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MASTER

Technical Project Officer
U. S. Department of Energy
Carbondale Mining Technology Center
P. O. Box 2587
Carbondale, Illinois 62901

Attention: Mr. Robert Wenzel

Gentlemen:

Site Selection Report Characterization of Subsidence over Longwall Mining Panels

We have completed our evaluation of candidate longwall mines available for study in the Rocky Mountain Coal Province. This report summarizes our views and evaluation of two candidate mines, the Allen Mine in Weston, Colorado, and the Hawk's Nest Mine in Somerset, Colorado. WCC visited the Allen and the Hawk's Nest Mines, and rated them in order of preference for subsidence monitoring according to criteria given in this report.

Based on these evaluations and related discussions with the Technical Project Officer, the Hawk's Nest Mine appears to be the preferred mine for subsidence monitoring, because it is the only candidate mine offering two adjacent longwall panels for monitoring wherein a full subsidence profile may be obtained for at least one of the panels. Selection of this mine requires that provisions be made for monitoring 2,000 ft of overburden, whereas our proposal addressed a mine with 600 ft of overburden. Changes in instrumentation which may permit the project to remain within the current budget were investigated and are discussed in this report.

The report is submitted for review by the Technical Project Officer, for approval of the Hawk's Nest Mine and a modified instrumentation program to suit conditions at that mine, as provided by Section 3.1.1.2 and

Consulting Engineers, Geologists
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Section 3.1.3.2 of the Contract Specifications. Detailed, site-specific instrumentation plans will be prepared in Task 2 once DOE has approved the recommended mine and modified program for monitoring. Please telephone us if you have any questions or wish to arrange a meeting to review selection criteria or recommendations.

Sincerely,

Pamela H. Rey

Pamela H. Rey
Staff Engineer

J. E. O'Rourke
John E. O'Rourke
Project Manager

adb

Attachments: Site Selection Report
Mine maps (to TPO only)

cc: Contract Specialist, Acquisition and Assistance Division
Patent Office
Special Assistant for Reproduction and Processing
Office of Mining

TASK 1 - SITE SELECTION

This report presents results of our site selection study, Task 1 in our program plan. Table 1 shows a compilation of longwall mining operations in the Rocky Mountain Province. Preliminary criteria that eliminated mines from consideration included excessive overburden (2,500+ ft), no current longwall operations, or conflicts in terms of subsidence monitoring by other agencies. Site visits were then made to two remaining candidate mines; to the Hawk's Nest Mine in Somerset, Colorado, on December 15, 1980, and to the Allen Mine in Weston, Colorado, on January 19, 1981. The evaluation team included John O'Rourke and Pamela Rey (WCC) and John Abel, consultant.

Site descriptions of the two mines are included as Appendices A and B. The two sites were rated according to criteria detailed in Table 2. Table 3 shows the site evaluation matrix in which both mines are rated. Although the Allen Mine scored slightly higher for the criteria and weighting system used, the difference in composite scores is not very significant. Major advantages and disadvantages of both mines are summarized in Table 4.

While the Allen Mine is 800 ft shallower than the Hawk's Nest Mine, DOE has stressed the need to monitor the complete subsidence behavior of at least one of the two adjacent longwall panels. At the Allen mine two adjacent longwall panels are currently being mined, and some subsidence over the second panel is expected to have occurred by the time any surface survey monuments are available for monitoring. A detailed surface survey of topography over the second panel prior to mining is not available, and therefore a comprehensive record of ground response to subsidence over the complete length of panel is not possible. Mining of additional adjacent panels at the Allen Mine is not planned for the near future.

The Hawk's Nest Mine in Somerset, Colorado, started its first 428-foot wide longwall panel in November, 1980, and completion of the 4,700 ft long panel is anticipated at the end of 1981. Mining of the adjacent panel is planned to start at the beginning of 1982. A third adjacent panel in the longwall

section is scheduled to start in May, 1982 and to be completed in December, 1982. See Appendix B for topography, mine plan and scheduling at Hawk's Nest.

Selection of the first two panels (November '80 and January '82) for the study is one option. Note, however that for a 2,000 ft depth of mining, the angle of draw may extend subsidence effects over to panel No. 2 and hence some subsidence could already be occurring there, even though there is no mining in that panel yet. If it is essential to instrument a panel that has experienced little or no surface subsidence due to earlier mining, we would have to base our program on panels 2 and 3. This still seems feasible to accomodate in our 48-month study period, and so is recommended.

Selection of the Hawk's Nest Mine for subsidence monitoring will have certain major implications for the instrumentation plan and costs. Extension of the proposed borehole instruments to depths of 2,000+ ft may exceed the practical limits of some instruments and certainly would invoke greater costs than already estimated. An alternative approach to avoid increased costs involves comprehensive but reduced instrumentation of the second panel and emphasizes primarily surface instrumentation for the first panel. Table 5 shows a modified program of estimated equivalent cost to the original estimated program. Approval of this modified program, as provided by Specification 3.1.3.2 to offset contingencies of unexpected increased contract costs, is recommended.

TABLE 1 - WESTERN LONGWALL OPERATIONS

<u>Mine Owner</u>	<u>Mine</u>	<u>Cover (if known)</u>	<u>Comments</u>
CF&I	Allen Mine Weston, CO	1500' - 1700'	Site selection visit made, 1/19/81. Candidate.
Mid Continent	Dutch Creek + LS Wood Mines, Carbondale, CO	2500'	Gassy, 11,000 ft elevation
Kaiser Steel	York Canyon, Raton, N.M.	400'	Conflict - already monitored.
Western Slope Carbon Co.	Hawks Nest Mine Somerset, CO	1800' - 2200'	Site selection visit made, 12/15/80. Candidate.
Price River Coal Co.	Price Mine No. 3 Helper, UT	1400' - 1600'	Conflict - already monitored.
Utah Power and Light	Deer Creek Mine Emery, UT	1800'	Conflict - already monitored.
Kaiser Steel	Sunnyside No. 1 & 3 Sunnyside, UT	2500'	Rock bursts and very deep cover
GEX	Roadside Mine Palisade, CO	500' - 1600'	No equipment yet and not yet ordered.
Western Coal Co.	Farmington, NM	unknown	Possible future longwall
Coastal States	Scofield, UT	unknown	Possible future longwall
Snowmass Coal Co.	Thompson Creek No. 1 Carbondale, CO	unknown	Possible future longwall

TABLE 2 - SITE SELECTION CRITERIA

SELECTION CRITERIA	R A T I N G		
	3 (DESIRABLE)	2	1 (UNDESIRABLE)
TOPOGRAPHY	flat, low vegetation, little surface water, little surface activity	INTERMEDIATE BETWEEN 1 AND 3	rugged, mountainous, tall vegetation, swampy lakes, much traffic and other surface activity
LOGISTICS	facilities close (motels, restaurants, rental cars, airport, highway, suppliers), good surface access, good underground access (drift mine best), services available (power, water, air), experienced drilling contractors available, close to major city		facilities farther than about 30 miles, surface access requires roadbuilding or foot travel only, underground access through shaft, services must be installed, experienced drilling contractors unavailable, far from major city
MINING	longwall operation well-established, good production rates, typical panel size; adjacent panels		longwall operation recently started, marginal production rates, atypical panel size and not adjacent
COOPERATION	interested, informed, needs data, willing to sign a cooperative agreement, able to divulge data, willing to provide on-site office facilities (or field office trailer space), surface is owned by mine, mine surveyors available		tolerant, disinterested, unable/unwilling to assist, reluctant to sign a coop agreement, data proprietary, field office facilities not available, surface is privately owned, mine surveyors not available
OVERBURDEN	less than 600 ft, stable borehole walls, consistent and known geology, simple structure		thicker than 1200 ft (approximate limit of instrumentation experience), boreholes require casing, complex/variable geology, geology not mapped, steeply dipping strata, highly faulted and jointed
COAL SEAM	more than 6 ft thick, thicker than overburden thickness $\div$ 100, competent roof		less than 5 ft thick, less than OB $\div$ 100, poor roof conditions
CLIMATE	low precipitation, moderate temperatures, minimal wind, little snow		heavy precipitation, extreme high/low temperatures, much high wind, heavy snow accumulation
TIMING	scheduling compatible with program plan and estimated firm		scheduling not consistent with program plan or indefinite

TABLE 3 - SITE EVALUATION MATRIX

<u>Selection Criterion</u>	<u>Weighting Factor</u>	<u>Hawk's Nest</u>	<u>Allen Mine</u>
Topography	2	1	1
Logistics	2	1	2
Mining	1	2	3
Cooperation	3	2	3
Overburden	3	1	2
Coal Seam	2	2	1
Climate	2	2	3
Timing	3	3	1
COMPOSITE SCORE		32	35

TABLE 4 - MAJOR ADVANTAGES AND DISADVANTAGES OF EACH MINE

	<u>Advantages</u>	<u>Disadvantages</u>
CF&I Allen Mine	<ul style="list-style-type: none"> a) Good general surface access b) Experienced longwall operation c) High level of cooperation indicated (Mine would provide water + electricity to site trailer, underground transportation, compressed air, repairs, safety course) d) Not much snow in winter e) Moderate modification of instrumentation plan might avoid extra cost due to overburden depth 	<ul style="list-style-type: none"> b) Rugged topography, heavily vegetated north slopes b) Specific drill site access difficult c) Overburden up to 1200' d) Poor roof-slickensided shale, creates delays in mining e) Mine schedule - only planned adjacent panels are currently being mined, and pre-mining topography above panels not known to sufficient accuracy for comparison with post-mining topography
Western Slope Carbon Co. Hawk's Nest Mine	<ul style="list-style-type: none"> a) Mine schedule permits several monitoring options - two adjacent panels planned for 1982-1983 following completion of an adjacent panel already being mined b) Mined thickness is 9' c) Competent roof - sandy shale and sandstone 	<ul style="list-style-type: none"> a) Rugged topography, surface access difficult b) BLM owns surface c) Overburden to 2200', requires significant modification of instrumentation plan to avoid cost increase d) 6' snow cover possible, usually cannot reach surface by road vehicles, October-May e) Limited parking at mine

TABLE 5 - MODIFIED INSTRUMENTATION PROGRAM PROPOSED FOR DEEP MINE

<u>Instrument Type</u>	<u>Approximate Number Panel A</u>	<u>Approximate Number Panel B</u>	<u>Measurement</u>	<u>Location of Readout</u>	<u>Layout</u>
Survey Points Horizontal	50	50	Vertical and Horizontal Displacements and Strain	Surface	Entire Panel and Bordering Area
Horizontal Strainmeters	2	4	Traveling Horizontal Strain	Surface	Panel Center and Edges
Deep Sondex Hole		1 - 590 ft deep	Overburden + Mine Roof Strata Separation	Surface	Panel Center
6-Point Deep Hole Rod Extensometer		1 - 2000 ft deep	Overburden + Mine Roof Strata Separation	Surface	Panel Center
Observation Wells	0	1 - 1000 ft deep	Groundwater Level and Quality	Surface	Panel Center
Roof Extensometers		2 - 50 ft up	Roof Strata Separation	Mine Entry	Mine Entry
Floor Extensometers		2 - 20 ft deep	Floor Strata Separation	Mine Entry	Mine Entry
Telescoping Convergence Meter	1	2	Convergence	Mine Entry	Mine Entry
Floor Pressure Cells	1 - vertical 1 - horizontal (~50 ft)	2 - horizontal 2 - vertical (~50 and 100 ft)	Floor Stress	Mine Entry	Panel - between Edge and Center
Pillar Pressure Cells	2 - horizontal 2 - vertical	3 - vertical 3 - horizontal	Pillar Stress	Mine Entry	Panel Edge to Center
Shield Hydraulic Load Cells	2 legs on 1 shield	2 legs on 4 shields	Support Load	Longwall Panel	Panel Edge to Center
Crib Load Cells	1	2 (as needed)	Support Load	Mine Entry	Mine Entry
Instrumented Rock Bolts	2	8 (as needed)	Support Load	Mine Entry	Mine Entry

APPENDIX A

Allen Mine, Weston, Colorado

Owner: CF&I Steel Corporation

Location: Near Trinidad, Colorado

1. Topography

- steep hills and valleys
- heavily vegetated north slopes, sparser south-facing slopes
- triangulation net on surface
- elevation 7000 ft on surface

2. Logistics

- Pueblo is 2 hours away, Denver is 4 hours away
- comprehensive facilities in Trinidad, 30 miles from mine
- mine can provide parking, water, electricity for site trailer
- 2 WD access to surface
- drift access to mine
- water haulage required for surface drilling

3. Mining

- production is 1 million tons/year
- relatively ungassy
- two adjacent panels being mined, next panels not adjacent or of typical length
- dip of coal seam is less than 1°
- mining thickness is 6 ft
- mine can provide underground transportation, repairs, compressed air
- chock-supported longwall panels
- chiefly electric power

4. Cooperation

- 400 UMWA employees, 50 non-union
- 4-5 engineers, also do survey work
- enthusiastic about study
- mine provides safety training course approximately every six weeks

- CF&I leases surface, requires OSM permit for surface work
- contact is William Boies, CF&I, Pueblo

5. Overburden

- 700 to 1200 ft
- strata relatively flat-lying
- slickenside carbonaceous shale in roof causes ground control problems and mining delays
- another coal seam (4 to 5 ft thick) is located 12 to 15 ft above mined seam

6. Coal Seam

- flat, relatively consistent thickness
- seam is 7 ft thick; 6 ft is mined to leave 10-inch coal roof
- deep overburden, but within experience of instrumentation

7. Climate

- dry, sunny, 8,500 ft elevation
- little snow in winter, about one ft maximum
- does not prevent surface access

APPENDIX B

Hawk's Nest Mine, Somerset, Colorado

Owner: Western Slope Carbon, Inc. Location: Near Paionia, Colorado

1. Topography

- steep hills and river valleys
- sagebrush, scrub oak and aspen vegetation
- elevation 8,500 ft

2. Logistics

- Paionia is 10 miles from mine, Grand Junction is two hours away
- suppliers and lodging available in Paionia, Delta
- mine can provide space for 8'x32' trailer, maximum size
- surface access difficult (not visited) and snowmobile access may be necessary in winter
- drift access
- require water haulage for surface drilling

3. Mining

- fairly dry conditions
- chiefly electric power
- one panel being mined since 11/80, adjacent panels to follow in 1982 and 1983
- production ~1 million tons/year
- limited repairs available
- two continuous miner sections in addition to longwall panels
- shield-supported longwall panel
- relatively ungassy

4. Cooperation

- 300 UMW, 50 non-union employees
- 2 engineers
- surveyors contracted from Delta
- safety course offered in Paionia through a Montrose college
- BLM owns surface, OSM permit required

- mine holds USGS mining permit
- contact: Al Amundsen, Western Slope Carbon, Inc., Salt Lake City
- anticipate a need for union cards for drillers

5. Overburden

- 1800 to 2200 ft
- deep overburden, beyond some instrumentation field experience
- strata dip 4⁰
- competent roof - sandy shale and sandstone

6. Coal seam

- 9 ft mined thickness, but thickness varies

7. Climate

- dry, sunny, 8200 ft surface elevation
- approximately 6 ft of snow in winter
- winter access to surface probably requires snowmobile