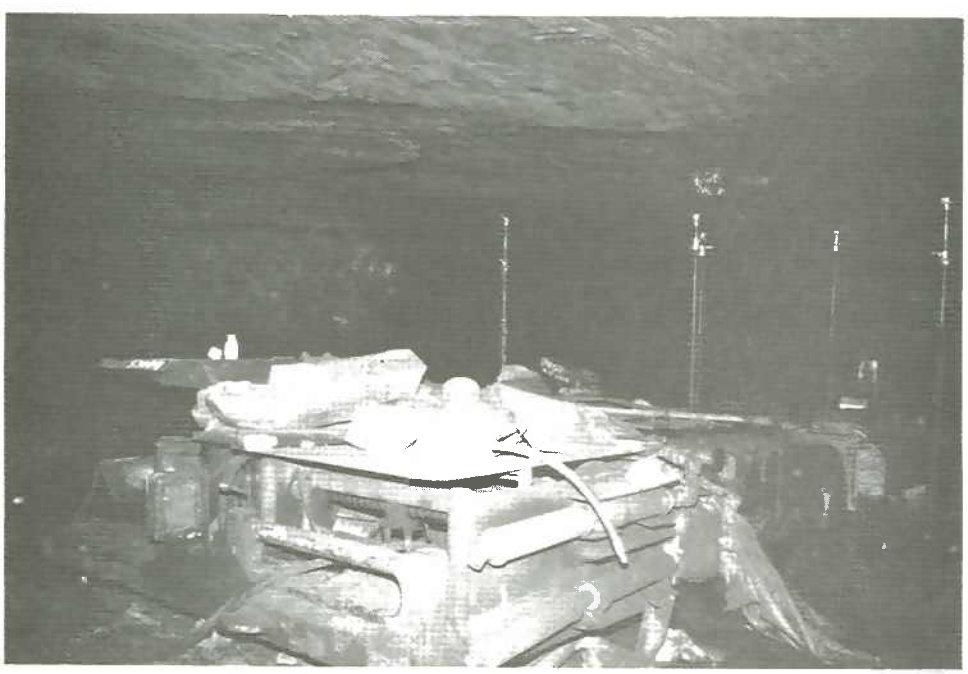
9. Extended To: ☐	9a. Date (Mo. Da. Yr.)
9b. Time (24 hr. clock)	
10. Vacated ☐ Terminated ☐ Modified ☒	
11. See Continuation Form ☐	
12. Type of Inspection	DGC
13. Event Number	
14. Signature	Nicholas R. Osmuth; Nicholas E. Brewer
AR Number	20448; 21023

MSHA Form 7000-3a., Apr 82 (revised)

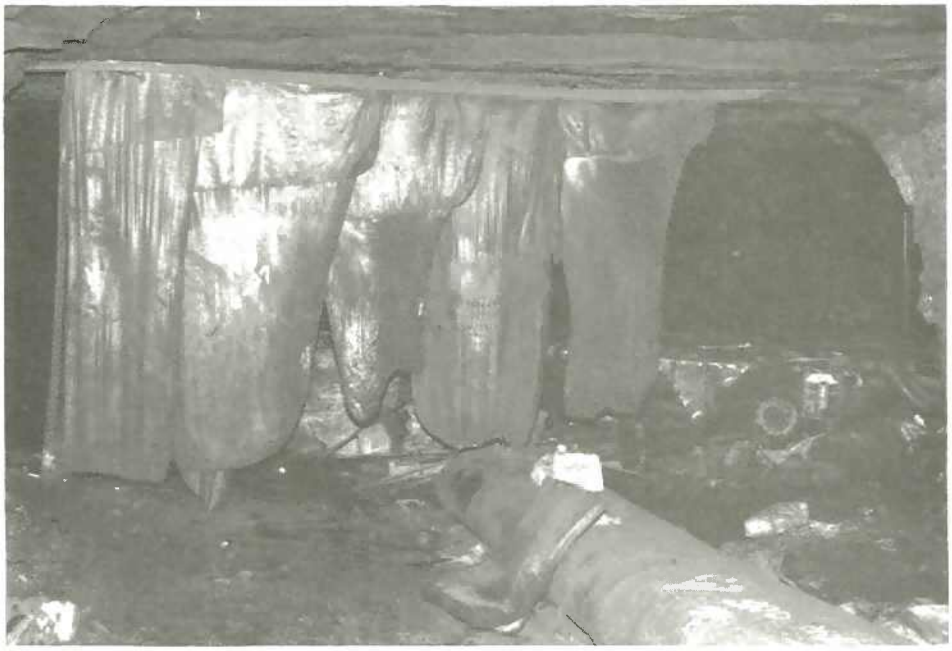
APPENDIX O



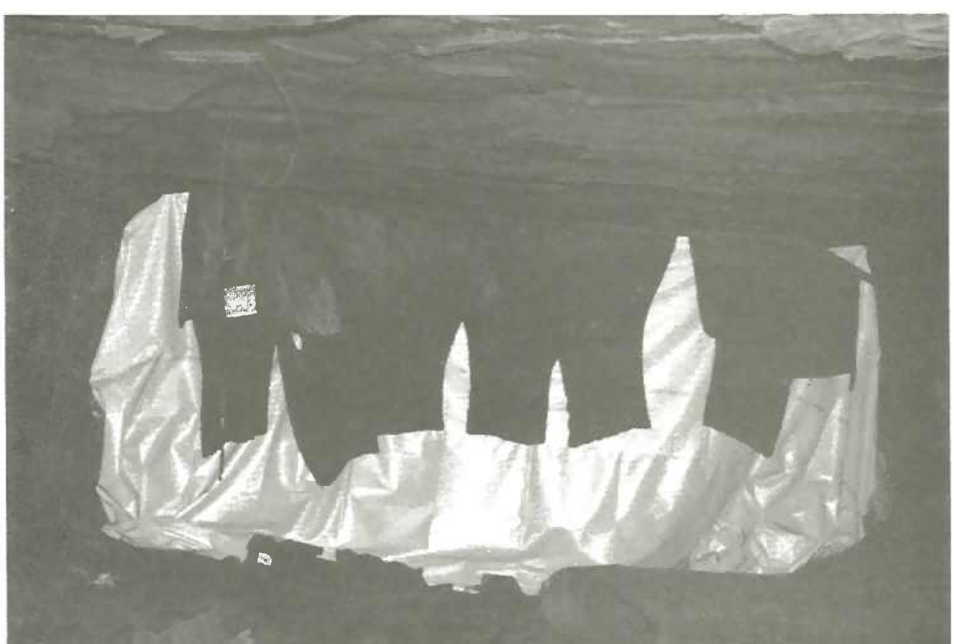
View of continuous mining machine located at the face of the No. 4 entry.



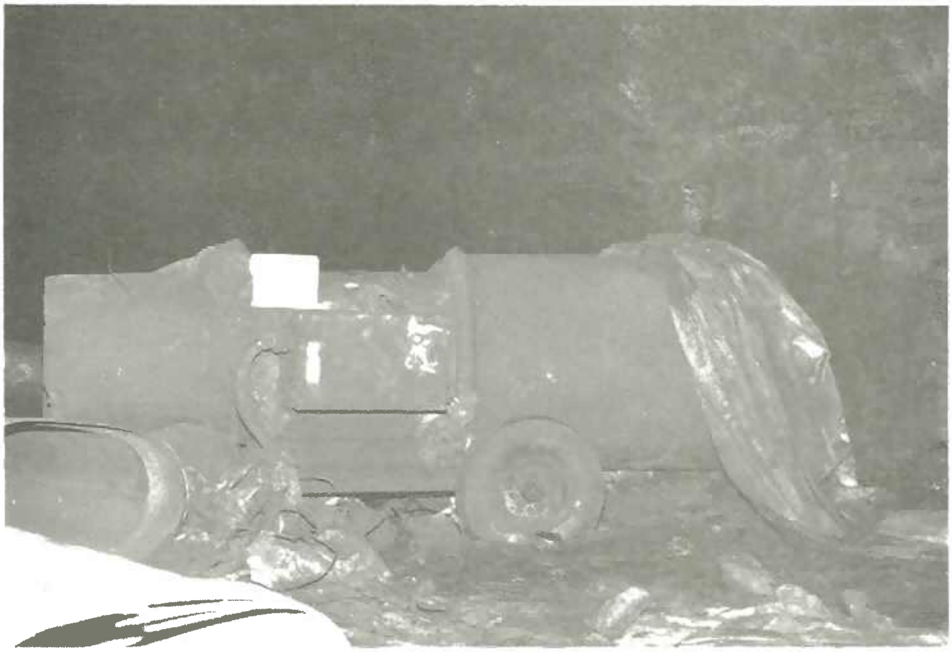
View of roof bolting machine located at the face of the No. 3 entry.



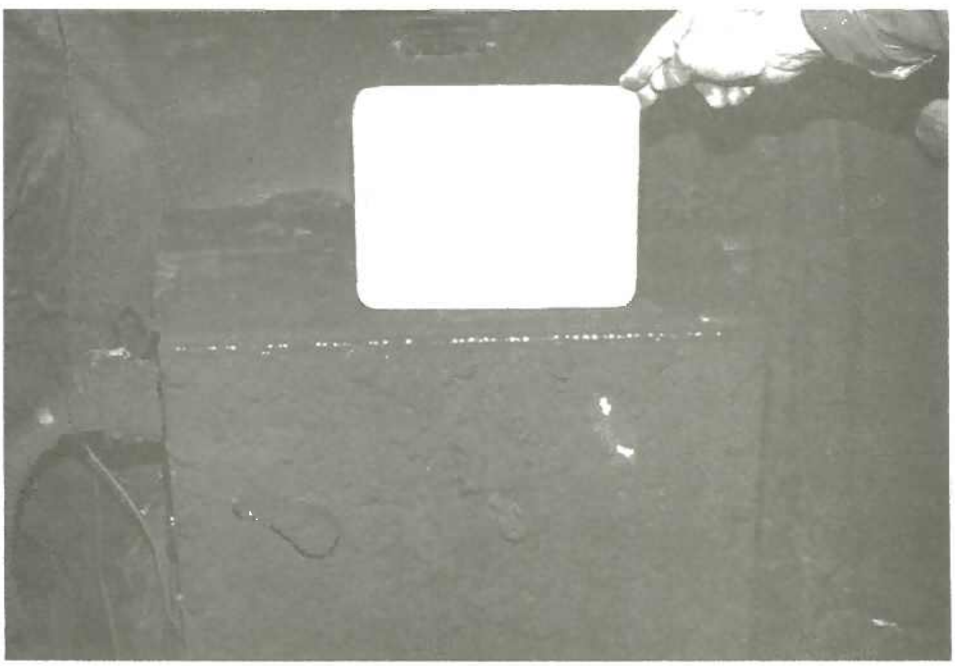
Fly curtain located in the No. 40 crosscut between the Nos. 3 and 4 entries.



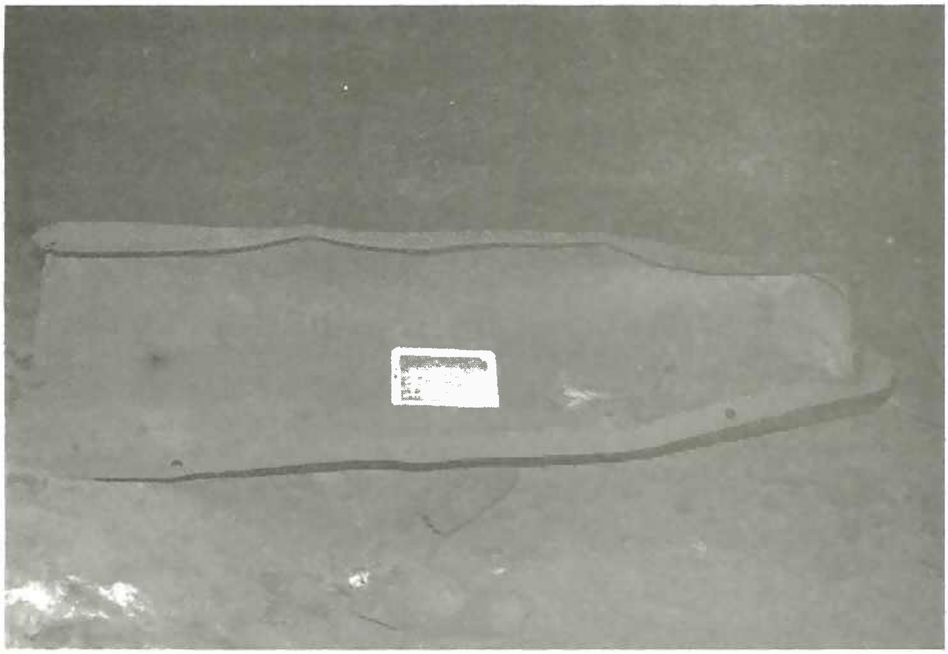
View of the No. 38 crosscut between the Nos. 3 and 4 entries.



Outby side of auxiliary fan located in the No. 4 entry.

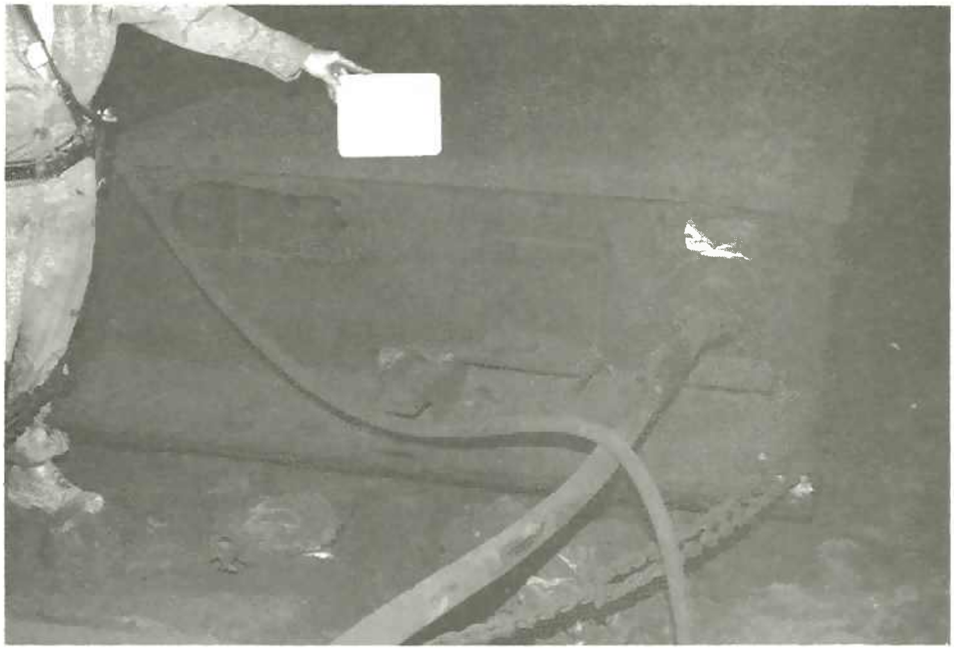


Auxiliary fan controller enclosure located on outby side of fan



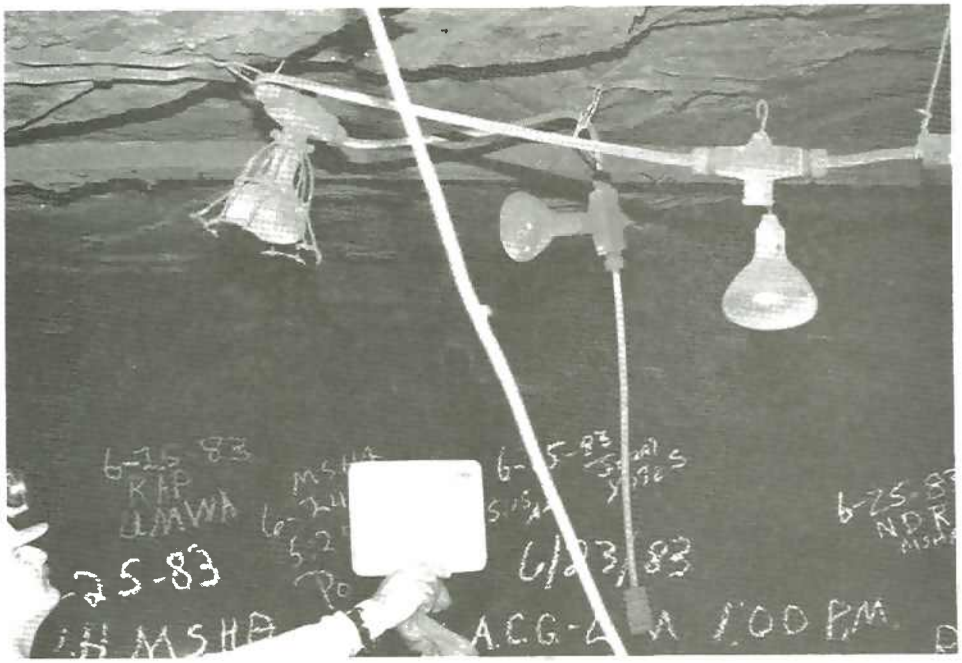
Power center lid found in the No. 3 entry
35 feet inby the power center.

View of the inby end of power center.

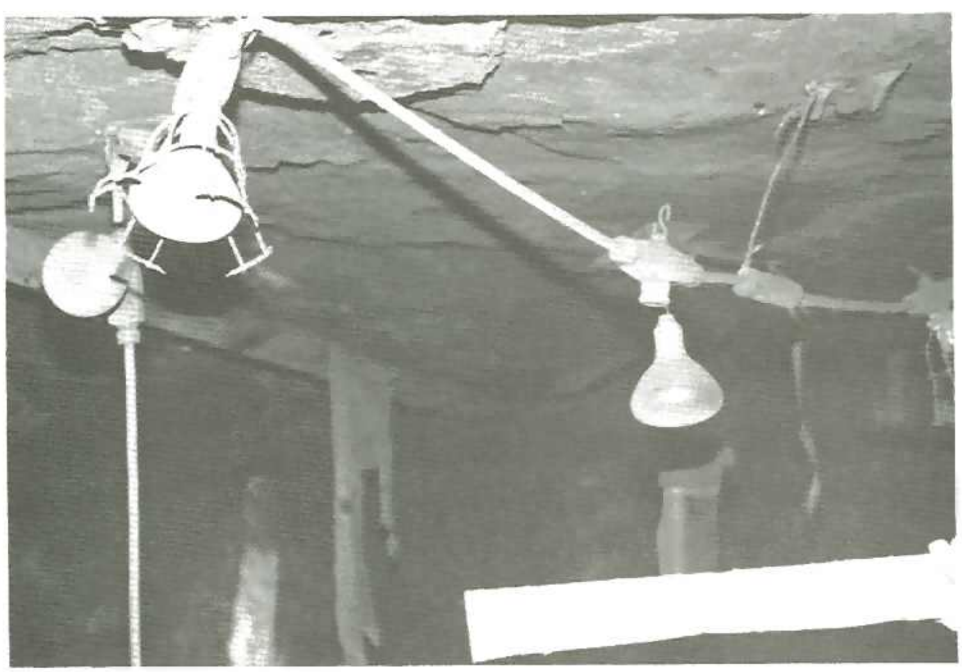


View of the outby end of power center.

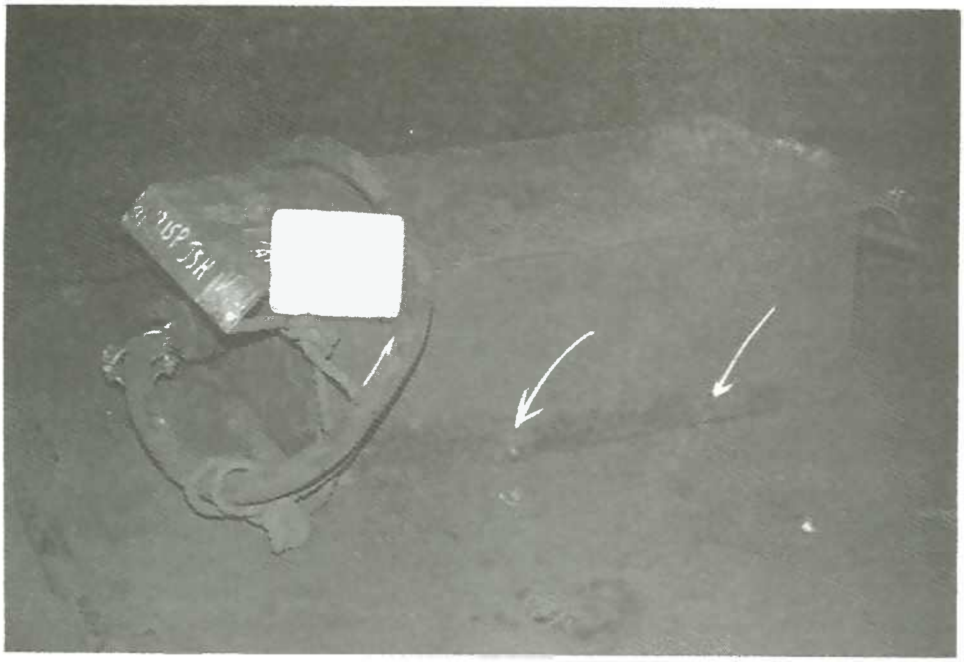
Portion of the power center lighting circuit
and supply cable marked "Dinner Hole Lights"
found 150 feet inby the power center.



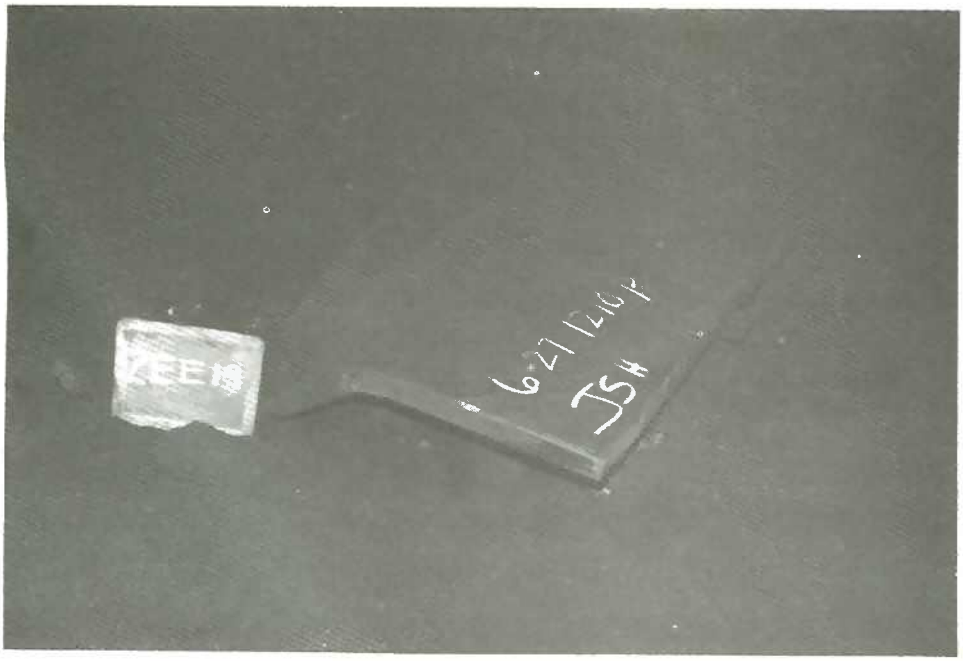
Incandescent lights hanging in dinner hole.



Incandescent lights hanging in dinner hole.

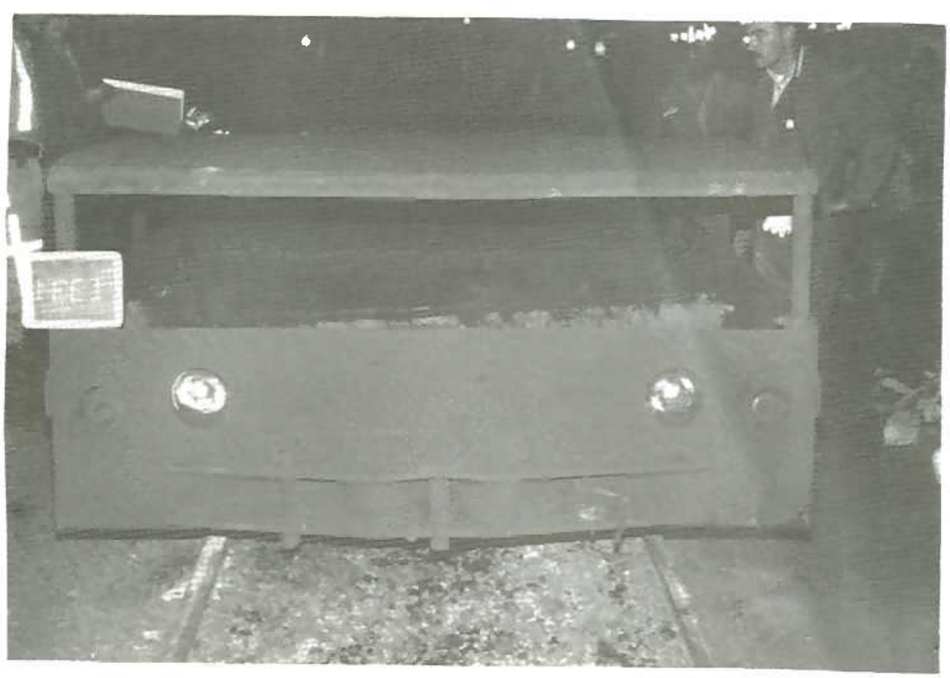


High-voltage splice box found in the No. 3 entry approximately 140 feet outby it's original location.



Lid to high-voltage splice box found in the intersection of the No. 3 entry and the No. 24 Left crosscut, 200 feet outby it's original location.

Outby end of the 2 Left section personnel carrier.



Inby end of the 2 Left section personnel carrier.