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U. S. Department of Labor

Mine Safety and Health Administration
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213

PITTSBURGH HEALTH TECHNOLOGY CENTER
Ventilation Division

November 30, 1989

MEMORANDUM FOR JOSEPH GARCIA
District Manager, CMS&H, District 7,
Barbourville, Kentucky

THROUGH: ROBERT G. PELUSO R. Dury
Chief, Pittsburgh Health Technology Center

EDWARD J. MILLER EJM
Chief, Ventilation Division

: Report of Investigations, Conducted at the
Jim Walter Resources, Incorporated, Mine No 4

Attached is the final report of the Mine Ventilation Pressure-Air Quantity and Face Ventilation Investigations conducted at the Blue Creek No. 4 Mine, Brookwood, Alabama, from September 18-20, 1989

Four additional copies of the report are attached for distribution to the appropriate parties. If you have any questions, or if you wish to arrange a meeting to discuss this report, please contact this office at FTS 721-8268 or 721-8462.

Attachments

cc: J. Urosek
W. Francart
G. Smith
G. Wirth
[redacted]
Vent. Files-6030(1) Ventilation Reports

MT:JDenk:gh:JD-Covers:11/22/89
Rm. D-243:PGH:Ext. 375

AB14- HEAR-5E
AB18- HEAR-5E

UNITED STATES DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
TECHNICAL SUPPORT

PHASE I

MINE VENTILATION PRESSURE-AIR QUANTITY AND FACE VENTILATION INVESTIGATIONS

Investigative Report No. P318-V222

Blue Creek No. 4 Mine - I.D. No. 01-01247
Jim Walter Resources, Incorporated
Brookwood, Tuscaloosa County, Alabama

September 18-20, 1989

by

Gary E. Smith, Gary J. Wirth and Joseph M. Denk

Originating Office

Pittsburgh Health Technology Center
Ventilation Division
Edward J. Miller, Chief
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213

PHASE I

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Gary E Smith[1], Gary J Wirth[2] and Joseph M. Denk[3]

INTRODUCTION

From September 18-20, 1989, concurrent ventilation pressure-air quantity, face ventilation and dust investigations were conducted by personnel from the Pittsburgh Health Technology Center (PHTC) at the Blue Creek No. 4 Mine, Jim Walter Resources, Incorporated, Brookwood, Alabama. This report includes the results of the limited pressure-air quantity and face ventilation investigations. A separate report of the dust investigation will be forthcoming from the Dust Division, PHTC.

The purpose of the investigations was to gather sufficient data to evaluate the ventilation system on the Longwall No. 2 Section in the northwest quadrant of the mine. These investigations comprised Phase I of a three phase project requested by the District Manager, Coal Mine Safety and Health (CMS&H) District 7, to assist in the review of the Ventilation System and Methane and Dust Control Plan for the Blue Creek No. 4 Mine as it relates to longwalls. A list of personnel participating in the investigations is included as Appendix I.

Phases II and III will involve similar investigations on the Longwall No. 2 Section and the Longwall No. 1 Section located in the southwest quadrant of the mine. The scheduling of these two

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[1] Mining Engineer, Ventilation Division, PHTC

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[3] Mining Engineer, Ventilation Division, PHTC

phases is dependent on the rate of mining as each section approaches the middle and end of the panel extraction.

GENERAL INFORMATION

The Blue Creek No. 4 Mine was opened by four intake airshafts and two return airshafts into the Blue Creek Coalbed, which was approximately 96 inches thick. Coal was produced on four developing continuous miner sections and two retreating longwall sections. The Longwall No. 1 (panel dimensions: 780 feet by 5,500 feet) and the Longwall No. 2 Sections (panel dimensions: 850 feet by 5,100 feet) are to be included in the three phase project. Daily coal production was 12,000 tons. Coal was transported from the sections to the skips at the production shaft by a network of belt conveyors. The service shaft was used for transporting personnel and supplies from the surface. Battery and diesel rail vehicles were used for transport throughout the mine. The total underground employment was 500 persons.

At the time of the investigations, the mine utilized an extensive underground and surface degasification program to recover [illegible].4 million cubic feet per day (cfd) of methane. This system combined in-seam horizontal drainage prior to mining with vertical gob well drainage after mining. The horizontal degasification program involved drilling in-seam boreholes spaced 250 feet apart, along the length of a developing longwall panel. The horizontal boreholes were connected to an underground pipeline for methane drainage. Once the longwall retreat approached a borehole location, the borehole was converted for water infusion to allay dust concentrations on the active face as it mined through the immediate area. There were approximately 90 horizontal boreholes on-line for methane drainage producing 1.4 million cfd. The vertical gob well program consisted of drilling boreholes from the surface prior to retreat mining (an average of three wells per panel) through the New Castle Coalbed, which was located approximately 30 to 50 feet above the proposed longwall panel. The vertical boreholes were connected to a commercial pipeline to recover methane and were left on-line after mining was completed on the panel. There were approximately 24 gob wells on-line producing 12.0 million cfd of methane. In addition to the methane captured by the degasification system, the mine liberated approximately 16.0 million cfd of methane to the atmosphere through the existing mine fans.

BACKGROUND LONGWALL NO 2 SECTION

Figure 1 is a copy of the mine map showing the Longwall No. 2 Section. The section was the seventh successive longwall unit, or "G" Panel, driven north off of the 3 West entries. As each panel was retreated it added to the total area of the Northwest Gob (approximately 1.25 square miles). The mine practiced a system of progressive sealing (a.k.a. progressive ventilation) in which the expanding Northwest Gob was sealed on three sides (north, east and south) with the exception of the previous mined-out panel abutting the active longwall section. The perimeter of this open portion of the gob was ventilated with a split of airflow regulated by the NW and SW Gob Vents (Figure 1). The environmental monitoring system installed at the mine was used to monitor continuously for methane (CH_4) and carbon monoxide (CO) concentrations at these two gob vents. According to the Ventilation System and Methane and Dust Control Plan, the methane monitors were set to alert at 1.5 percent and the carbon monoxide monitors were set to alert at 35 ppm. The alarm levels were set at 2.0 percent methane and 50 ppm carbon monoxide.

The section had been developed with a panel width of 850 feet and a length of 5,100 feet. At the time of the investigations, the panel had been retreated approximately 1,350 feet. The longwall unit had experienced the "first fall" of the immediate roof inby the shield supports prior to the investigations. The active face was mining through an area of unstable roof caused by geological anomalies in the coal seam and the immediate roof strata. On several occasions mining was interrupted by large rock falls on the panline. At these times, the rocks were either broken with the shearer or shot with explosives.

The longwall panel had been drilled with 18 horizontal in-seam degasification boreholes along the panel length and one active vertical gob well located approximately 1,000 feet inby the active face. However, according to a company representative the horizontal boreholes in the portion of the panel encompassed by the face ventilation investigation had not been effectively used for degasification or water infusion due to geological anomalies in the coal seam which prohibited drilling full length boreholes. Reportedly, the methane production prior to the investigations from the horizontal boreholes in the panel could not be discriminated from the total 1.4 million cfd collected by the horizontal degasification system.

The section mined coal on three shifts per day using an Anderson Mavor Model 500 Double Drum Shearer. A 54 inch diameter drum with 54 bits and a 30 inch web depth was located on the headgate and tailgate sides of the machine. Two operators positioned at either end of the shearer controlled its movement across the face. The section employed a unidirectional mining sequence in which coal was mined during a cutting pass traversing the face from the tailgate to the headgate entries. The return or cleanup pass traversed the face in the opposite direction. Reportedly, normal production for the section involved three to four cutting passes of the shearer along the face, or 3,000 to 4,000 tons. Tonnages mined on the section during the three shifts of the investigations were 2,300, 925 and 3,200 tons, respectively.

According to the Ventilation System and Methane and Dust Control Plan, a methane monitor was installed on the tailgate of the active longwalls to monitor any movement of gob gas toward the longwall. The methane monitor for the No. 2 Longwall was located on the panline at the No. 170 shield as shown in Figure 2.

Approximately 172 Thyssen 2-legged 575 ton shields were used for roof control across the longwall face. Each shield had been modified with a Kloechner ram system and Gullick-Dobson valve bank. The shields were manually advanced by four shield setters that were responsible for 43 shields each.

LIMITED MINE VENTILATION PRESSURE-QUANTITY INVESTIGATION

MINE VENTILATION

During the investigation, airflow was induced into the mine by three surface mounted exhaust fans. At the South Return Shaft a Joy Axivane Mine Fan, Model M144-79-890, operated at a pressure of 10.3 inches of water and a fan speed of 880 RPM. At the North Return Shaft two TLT Babcock, Incorporated Variable Pitch Axial Fans, Model GAF 31.5/18-1, operated in parallel at a pressure of 15.7 inches of water and at fan speeds of 880 RPM.

The balance of airflow entering and leaving the mine is listed in Table 1. The air quantities were provided by the Engineering Department at the mine from a ventilation survey conducted prior to the investigations.

LONGWALL NO. 2 SECTION VENTILATION

Figure 3 is a ventilation schematic showing mine airflow direction, air quantities and ventilating pressures throughout a limited area of the mine immediately surrounding the Longwall No. 2 Section. The ventilating pressures shown at various locations are given to the nearest 0.01 inches of water and the air quantities are given to the nearest 1,000 cfm (100,000 cfm is shown as 1.00). The air quantities and pressures have been balanced and are suitable for digital computer forecasting of the effects of changes to the segment of the ventilation system encompassed by the investigation. Also, included in the figure are the locations of vacuum bottle air samples (10 cc) taken throughout the area. The numbered locations correspond to the analytical results in the table included as part of the figure. Each 10 cc bottle sample was analyzed for oxygen (O_2), methane (CH_4), and carbon dioxide (CO_2). The sample analyses indicate acceptable air quality at all locations.

Intake airflow for the section was supplied through the West Intake Shaft and was directed to the face through three separate intake entries: the belt conveyor entry (in accordance with petition for modification and decision granting petition to use belt air at the face), the track entry and a separate intake escape entry. Air quantities measured at the mouth of the section in these entries totaled 271,000 cfm. Air quantities measured along the active face on each shift averaged 57,200 cfm on the headgate side and 44,700 cfm on the tailgate side. However, the face air quantities measured during the second shift were used for the ventilation balance shown in Figure 3, since the majority of the air quantity measurements were taken at that time. The average face air quantities indicated that 12,500 cfm (22 percent of available airflow) was lost as leakage to the gob through the shields along the face. A separate split of intake airflow (50,000 cfm) was also directed through one of the tailgate entries and was used primarily to ventilate the perimeter of the Northwest Gob. Of this split, 31,000 cfm exited the SW Gob Vent, 18,000 cfm entered the northern bleeders through the NW Gob Vent and 1,000 cfm mixed with the return airflow on the tailgate side of the longwall.

Return airflow from the section was directed to the single return entry on the headgate side (27,000 cfm) or to the northern bleeder entries (244,000 cfm). Of the airflow that entered the northern bleeder entries, 81,000 cfm entered through the regulators on the headgate entries, 45,000 cfm entered through the regulators on the tailgate entries, 103,000 cfm entered through the NW Gob Vent and 15,000 cfm entered as leakage through the permanent stoppings adjacent to the regulators in the headgate and tailgate entries. All of the return airflow from the section was directed to the North Return Shaft.

VENTILATION PRESSURE GRADIENTS

Figure 4 shows the ventilation pressure losses incurred by airflow traveling from the mouth of the Longwall No. 2 Section to the NW Gob Vent. The gradient was constructed by plotting the total pressure at selected locations against the distance of the location from the mouth of the section. The steeper the slope on the pressure gradient, the greater the pressure loss per unit length. Increased or relatively higher pressure losses could be the result of high resistance to airflow or a high air quantity. Table 2 summarizes the major pressure losses for each segment shown on the pressure gradient.

Each of the segments on the gradient has little or no slope, indicating that at the time of the investigation there were no areas of high pressure loss within the portion of the mine around the Longwall No. 2 Section. Therefore, there are no needed improvement in terms of pressure losses.

FACE VENTILATION INVESTIGATION

TEST PROCEDURE AND INSTRUMENTATION

Continuous remote sensing recording methanometers (CSE Corp., Model 180R) were used to detect and record methane concentrations on the Longwall No. 2 Section. The instruments were calibrated throughout the range of 0.0 to 2.0 percent methane and the recorders were driven at a rate of four inches per hour. Methane concentrations were monitored in the immediate intake entry, the immediate return entry (tailgate), the belt entry, on the shearer and at five locations across the active face (Nos. 5, 45, 85, 125, and 165 shields). Figure 5 shows a schematic of the longwall face with the typical sampling locations. The methane monitors placed in the intake, belt and return entries were hung approximately 12 inches from the roof near the center of each entry. However, along the active face this sampling method was not practical due to the adverse conditions and limited clearance above the shearer as it passed the proposed sampling locations. Therefore, a modified dust pump was used to draw an air sample from a location over the panline approximately 6 inches from the top plate of the shield through a flexible rubber tube to the methane monitor located along the walkway. A similar setup was used during two sampling shifts to draw an air sample from between the two drums on the shearer to the methane monitor mounted on the shearer body. Figure 6 shows the sampling technique used at the six locations in the active face area.

In addition to monitoring methane concentrations, a time study was conducted to relate activity on the face to the recorded methane concentrations. Air quantity measurements were taken in the belt conveyor, track and intake escapeway entries and at the No. 5 shield (face intake) and No. 165 shield (face return) on each shift. Table 3 summarizes the air quantity measurements at these locations.

METHANE DATA ANALYSIS

The information obtained from the time study was correlated with the methanometer recording charts to find the peak and average methane concentrations at each sensor location during the three sampling shifts of the investigation. Calibration curves were used to convert the recorder chart readings to methane concentrations. The recorder methane concentrations were corrected to agree with vacuum bottle air samples (10 cc) that were taken prior to each shift at the various recorder locations. Typical methane concentrations encountered during the longwall mining cycle are illustrated in Figure 7, which is a copy of four recorder charts for a six hour period on September 20, 1989.

The lowest methane concentrations on the section were recorded by the monitors in the immediate intake and belt conveyor entries.

Airflow from these two entries mixed to provide the intake airflow for the active face. At each monitor location along the face the lowest methane concentrations (0.11 - 0.58 percent) were recorded prior to mining at the beginning of the shift and gradually increased from the No. 5 shield to the No. 165 shield. As shown in Figure 7, the methane concentrations increased during mining. The methane concentrations remained elevated for the remainder of the shift at the return side monitor locations, except during idle periods when methane concentrations fell to the initial baseline levels.

The highest methane peaks (0.15 - 1.02 percent) recorded during mining occurred as the shearer moved by the monitors on a cutting pass. Two of these short duration (less than one minute) methane peaks exceeded 1.0 volume percent. These methane peaks (1.02 percent) occurred at the No. 125 shield directly above the shearer as it passed this sampling station. These were the only recorded excursions over 1.0 volume percent in approximately twenty one hours of monitoring face operations.

In addition, a methane recorder was mounted on the shearer to monitor methane concentrations in between the cutting drums as close to the face as possible. Due to the adverse conditions present on the section, falling face coal and rocks from the immediate roof strata damaged or covered the sampling equipment on several occasions. Therefore, the amount of data collected on the shearer was limited to a total of approximately ten hours over two sampling shifts. However, the methane concentrations (0.14 - 0.78 percent) recorded indicated that the methane between the drums was being diluted to acceptable levels. Table 4 gives a summary of the average methane concentrations, standard deviations, and range of values recorded at each monitor location during the investigation.

METHANE LIBERATION

The amount of methane liberated on a mining section during the cutting and loading of coal is known as the peak face area methane liberation rate. From past face ventilation studies on continuous miner sections an average methane liberation rate (FL) can be calculated by substituting the average intake and peak return methane concentrations (C_I and C_R, respectively) and the air quantity passing over the return recorders (Q_R) into the following equation:

$$FL = [(C_R - C_I) \times Q_R] / 100.$$

However, to use this equation, the total amount of methane released by the mining activity must be directed to the immediate return monitoring station. During the investigation on the Longwall No. 2 Section trying to quantify the results by calculating an average face area methane liberation rate was impossible, since a portion of the methane released during mining was lost to the gob with airflow leakage through the shields.

From methane data collected at monitoring stations along the face, it was obvious that the exposed longwall face liberated methane at all times and mining significantly increased the rate at which it was released. In addition, the methane concentrations gradually built up from the headgate to the tailgate side of the longwall face over the course of the production shifts. To calculate the increase in methane (EM) from the headgate to the tailgate side of the longwall face over the course of a production shift, the equation was modified as follows:

$$EM = [(C_R \times Q_R) - (C_I \times Q_I)] / 100$$

where,

EM = Estimated increase of methane from the headgate to the tailgate side of the longwall face, cfm,

C_R = Average peak methane concentration in the face return (No. 165 shield), percent,

Q_R = Air quantity passing over face return recorder, cfm,

C_I = Average peak methane concentration in the face intake (No. 5 shield), percent,

Q_I = Air quantity passing over face intake recorder, cfm.

Substituting the corresponding data from the investigation into the equation, the estimated methane increases from the headgate to the tailgate were 175, 106 and 211 cfm, respectively for the three sampling shifts.

Reportedly, a normal production shift on the Longwall No. 2 Section produced coal from three or four cutting passes of the longwall face. On the third shift, the section produced 3,200 tons from three cutting passes. Therefore, the value of 211 cfm from this shift can be used as an estimate of the increase in methane from the headgate to the tailgate side of the longwall for a normal production shift.

CONCLUSIONS

1. The Longwall No. 2 Section had been developed with a panel width of 850 feet and a length of 5,100 feet. At the time of the investigation, the panel had been retreated approximately 1,350 feet.

2. The section was the seventh consecutive longwall unit driven north off of the 3 West entries. As each panel was retreated, it added to the total area of the Northwest Gob.

3 The open portion of the Northwest Gob was ventilated by a split of airflow, which was regulated at the NW and SW Gob Vents. The Gob Vents were monitored by the environmental monitoring system continuously for methane and carbon monoxide.

4 The mine utilized an extensive underground and surface degasification program to recover 13.4 million cfd of methane from the mine.

5 The mine liberated 16.0 million cfd of methane through the existing mine fans.

6 Prior to the investigations, degasification on the Longwall No. 2 Panel had been conducted through eighteen in-seam horizontal boreholes and one vertical gob well. However, the horizontal boreholes in the area of the panel encompassed by the face ventilation investigation had not been effectively used for degasification or water infusion due to the geological anomalies in the coal seam.

7 Normal production for the section was 3,000 to 4,000 tons per shift. Tonnages mined during the three shifts of the investigations were 2,300, 925 and 3,200 tons, respectively.

8 The analyses of vacuum bottle air samples collected during the investigations indicated that there was acceptable air quality in the outby areas around the longwall face.

9 The available intake airflow for the longwall unit at the mouth of the section was 271,000 cfm.

10. Air quantities measured along the active face averaged 57,200 cfm on the headgate side and 44,700 cfm on the tailgate side for the three sampling shifts.

11 The lowest methane concentrations in the face area were recorded prior to mining. The highest methane concentrations in the face area were recorded during mining as the shearer passed each monitor location on a cutting pass.

12 The highest methane peaks during mining (1.02 volume percent) were recorded at the No. 125 shield directly above the shearer as it passed the sampling station.

13 The methane concentrations recorded on the shearer between the two drums were being diluted to acceptable levels.

14 The methane concentrations gradually built up from the headgate to the tailgate side of the longwall face over the course of the production shifts.

15 The highest average increase in methane from the headgate to the tailgate side of the longwall face over the course of the sampling shifts was 211 cfm.

ACKNOWLEDGEMENT

The cooperation and courtesies extended by mine management and union members during the investigations is greatly appreciated

Gary E. Smith
Mining Engineer

Gary J. Wirth
Mining Engineer

Joseph M. Denk
Mining Engineer

Approved by:

Edward J. Miller
Chief, Ventilation Division

Table 1 Balance of Airflow Entering and Leaving the Mine.

Intake Shafts	Quantity (cfm)	Return Shafts	Quantity (cfm)
Service	395,000	South	1,103,000
Production	552,000	North	2,160,000
Main Intake	756,000	Total -	3,263,000
West Intake	1,560,000		
Total -	3,263,000		

Table 2 Summary of Major Pressure Losses Through the Mine Aircourses Around the Longwall No. 2 Section.

Mine Segment	Total Pressure Loss (inches of water)
Surface to Longwall No. 2	3.04
Mouth of Section to Longwall Face	1.00
Headgate to Tailgate (Face)	0.68
Tailgate to Regulators (Tailgate Entries)	0.04
Regulator Loss	5.10
Regulators to NW Gob Vent	0.03
Total -	9.89

Table 3 Summary of Air Quantities Measured on Each Sampling Shift of the Face Ventilation Investigation.

Location	9-18-89 (cfm)	9-19-89 (cfm)	9-19-89 (cfm)
Intake Escapeway	104,400	102,900	96,500
Track Entry	107,700	91,800	96,000
Belt Conveyor Entry	62,100	65,700	64,100
Total -	274,200	260,400	256,600
Longwall Face:			
Headgate (No. 5 shield)	63,900	52,600	55,100
Tailgate (No. 165 shield)	55,300	38,700	40,000

Table 4. Summary of Average Methane Concentrations, Standard Deviations, and Range of Values Recorded at Each Monitor Location.

Monitor Location	9-18-89 (% Methane)	9-19-89 (% Methane)	9-20-89 (% Methane)
Intake:			
Average	0.13	0.12	0.11
Std. Dev	0.02	0.02	0.01
Range	0.08 - 0.17	0.10 - 0.16	0.10 - 0.16
Belt:			
Average	0.16	0.20	0.19
Std. Dev	0.02	0.03	0.02
Range	0.14 - 0.19	0.16 - 0.23	0.15 - 0.21
No. 5 Shield			
Average	0.15	0.13	0.19
Std. Dev.	0.02	0.02	0.02
Range	0.13 - 0.20	0.11 - 0.15	0.17 - 0.23
No. 45 Shield:			
Average	0.31	0.42	0.44
Std. Dev.	0.03	0.01	0.05
Range	0.22 - 0.38	0.41 - 0.47	0.33 - 0.56
No. 85 Shield			
Average	0.40	0.53	0.60
Std. Dev.	0.04	0.02	0.12
Range	0.34 - 0.48	0.50 - 0.61	0.36 - 0.99
No. 125 Shield			
Average	0.52	0.63	0.82
Std. Dev.	0.03	0.03	0.10
Range	0.45 - 0.61	0.58 - 0.74	0.42 - 1.02
No. 165 Shield:			
Average	0.49	0.45	0.79
Std. Dev.	0.02	0.02	0.07
Range	0.46 - 0.53	0.42 - 0.58	0.56 - 0.91
Tailgate Return:			
Average	0.49	0.44	0.48
Std. Dev.	0.05	0.04	0.04
Range	0.36 - 0.61	0.39 - 0.62	0.24 - 0.61
Shearer:			
Average	0.48	0.28	-
Std. Dev	0.09	0.13	-
Range	0.27 - 0.61	0.14 - 0.78	-

APPENDIX 1

Personnel participating in the investigations conducted at the Blue Creek No. 4 Mine, September 18-20, 1989, are as follows:

MSHA - PITTSBURGH HEALTH TECHNOLOGY CENTER

J Denk, Mining Engineer, Ventilation Div.
R. Ondrey, Mining Engineer, Dust Div.
G. Smith, Mining Engineer, Ventilation Div
G. Wirth, Mining Engineer, Ventilation Div

MSHA - COAL MINE SAFETY AND HEALTH, DISTRICT 7

J Saunders, Coal Mine Inspector, Jasper Field Office

JIM WALTER RESOURCES, INCORPORATED

W. Andrews, Safety Supv., Mine No. 4
J. Casner, UMWA Safety Rep.
J. Cooley, Mine Manager, Mine No. 4
D. Hagood, Sr. Engineer, Mine No. 4
B. Hendrix, Asst. Safety Supv., Mine No. 4
D. McAteer, UMWA Safety Rep.
T. McNider, Deputy Mgr. Ventilation, CMO
G Nicosia, Hort. Degas. Coordinator, Mine No. 4
T. Sartain, Ventilation Engineer, CMO
D. Scott, Ventilation Engineer, Mine No. 4
L. Scott, Asst. Safety Supv., Mine No. 4
J. Stevenson, Mgr. Ventilation, CMO
and
The Longwall No. 2 Section Dayshift Crew

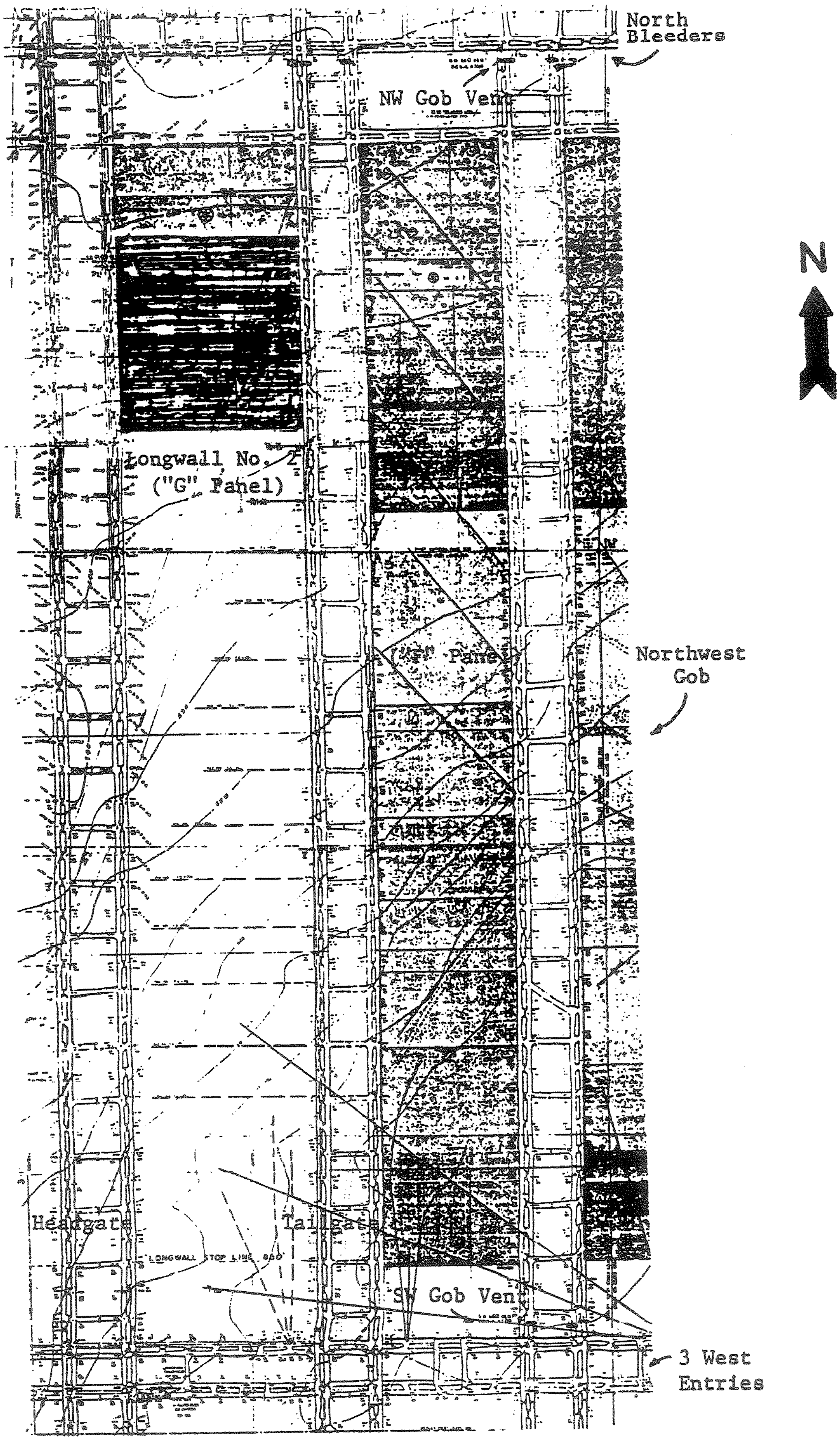


FIGURE 1 - Copy of Map Showing Area Around Longwall No. 2

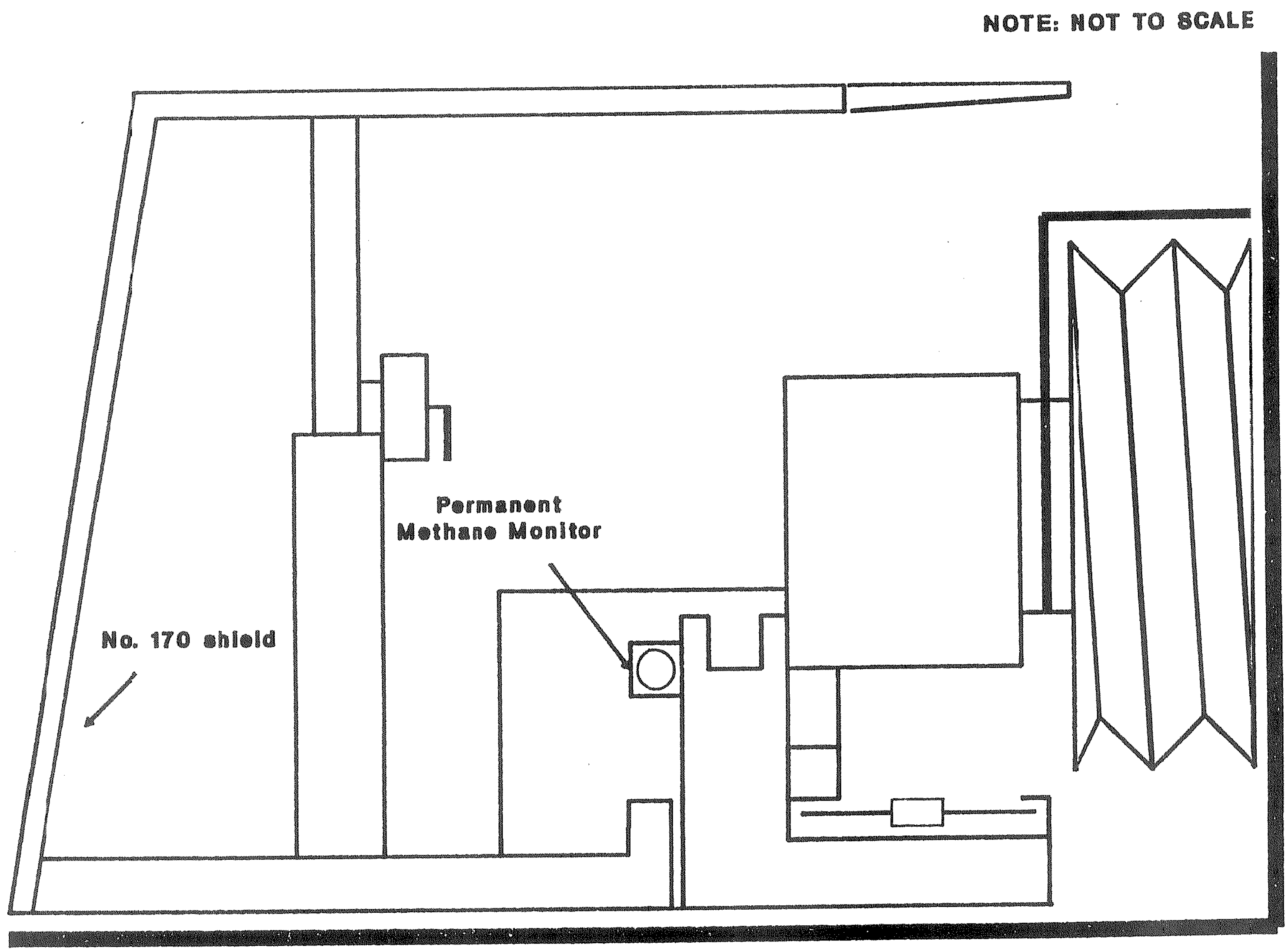
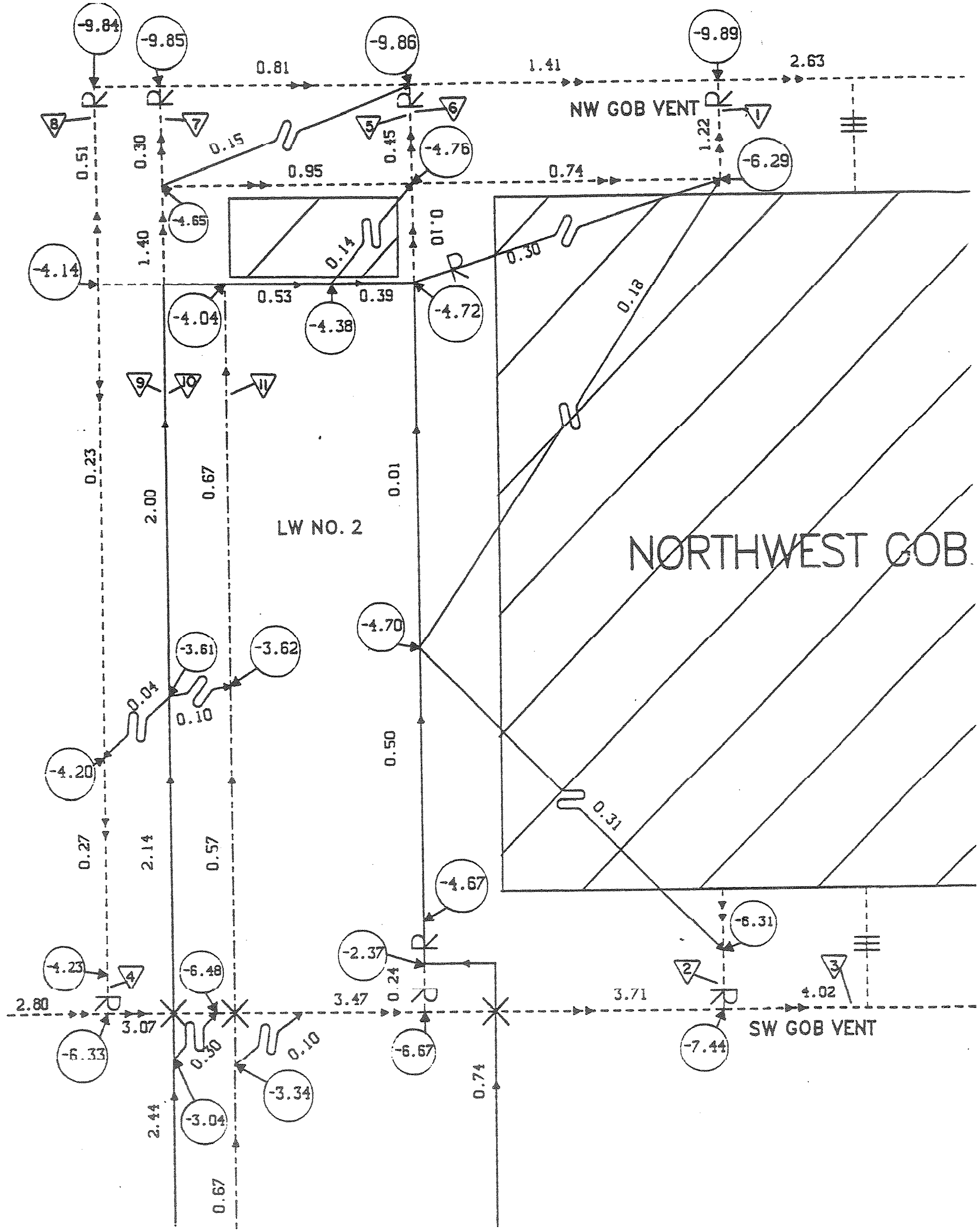


FIGURE 2 - Location of Methane Monitor on Longwall Tailgate



NW GOB VENT
SW GOB VENT
LW NO. 2
NORTHWEST GOB
-9.84
-9.85
-9.86
-9.89
0.81
1.41
2.63
0.51
0.30
0.15
0.45
1.22
-4.76
-6.29
0.95
0.74
-4.65
1.40
0.14
0.10
0.30
-4.14
-4.04
0.53
-4.38
0.39
-4.72
0.18
0.23
2.00
0.67
0.01
-4.70
-3.61
-3.62
0.04
0.10
-4.20
0.50
0.31
0.27
2.14
0.57
-4.67
-6.31
-2.37
-4.23
-6.48
2.80
3.07
3.47
0.24
3.71
4.02
-6.33
0.30
0.10
-6.67
-7.44
0.74
2.44
-3.04
-3.34
0.67

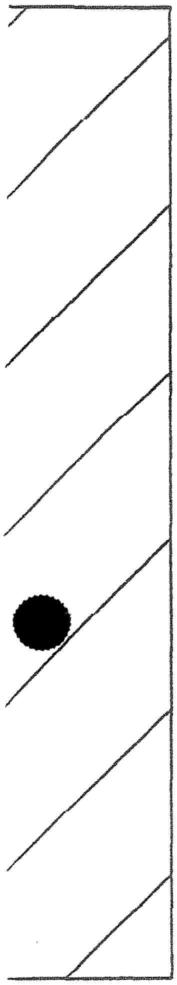


FIGURE-3

VENTILATION SCHEMATIC - NO. 2 LONGWALL

JIM WALTER RESOURCES, INC.

BLUE CREEK NO. 4 MINE

BROOKWOOD, TUSCALOOSA CO., ALABAMA

SEPTEMBER 18-20, 1989

NOT TO SCALE

LEGEND	
INTAKE AIR (100,000 CFM UNITS)	0.91
RETURN AIR (100,000 CFM UNITS)	0.62
BELT AIR (100,000 CFM UNITS)	0.16
AREA LEAKAGE (100,000 CFM UNITS)	0.23
REGULATOR	R
OVERCASTS OR UNDERCASTS	X
TOTAL PRESSURE (INCHES OF WATER)	
GOB	
SEAL	
BOTTLE SAMPLING LOCATION	

VACUUM BOTTLE AIR SAMPLE ANALYSIS

No.	Location	O2%	CH4%	CO2%
1	NW GOB VENT	20.90	0.51	0.09
2	SW GOB VENT	20.86	0.13	0.07
3	3 WEST RETURNS	20.95	0.28	0.06
4	HEADGATE RET. REG.	20.95	0.30	0.06
5	TAILGATE RET. REG.	20.95	0.09	0.05
6	TAILGAT RET. REG.	20.93	0.29	0.06
7	HEADGA RET. REG.	20.95	0.08	0.05
8	HEADGA RET. REG.	20.86	0.36	0.05
9	INTAKE .SCAPEWAY	20.90*	0.05	----
10	TRACK (INTAKE)	20.90*	0.04	----
11	BELT ENTRY	20.80*	0.14	----

* HANDHELD READING (MX240)

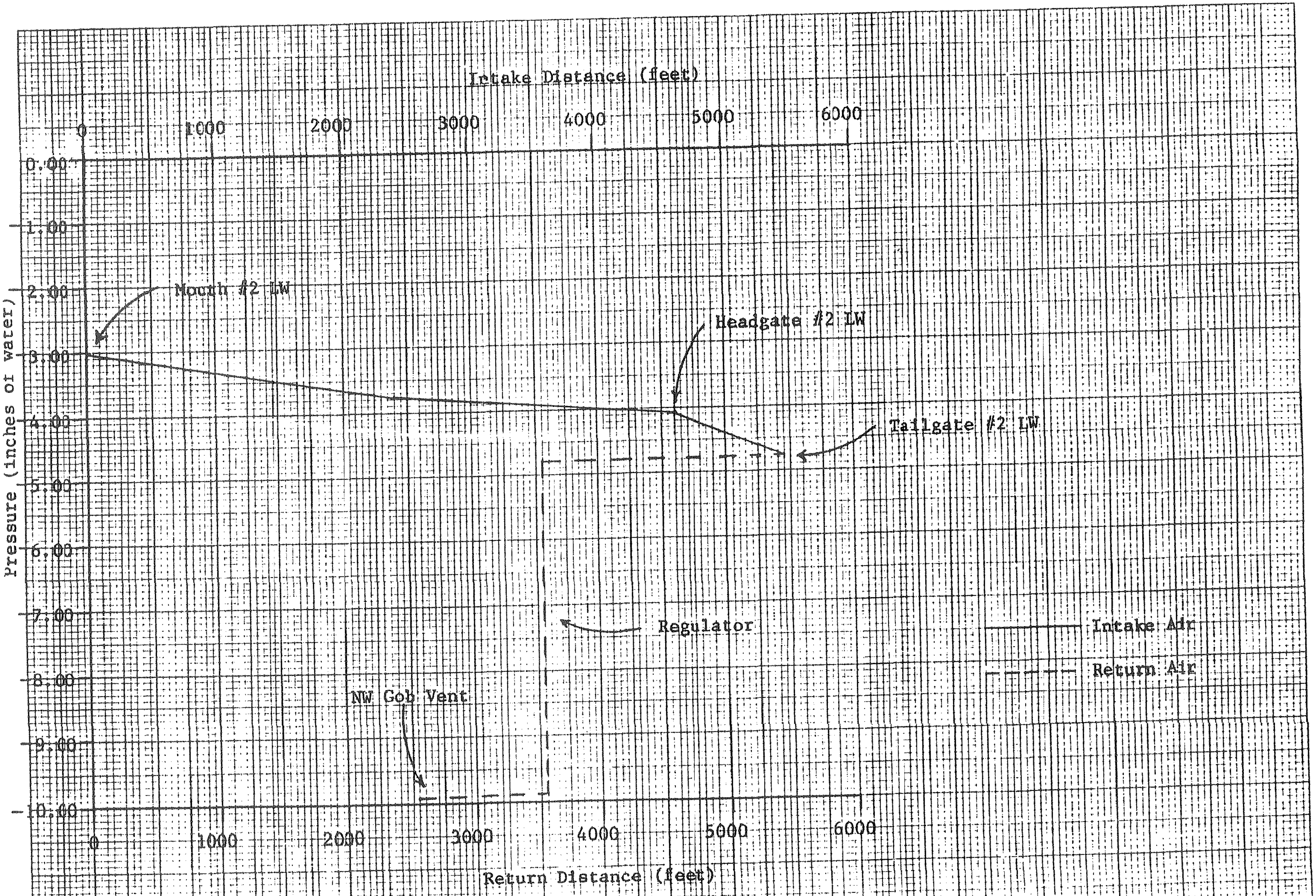


FIGURE 4 - Pressure Gradient for Longwall No. 2 Section

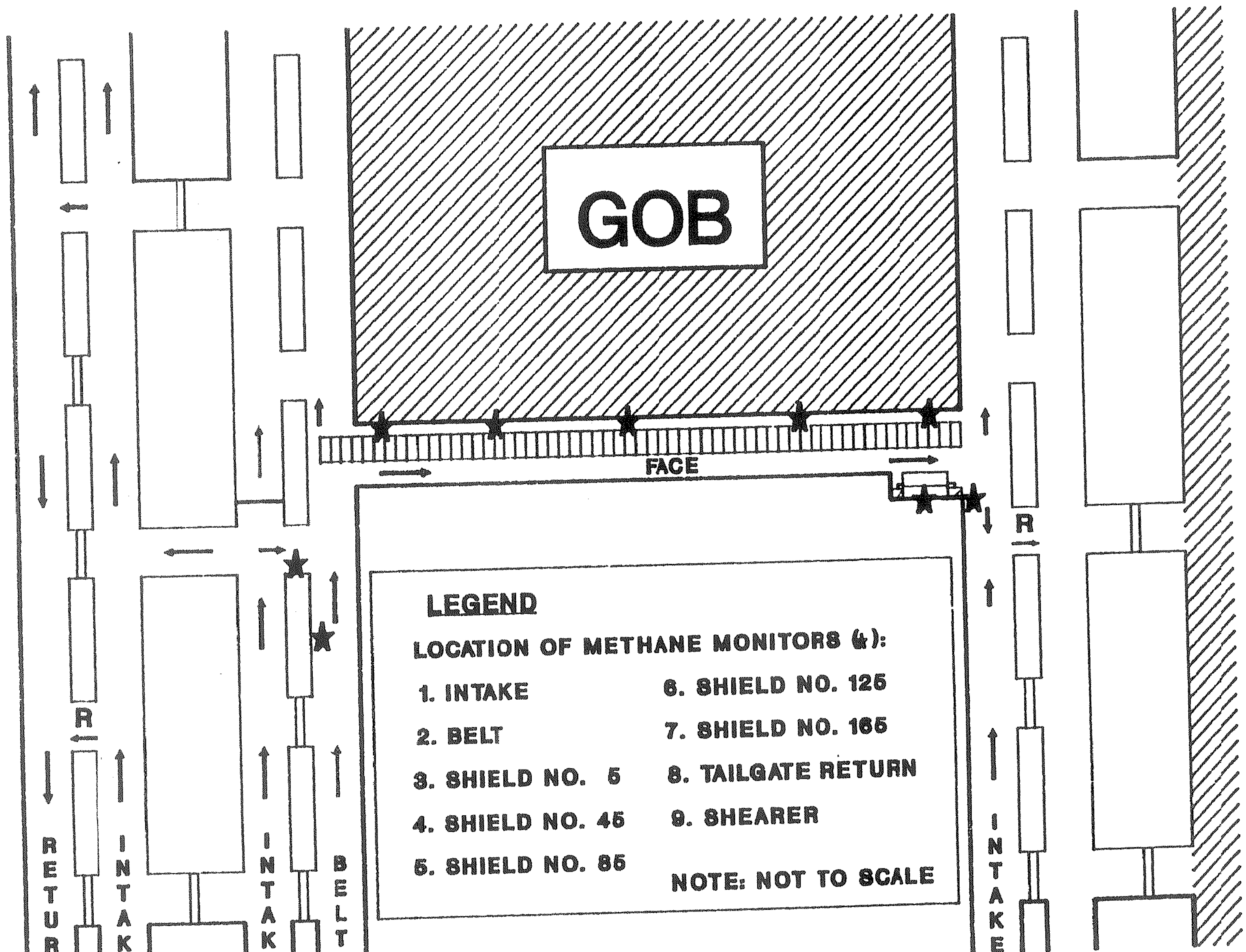


FIGURE 5 - Section Diagram

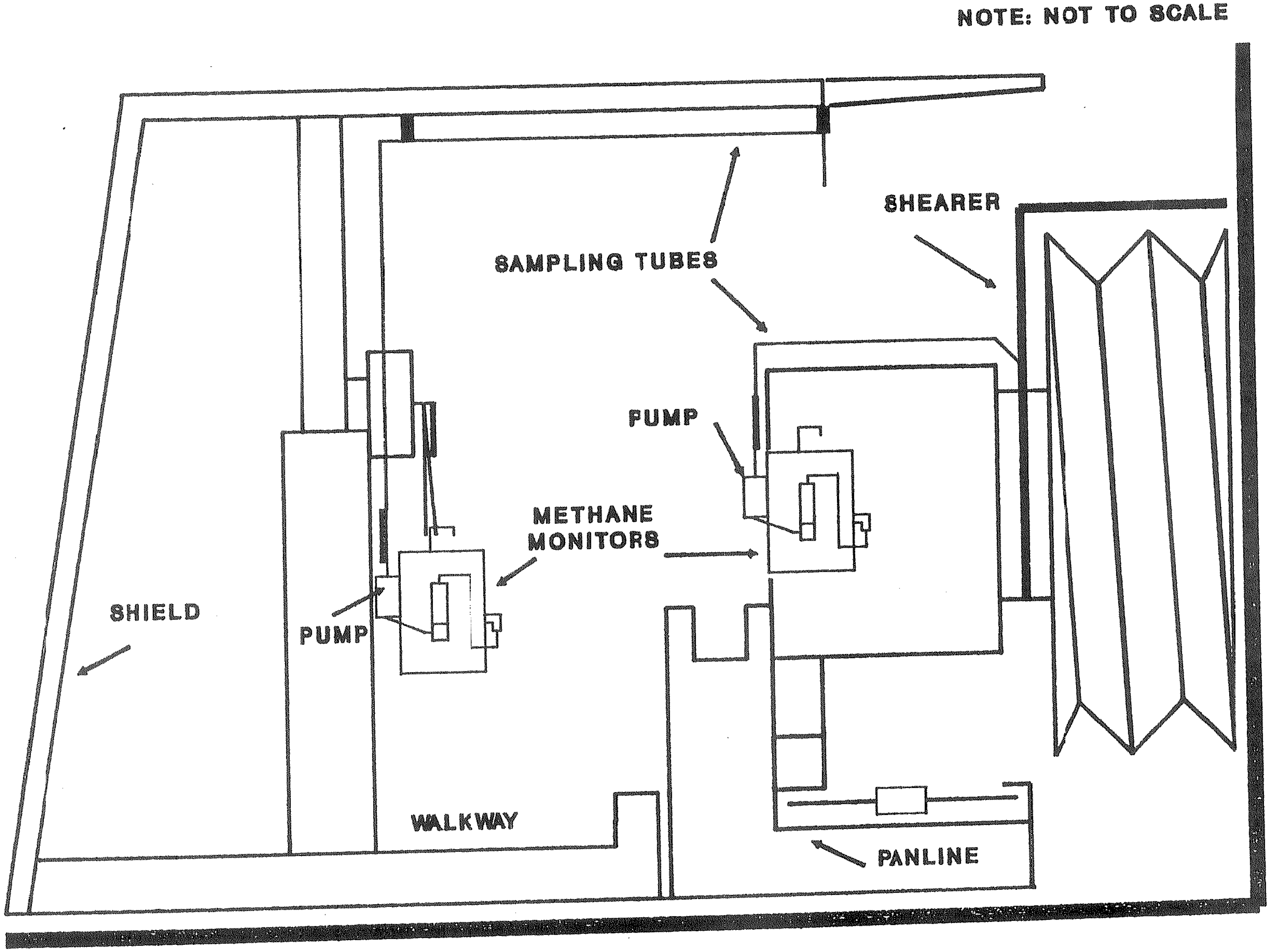


FIGURE 6 - Methane Sampling Setup in Face Area

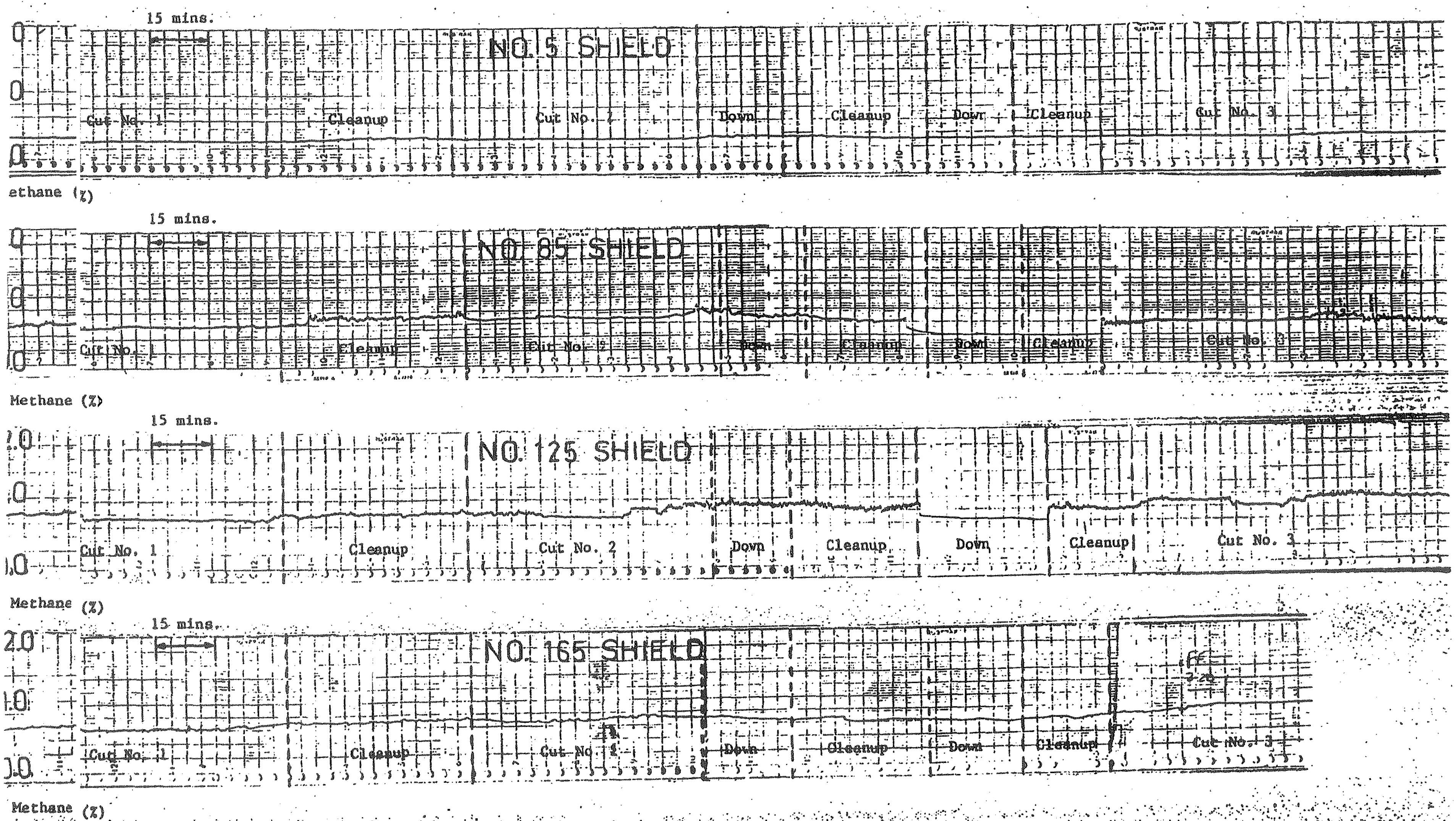


FIGURE 7 - Copy of Methane Recorder Charts