This is the Ninth Quarterly Technical Report of Grant Number DE-FG01-93CE15394 entitled Kelastic Variable Wall Mining Machine. This reporting period comprised a time extension which was requested and authorized by correspondence from the Department of Energy on August 9, 1995. The work described herein was completed on the modified termination date, i.e. January 23, 1996. The Kelastic Mine Beam Company also requested a funding addition by letter on November 12, 1995 and approved by telephone on November 20, 1995. The Company was also informed on January 23, 1996 that the requested amount of $16,750 had been authorized and was in the procurement process. However, the Company has not obligated any additional funds over and above the $83,000 of the original grant.

During this period, Brush Seal Tests were continued at the WVU Mine Ventilation Laboratory in Morgantown, WV. The laboratory data on leakage which can be extrapolated to real leakage between actual underground mine chambers or zones are essential as input to the computer model. A generalized computer model of the Dual Duct system is the primary objective of this R&D project. The Test Plan of the laboratory trials follows as Appendix A.

The strategy of the testing for leakage was to obtain velocity measurements for each pressure difference across the test element. The setup used an 18" Joy Axivane fan with the test element placed in the suction side of the fan. Pitot tubes on the upstream and downstream sides of the test element measured the pressure difference while velocities were measured by pitot tubes, hot wire anemometers and vane type anemometers on both sides of the element. Initially, with single layer brush tests there was sufficient flow so that velocities could be detected by pitot tubes, or hot wire anemometers. Moreover, since the latter transducers are non-directional, erroneous results are registered either with manually viewed signals or with computer based electronic signals. Also, the location of the anemometer is critical. When situated between the test seal element and the fan, with the fan in a near stall condition, non-linear turbulent vortex-type flows cause the hot-wire anemometer to transmit those non-linear flows.

To correct this test setup, the location of the transducer was moved to the test station on the upstream side of the test element where no vortex would disrupt the linear flow measurement. Nevertheless, even very low linear flows are difficult to measure. Thus, for
each trial of a given seal element, an array of pressure differences was used ranging from a maximum of 4" water gauge to .1" water gauge. Then when a zero-zero value is inserted with all other test readings, realistic relationships between pressure differences versus velocities are obtained. Regression-correlation analysis of these data establish realistic curves upon which leakage can be found. We expect to insert these relationships into our models.

While the Test Plan envisioned seal configurations of four brush layers in addition to one, two, and three layers, the four-layer trials were abandoned due to the fact that the three-layer elements seemed to be effective and to provide enough information so that multiple layer seals in practice could be extrapolated.

Figure 1, attached and Figure 2 also attached, show the regression curves of the configuration groupings: Brushes facing (Figure 1) and Brushes on cut rock with an interference fit (Figure 2).

The project team also continued preparation of a paper on the Dual-Aircourse Project scheduled to be delivered at the Society of Mining, Metallurgy & Exploration Annual Meeting on March 13, 1996 in Phoenix, Arizona.

The Project team’s computer model simulates underground mining environmental conditions of varying concentrations of gases during time sequences of the cutting operation. The model addresses the ever-present and most serious danger of gas mixing to an explosive condition. It also addresses the problem of respirable dust concentrations. By changing input parameters in the model, the team can see which mixtures are to be avoided and which can be tolerated. Analysis of various scenarios then leads to counteractions that eliminate or reduce the danger. For example, an approaching critical methane/air mixture will display precisely when explosivity can occur. Changing an appropriate parameter, say by injecting an inert gas will neutralize the mixture, thus avoiding an explosive occurrence.

These kinds of analyses will provide the protocol, that can determine the requirements to achieve non-explosivity throughout the mine. Requirements dictate selection of the instrumentation based on their specifications and capabilities to be integrated into the design of the Variable Wall Mining Machine in the dual-duct ventilation system.

During the anticipated extended (final) period we expect to finalize the on-going efforts in system automation and to refine non-explosive and dust abatement parameters of the dual-duct ventilation system. Finally, we will complete development of both cost comparative data and safety and health rating comparative factors of the Variable Wall Mining System with the dual-duct ventilation system.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
FIGURE 1

BRUSH SEAL CONFIGURATIONS COMPARED
TEST1B, TEST2A, TEST3M, TEST4

AIR FLOW (m/sec.)

PRESSURE DIFF (inches wa.ga.)

SINGLE FACING BRUSHES
BRISTLES AButting
SINGLE FACING BRUSHES
WITH 3/8 INCH OVERLAP
DOUBLE LAYER FACING
BRUSHES WITH 3/8 INCH OVERLAP
TRIPLE FACING BRUSHES WITH 3/8 IN. OVERLAP
BRUSH SEAL TESTS ON CUT ROCK
BRUSH TEST 6, TEST 7, TEST 8

FIGURE 2
KELASTIC MINE BEAM COMPANY
TEST PLAN
FOR LEAKAGE PARAMETERS FOR FELTON BRUSH SEALS

Configurations:

Brushes Facing, Flow in Series

A 1 set in Series, brushes abutting
B 2 sets in Series, brushes abutting
C 3 sets in Series, brushes abutting
D 4 sets in Series, brushes abutting

Brush Facing with a 3/8 inch overlap

E 1 Brush in Series
F 2 Brushes in Series
G 3 Brushes in Series
H 4 Brushes in Series

Brushes Facing Solid Simulated Roof Surfaces

E 1 Brush in Series
F 2 Brushes in Series
G 3 Brushes in Series
H 4 Brushes in Series

TRIALS

Independant Variable - Pressure Difference

12 in. Water Gauge
10 in. " "
8 in. " "
6 in. " "
4 in. " "
2 in. " "
1.5 in. " "
1.0 in. " "
.8 in. " "
.4 in. " "
.2 in. " "
.1 in. " "
.07 in. " "
.04 in. " "
.02 in. " "

Dependant Variables - Measure air velocity, then compute air quantity at each pressure and leakage per inch of brush length.

APPENDIX A