SAND78-0284

Unlimited Release

Seismic Reflection Data Report Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico

Volume I

December 1978

John L. Herr, G. J. Long & Associates, Inc.
Dennis W. Powers, Lawrence J. Barrows, Sandia Laboratories

Sandia Laboratories

52 2000 0175

REPRODUCTION OF THIS DOCUMENT IS UNLIMITED

SAND79-0264

Unlimited Release

Printed May, 1979

SEISMIC REFLECTION DATA REPORT

Waste Isolation Pilot Plant (WIPP) Site,
Southeastern New Mexico

VOLUME I

John L. Hern
G. J. Long & Associates, Inc.
Houston, Texas

Dennis W. Powers
and
Lawrence J. Barrows
Division 4511
Sandia Laboratories
Albuquerque, New Mexico

DECEMBER, 1978

REPRODUCTION OF THIS DOCUMENT IS UNLIMITED

Table of Contents
VOLUME I

	<u>Page</u>
1.0 ABSTRACT.	1
2.0 INTRODUCTION.	1
2.1 PURPOSE OF SEISMIC REFLECTION SURVEYS.	7
3.0 GEOPHYSICAL OPERATIONS.	7
3.1 DATA ACQUIRED.	8
3.2 1976 SAN GEOPHYSICAL PROGRAM	8
3.2.1 <u>General Information</u>	8
3.2.2 <u>Recording Parameters</u>	9
3.2.3 <u>Processing Parameters</u>	9
3.2.4 <u>Statistical Summary</u>	10
3.3 1977 X GEOPHYSICAL PROGRAM	10
3.3.1 <u>General Information</u>	10
<u>Location and Topography</u>	11
<u>Operating Conditions</u>	11
<u>Surveying</u>	11
<u>Recording Instruments</u>	11
3.3.2 <u>Recording Parameters</u>	12
3.3.3 <u>Data Processing</u>	13
<u>Equipment</u>	13
<u>Generalized Procedures</u>	13
<u>Processing Sequence</u>	13
3.3.4 <u>Field Control</u>	14
3.3.5 <u>Statistical Summary</u>	14
3.4 1978 Y GEOPHYSICAL PROGRAM	14
3.4.1 <u>General Information</u>	14
<u>Recording Instruments</u>	14
3.4.2 <u>Recording Parameters</u>	15
3.4.3 <u>Data Processing</u>	15
<u>Equipment</u>	15
<u>Processing Procedures</u>	15

Table of Contents

VOLUME I

	<u>Page</u>
3.4.4 <u>Field Control</u>	17
3.4.5 <u>Statistical Summary</u>	17
4.0 SUPPORT DATA.	17
5.0 SUMMARY	18
6.0 REFERENCES.	19
7.0 INDEX TO ENCLOSURES IN POCKETS.	20

APPENDICES

1976 SAN LINES, STATEMENT OF WORK.	21
1977 X SERIES, STATEMENT OF WORK	22
1978 Y SERIES, STATEMENT OF WORK	24

VOLUME II

7.0 INDEX TO ENCLOSURES IN POCKETS	
ENCLOSURES	

1.0 ABSTRACT

This report describes three seismic reflection (Vibroseis) surveys conducted from 1976 through 1978 by Sandia Laboratories to support investigations for the Waste Isolation Pilot Plant (WIPP). Volume I describes the purpose, field parameters, and data processing parameters. Volume II contains uninterpreted processed lines and shotpoint maps. Data interpretations will be the subject of the subsequent reports.

The data collected during these three surveys totals 77 line miles; 72 line miles of this are on or very near the WIPP site. The first of the surveys (1976 SAN) covered 25 line miles and was conducted similarly to previous petroleum industry surveys in the area. 1976 SAN supplemented existing petroleum industry data. The two subsequent surveys (1977 X and 1978 Y) used shorter geophone spacings (110'), higher signal frequencies (up to 100 Hz), and higher data sampling rates (2 ms.) to better define the shallow zone (less than 4000') of primary interest. 1977 X contained 47 line miles on or near the WIPP site and over several structural features northwest of the site. 1978 Y contains 5 line miles over a one square mile area near the center of the WIPP site. These data show increasing discrimination of shallow reflectors as data collection parameters were modified. Data tables of recording and processing parameters are included.

A fourth Vibroseis survey was conducted at the WIPP site in 1978 by Grant Geophysical Company for Bechtel; the data are not in final form and are not included. Petroleum industry data and an inconclusive weight-drop survey, conducted in 1976, are also not included in this report.

2.0 INTRODUCTION

In 1975, Sandia Laboratories accepted responsibility for evaluation of bedded salt at a site in southeastern New Mexico (Figure 1) for the disposal of radioactive waste. The project, now known as the Waste Isolation Pilot Plant (WIPP), includes the study of the characteristics of the bedded salt as well as processes which might affect a repository within bedded salt of the

lower Salado Formation (Figure 2). Further information on the geology and geophysical studies of the WIPP site and background may be obtained in Powers, et. al. (1978). Hern and Elliot (1978) presented a paper on geophysical investigations of the WIPP site.

Geophysics has been extensively employed as an indirect, non-disruptive, and relatively inexpensive means of characterizing the site geology. Seismic reflection techniques have been extensively developed by the petroleum industry, and are an effective tool for the determination of subsurface structure in an area which may be confirmed as necessary through direct observation by drilling. The petroleum industry made available to Long & Associates the shallow portions of approximately 1500 line rules of proprietary data. These data only encompassed the upper portions of the recorded data by the individual recording companies, and was loaned for review only during the early phase of the WIPP. These data greatly facilitated early studies of southeastern New Mexico, and allowed the development of well-defined seismic reflection studies early in the WIPP.

Nuclear Waste Technology, Division 4511, Sandia Laboratories, maintains overall responsibility and authority for direction of site geological characterization and study of long-term processes affecting the WIPP site. Professional geophysicist consultants have been retained since 1975 to complement geological expertise available through the project. Permian Basin Exploration Company, Roswell, directed the field data collection for 1976 SAM lines and contributed information on weathering conditions. Reynolds and Associates, Albuquerque, in 1976 attempted an experimental high-resolution survey, using a weight-drop technique, of shallow reflectors which appears uninterpretable in terms of our present geological and geophysical information; that data is not included here. G. J. Long & Associates, Houston, has functioned as consultant and interpreter of geophysical data acquired during 1977 X and 1977 Y and has directed those field operations for Sandia Laboratories. Long and Associates continue to serve as geophysical consultants to Sandia Laboratories for the WIPP.

This report serves as a source document of uninterpreted seismic reflection data as well as a tabulation of the collection and processing parameters and statements of work. Interpretation of the data will be the subject of other reports. The document is intended as a data source document rather than a primer in geophysics; Sheriff (1973) is a source of definitions for unfamiliar terms.

FIG. 1 GENERAL LOCATION OF WIPP SITE IN SOUTHEASTERN NEW MEXICO.

FIG. 2 GENERALIZED GEOLOGIC SECTION FROM SOUTHWEST (LEFT) TO NORTHEAST (RIGHT) THROUGH THE WIPP SITE. REPOSITORY WOULD BE LOCATED IN LOWER SALADO FORMATION.

2.1 PURPOSE OF SEISMIC REFLECTION SURVEYS

The purpose of 1976 SAN seismic reflection data collection was to determine in a preliminary way that the gross structure and depth of beds at the present WIPP site conformed to the geological expectations for the area. As such, the data collection was limited to about 25 miles and was collected using standard petroleum industry practices.

1976 X data collection followed a study of existing petroleum industry data for the area. That study of existing data showed several areas of ambiguous interpretation or anomalous seismic data which warranted further investigation. 1977 X data collection was aimed primarily at the seismic anomalies at or near the site, and the survey parameters were specifically shaped to better resolve these anomalies. In addition, several lines (X10-X13) were located over known geologic anomalies, the so-called breccia pipes, to determine the seismic characteristics of these off-site features.

1978 Y data collection was restricted in purpose and geography. The effort was limited to about one square mile at about the center of the WIPP site; the purpose was to collect seismic data in a series of small loops to allow definitive correlation of reflectors or, conversely, to define correlation problems.

Figure 3 shows the locations of lines for the three programs.

3.0 GEOPHYSICAL OPERATIONS

The enclosed data are the sum total of the conventional Vibroseis seismic reflection data actually acquired in the field for Sandia Laboratories (Albuquerque, New Mexico) beginning early in 1976 and running until 1 October 1978. In the initial phase of the geophysical studies, Permian Basin Exploration Company, New Mexico, was involved in this project. Their participation ended with the completion of 1976 SAN lines, to be discussed later in this report.

Beginning in July, 1976, G. J. Long & Associates, Inc., of Houston, Texas, was involved in the WIPP studies under contract to Sandia Laboratories. The areas of work that Long & Associates have performed are geophysical-geological with emphasis on:

- 1) petroleum geophysics (evaluation of potential hydrocarbon bearing structures),
- 2) planning, direction and interpretation of geophysical surveys,
- 3) acquire, interpret and reprocess oil company data,
- 4) review and interpret data for possible alternate site(s),
- 5) plan and supervise the up-hole velocity surveys of various boreholes,
- 6) inventory, file and store various geophysical data for Sandia Laboratories,
- 7) subcontract, as needed, additional geophysical services.

3.1 DATA ACQUIRED

Three programs of seismic data gathering and processing were conducted for the specific purpose of assessing shallow geologic conditions (less than 4000') at and in the immediate vicinity of the proposed WIPP site centered at the location of the ERDA 9 well (Sec. 20, Township 22S, Range 31E) of southeast Eddy County, New Mexico. Program maps and all uninterpreted processed data resulting from these activities may be found in sequence as follows in the individual folders in Volume II of this report:

1. Combined Vibroseis Program Within WIPP Site Area.
2. 1976 Seismic Program Map (1976 SAN lines)
- 3-5. Seismic Lines 1, 2, 3 from 1976 Seismic Program.
6. 1977 Seismic Program Maps (2), (1977 X lines).
- 7-20. Seismic Lines X-1, X-2, X-3, X-3A, X-4, X-5, X-6, X-7, X-8, X-9, X-10, X-11, X-12, X-13.
21. 1978 Seismic Program Map, (1978 Y lines).
- 22-26. Seismic Lines Y-1, Y-2, Y-3, Y-4, Y-5.

3.2 1976 SAN GEOPHYSICAL PROGRAM

3.2.1 General Information.

Early in May, 1976, under the supervision of Mr. Colin McMillan of Permian Basin Exploration Company, Dresser Olympic of Houston, Texas, acquired and processed approximately 25 miles of Vibroseis seismic data in a series of three lines. This project was designed to provide an overview of the subsurface geology in the area and provided limited control centered at the

ERDA 9 well and extending several miles beyond the outer limits of the proposed withdrawal area.

3.2.2 Recording Parameters.

Recording parameters employed in the 1976 Dresser Olympic survey are considered standard for oil exploration objectives where the effort is directed at obtaining structural information greater than 5,000 feet in depth within a prospective area such as the Delaware Basin. Consequently, the shallower information which is of prime interest to locate and design the WIPP facility is not emphasized with the chosen field parameters:

220 foot geophone group interval, 24 fold (stack) coverage

Sweep: 8-38 Hz

Cable Spread: 5060-0-5060 feet, 48 groups

Vibrator pattern inline: 4 units, 16 sweeps each, over 220'

Recording filter: 8-18 Hz Low Cut; 62 Hz High Cut

4 millisecond sample rate

3.2.3 Data Processing.

Data processing on lines 1, 2 and 3 was performed by Dresser Olympic and involved application of the following sequence of operations:

1. Demultiplex field tapes
2. Recover binary gain
3. Perform Vibroseis correlaton
4. Gather traces into common depth point locations
5. Apply datum corrections for elevation of +3150' above sea level using velocity of 8000 feet/second
6. Apply deconvolution:

Operator length	240 ms
Gate length	3000 ms
7. Filter CDP gathers using 8-38 Hz bandpass applied to entire trace
8. Determine stacking velocities
9. Apply normal moveout corrections to CDP gathers
10. Mute (suppress) ground roll and refraction arrivals
11. Apply automatic residual statics corrections to traces within CDP gathers
12. Stack (or sum) 24 traces in CDP gathers

13. Apply final filter pass:

t = 0-600 ms, 12-38 Hz
= 600-4000 ms, 8-30 Hz

14. Display sections at 8 traces/inch horizontal and 7.5 inches/second vertical scales in variable area, wiggle trace format

3.2.4 Statistical Summary.

SAN-1 Recorded 4/28-5/3/76
Vibrator Points (VP's) 1-261
Progression SE to NW
Length 10.93 miles

SAN-2 Recorded 5/4-5/11/76
VP's 1-205
Progression E to W
Length 5.53 miles

SPN-3 Recorded 5/11-5/14/76
VP's 1-135
Progression E to W
Length 5.53 miles

Total Survey 24.98 miles

3.3 1977 X GEOPHYSICAL PROGRAM

3.3.1 General Information.

In the fall of 1977, G. J. Long & Associates, Inc. and Sandia planned a Vibroseis seismic program to provide resolution of shallow geologic structure in the WIPP site area. The program was supervised by John Bern of Long and Associates for Sandia. The 1977 X survey totals 47 miles of data involving thirteen lines. Nine of these lines are within or near the subject area. Another four lines, totaling nearly five miles, were obtained in a separate area adjacent to the WIPP site. Dresser Olympic (now Grant Geophysical Co.) was contracted to perform the field work.

Location and Topography. The center of the project is located approximately 30 miles east-southeast of the town of Carlsbad, New Mexico, on the Eddy and Lea County lines just north of State Highway 128. The area is arid with desert vegetation and sand dunes. Most of the area is leased by ranchers for grazing cattle and sheep. Elevations vary from 3270 to 3727 feet above sea level. Topography for the most part is rolling with some localized areas of relatively steep relief. Drainage is generally southwest to the Pecos River.

Operating Conditions. The lines were all generally accessible by highways, gravel roads, and trails. Most of the lines had at least some cross country travel. The closest line to Carlsbad was approximately 17 miles, and the greatest distance traveled was approximately 45 miles. In areas where cross country travel was required, four-wheel drive equipment was utilized to transport personnel to and from the areas. Two-wheel drive equipment was virtually useless where no roads or trails were available. The deep sand in the area made driving conditions very difficult. There was very limited use of bulldozers on this project.

Surveying. Vertical and horizontal measurements were taken using a Wild TIA theodolite and with a K & E Self-Indexing Alidade and Plane Table. Control was obtained from bench marks and triangulation stations in the area; topographic sheets from the US Geological Survey were used.

Maximum elevation in the area was 3726.8 feet at VP 1 on Line X-8, and minimum elevation was 3270.2 feet at VP 4 on Line X-14. Sketches and Plane Table sheets were posted on a scale of 1 inch to 2,000 feet.

Recording Instruments. The crew was equipped with a Texas Instruments DFS-IV recording system which stored data on a 9-track SEG B format at 800 bits per inch. This was a 48-channel seismic system, but only 24 channels were used on this job because of the sample rate chosen. The system included the IFP (Instantaneous Floating Point) gain control which constantly adjusted the gain at each sample interval prior to digitizing.

A Texas Instruments CFS-1 (Computer Field System) which housed a R-980A computer was utilized in conjunction with the DFS-IV system. The CFS-1 provides operational control of the DFS-IV system and seismic data manipulation prior to recording on tape. The system is a field summing unit, and will also correlate the Vibroseis data and display it with the aid of the

SIR SMC-10 camera. Instruments were mounted on a Ford F-600 4 x 4 truck. The power source for the instruments is a Lima generator and a Deuts air-cooled diesel engine.

A fan geophone array of 36 geophones per station (Figure 4) was used throughout the area. The geophones were GeoSpace Model GSC 20D, with six strings of six geophones per string, centered at each geophone station stake. Each arm of the fan was spread over a distance of 110 feet from the center making an overall distance of 220 feet from end to end. The geophones were spaced at 20 foot intervals.

The recorder and the Vibroseis units were controlled by Pelton Electronics Company Advance I Model 2 automatic digital vibrator control electronics with sweep generators.

The crew was equipped with Four (4) MERTZ VSR-11 Servo-Hydraulic Vibrators mounted on 1974 International Paystar 5000 series 4 x 4 diesel powered trucks.

3.3.2 Recording Parameters.

Recording parameters for this survey were selected on the basis of field tests performed with the objective of improving data resolution (detail) within the upper 4000 ft. (about 0.5 sec. two-way travel time) of section within the limits of budgetary requirements, field conditions and hardware performance. Vibrators were again chosen as the energy source primarily because of the prohibitive cost of drilling the high density of shot holes required and the potential hazards associated with the use of explosive charges. The major changes as compared to the previous survey were:

1. raising of the vibrator sweep frequency
2. doubling the digital sample rate, and
3. doubling the density of vibrator sections.

Testing and experimenting were performed on the first two days of operations, September 8 and 9, 1977. A noise study was made the first day to determine dominant noise in the areas; the test showed none. The crew experimented the second day with sweep frequencies, offset distances, and geophone patterns. The following are the parameters used:

110 foot geophone group interval, 12 fold (stack) coverage
Sweep: 25-100 Hz; Sweep Length: 12 seconds
Listen period: 4 seconds; Total Sweep/record cycle: 16 seconds
Cable spread: 1650-440-0-440-1650 feet with 7 group gap (770')
Vibrator pattern inline; 4 units 16 sweeps each over 110'

Recording Filter: 18 Hz Low Cut; 124 Hz High Cut; 36 DB/Octave
Slope; 2 millisecond sample rate

Geophone Pattern: 36 geophones per station in 6 arm fan, twenty-four groups

3.3.3 Data Processing.

Data Processing of the 1977 X lines was accomplished by Dresser Olympic.

Equipment. Texas Instruments TIMAP computer system with the MATE-5000 software package. Final stacks were displayed on film using a Geospace Model 44/11 Digital Plotter.

Generalized Procedures. Parameters for deconvolution were determined by use of an autocorrelogram program. The first break suppression was very critical since shallow data was the main objective. To determine the muting pattern, the data were corrected for datum statics and normal moveout and visually inspected to determine the optimum parameters. Velocity determinations were done by using a constant velocity stacking method instead of the normal multichannel coherence statistical method since the data were recorded at very short spread lengths. The velocities were examined at one mile intervals.

Processing Sequence.

1. Demultiplex field tapes
2. Recover binary gain
3. Correlate traces
4. Gather traces into common depth point (CDP) locations
5. Deconvolve traces using Operator length 140 ms
6. Filter CDP gathers using 25-80 Hz, time-invariant bandpass filter
7. Apply datum statics corrections to elevation of +3200 ft. above sea level using velocity of 5000 ft/second
8. Determine stacking velocities
9. Apply normal moveout corrections to CDP gathers
10. Mute (suppress) ground roll and refraction arrivals
11. Stack (or sum) 12 traces in CDP gathers
12. Apply final filter pass to stacked traces using 25-80 Hz time-invariant bandpass filter
13. Apply automatic gain correction
14. Display sections at 8 traces/inch horizontal and 10 inches/second vertical scale in variable area, wiggle trace format

3.3.4 Field Control.

Field testing and general field supervision was conducted under the on-site direction of Messrs. Tom Greene and Mark Johnstone, with the overall project management under Mr. John L. Hern.

3.3.5 Statistical Summary.

Permitting Started	August 29, 1977
Surveying Started	September 1, 1977
Recording Started	September 8, 1977
Total Line Recorded	47.04 miles
Total Experimental Time	36 hours
Weather (Rain)	2 days
Maintenance	5 days
Vibrators Down	1 day
Recording Instruments Down	4 days
Production Time	59.5 days
Average Daily Production	0.79 miles
Total Line Surveyed	49.87 miles

3.4 1978 Y GEOPHYSICAL PROGRAM

3.4.1 General Information.

In early July, 1978, G. J. Long & Associates planned and supervised a brief Vibroseis survey in order to obtain more detailed coverage in a 1 x 1 mile area located north of and contiguous to the proposed WIPP site. Approximately 5 line miles of full-stack data (1978 Y) was obtained using almost identical procedures as in the 1977 X program. CMC, Inc. and Seismic & Digital Concepts, Inc., both of Houston, were contracted for the data acquisition and data processing respectively.

Recording Instruments. The crew was equipped with a GUS HDDR, High Density Digital Recording system which stored data in serialized format at a density of 8000 bits per inch on 14 recording tracks. Data was recorded on 24 channels at a 2 millisecond sample rate. The system included a Globe 4000 Binary Gain Amplifier Unit which continuously adjusted and recorded the gain at each sample interval prior to digitizing.

For monitoring individual records, a Geospace AM 280 24-channel summer/recorder and a Pelton 12-channel correlator were used to process the Vibroseis sweeps in a read-after-write mode prior to display on a Mandrel

Instruments SDW 400 seismic camera in 12-channel sets. Hard copies of the displays were used to evaluate the data quality.

The energy source for the survey consisted of one Failing Y-1100 vibrator mounted on a 4 x 4 Ford 8000 diesel truck. The unit can deliver a peak force of 27,240 pounds and can generate frequency components above 100 Hz.

The recorder and vibrator were controlled by Pelton Electronics Company Advance I Model 3 automatic digital vibrator control electronics with sweep generator.

Each recording station consisted of 36 Mark Products L-10B, 8 Hz geophones arranged in a six arm fan pattern (Figure 4). There was no ground overlap between arrays of adjacent groups.

3.4.2 Recording Parameters.

Recording parameters were identical to those employed in the 1977 X survey (Sec. 3.3.2), with the following exceptions. Only one vibrator was employed from which sixteen (16) sweeps were recorded over the 110' distance between vibrator points. The near offset distance was 110' giving slightly smaller cable spread dimensions of 1440'-110'-0-110'-1440'.

3.4.3 Data Processing.

Data processing of the 1978 Y lines was accomplished in August, 1978, with the objective of enhancing the high frequencies contained in the upper 1.0 second of reflected energy. The data were processed at a 2 ms sample interval.

Equipment. Xerox Sigma V computer with DRC/PASS software package, sections displayed with 24-trace Paragon/Geospace seismic plotting camera.

Processing Procedures.

1. Demultiplexing, summing and reformatting HDDR records to SEG Exchange format.
2. Vibroseis correlation
3. Frequency analysis revealed excessive 30 Hz component
4. Deconvolution with time variant spiking operator, 100 ms in length to suppress "ringy" character of data.
5. Apply time varying filter:
 t = 0.0-0.5 sec 40-90 Hz
 = 0.7-1.1 sec 30-75 Hz
 = 1.3-2.0 sec 20-65 Hz
6. Determine stacking velocities using constant velocity stacks located at 1 mile intervals.

GEOPHONE ARRAY
for
1977 X and 1978 Y

FAN PATTERN
6 ARMS
36 ELEMENTS

FIGURE 4

7. Correct data to datum elevation of +3200 feet using velocity of 6000 feet per second.
 8. Apply normal moveout and automatic residual statics corrections.
 9. Stack (sum) data 12 fold.
 10. Re-apply time-variant filter.
 11. Display 2 seconds of data at horizontal scale of 8 traces/inch and vertical scale of 10 inches/second.
- 3.4.4 Field Control.

Field testing and general field supervision was conducted under the on-site direction of Messrs. G. J. Long and Mark Johnstone, with the overall project management under Mr. John L. Hern.

3.4.5 Statistical Summary.

Recording Started	July 1, 1978
Total Line Recorded	7.50 miles
Weather Downtime	None
Vibrators Down	7 hours
Travel Time	16-1/2 hours
Production Time	73 hours
Average Daily Production	1 07 miles

4.0 SUPPORT DATA

Various support data are available for interpretation and checking the seismic reflection data. Petroleum industry drillholes in the vicinity of seismic reflection lines will normally provide some stratigraphic information, and borehole geophysical logs are commonly on file with log services. In addition, borehole sources of stratigraphic information have been obtained through the WIPP project and are generally summarized in Jones (1978) or Powers, et. al. (1978). Lines were laid out to tie deliberately to boreholes in the area of the WIPP site. Uphole velocity surveys are now available from some borehole drilled for the WIPP. These data will be included in basic borehole information reports in preparation or the seismic reflection interpretation, as appropriate.

5.0 SUMMARY

Seventy-seven line miles of Vibroseis seismic reflection data have been collected specifically for the WIPP. Twenty-five line miles (1976 SAN) were collected using standard petroleum industry techniques. Fifty-two line miles (1977 X and 1978 Y) of seismic reflection data were collected, mainly over the WIPP site, using shorter geophone spacings, higher signal frequencies, and higher data sampling rates. Higher frequencies and shorter spacings provide increased resolution over standard industry parameters for the shallow (less than 4000') depths of main interest for the WIPP. Overall data quality varies from fair to good over the area of interest.

6.0 REFERENCES

Hern, J. L., and Elliot, C. L., 1978, Geophysical Investigations for a Nuclear Waste Isolation Pilot Plant in Southeastern New Mexico: Abstr., Society of Exploration Geophysicists, 48th Annual International Meeting.

Jones, C. L., 1978, Test Drilling for Potash Resources: Waste Isolation Pilot Plant Site, Eddy County, New Mexico: US Geological Survey, Open-file report 78-592, 2 volumes.

Powers, D. W., Lambert, S. J., Shaffer, S-E., Hill, L. R., and Weart, W. D., editors, 1978, Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico: Sandia Laboratories, SAND78-1596, 2 volumes.

Sheriff, R. E., 1973, Encyclopedic Dictionary of Exploration Geophysics: Society of Exploration Geophysicist, Tulsa, Oklahoma, 266 p.

7.0 INDEX TO ENCLOSURES IN POCKETS*

Combined Vibroseis Program within WIPP Site Area Map

1976 Seismic Program Map

Seismic Line 1

Seismic Line 2

Seismic Line 3

1977 Seismic Program Maps (2)

Seismic Line X-1

Seismic Line X-2

Seismic Line X-3

Seismic Line X-3A

Seismic Line X-4

Seismic Line X-5

Seismic Line X-6

Seismic Line X-7

Seismic Line X-8

Seismic Line X-9

Seismic Line X-10

Seismic Line X-11

Seismic Line X-12

Seismic Line X-13

1978 Seismic Program Map

Seismic Line Y-1

Seismic Line Y-2

Seismic Line Y-3

Seismic Line Y-4

Seismic Line Y-5

*Please note that all of the above data were corrected and processed with a 3200 foot elevation datum.

APPENDICES

1976 SAN LINES, STATEMENT OF WORK

1976 X seismic reflection data was acquired under contract 03-6325 with Dresser Olympic. The Statement of Work is as follows:

Perform 25 line miles of seismic profiling. Location of lines shown on Sketch 1 dated March 26, 1976. Additional criteria are:

1. Common depth point type data.
2. Vibroseis energy source.
3. Four vibrators with 16 sweeps each. 11 second sweep.
4. A minimum of 36 geophones per trace.
5. 24 fold common depth point stack.
6. 220 foot group interval.
7. Digital recording and playback including:
 - a. 0.004 (second) sample rate
 - b. deconvolution (before stack)
 - c. velocity analysis - 1 per 3 miles and/or at a line intersection
 - d. automatic statics (before stack)
 - e. stack
 - f. time variant filter
 - g. final section
 - h. display
8. Contractor will obtain and comply with land use permits from the Bureau of Land Management.

1977 X SERIES, STATEMENT OF WORK

1977 X seismic reflection data was acquired under contract 05-7828 with Dresser Olympic (Later Grant Geophysical Company). The Statement of Work contains the following:

The contractor or contractors will be responsible for the acquisition and processing of new seismic reflection data, from a selected area in Southeastern New Mexico, in support of the Waste Isolation Pilot Plant (WIPP) Program conducted by Sandia Laboratories. The objective of the field program is to evaluate the shallow subsurface section with primary interest focusing on the Salado and bounding formations. This consists of the upper .8 to 1.0 seconds of seismic data. The requirement is for a state-of-the-art, digital recording, Vibroseis seismic crew. The contractor or contractors are expected to provide normal industrial location surveys. It is expected that the daily supervision and direction of the field and processing activities, including quality control, will be carried out by G. J. Long & Associates of Houston, Texas.

The following parameters apply to the acquisition and processing of the field data: The Vibroseis crew will have three or four vibrators always operating; geophone group spacings will be 110 feet; 24 trace recording unit; 12 fold recording and processing; 16 sweeps per location; possibly 12 to 14 second sweep duration; minimum of 32 phones per group; split spread recording with 440 to 880 feet offset; 2 millisecond recording sample rate; ability to sweep to or in excess of 120 hertz; 4.0 second recording; processing may only be to 2.0 second; processing located from a Houston center.

Data collection will cover about 45 line miles in about 12 lines, and will require a full basement stack. About 34 miles, in 6 lines, will be located in T22S, R31E and the immediate surroundings. About 11 miles will consist of about 6 shorter lines in adjacent townships T21S, R29E; T21S, R30E; T20S, R29E; and T20S, R30E.

Permitting and surveying will be done by the contractor. Payment of permits will be done through the contractor or directly by Sandia at the option of Sandia.

Date of crew availability should be about August 15, 1977. Data acquisition and the bulk of the data processing should be completed as early as possible, but no later than November 15, 1977.

1978 Y SERIES, STATEMENT OF WORK

1978 Y seismic reflection data was acquired by CXG, Inc., on subcontract through G. J. Long & Associates, Inc., under contract 05-7814. The Statement of Work for collection of this data is as follows:

Obtain through subcontract with a competent geophysical company about five (5) line miles of full-stack seismic reflection data in the vicinity of ERDA 9, Sections 20 and 21, T22S, R31E. The seismic reflection data so obtained is to be processed, and an interpretation made on significant reflectors, especially within or near the evaporite beds.

Further specifications:

- a. The following specifications from work done in 1977 are to be used as guidelines, but may be adjusted based on field observations to obtain better definition of shallow reflectors.

110 feet geophone group interval; 12 fold (stack); coverage sweep: 25-100 HZ; sweep length: 12 seconds; listen period: 4 seconds; total sweep/record cycle: 16 seconds; cable spread: 1650-440-0-440-1650 feet with 7 group gap (770'); vibrator pattern inline; 4 units 16 sweeps each over 110' recording filter: 18 HZ low cut, 124 HZ high cut, 36 DB/octave slope; 2 millisecond sample rate.

Geophone pattern: 36 geophones per station in 6 arm fan, twenty-four groups.

- b. It is expected that the bulk of data processing will be performed by the contractor collecting field data.
- c. Field data tapes will be duplicated and both copies temporarily retained at G. J. Long & Associates; desirable processed tapes will also be duplicated and retained.
- d. A qualified geophysicist from G. J. Long & Associates will monitor field procedures and maintain a log of the relevant field activities.