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Basic Data Report for Drillhole WIPP 33 (Waste Isolation Pilot Plant - WIPP)

Sandia National Laboratories
United States Geological Survey

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for
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WIPP 33

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1.0 ABSTRACT

WIPP 33 is an exploratory borehole to investigate the nature of unusually thick fill material in the northwest portion of the WIPP site; a breccia pipe was considered a possible, though unlikely, cause of the fill. The borehole is located in Section 13, T22S, R30E, in east central Eddy County, New Mexico and was drilled during July, 1979. The hole was drilled to a depth of 840 feet, and encountered, from top to bottom, surficial Holocene deposits (44' including artificial fill for drill pad), the Dewey Lake Red Beds (357'), the Rustler Formation (276') and the upper portion of the Salado Formation (163'). Selected intervals were cored, and cuttings were taken for examination by geologists. Geophysical logs were taken the full length of the borehole to measure radioactivity, resistivity and density. The stratigraphic profile was found to be normal, and no breccia was observed.

2.0 INTRODUCTION

The introduction describes background information on the Waste Isolation Pilot Plant (WIPP) and the investigation at WIPP 33.

2.1 The Purpose of WIPP

The purpose of the WIPP is distinct from that of several other projects for the disposal of radioactive waste. The WIPP is planned to demonstrate disposal technology for the transuranic (TRU) waste resulting from this nation's defense programs of over 30 years. After a period (5-10 years) of limited (pilot) operation, during which the waste is readily retrievable, it is anticipated that the WIPP will be converted to a full-scale repository for permanent disposal of defense TRU waste. The WIPP plans also include a research facility to examine, on a large scale, the interactions between bedded salt and high-level radioactive waste resulting from thermal and radiation fluxes. There is no plan at this time to dispose of high-level waste or spent fuel in the WIPP. DOE had expressed an intent to request licensing of the WIPP by the Nuclear Regulatory Commission (NRC). This licensing policy was not acceptable to the congressional committees responsible for WIPP and DOE has agreed to proceed without licensing.

Additional information on the WIPP and characterization of the WIPP site may be found in Powers, et. al. (1978).

2.2 The Purpose of Borehole WIPP 33

WIPP 33 was drilled to determine the nature of unusually thick fill in a small closed basin in the northwest portion of the WIPP site area. (G. O. Bachman advised us of the fill which he had encountered during field mapping and hand auguring in support of his studies of Pecos Valley history in Bachman, 1980.) It seemed possible that the sink was related to processes which formed Nash Draw, or less likely, that it was the surface manifestation of a breccia pipe. Drilling was intended to provide information on the stratigraphy of the near-surface formations, the relationship between the subsurface structure and the surficial basin and on the dissolution of the soluble rocks by ground water. Coring of

important marker zones such as the Magenta and Culebra dolomites and the top of the Salado was expected to provide evidence of any abnormality in structure.

3.0 GEOLOGICAL DATA FOR BOREHOLE WIPP 32

by

R. P. Snyder¹ and A. F. McIntyre²

3.1 Abstract

Borehole WIPP 33 was drilled in eastern Eddy County, New Mexico, during July 1979. It penetrated the Dewey Lake Red Beds, the Rustler Formation and part of the Salado Formation, all of Permian age. Dissolution residues were found in the Rustler Formation and in the upper part of the Salado Formation. The stratigraphic sequence is normal, and no breccia was observed.

3.2 Introduction

Borehole WIPP 33 was drilled on behalf of the WIPP (Waste Isolation Pilot Plant) Project Office of the DOE (U.S. Department of Energy) to determine the nature of a small closed basin near the northwest corner of the WIPP site. Concern about this basin arises from the uncertainty of whether it is the surficial expression of a breccia pipe or some other structure involving deep salt dissolution and collapse. The drilling was designed to: (1) determine the stratigraphy of the near-surface formations, (2) examine the relationships between subsurface structure and the surficial basin, and (3) investigate the dissolution of soluble rocks (rock salt, gypsum, and dolomite) by ground water.

All measurements related to the drill site are in English units. These measurements include: The survey to locate the drill hole (both horizontally and vertically), the drilling depths as furnished by the driller, and the wireline logs as furnished by the logging company. Borehole location and depths in the borehole are given in this report in English units. If metric units are desired, the following conversion factors should be used.

¹U.S. Geological Survey, Denver, CO.

²Fenix & Scisson, Inc., Carlsbad, NM.

Multiply English UnitByTo Obtain Metric Unit

foot (ft)

0.3048

meter (m)

inch (in)

25.4

millimeter (mm)

pounds per square inch

0.006895

megapascal (MPa)

(lb/in²)

3.3 Description of Borehole WIPP 33

Borehole WIPP 33 is located in east-central Eddy County, N. Mex., in the NE 1/4, SW 1/4, sec. 13, T. 22 S., R. 30 E. (fig. 1). The borehole was drilled during July 1979, to a depth of 840 feet, measured from a land surface altitude of 3,323.23 feet above MSL (mean sea level). Table 1 is an abridged borehole history, and table 2 is a stratigraphic summary of WIPP 33. General stratigraphy for the area is summarized elsewhere (Jones, 1973). WIPP 33 penetrated about 44 feet of surficial deposits (mostly unconsolidated sand); 357 feet of siltstone, claystone, and mudstone of the Dewey Lake Red Beds (Permian); 276 feet of gypsum, mudstone, dolomite, and anhydrite of the Rustler Formation (Permian); and 163 feet of halite (rock salt) and other rocks of the Salado Formation.

Nearly all of the anhydrite in the Rustler Formation has been converted to gypsum, and some of the gypsum has subsequently been dissolved out of the formation. The Magenta Dolomite Member has lost much of its dolomite by dissolution. The dissolution of salt and the alteration of anhydrite to gypsum below the Culebra Dolomite Member has resulted in considerable fracturing of the Culebra. The upper part of the Salado Formation contains about 1 foot of dissolution residue which may represent about 10 feet of salt.

Additional stratigraphic details of the rock are summarized in table 3 and on figure 2. Selected intervals were cored and cuttings and core were examined at the drill site by S. L. Drellack, Jr., J. L. Gonzales, and A. F. McIntyre of F&S (Fenix & Scisson, Inc.). The identification of rock units was made in collaboration with C. L. Jones of the USGS (U. S. Geological Survey).

As part of the exploratory work, geophysical logs were taken the full length of the borehole. The logging was done to facilitate the identification and correlation of gross lithologies (i.e., dolomite, anhydrite, polyhalite, and rock salt), and to provide an independent depth determination. The geophysical logs include (1) a gamma-ray curve that recorded variations in the potassium and other radioactive elements, (2) a neutron curve that recorded variations in the distribution of hydrogen and (3) a microlaterolog that recorded variation of electrical resistivity of the rock units (fig. 2).

Figure 1 Location of borehole
WIPP-33

Table 1.--Abridged history of borehole WIPP-33

LOCATION: sec. 13, T. 22 S., R. 30 E.

1,762.48 feet from south line

2,426.65 feet from west line

ALTITUDE (LAND SURFACE): 3,323.23 feet. Datum for depth measurement in drilling and logging.

LITHOLOGIC LOG PREPARED BY: S. L. Drellack, Jr., J. L. Gonzales, and A. F. McIntyre.

DRILLING CONTRACTOR: Pennsylvania Drilling Co.

DRILLING RECORD: Commenced drilling July 17, 1979, and completed on July 25, 1979, at 840 feet below land surface.

Circulation lost intermittently from 356 to total depth (840 ft).

Hole "filled" with drilling mud (top of fluid at 248 ft).

Core No.	Depth Interval		RPM	Weight on bit (lbs.)	Circulating pressure (lb/in ²)	Interval		Percent recovered
	Feet					Feet cored,	Feet recovered	
1	46	51	64	A11	150	5	2.1	42
2	51	58	90	A11	75	7	2.4	34
3	384	388	80	A11	150	4	0	0
4	393	403	70	12,000	150	10	2.4	24
5	403	407	70	12,000	75	4	2.8	70
6	407	417	80	12,000	150	10	4.7	47
7	417	436	80	12,000	100	19	1.1	6
8	436	446	75	12,000	75	10	2.8	28
9	446	456	80	12,000	75	10	0	0
10	456	466	80	12,000	150	10	2.1	21
11	466	480	80	13,000	125	14	6.4	46
12	540	550	85	10,000	0-150	10	9.0	90
13	550	560	85	10,000	0-150	10	5.4	54
14	560	570	85	10,000	0-150	10	4.0	40
15	570	578	80	10,000	0-100	8	.3	4

Core No.	Depth Interval		RPM	Weight on bit (lbs.)	Circulating pressure (lb/in ²)	Interval		Percent recovered
	Feet	Feet				Feet cored	Feet recovered	
16	578	588	60	10,000	150	10	9.8	98
17	¹ 652	662	80	10-12,000	0-100	10	9.3	93
18	662	672	80	10,000	50	10	7.5	75
19	672	682	80	10,000	0	10	6.7	67
20	682	692	80	10,000	0	10	9.7	97
21	692	702	80	12,000	0-100	10	10	100

¹Depth changed from driller's depth of 650 ft to 652 ft using interpretation of geophysical logs.

Table 2.--Stratigraphic summary of borehole WIPP-33

ROCK UNIT	DEPTH INTERVAL ¹ FEET
Holocene deposits ²	0-44
Permian rocks	
Dewey Lake Red Beds	44-401
Rustler Formation	401-677
Dissolution residue	421-429
Magenta Dolomite Member	449-468
Dissolution residue	540-545
Culebra Dolomite Member	550-578
Dissolution residue	580-586
Salado Formation	677-840
Upper member	675-840+
Dissolution residue	677-678
Salt interval	678-840+
³ MB 101	⁴ 785
³ MB 102	⁴ 818
Maximum recorded depth-----	840

¹Depth intervals recorded from gamma-ray and microlaterolog.

²Includes artificial fill for drill pad.

³MB, marker bed.

⁴Base of rock unit.

Table 3 -- Lithologic log of borehole WIPP 33

(Color designation from Rock-Color Chart (Goddard and others, 1948). No cuttings or no core designates interval where cuttings or core were not recovered during drilling operations.

Lithologic description	Depth Interval Feet
No sample-----	0-5.0
Sand, moderate-reddish-brown (10R 4/6) with an orange tint; quartz grains, fine-grained, some medium-grained, rounded to subrounded, unconsolidated-----	5.0-25.0
Sand, grayish-orange-pink (5YR 7/2), fine-grained, some medium- grained, rounded to subrounded, very poorly consolidated, friable, calcium carbonate cement-----	25.0-30.0
Sand, same as unit at 25.0-30.0 feet, with some very fine grained sand-----	30.0-35.0
Sand (75 percent), moderate-reddish-brown (10R 4/6) to dark- reddish-brown (10R 3/4), very fine grained, rounded to subrounded, well consolidated; grayish-red (10R 4/2) siltstone (20 percent); very light gray (N8), fine-grained, rounded to subrounded, poorly consolidated, friable, biotitic sandstone (5 percent)-----	35.0-40.0
Mudstone (70 percent), dark-reddish-brown (10R 3/4), moderately consolidated; moderate-reddish-brown (10R 4/6) to dark-reddish-brown (10R 3/4) moderately consolidated, siltstone (30 percent)-----	40.0-46.0
Siltstone, moderate-reddish-brown (10R 4/6) to dark-reddish-brown (10R 3/4), grading toward mudstone; fine-grained sandstone with greenish-gray (5GY 6/1) reduction spots and small-scale cross- bedding from 46.3 to 46.6 feet; band of greenish-gray (5GY 6/1), fine-grained sandstone from 47.5 to 47.7 feet; core broken horizontally into 0.1-0.5 foot long sections-----	46.0-48.1
No core-----	48.1-51.0

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
Siltstone, moderate-reddish-brown (10R 4/6) to dark-reddish-brown (10R 3/4)-----	51.0-51.2
Sandstone, dark-reddish-brown (10R 3/4) to grayish-red (10R 4/2), fine- to medium-grained, some intergranular porosity, numerous greenish-gray (5GY 6/1) reduction spots from 53.0 to 53.2 feet, sandstone changes to greenish-gray (5GY 6/1) from 53.2 to 53.4 feet, faint undulating laminae from 51.2 to 51.7 feet and 52.8 to 53.4 feet; MnO ₂ speckled fracture dipping 34° at 53.3 feet; irregular breaks dip less than 7° elsewhere-----	51.2-58.0
Sandstone (60 percent), dark-reddish-brown (10R 3/4) to grayish-red (10R 4/2), very fine grained, slightly biotitic, few greenish-gray (5GY 6/1) reduction spots; moderately consolidated, moderate-reddish-brown (10R 4/6) to dark-reddish-brown (10R 3/4) siltstone (40 percent), trace dark-reddish brown (10R 3/4) mudstone; trace very fine grained, greenish-gray (5GY 6/1) sandstone-----	58.0-65.0
Sandstone (60 percent), same as unit at 58.0-65.0 feet; siltstone (35 percent), same as unit at 58.0-65.0 feet; very fine grained, greenish-gray (5GY 6/1) sandstone (5 percent)-----	65.0-70.0
Sandstone (70 percent), same as unit at 58.0-65.0 feet; siltstone (30 percent), same as unit at 58.0-65.0 feet-----	70.0-75.0
Sandstone (50 percent), same as unit at 58.0-65.0 feet; siltstone (50 percent), same as unit at 58.0-65.0 feet; trace dark-reddish-brown (10R 3/4) mudstone-----	75.0-80.0
Siltstone (90 percent), dark-reddish-brown (10R 3/4) to grayish-red (10R 4/2), some grading toward very fine grained sandstone, slightly biotitic, some MnO ₂ specks, few greenish-gray (5GY 6/1)	

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
reduction spots; sandstone (10 percent), same as unit at 58.0-65.0 feet; trace dark-reddish-brown (10R 3/4) mudstone-----	80.0-105.0
Siltstone, same as unit 80.0-105.0 feet; trace sandstone, same as unit at 58.0-65.0 feet; trace dark-reddish-brown (10R 3/4) mudstone-----	105.0-125.0
Siltstone, same as unit 80.0-105.0 feet; trace sandstone, same as unit 58.0-65.0 feet; trace dark-reddish-brown (10R 3/4) mudstone; trace greenish-gray (5GY 6/1) siltstone, possibly large reduction spots-----	125.0-140.0
Siltstone, dark-reddish-brown (10R 3/4), grading toward very fine grained sandstone, well consolidated, biotitic, few greenish-gray (5GY 6/1) reduction spots, some MnO ₂ specks; trace dark-reddish-brown (10R 3/4) mudstone-----	140.0-165.0
Siltstone, same as unit 140.0-165.0 feet; trace sandstone, same as unit 58.0-65.0 feet; trace dark-reddish-brown (10R 3/4) mudstone-----	165.0-190.0
Siltstone, same as unit 140.0-165.0 feet; trace very fine grained dark-reddish-brown (10R 3/4) sandstone-----	190.0-195.0
Siltstone, same as unit 140.0-165.0 feet; trace dark-reddish-brown (10R 3/4) mudstone-----	195.0-200.0
Siltstone (80 percent), same as unit 140.0-165.0 feet; very fine grained, moderately consolidated, dark-reddish-brown (10R 3/4) to grayish-red (10R 4/2) sandstone (20 percent)-----	200.0-215.0
Siltstone, dark-reddish-brown (10R 3/4), well consolidated, biotitic, few greenish-gray (5GY 6/1) reduction spots, some MnO ₂ specks-----	215.0-245.0

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
Siltstone (90 percent), same as unit at 215.0-245.0 feet; soft and "gumbo-like", moderate-reddish-brown (10R 4/6) mud (10 percent)-----	245.0-255.0
Siltstone, same as unit 215.0-245.0 feet-----	255.0-275.0
Siltstone (90 percent) and mud (10 percent), same as unit at 245.0-255.0 feet-----	275.0-285.0
Siltstone, same as unit 215.0-245.0 feet-----	285.0-356.0
No cuttings (no returns) -----	356.0-384.0
No core-----	384.0-388.0
No cuttings (no returns) -----	388.0-393.0
No core-----	393.0-400.6
Siltstone, 0.18 x 0.25 foot, irregular shape, dark-reddish-brown- (10R 3/4) to moderate-reddish-brown (10R 4/6), with numerous greenish-gray (5G 6/1) reduction spots, trace MnO ₂ ; scattered vugs pinpoint to 2mm in size-----	400.6-400.7
Gypsum, loose cobbles, largest is 0.3 x 0.2 foot, several less than 0.1 foot across, light-olive-gray (5Y 6/1), finely crystalline, trace with light-gray (N7) tint, several "faces" of these cobbles appear very irregular and pitted (fracture surface?) and are coated/filled with moderate-reddish-brown (10R 4/6) to dark-reddish-brown (10R 3/4) mud and silt, other fillings greenish-gray (5G 6/1) in color-----	400.7-401.1
Gypsum, light-olive-gray (5Y 6/1), finely crystalline, laminated light-olive-gray (5Y 6/1) with light-gray (N7) and grayish-red (5R 4/2); numerous irregular, wavy argillaceous hairline stringers, light-olive-gray (5Y 6/1) to grayish-red (10R 4/2) partially mud-coated fracture dips 38° at 401.1 feet-----	401.1-403.0

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
Gypsum, same as unit 401.1-403.0 feet, fracture dips 80° at 403.5 feet, coated with moderate-reddish-brown (10R 4/6) clay-----	403.0-405.8
No core-----	405.8-407.0
Gypsum, light-olive-gray (5Y 6/1), finely crystalline, with numerous blebs, ranging from 3-5 mm to as large as 1 cm---	407.0-407.8
Gypsum, light-olive-gray (5Y 6/1) approaching olive-gray (5Y 4/1), finely crystalline, with argillaceous, wavy laminae of pale-red (5R 6/2) to grayish-red (5R 4/2), very concentrated from 409.5 to 411.4 feet; numerous vuggy, unfilled depressions on internal surface of core from 408.4 to 408.6 feet; some recrystallized gypsum as elongate plates, 3-5 mm to 2 mm to less than 1 mm in width, throughout core overlapping one another in upward direction; rounded gypsum blebs 1-4 mm, faint and distinct from 410.7 to 411.7 feet; horizontal, very irregular, healed fracture at 408.4 feet; very irregular, discontinuous open fractures with 1 mm or less displacement from 409.3 to 409.4 feet; at interval 410.8-410.9 feet, very irregular, discontinuous open vertical fracture with 1-2 mm displacement-----	407.8-411.7
No core-----	411.7-416.5
Cavity; determined by drop of drill string during drilling and through interpretation of caliper log-----	416.5-426.0
Gypsum, olive-gray (5Y 4/1), some light-olive-gray (5Y 6/1) finely crystalline, with argillaceous, wavy grayish-red (5R 4/2) laminae; very few scattered 1-3 mm vugs; at 427.6 feet a dark-reddish-brown (10R 3/4) to greenish-gray (5G 6/1) gypsiferous siltstone cobble-----	426.0-427.0

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
No core (drill string dropped from 430.0 to 436.0 feet;) possible cavernous formation-----	427.1-436.0
Gypsum, same as unit at 427.0-428.1 feet; from 437.5 to 438.4 feet is a zone of light-olive-gray (5Y 6/1) and olive-gray (5Y 4/1) very finely crystalline, irregularly banded gypsum	435.0-438.8
No core, (cavernous 452.0 to 454.0 feet)-----	438.8-456.0
Dolomite, light-olive-gray (5Y 6/1), clayey and soft from 456.0 to 456.2 feet, becoming harder toward bottom; wavy laminae throughout, some darker laminae approaching olive- gray (5Y 4/1); gypsum blebs up to 1 mm across scattered in some laminae from 456.9 to 458.1 feet, becoming numerous in bottom 0.4 foot; discontinuous, 1-2 mm thick selenite laminae at 456.4, 456.6, and 457.7 feet-----	456.0-458.1
No core-----	458.1-462.0
Cavity (drill string dropped)-----	462.0-467.0
Gypsum; dark-yellowish-brown (10YR 4/2) to light-olive-gray (5Y 5/2); predominantly finely crystalline, some very finely crystalline in nodular parts; "nodules" tend to be light- olive-gray (5Y 6/1) with medium-light-gray (N6) tint, "chicken-wire" appearance in parts of core may be a slightly harder anhydritic gypsum; darker laminations and zones with nodular appearance dip 20°; top 0.8 foot has occasional light-olive-gray (5Y 6/1 and 5Y 5/2) dolomitic laminae, as much as 4 mm thick at 470.8 feet; a 6 x 2 x 1 cm deep vug lined with selenite crystals as much as 3 mm long at 471.0 feet; few small-scale solution expanded fractures with etched surface in a 0.15 x 0.25-foot slightly rounded dolomitic gypsum fragment at top of core from 473.8 to	

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
<p>474.1 feet is a zone with moderate-reddish-brown (10R 4/6) mud-filled unhealed fractures dipping 33°, fractures have some horizontal connection, pinch-out both upward and downward, and are as much as 5 mm wide with a few very coarse, platy selenite crystals within the mud-filling; at 470.7 feet is a 6-mm thick horizontal, healed fracture or laminae of very coarsely crystalline selenite; vuggy, horizontal, 1-2 cm thick healed (with very coarse, platy selenite) fracture at 476.1 feet; an "opened" (possibly induced by coring) vertical hair-line fracture starting at the above horizontal healed fracture and pinching out downward at 476.4 feet-----</p>	467.0-475.4
No core-----	476.4-480.0
No cuttings (no returns)-----	480.0-540.0
<p>Clay, medium-gray (N5) to medium-dark-gray (N4), calcitic; with numerous and very irregular, discontinuous stringers and bands of chalky, fibrous, finely crystalline, translucent to transparent and light-olive-gray (5Y 6/1) gypsum (some selenite)-----</p>	540.0-541.5
<p>Clay, moderate-reddish-brown (10R 4/6), pliable, silty, with very irregular, discontinuous stringers, 1-2 mm thick of platy, translucent to transparent selenite; from 543.0 to 543.3 feet, 2 mm to 1.5 cm rounded fragments generally dipping 45°, moderately hard, greenish-gray (5GY 6/1) siltstone; contact zone between clay and gypsum contains argillaceous, moderate-reddish-brown (10R 4/6) gypsum, dipping 50° at base of unit-----</p>	541.5-545.8

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
Gypsum, olive-gray (5Y 3/2), recrystallized, finely to medium crystalline; irregular void at 546.6 feet, 2.0 x 1.0 x 3.0 cm; at 546.6 feet core is broken, along solution surfaces, possible void-----	545.8-546.7
Gypsum, light-olive-gray (5Y 6/1 to 5Y 5/2), finely crystalline-----	546.7-549.0
No core-----	549.0-552.0
Dolomite, light-olive-gray (5Y 6/1), very silty, very clayey in part, highly fractured; numerous pits, less than 1 mm to 1 cm-----	552.0-556.6
No core-----	556.6-560.0
Dolomite, light-olive-gray (5Y 6/1), very silty, numerous pits, 1-2 mm; highly fractured-----	560.0-564.0
No core-----	564.0-570.0
Dolomite, light-olive-gray (5Y 6/1), with greenish-gray (5GY 6/1) tint, silty very hard, faintly laminated-----	570.0-570.3
No core-----	570.3-578.0
Clay, dark-gray (N3), with medium-dark-gray (N4), slightly silty, dispersed laminae bands and blebs-----	578.0-581.3
Clay, moderate-reddish-brown (10R 4/6), with interconnected network of irregular bands, stringers, and blebs 3-4 cm thick of chalky, fibrous, translucent to transparent, and moderate-reddish-brown (10R 4/6) gypsum; from 581.3 to 584.3 feet, frequent blebs and stringers, and dispersed zones of dark-gray (N3) clay, with irregular clay band from 583.8 to 584.1 feet-----	581.3-586.6

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
Gypsum, olive-gray (5Y 4/1), with moderate-red (5R 5/4) tinted zones, finely crystalline, some medium crystalline; from 587.5 to 587.8 feet, numerous irregular blebs and stringers, 1 mm to 1 cm thick of moderate-red (5R 4/6) polyhalite----	586.6-587.8
No core-----	587.8-588.0
No cuttings (no returns)-----	588.0-652.0
Siltstone grading toward mudstone, dark-greenish-gray (5GY 4/1), with medium-dark-gray (N4) tint, massive, numerous unfilled pits/vugs, 1-10 mm in size that tend to be elongated horizontally; numerous unfilled fractures, dipping 40°-60°; one vertical continuous fracture from 653.9 to 657.4 feet-----	652.0-659.7
Mudstone, dark-greenish-gray (5GY 4/1), with medium-dark-gray (N4) tint, massive, core highly broken-----	659.7-661.3
No core-----	661.3-662.0
Siltstone, dark-greenish-gray (5GY 4/1), massive, numerous unfilled pits or vugs 1-15 mm in diameter; numerous unfilled low-to high-angle hairline fractures, a few filled with white (N9), chalky gypsum; three cobble-sized, rounded fragments of dark-reddish-brown (10R 3/4) siltstone on top of core-----	662.0-669.5
No core-----	669.5-675.3
Siltstone, dark-greenish-gray (5GY 4/1), faintly banded with greenish-black (5GY 2/1) laminae dipping approximately 10°; few scattered gypsum inclusions, 1-3 mm in diameter; at 674.2 feet there is a 2 mm-thick selenite vein dipping 30°; few scattered 1 mm diameter pits/vugs throughout core-----	675.3-676.4
Mud, dark-reddish-brown (10R 3/4), soft, gypsiferous-----	676.4-676.5
Gypsum, medium-light-gray (N6) to dusky-yellowish-green (5GY 5/2) massive, faintly laminated; upper contact dips approximately 25°	676.5-676.8

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
Clay, greenish-gray (5GY 6/1) to dark-greenish-gray (5GY 4/1), soft	676.8-677.0
Clay, dark-reddish-brown (10R 3/4), soft, few small scattered gypsum fragments, few small halite fragments near base-----	677.0-678.0
Halite, translucent, with moderate-reddish-brown (10R 4/6) tint, medium- to coarsely crystalline, very argillaceous from 678.0 to 679.0 feet, almost colorless from 679.0 to 679.5 feet; few scattered small irregular stringers and masses of anhydrite at 680.3 feet; 0.25-foot thick band of pale-red (10R 6/2) to moderate-orange-pink (10R 7/4) anhydrite, with halite-filled fracture in the middle of unit; 0.1-foot thick, dark-reddish-brown (10R 3/4) mud seam at base-----	678.0-680.6
Halite, translucent, with moderate-reddish-brown (10R 4/6) tint, finely to medium-crystalline, very argillaceous, with many small irregular stringers and masses of anhydrite-----	680.6-682.0
Halite, predominantly translucent, parts with moderate-reddish-brown (10R 4/6) tint, medium-crystalline; moderate-reddish-brown (10R 4/6) to dark-reddish-brown (10R 3/4) clay in upper 0.1 foot; irregular stringers of light-gray (N7) anhydrite scattered through interval, stringers are usually horizontally oriented; trace of moderate-reddish-brown (10R 4/6) polyhalite blebs scattered throughout; transparent to translucent, medium- to coarsely crystalline clear halite from 685.0 to 685.7 feet; several irregular shaped vugs as much as 2 cm across, some on top of anhydrite stringers-----	682.0-690.4
Halite, argillaceous, moderate-reddish-brown (10R 4/6) to dark-reddish-brown (10R 3/4), finely crystalline-----	690.4-691.7

Table 3 -- Lithologic log of borehole WIPP 33--Continued

Lithologic description	Depth Interval Feet
No core-----	691.7-692.0
Halite, same as unit 688.4-689.7 feet-----	692.0-692.3
Halite, translucent, with moderate-reddish-orange (10R 6/6) and moderate-reddish-brown (10R 4/6) tints; finely to medium-crystalline, trace of moderate-reddish-brown (10R 4/6) polyhalite and moderate-reddish-brown (10R 4/6) mud-----	692.3-694.7
Halite, same as unit at 688.4-689.7 feet; very finely to finely crystalline; light-gray (N7) anhydrite blebs and nodules as much as 1 cm cross from 692.7 to 693.0 feet; moderate-red (5R 4/6), irregular, argillaceous, 3x5-cm polyhalite mass at 693.5 feet; less argillaceous from 696.3 to 697.7 feet; very argillaceous from 697.7 to 699.6 feet-----	694.7-701.6
Sandstone, light-brown (5YR 5/6), with moderate-reddish-brown (10R 4/6) tint, fine-grained, mottled, with 1-4 mm, irregularly shaped greenish-gray (5GY 6/1) blotches, halitic-----	701.6-702.0
No cuttings (no returns)-----	702.0-840.0

4.0 HYDROLOGICAL DATA

No hydrological data have been obtained to date from WIPP 33.

5.0 REMARKS

At a depth of 420', a cavernous zone was penetrated. After all other work was completed on the hole, a local water-well service company was contracted to produce a video tape of WIPP 33. A closed circuit television system was used (see SAND80-0459C, Downhole Television (DHTV) Applications in Borehole Plugging). Figures 3 and 4 are photos reproduced from the tape. Filming was done from near-surface to a depth of 423'. At that depth the cable tension slackened, possibly indicating a ledge, and viewing was obscured by drilling mud in the water. Based on the caliper log, the cavernous zone was not extensive, and the stratigraphic profile of the entire hole was normal.

Figure 3. Sample DHTV photos at depths of 241', 257', 273' and 285' below surface.

Figure 4. Sample DHTV photos at depths of 420' and 423' showing cavity zone.

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- Powers, D. W., Lambert, S. J., Shaffer, S-E., Hill, L. R., and Weart, W. D., eds., Geological characterization report, Waste Isolation Pilot Plant (WIPP) site, southeastern New Mexico: SAND78-1596, vol. I and II.

APPENDIX A

JUSTIFICATION

by

D. W. Powers
Division 4511
Sandia Laboratories

INTRODUCTION TO APPENDIX A, JUSTIFICATION

Appendix A consists of the memorandum from D. W. Powers to R. D. Statler, dated 3/8/79, "Scope of Work, Borehole(s) in Section 13, T22S R30E." This document provides details of background information and program options as understood at the time of initiation. The reader is cautioned, therefore, that the details of the program may have been altered as information became available and that preliminary interpretive hypotheses or ideas guiding the program formulation may need revision based on information presented in this report. Later interpretive reports may deal with such items.

Sandia Laboratories

Albuquerque, New Mexico
Livermore, California

date: March 8, 1979

to: R. D. Statler, 1133

from: D. W. Powers, 4511

subject: Scope of Work, Borehole(s) in Section 13, T22S, R30E

Objective: To determine the nature of unusually thick fill material in section 13, T22S, R30E, through a drilling and logging program, and to further assess the effects of the anomaly, if any, upon the WIPP. The fill material has been located in the southern half of the section in unpublished mapping by George O. Bachman of the USGS for the WIPP program. The area is near Livingston Ridge and Nash Draw to the west and also shows a small topographic depression. Hydrologic information will be obtained from the borehole(s) to supplement existing data in the area.

Method: An initial drill hole is expected to provide information on the nature of the fill sediment. The hole will be drilled to below an identifiable marker bed near the top of the Salado Fm (probably the 101 marker bed) or the equivalent depth of about 800'. Logging of the hole is to provide information on the acoustic velocities, formation resistivities, porosity, density, natural radioactivity, and formation attitudes. An additional borehole may be required, following the initial drilling, adjacent to the area with fill to determine stratigraphic relationships and origins.

Details: The specific hole location will be selected after completion of mapping. The borehole should be primarily rotary drilling with provision for taking core at least NX in size. Coring will be undertaken to provide samples of the fill sediment and may be continued if expected beds are encountered more than about 50' above or below projected intercepts. If the stratigraphy appears normal, coring of important marker zones such as the Magenta, Culebra, and top of Salado may be undertaken to provide further evidence of normality.

Under these circumstances, not more than about 250' total of core should be anticipated. Logging undertaken by commercial concerns shall include compensation for hole effects. The USGS/Water Resources Division, Albuquerque, should independently plan to log the resulting hole for cross-documentation with nearby potash (P) and hydrologic holes.

Data Requirements: The following data requirements support the drilling program to investigate the area with unusual sedimentary fill.

The location shall be established on the basis of the field mapping, and shall be determined areally $\pm 10'$ relative to the nearest readily accessibly permanent corner marker and $\pm 1'$ vertically relative to the nearest readily accessible NGS permanent marker.

Continuous coring shall be required through important stratigraphic markers or unusual stratigraphy, though 100% core recovery is not required. All core taken will be marked to the nearest foot relative to measurements of drilling pipe, and will be sealed in heavy plastic as in ERDA 9. Further core handling instructions have previously been established and are adequate when appropriately modified for hole number and size (see WIPP 11 Drilling Program, Schedule, and Test Plan, Appendix A, from R.D. Statler to Distribution, January 26, 1978).

Borehole geophysical logging is required to supply information on stratigraphy, formation density, porosity, formation resistivity, and formation attitude. Logging done by commercial firms should be in accordance with industry standards. The dipmeter log is to be corrected for tool orientation. Depths measured by logging tools should be accurate to 1 foot per thousand feet depth. A trained logging engineer is required to perform the logging task.

Hole plugging programs may be deferred for the moment since the hole is likely to remain open for some time or be re-entered. Ultimate hole plugging may follow the program outlined in the memorandum: WIPP 18 through 22 Drill Holes, Plugging Plan, dated March 28, 1978, from C.W. Gulick to R.D. Statler.

Field Support: Division 4511 will depend on Division 1133 for support in obtaining permits, carrying out the drilling and logging programs, establishing procedures, and supplying field support. Support from the USGS/WRD for logging and core description is requested, as is support from the Special Projects Division in examining the stratigraphy.

Decision Points: The total depth of the hole is expected to be less than 800', deep enough to confirm the stratigraphy in the upper Salado Fm or determine that abnormalities persist into the Salado. Other decision points during the drilling float based on the observed stratigraphy:

March 8, 1979

- a) if the stratigraphy is normal, coring of three stratigraphic markers (Magenta, Culebra, top of Salado) will take place. Ordinarily a hole in section 13 might be expected to encounter normal stratigraphy with approximate depths to the Magenta, Culebra, and top of Salado of approximately 470', 585', and 690', respectively.
- b) if the cuttings and/or drilling rates indicate that marker beds are absent or displaced more than about 50' from expected stratigraphic positions, core will be taken to determine the nature of the abnormality.

If the stratigraphy is abnormal, the hole will be logged at total depth, and may be readied for testing of zones within the hole that indicate possible fluids. If the stratigraphy is indicating fill only very near the surface, the hole will be drilled to total depth of about 800' to ascertain that a localized surficial feature is not present. If the hole continues to show abnormal features to that depth, it is anticipated that the hole will be abandoned temporarily, and the location will be reoccupied at a later date with appropriate equipment and a test plan designed to thoroughly evaluate the anomaly.

Background: Mapping of the Nash Draw and WIPP site area by George Bachman of the USGS over the past year indicates sedimentary fill in section 13 having a thickness and characteristics not normally seen in this area. It is not possible on the basis of known information to assign the sedimentary fill to a particular process. Drilling and coring of the material, and the relationships to the normal stratigraphy of the area, should indicate whether the fill is thick because of prior erosion or because of solution. The proximity to Livingston Ridge and Nash Draw indicates the possibility of solution effects. In addition, the resistivity gradient survey carried out over the WIPP site and immediate surroundings in 1977 indicates the presence of a broad resistivity low through much of section 13. This resistivity low itself is not a localized feature, and may simply be reflecting changes in porosity associated with the fill or shallow solution along Livingston Ridge.

Approved:

L. R. Hill, Supervisor
Nuclear Waste Technology
Division 4511

Copy to:

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W. S. Twenhofel, USGS, SPD, Denver
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APPENDIX B

DRILLING AND TESTING PLAN

compiled by

R. D. Statler

Division 1133

and

P. D. Seward

Division 1135

Sandia Laboratories

INTRODUCTION TO APPENDIX B, DRILLING AND TESTING PLAN

The drilling and testing plan is the translation of technical objectives contained in documents in Appendix A into field engineering terms. Changes or amendments are included as well. The approvals and permits obtained from various agencies prior to drilling are kept on file but are not included here.

subject: Site Investigations for WIPP 33

The attached document contains the Field Operations Plan for conducting WIPP 33. Drilling, logging, coring, and cementing procedures are included for your use and information. Revisions and additions shall be added to this document as required and appropriate distribution made.

RDS:mnw

Distribution:

C. L. Jones, USGS, Special Projects Div., Denver
J. W. Mercer, USGS/WRD, Albuquerque
G. O. Bachman, USGS/WRD, Albuquerque
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Field Operations Plan of Sandia Laboratories
WIPP Site Investigations
Possible Breccia Pipes

Exploratory Well: WIPP 33

Los Medanos Area: Section 13, Township 22S, Range 30E

Eddy County, New Mexico

Purpose: To determine the nature of unusually thick fill
material through a drilling and logging program.

Prepared by

R. D. Statler
R. D. Statler, Supervisor
Field Engineering Projects
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Reviewed by

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INTRODUCTION

This document includes a scope of work for an exploratory borehole WIPP 33 to determine the nature of an unusually thick fill material. It describes the operational plan for conducting the field activities required to meet specified objectives. Procedures with drawings, specifications and instructions as necessary to promote good quality control of essential features are also included.

1. FIELD OPERATIONS PROGRAM CRITERIA

The memorandum from D. W. Powers to R. D. Statler dated 3/8/79 "Scope of Work, Borehole(s) in Section 13, T22S, R30E" has been accepted as the design criteria for WIPP 33. It is reproduced in its entirety as Appendix A.

2. FIELD OPERATION PLAN - WIPP 33

2.1 Organization

Technical direction will originate within Sandia Division 4511. Field operations, managed by Bob Statler, Sandia Division 1133, will be conducted by W. E. Cunningham, Fenix and Scisson. Drilling contract and associated support service contracts will be let and administered by F&S as arranged for by Federal Agency Order through Nevada Operations Office, DOE.

Identification of marker beds, core logging and other geologic interpretations will be provided by duty geologist.

Quality control and inspection will be conducted by designated experts.

Administrative assistance, logistical support of Sandia Programs will be provided by P. D. Seward and J. E. Magruder, Sandia Division 1135.

2.2 Supporting Data - WIPP 33

Geology

The geology of the drill location is not certain and the stratigraphy may prove unusual. The following prognosis has been provided by G. O. Bachman, USGS, and is based on projections from nearby holes assuming normal conditions:

Ground Elevation above Sea Level	3320'
Allunium	0-20'
Top Dewey Lake	20'
Top Rustler	420'
Top Magenta	480'
Top Colebra	595'
Top Salt	710'
Expected TD	800'

2.3 Drilling Parameters and Expected Drilling Requirements

It should be recognized that the stratigraphy may be unusual, therefore, the drilling program may be adjusted to provide for abnormalities. If the conditions are found to be relatively normal, the following program is expected to be employed:

2.3.1 Level and prepare a surface location of 100' x 200' minimal size using approximately 6" caliche base.

2.3.2 Machine auger a conductor hole of sufficient depth and diameter to permit installation and cementing of a 30-40' x 9-5/8" O.D. conductor pipe.

Construct a timber-cribbed cellar which will be compatible with appropriate wellhead safety equipment and other associated drilling equipment.

2.3.3 Move in rig and rig up intermittent NX core from selected intervals to a TD of approximately 800' Use circulating fluids best suited to enhance full core recovery.

All core is to be logged, marked and handled according to procedures outlined in Section 3.2.

2.3.4 Following coring operations, hole should be opened and conditioned for running logs by commercial service and USGS/WRD. Logs to be run include sonic, resistivity, density, gamma, neutron, dip-log and possibly up-hole velocity. Procedures for logging program are outlined in Section 3.3.

2.3.5 When rotary drilling, take drill cuttings at 5' intervals, log, mark, and retain for storage in 100' bundles.

2.3.6 When logging is completed, recondition hole and fill with fluid compatible with formation encountered.

2.3.7 Clean up pad area, fill in pits and leave hole temporarily abandoned pending subsequent reoccupation for possible testing.

As stated previously, the drilling program may be adjusted to provide for a study of abnormalities. If the drilling program reveals abnormal stratigraphy, the progress may be revised in the field.

2.4 Discussion of Potential Hazards

Drilling this hole may produce unusual fluids and/or gas pockets. Preparations should be included for monitoring and flaring combustible gases.

3. FIELD OPERATING PROCEDURES FOR QUALITY CONTROL REQUIREMENTS

Some parts of this program are considered important enough to establish specific procedures for their conduct. These activities are:

- Measurement of Surface Location and Elevation. See Section 3.1
- Coring Operations. See Section 3.2
- Geophysical Logging Operations. See Section 3.3

The above activities should be monitored in detail or reviewed by designated experts whose education, knowledge and/or experience makes him qualified to assure adherence to operating procedures or to ascertain or certify that desired objectives have been met.

When designated, this individual shall take appropriate measure to negotiate with pertinent officials to whatever extent necessary to assure acceptable results.

3.1 Measurement of Surface Location and Elevation

The general location will be established by Division 4511 following a review of resistivity surveys, surface features, accessibility and other geo-political considerations. A preliminary land survey shall be conducted by a Registered Land Surveyor to establish access routes and set stakes for drill location and pad boundaries. Dimension of the location will be established with nearest section boundaries and nearest marked section corners to provide data necessary for obtaining land use permits. Drawings or sketches suitable for construction use shall be submitted. After pad construction is complete and at the time of hole spudding, a concrete monument with a brass cap will be set in the immediate vicinity of the borehole such that it can be used as the datum point for all borehole vertical measurements. Once this monument is established, this monument and its lateral relation to borehole axis is to be surveyed by a Registered Land Surveyor to establish the vertical elevation within $\pm 1'$ of the nearest NGS monument and the lateral coordinates within $\pm 1'$ with respect to nearest section boundaries and recoverable section corners.

3.2 Coring Operations Procedure of Sandia Laboratories - WIPP Site Investigations

3.2.1 Introduction

This procedure is prepared by the Field Engineering Division 1133 for use in Sandia Laboratories' WIPP Program. The objective is to establish the methods and techniques to be used in coring operations in order to obtain reliable samples in a uniform manner.

3.2.2 Scope of Work

This coring operation is to be done as a part of exploratory drilling of possible breccia pipes. Coring operation will consist of taking approximately 300' of NX size core to a TD of approximately 800'. Core is to be removed from the core barrel, logged, measured, cleaned, marked, photographed, packaged, transported and stored according to the procedures presented in this document.

3.2.3 Organization

Sandia Laboratories is conducting this field work under technical direction from Division 4511 and the Sandia Field Engineering Division 1133 will manage the field operations.

Sandia Labs has arranged with Nevada Operations Office, DOE, for their contractor, Fenix & Scisson, to prepare and administer a field program on behalf of Sandia and from criteria provided by Sandia that includes the taking of core. The drilling contractor, the coring contractor and the roustabout contractor are under contract to Fenix & Scisson.

Sandia Labs has arranged with Albuquerque Operations, DOE, for support of USGS. USGS will provide the duty geologist for logging and identifying the core and supervision of core handling in the field.

Sandia Labs will provide core photography.

Sandia Labs will provide core storage.

3.2.4 Operations

3.2.4.1 Coring (F&S and their contractors)

Continuous wireline coring with NX size diamond core bit and a nominal 10' split core barrel is required.

Other equipment and material such as drill-collars and stabilizers, drilling fluid should be utilized according to best judgment to match the formation and produce optimum core recovery.

Select and use drilling weight, rotary speed and circulation rates that will produce optimum core recovery.

Maintain a daily record which shows: date; tour and operating personnel; sequence of core interval; depth of core interval; drilling time of core interval; drilling weight; rotary speed and circulation rate; and, type circulating fluid.

- 3.2.4.2 Removal from Barrel (F&S and their contractors)
Core should be removed from core barrel as gently as possible to cause a minimum alteration of the core. Light hammering or jarring is permissible but heavy hammering or pounding the barrel on its end is to be avoided. Removal by pumping is permissible.

As the core is removed it will be placed in troughs in the order coming out of the barrel. Troughs will be marked with red at top end and black at bottom indicating down direction.

- 3.2.4.3 Logging and (USGS Duty Geologist)

If core is suitable for marking, each major piece should be marked with a visible waterproof ink arrow pointing in the direction the hole is advancing. Each core piece should be measured, identified and logged indexing each foot with footage expressed to the closest 1/10 of a foot. Depths should be reconciled from measurements of the drill pipe to the nearest foot taken from the top side of the Kelly bushing (KB) unless otherwise specified. Any lost recovery should be logged at the bottom of each core interval unless known to be otherwise and so explained on the core log.

3.2.4.4 Cleaning (F&S and contractors)

Core will be wiped or brushed to remove soft mud cake and excess mud as soon as possible following removal from the core barrel. A rag dampened in drilling fluid will be used to wipe the core. If core is accidentally washed with fresh water, it will be noted in the log stating intervals exposed and time of occurrence.

3.2.4.5 Photograph (Sandia and Duty Geologist)

After core has been logged, labeled and cleaned it will be carefully moved to the core/photo shed and prepared for photography. Core may be wetted to enhance photo coverage. Core should be positioned by the duty geologist to promote coverage of pertinent features such as fractures, bedding plane, color or any other significant characteristics. Each photo should have a title block showing well number, date, core interval and photo number.

3.2.4.6 Preservation (Duty Geologist, F&S Contractor)

After core has been photographed it will be wiped dry and preserved for transportation and storage in the following method.

3.2.4.6.1 Sealing in Plastic Bags

Core pieces will be separated into lengths appropriate to fit into the core boxes. Pieces will be placed into plastic sleeves of appropriate length or wrapped and taped with plastic sheet. When using sleeves, use a hot iron sealing tool, seal both ends of plastic sleeve after squeezing all air possible from sleeve. Place sleeved or wrapped core into box and tape shut. When core intervals are missing, spacers marked with missing footage figures may be inserted in the box as necessary to preserve sequence. Boxes should be labeled in sequence with name of agency, well number, date, core number and depth of core pieces in the box.

3.2.4.7 Handling and Storage (Sandia, Duty Geologist, F&S)

After core pieces have been properly boxed they should be stored under protective cover to avoid adverse weather and temperature extremes until ready for transportation to core library in Carlsbad. The duty geologist will be responsible for assuring correct markings on the exterior of all the boxes, accurate inventory of core being transported, safe transport of core from drill pad to core library in Carlsbad.

Duty geologist will prepare a record for placing the core into storage and delivery to core library custodian at the time of core delivery. Record will include name of agency, well number, location of well, date core taken, depth of core interval and number of boxes being delivered and name of duty geologist.

3.2.5 Records (F&S and Duty Geologist)

3.2.5.1 A daily core drilling record will be maintained which shows - date, tour, operating personnel, drilling weight, rotary speed, lengths of drilling tools used, number and time of core interval being drilled, depths, circulation rate.

3.2.5.2 A daily core logging record will be maintained which shows - date, name of duty geologist, well number, location, permanent datum, elevations of Kelly bushing, ground level, interval drilled, footage drilled, footage cored, feet recovered, percent recovered.

DAILY CORE LOGGING RECORD

Date _____ DUTY GEOLOGIST _____

LOG HEADINGS:

Company _____

Well Number _____ WIPP No. _____

Field _____ County _____ State New Mexico

Location _____

Section _____ Township _____ Range _____

Permanent Datum _____ Elevations: K.B. _____

D.F. _____

G.L. _____

[illegible]

3.3 Borehole Geophysical Logging Operations Procedure of Sandia Laboratories - WIPP Site Investigations

3.3.1 Introduction

This procedure is prepared by the Sandia Laboratories Field Engineering Division 1133 for use in Sandia's WIPP Site Investigation. The objective is to establish standard routines and methods for borehole geophysical logging in order to assure qualified data in a reliable manner.

3.3.2 Scope of Work

Geophysical logging of boreholes in the WIPP site investigations may include a wide variety of individual logging services. Logging services may be provided by several different commercial firms utilizing different types of tools and techniques. Services may be purchased directly by Sandia Labs or through engineering firms such as Fenix & Scisson.

The scope of logging services will change from borehole to borehole and will depend on the specific objectives of the borehole program.

It is not the intent of this document to tell the logger how to run his business. Rather it is to establish standard routines and "check list" to make certain the objectives of the logging program as stated by the technical director can be achieved through the exchange of pertinent information and utilization of qualified personnel.

3.3.3 Organization

The Sandia Laboratories is conducting this field work with Technical Director from Division 4511. Field operations is managed by Sandia Field Engineering Division 1133.

Sandia Labs has arranged with DOE/NV00 for their contractor, F&S, to prepare and administer a drilling program and associated subcontracts from criteria provided by Sandia which includes borehole logging on WIPP 33

3.3.4 Operations

3.3.4.1 The Field Operations Plan prepared for each borehole will identify the probable logs to be run. Since the logging program is usually customized to fit the hole conditions, the specific logs to be run may not be included but will be the subject of a written supplement to the Field Operations Plan and distributed in time to select the proper service.

3.3.4.2 Prior to selecting a logging service, a Sandia representative will meet with Fenix & Scisson and prepare the form "Instructions to Logging Company" for the specific logs to be run.

3.3.4.3 Prior to logging a qualified representative of Sandia Labs will meet with the logging service company's logging engineer. He will present the "Instructions" and discuss:

- a) the entire logging program and special requirements,
- b) hole conditions that may cause problems, and
- c) zones of special interest.

3.3.4.4 During the pre-log conference, the Sandia representative will discuss and request the following be done:

- The equipment will be "warmed up" for the adequate amount of time and tools will be checked to see that they are functioning properly upon arrival at the location.
- Rm, Rmf, and Rmc will be measured on mud samples. Estimated values are not acceptable. The service company should run the sample through a mud press.
- All Sidewall and Compensated Neutron logs and all density porosity curves will be run on limestone matrix over the zones of interest, regardless of the lithology.
- Equipment will be tested while running in hole.
- Before and after log calibrations will be shown for all curves.
- Panel calibrations will be shown for all density and neutron logs, integration checks will be shown for all integrated Acoustic logs.
- In addition to caliper rings, the caliper calibration should show "tool full open" and casing readings.

- A minimum 200 feet repeat must be shown.
- Overlap previous runs by at least 200 feet.
- All headings information will be completely filled out.

3.3.4.5 The Sandia logging representative will be present and observe the logging operation to the extent necessary to assure objectives have been met. He should complete a "Log Quality Report" following the operation and, along with a copy of "Instructions to Logging Company," forward to Sandia Field Engineering Division 1133.

3.3.5 Records

3.3.5.1 "Instruction to Logging Company"

F&S should prepare, following a conference with Sandia representative.

Distribution should be made as follows:

- 1 Logging Company
- 1 Sandia Representative - observing log operations
- 1 F&S
- 1 Sandia Carlsbad Hole File
- 3 Sandia Division 1133, ABQ (3 copies)
- 1 USGS, Spec. Proj., Denver
Attn: C. Jones
- 1 USGS/WRD, ABQ, Attn: J. Mercer
- 1 USGS/WRD, ABQ, Attn: G. O. Bachman

3.3.5.2 Log Quality Report

Sandia representative should prepare and distribute as follows:

- 3 Original and two copies to Sandia Field Engineering Division 1133, ABQ, who will be responsible for forwarding to WIPP Central Files
- 1 Sandia Carlsbad Hole File
- 1 F&S, Carlsbad

3.3.5.3 Geophysical Logs (Field Prints)

F&S Carlsbad should obtain 9 copies of log field prints and distribute as follows:

- 1 Sandia Carlsbad Hole File
- 1 USGS, Spec. Proj., Denver
Attn: C. Jones
- 1 USGS/WRD, ABQ, Attn: J. Mercer
- 1 USGS/WRD, ABQ, Attn: G. O. Bachman
- 1 Sandia Division 4511, ABQ
Attn: D. W. Powers
- 4 F&S Carlsbad (4 copies)

3.3.5.4 Geophysical Logs (Final Prints)

F&S should order 15 final copies of logs and two copies of library magnetic tapes of the logs and distribute as follows:

- 1 Sandia Carlsbad Hole File
- 2 USGS, Spec. Proj., Denver
Attn: C. Jones
- 1 USGS/WRD, ABQ, Attn: J. Mercer
- 1 USGS/WRD, ABQ, Attn: G. O. Bachman
- 3 Sandia Division 4511, ABQ
Attn: D. W. Powers
- 2 Sandia Division 4512, WIPP Central
File, ABQ; 2 copies logs and
2 copies tapes
- 1 F&S Carlsbad
- 1 F&S Las Vegas
- 1 State Engineer, Roswell, NM
- 1 USGS Area Geologist, Roswell, NM
- 1 West Texas Electric Log Service

FENIX & SCISSON
LOG QUALITY REPORT

Hole _____ Log Date _____ Current Date _____

Log _____ Run : _____ Engr. _____

Field Print ☐

CHECK ALL BOXES - ACCEPTABLE YES OR
UNACCEPTABLE NO
Sections not applicable to a particular service,
Leave Blank.

REMARKS: Code Remarks with the proper Section Number.
For Example: Remarks concerning before log
calibrations would be coded D-5.

A. HEADING

YES NO

1. Correct Heading Used
2. Heading Data Properly Completed
3. Equipment Used Section Completed
4. Equipment Data Section Completed
5. Scale Changes Noted on Heading
6. Are all abnormal conditions explained in the remarks section

B. CALIBRATIONS AND SCALES

1. Scales Correct for Argon
2. Scales Labelled
3. Scale Changes Labelled
4. Zeroes Recorded
5. Before Log Calibrations
6. After Log Calibrations
7. Repeat Section Recorded
8. Repeat Section Acceptable

[illegible]

C. VALIDITY OF LOG

1. Curves Functioning Correctly
2. Do Log values fall within reasonable limits
3. Curves on Depth
4. Logging Speed Indicated
5. Logging Speed Correct

D. APPEARANCE

1. Printing or Typing Neat
2. Printing or Typing Accurate
3. Grid and Pen Traces
4. Splices Straight and Clean
5. Film Correctly Processed
6. General Print Quality

Log. No. _____

- (a) Vertical Depth Scales 2-inches/100-feet and 5-inches/100-feet
- (b) Horizontal Logging Scales _____
- (c) Logging Speed Desired _____
- (d) Interval to be Logged _____
- (e) Zones of Special Interest _____

- (f) Special Instruction _____

Log. No. _____

- (a) Vertical Depth Scales 2-inches/100-feet and 5-inches/100-feet
- (b) Horizontal Logging Scales _____
- (c) Logging Speed Desired _____
- (d) Interval to be Logged _____
- (e) Zones of Special Interest _____

- (f) Special Instruction _____

Log. No. _____

- (a) Vertical Depth Scales 2-inches/100-feet and 5-inches/100-feet
- (b) Horizontal Logging Scales _____
- (c) Logging Speed Desired _____
- (d) Interval to be Logged _____
- (e) Zones of Special Interest _____

- (f) Special Instruction _____

FENIX & SCISSON, INC.

Page ____ of ____

INSTRUCTIONS TO LOGGING COMPANY

Date _____ Logging Company _____
 Logging Engineer _____
 Witnessed By _____

Log Headings:

Company Fenix & Scisson, Inc. for Sandia Laboratories

Well Number WPP No.

Field _____ County _____ State New Mexico

Location _____

Section _____ Township _____ Range _____

Permanent Datum _____ Elevations: K.B. _____

Log Measured From _____ D.F. _____

Drilling Measured From _____ G.L. _____

Hole Status.	SIZE	FROM	TO		SIZE	FROM	TO
Casings	_____	_____	_____	Borehole	_____	_____	_____
	_____	_____	_____		_____	_____	_____
	_____	_____	_____		_____	_____	_____

Type Fluid in Borehole _____ Fluid Level _____

Density _____ pH _____

Viscosity _____ Fluid Loss _____

Purpose of Logging Program, Zones of Special Interest, Critical Hole
 Conditions, Remarks, Etc. _____

Number of Prints: Field _____ Final _____

Invoice To: Fenix & Scisson, Inc.
 401 N. Canal Street
 Carlsbad, NM 88220

4. REPORTS

Distribution Instructions:

4.1 Daily Report

F&S, Carlsbad, shall provide to Sandia, Carlsbad, a copy of the daily report. Sandia, Carlsbad, will telefax weekdays to DOE, Carlsbad office and Statler, 1133. A copy of the daily report is to be kept by Sandia, Carlsbad.

4.2 Hole History

Compiled by F&S, Carlsbad, and Las Vegas, NV. Send copy to R. D. Statler, 1133, for Sandia, Albuquerque distribution.

4.3 Miscellaneous Records shall be provided by F&S, Carlsbad, including the following, with original to be kept on file at F&S, Carlsbad, and one copy to Sandia, Carlsbad:

- Drillers Logs, Bit Records, Drill Fluid Recaps
- Equipment Certification
- Drilling History Chart
- Cost Records (copy also to R. D. Statler, 1133,
Albuquerque)

APPENDIX C

HOLE HISTORY

compiled by

R. D. Statler

Division 1133

and

P. D. Seward

Division 1135

Sandia Laboratories

INTRODUCTION TO APPENDIX C, HOLE HISTORY

The hole history is a document provided soon after completion of the borehole, and it summarizes the relevant information on the daily log kept by the contractor. The hole history is not edited to ensure conformance in every detail with later information developed for previous chapters. Further information may be obtained as necessary through examination of the original daily time logs.

FENIX & SCISSON, INC.

HOLE HISTORY DATA

DATE: 9-5-79

HOLE No.: WIPP #33	W. O. No.:	I. D. No.:
USER: Sandia Lab	TYPE HOLE: Exploratory	
LOCATION: New Mexico	COUNTY: Eddy	AREA: WIPP
SURFACE COORDINATES: * 1762.48' FSL, 2426.65' FWL		GROUND ELEVATION: *
RIG ON LOCATION:	SPUDED: 7-13-79	COMPLETED: 7-26-79

CIRCULATING MEDIA: Salt base mud.

No. of COMPRESSORS & SIZE:

BURE HOLE RECORD			CASING RECORD							
FROM	TO	SIZE	I. D.	WT./FT.	WALL	GRADE	CPL'G	FROM	TO	CU. FT. CMT.
0'	5'	Excav.		(5' x 5' cellar)						Dirt
5'	38'	18"	8.921"	36#				0'	38'	192
38'	840'	6-3/4"								

TOTAL DEPTH: 840'

MANDREL DEPTH

PLUGS:

JUNK:

LOGGING DATA: Page 3

SURVEYS PAGE:

CORING PAGE:

BOTTOM HOLE COORDINATES:

REFERENCE:

NON-OPERATIONAL TIME		OPERATIONAL DELAY TIME		WORKING TIME	
Move Rig up & down	Gov. Mat'l 0.19 days	Equipment Repair	0.31 days	Drilling Time	0.98 days
Secured	2.00 days	Coring	_____ days	Trip Time	0.46 days
Bull & Run Mandrel	_____ days	Lost Circ.	_____ days	Single Shot Survey Time	_____ days
Logging	0.60 days	Fishing	_____ days		_____ days
Survey	_____ days	W. O. Equipment	_____ days	Total	1.44 days
Casing	_____ days	Mix & Condition Mud	0.99 days	Total Suspended Time	_____ days
Cement	_____ days		_____ days	Non-Operational Time	5.99 days
Coring	3.20 days		_____ days	Operational Delay Time	1.30 days
	_____ days		_____ days	Working Time	1.44 days
TOTAL	5.99 days	TOTAL	1.30 days	TOTAL ELAPSED TIME	8.73 days

REMARKS: Depths reported from ground level.

* Location of brass monument: 1758.96' FSL, 2430.20' FWL,

Sec. 13, T22S, R30E. Elevation 3323.23'

Rig No.	Name	Type
1	Penn. Drilling Co.	Failing 2000 8.73 days
		_____ days
		_____ days
		_____ days
		_____ days
		_____ days

WIPP #33
HOLE HISTORY

- 7-13-79 Construction Enterprise completed constructing a 200' x 100' pad with a 5' x 5' cellar 5' deep lined with boards in the center. Link Rat Hole, Inc., drilled an 18" hole from 5' to 38' with an auger rig. Hole caved badly, used mud to hold open. Set 9-5/8" O.D., 36#, J-55 casing at 38'. Cemented annulus and bottom of cellar with 192 ft³ of grout.
- 7-16-79 Welded a slip on flange for 7" rotating head on the 9-5/8" casing. Moved in Pennsylvania Drilling Company's rig #1.
- 7-17-79 Rigged up. Drilled 6-3/4" hole from 38' to 48' using salt base mud. Made up 10' split core barrel with a 6-11/16" core head and cut core #1 from 46' to 48'. All depths reported from ground level.
- 7-18-79 Completed core #1 from 48' to 51', recovered 2.1'. Cut core #2 from 51' to 58', recovered 2.3'. Drilled 6-3/4" hole from 58' to 380' with 98% returns to complete loss of circulation. Mixed lost circulation materials during drilling progress.
- 7-19-79 Drilled 6-3/4" hole from 380' to 383' with no returns and to 384' with 95% returns. Made trip for core barrel and cut core #3 from 384' to 387', no recovery. Lost returns at 384'. Added lost circulation materials to the hole at surface and pumped down hole, regained circulation. Drilled 6-3/4" hole from 387' to 393' with full returns at 387' to 5% returns at 393'. Conditioned hole and added lost circulation materials. Cut core #4 from 393' to 403' with no returns, recovered 2.4'. Started core #5.
- 7-20-79 Cut core #5 from 403' to 407', recovered 2.8'. Cut core #6 from 407' to 417', recovered 4.7'. Cut core #7 from 417' to 436', recovered 1.1'. Found cavity from 417' to 427'. Cut core #8 from 436' to 446', recovered 2.8'.
Cut core #9 from 446' to 456', no recovery.
No circulation for 24 hour period.
- 7-23-79 Rig secured from 7-20-79 to 7-23-79. Cut core #10 from 456' to 466', cavity from 462' to 466', recovered 2.21'. Cut core #11 from 466' to 480', cavity from 466' to 470', recovered 6.4'. Drilled 6-3/4" hole from 480' to 540'. Ran core barrel in the hole and reamed tight hole from 500' to 505'. Cleaned out 2' of fill and cut core #12 from 540' to 550', recovered 9'. Cut core #13 from 550' to 560', recovered 5.4'. Cut core #14 from 560' to 570', recovered 4'. No circulation for 24 hour period.

7-24-79 Cut core #15 from 570' to 578', recovered 0.3'. Cut core #16 from 578' to 588', recovered 9.8'. Drilled 6-3/4" hole from 588' to 650'. Cut core #17 from 650' to 660', recovered 9.3'. Cut core #18 from 660' to 670', recovered 7.5'. Cut core #19 from 670' to 680', recovered 6.7'. Cut core #20 from 680' to 690'. No circulation for 24 hour period.

7-25-79 Recovered 9.7' on core #20. Cut core #21 from 690' to 700', recovered 10'. Drilled 6-3/4" hole from 700' to 836'. Circulated hole 20' off bottom and mixed mud. Stuck drill pipe and worked free. Drilled 6-3/4" hole from 836' to 840'. Mixed mud and lost circulation materials. Conditioned hole for logging. No returns. Ran USGS logs. Fluid level at 273'. Ran Dresser Atlas logs.

7-26-79 Completed logging. Fluid level at 273'. Pumped mud in the hole, fluid level at 248'. Laid down drill pipe and government equipment. Release rig at 1230 hours.

BIT RECORD

<u>Run NO.</u>	<u>SIZE</u>	<u>MAKE</u>	<u>TYPE</u>	<u>DEPTH OUT</u>	<u>FEET DRILLED</u>	<u>ROTATING HOURS</u>
1	6-3/4"	Security	S4J	46	8	3/4
				384	326	10-3/4
				393	6	1/4
				540	60	2-1/2
				650	62	3-1/2
2	6-3/4"	Security	S4J	840	140	3-3/4

CORE BIT

1 Rerun	6-11/16"			58	12	4-1/2
				387	3	3-3/4
				480	87	9-1/2
				588	48	5-1/4
				700	50	5-1/2

WIPP #33
HOLE HISTORY
PAGE 3

LOG INDEX

<u>TYPE LOG</u>	<u>DATE</u>	<u>RUN NO.</u>	<u>DEPTH DRILLER</u>	<u>DEPTH LOGGER</u>	<u>LOGGED FROM TO</u>
<u>DRESSER ATLAS LOGS</u>					
Acoustilog, BHC	7-26-79	1	840	831	272 824
Densilog Neutron	7-26-79	1	840	837	0 835
Gamma Ray Neutron	7-26-79	1	840	836	0 834
Dual Laterolog, Micro Laterolog	7-26-79	1	840	835	0 832

WIPP 33

S 1/2 Sec. 13 T22S R30E

PROPOSED DRILL HOLE LOCATION

"COLLAPSE FEATURE" W.I.P.P. 33
SECTION 13, TOWNSHIP 22 S, RANGE 30 E N.M.P.M.
EDDY COUNTY, NEW MEXICO
GROUND ELEVATION 3319.9'
1763.0 FSL & 2425.7 FWL

This is to certify that the foregoing plat was made from field notes of a bonafide survey made by me and is true and correct to the best of my knowledge and belief.

Dan R. Reddy
Dan R. Reddy NMPEALS #5412

3/6/79
Date

APPENDIX D

LOGS

compiled by

S-E. Shaffer

Division 4511

Sandia Laboratories

WIPP 33 Logs¹

Log	Company	ELSI# ²	Top of Logged Interval ³ (feet)	Bottom Logged Interval (feet)	Date
BHC Acoustilog	Dresser Atlas	W9146Z	273	840'	7/26/79
Dual Laterolog Micro Laterolog	Dresser Atlas	W9146X	38	832	7/26/79
Gamma Ray Neutron	Dresser Atlas	W9146Y	Surf.	834	7/26/79
Compensated Densilog Compensated Neutron	Dresser Atlas	W9146W	Surf.	835	7/26/79

¹Original data is retained in Sandia WIPP Central File, Division 4542, Sandia Laboratories, Albuquerque, NM 87185

²Order number for logs available through West Texas Electric Log Service, Inc. (ELSI), 105 West Wall Ave., Midland, TX

³Depths measured from ground surface; elevation officially 3323.23 above MSL.

Distribution:

U.S. Department of Energy, Headquarters
Office of Nuclear Waste Management
Washington, DC 20545

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Colin A. Heath, Director, Division of Waste Isolation (2)

U.S. Department of Energy, Albuquerque Operations
P.O. Box 5400
Albuquerque, NM 87185

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Carlsbad WIPP Project Office
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Carlsbad, NM 88220

U.S. Department of Energy
c/o Battelle Office of Nuclear
Waste Isolation
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Columbus, OH 43201
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Fifty Beale Street
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WIPP Public Reading Room
Atomic Museum, Kirtland East AFB
Albuquerque, NM 87185
Attn: Ms. Gwynn Schreiner

WIPP Public Reading Room
Carlsbad Municipal Library
101 S. Hallagueno St.
Carlsbad, NM 88220
Attn: Lee Hubbard, Head Librarian

Thomas Brannigan Library
106 W. Hadley St.
Las Cruces, NM 88001
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Roswell Public Library
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J. A. Cross

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