

Basic Data Report For Monitor Well Cabin Baby 1 (CB-1) Reconfiguration

Waste Isolation Pilot Plant

U.S. Department of Energy
Carlsbad Field Office

Revision 1

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DOE/WIPP-04-3306, Rev. 1**

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Basic Data Report
Monitor Well Cabin Baby 1 (CB-1)
(Waste Isolation Pilot Plant)

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September 2008

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS	5
1.0 INTRODUCTION	6
1.1 History of Monitor Well Cabin Baby 1	6
1.2 Regulatory Requirements for Reconfiguration of CB-1	9
1.2.1 New Mexico Statutes	9
1.2.2 New Mexico OSE Rules and Regulations	10
1.2.3 State of New Mexico Energy, Minerals, and Natural Resources Department Oil Conservation Commission (Order No. R-111-P)	11
2.0 WELL RECONFIGURATION	11
2.1 Removal of Packers and Tubing	12
2.2 Casing Preparation and Geophysical Logging	12
2.3 Reconfiguration and Cement Emplacement	13
2.4 Other Background	15
3.0 WASTE MANAGEMENT	15
4.0 SUMMARY	15
5.0 REFERENCES	15
Appendix A - Photographs	16
Appendix B - Field Report by Baker Atlas Logging Engineer Charles Childress	21

LIST OF FIGURES

Figure 1-1 - Location Map	7
Figure 1-2 - Configuration of Cabin Baby (CB-1) Before Reconfiguration (08/20/99) .	8
Figure 2-1 - Configuration of Cabin Baby (CB-1) After Reconfiguration (02/11/04) .	14

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
BLM	U.S. Bureau of Land Management
CB-1	Cabin Baby Federal 1 Well
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	foot/feet
NMED	New Mexico Environment Department
OSE	Office of State Engineer (New Mexico)
P&A	plugging and abandonment
PIP	production-injection packer
psi	pounds per square inch
ROW	right-of-way
SNL	Sandia National Laboratories
WIPP	Waste Isolation Pilot Plant

Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration DOE/WIPP-04-3306, Rev. 1

1.0 INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) facility disposing of transuranic and mixed waste under the Hazardous Waste Facility Permit (Permit NM4890139088-TSDF, as amended) issued by the New Mexico Environment Department (NMED). WIPP is located approximately 26 miles east of Carlsbad, New Mexico, in eastern Eddy County (Figure 1-1). Disposal panels are being excavated in the Permian Salado Formation at a depth of approximately 2,150 feet (ft) below ground surface (bgs).

Over the years, a number of groundwater monitor wells have been installed to monitor temporal and spatial changes in groundwater elevation and chemistry at WIPP. Many of the wells used for this purpose were constructed of carbon steel casing that has deteriorated to varying degrees due to corrosion. For some wells, the deterioration has led to failure of the well integrity. In such cases, the well must either be reconfigured or completely plugged, according to New Mexico Office of the State Engineer (OSE) regulatory requirements, to prevent commingling of groundwater from different formations. Other wells are nearing the end of their useful life and/or are duplicative of wells that serve the same purpose. Because of these integrity issues, WIPP has begun a program to plug and abandon wells that are no longer useful for the monitoring program or are redundant, and to reconfigure wells for future monitoring. One such well is known as Cabin Baby Federal 1 (CB-1). In 2004, CB-1 was reconfigured to provide only Bell Canyon Formation water level data. This basic data report provides a historical account of the well from the original installation to the current configuration. CB-1 was permitted by the New Mexico OSE and designated as "well C-2664." This well has been part of the far-field monitoring network since it was reentered by WIPP in 1978 up through reconfiguration in 2004. The well was used to obtain water level elevations and hydraulic parameters from both the Bell Canyon Formation and the Culebra Member of the Rustler Formation.

1.1 History of Monitor Well Cabin Baby 1

CB-1 (OSE File #C-2664) is located 200 ft south of the southern WIPP site boundary in the northeast quarter of Section 5, Township 23 south, Range 31 east (Figure 1-1). CB-1 was originally drilled in 1974 and 1975 as a petroleum wildcat well by the M.P. Grace Company. It was drilled to a depth of 4,150 ft bgs in the Bell Canyon Formation and cased with 13.375-inch outside diameter casing from ground surface to a depth of approximately 650 ft bgs, a few feet above the contact between the Rustler Formation and Salado Formation. M.P. Grace abandoned the well in 1974 after it was proved to be a non-petroleum-producing "dry hole" (Beauheim 1983).

During 1978, D'Appolonia (on behalf of the DOE) deepened CB-1 to a total depth of 4,290.6 ft and ran a caliper logging tool for borehole diameter measurements. From 1983 through 1999, Sandia National Laboratories (SNL) set up the well with variations of bridge plugs and production-injection packer (PIP) configurations for monitoring both the Rustler and Bell Canyon Formations. In 1999, SNL installed a final PIP and bridge plug configuration for multi-zone monitoring (Figure 1-2).

Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1

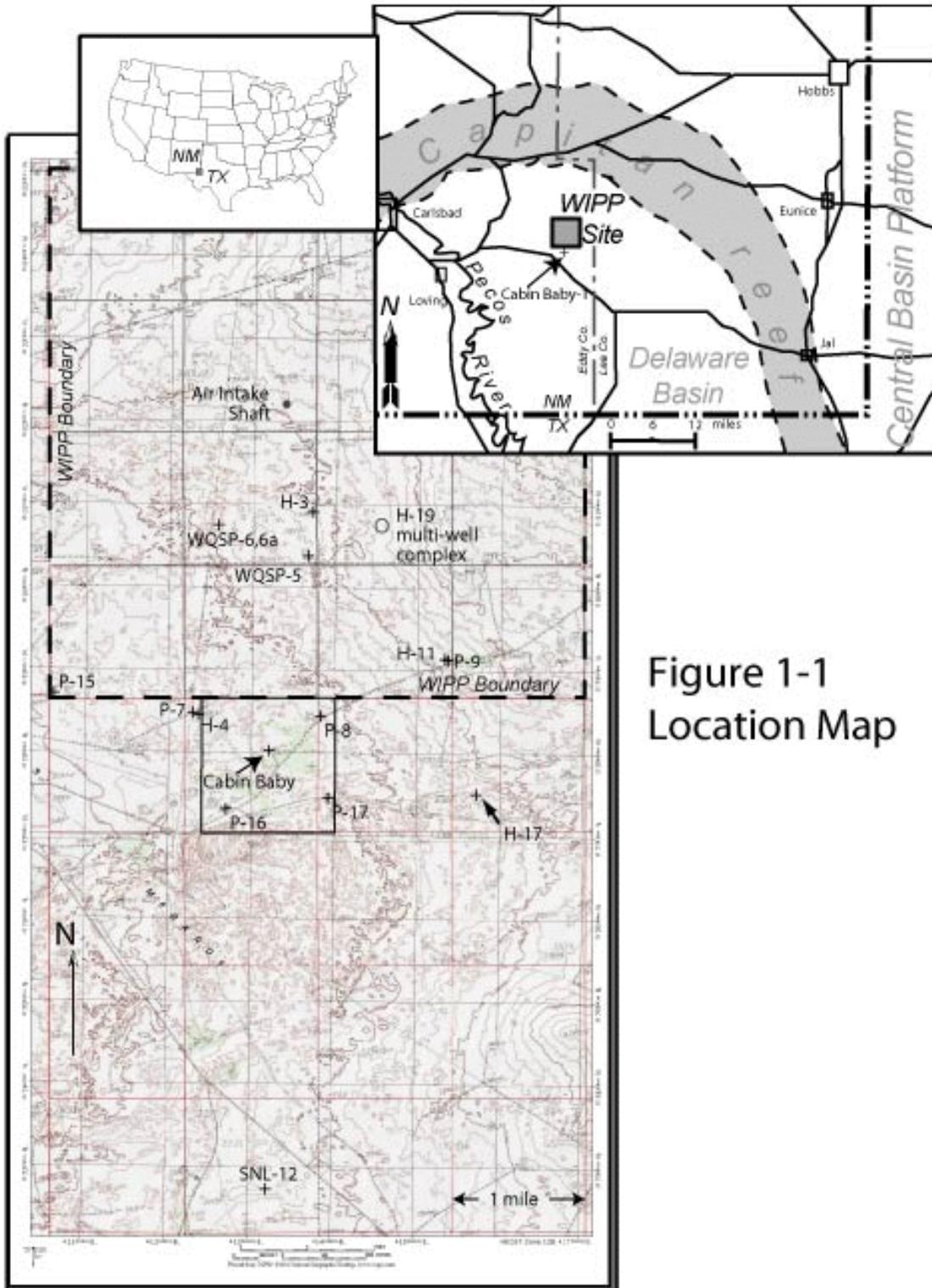
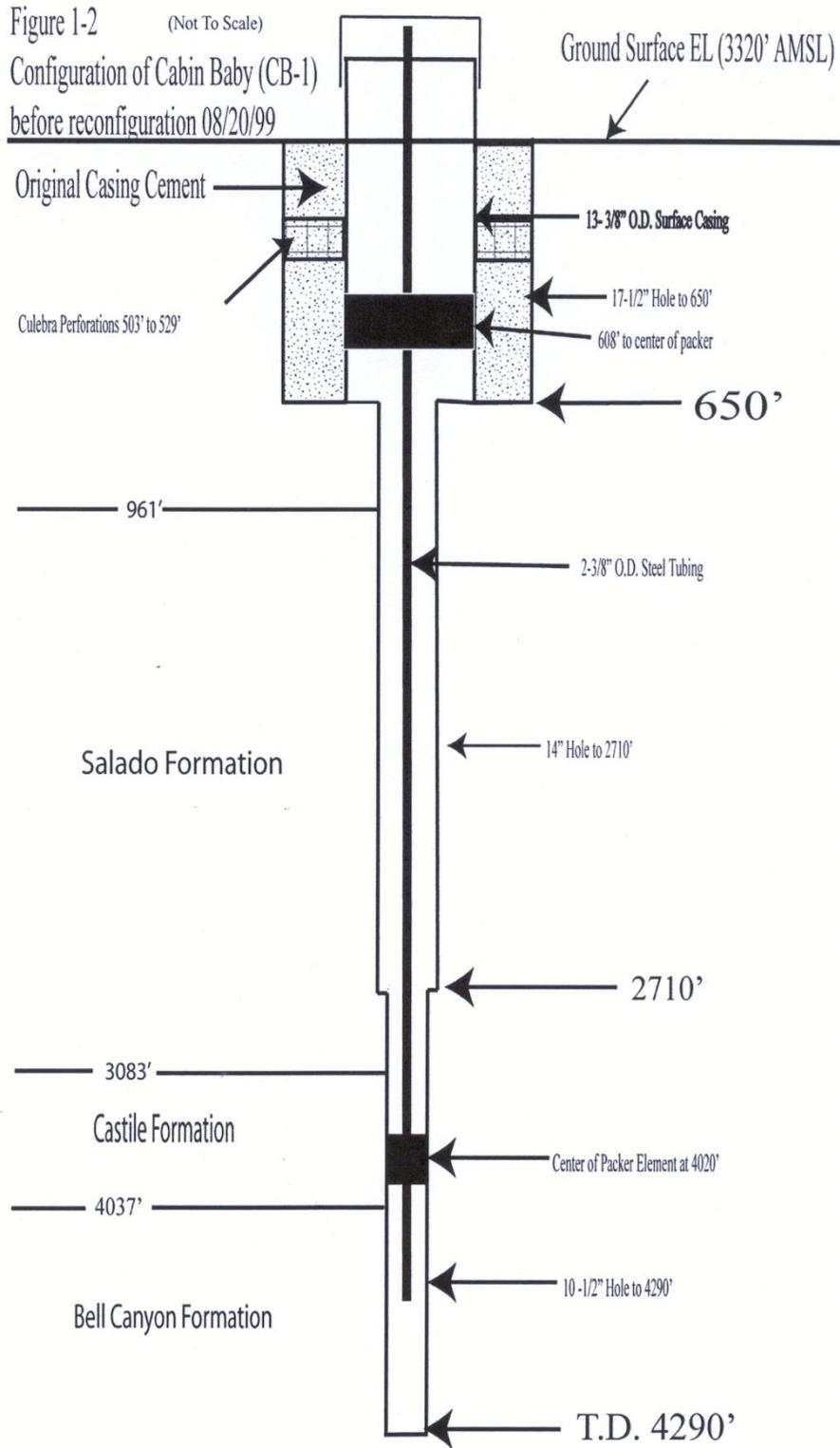


Figure 1-1
Location Map

Adapted from Powers 2004

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**



**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

M.P. Grace Company originally retained the right-of-way (ROW) reservation lease with the U.S. Bureau of Land Management (BLM). This ROW was transferred to WIPP in 1976 with special stipulations (ROW 107944). One of the stipulations required any monitoring well which penetrated the salt section be cased. CB-1 was completed as an open hole through the salt section. Therefore, based on this stipulation, the BLM required WIPP to reconfigure this well, or plug and abandon it, to prevent the salt section exposure to the groundwater.

1.2 Regulatory Requirements for Reconfiguration of CB-1

Prior to initiating the plugging and abandonment (P&A)/reconfiguration program the applicable regulations regarding the subject were analyzed. The following regulations were reviewed for this analysis:

- New Mexico Statutes Annotated 1978, Section 72-14 regarding drilling, casing, repairing, and abandonment of artesian wells.
- New Mexico OSE Rules and Regulations regarding application filing for well drilling, repair, and P&A.
- State of New Mexico Energy, Minerals, and Natural Resources Department Oil Conservation Commission (Order No. R-111-P) regarding the protection of mineral resources from commingling or leaking water sources.
- BLM Stipulations for ROWs NM107944 and NM108365.

In the following sections there are terms used which are unique to the geology of southeastern New Mexico.

- "Potash area" is defined in Oil Conservation Division Order No. R-111-P. This represents the area of which potash mining operations are now in progress, or in which core tests indicated commercial potash reserves. This area is coterminous with the Known Potash Leasing Area, as determined by the BLM. CB-1 is located in this area and is subject to these regulations.
- "Salt section" refers to the Salado Formation in which the McNutt Potash unit is deposited. Figure 2-1 depicts the Salado Formation graphically.

The applicable portions of the listed regulations are described in the following sections.

1.2.1 New Mexico Statutes

Section 72-13-4 of the New Mexico Statutes Annotated prescribes the rules and regulations governing the drilling, casing, repairing, and abandonment of artesian wells. This section authorizes the State Engineer "to prescribe and enforce reasonable rules and regulations consistent with terms of this act." Additionally, this section states that application to the State Engineer is required to drill, repair, plug or abandon an artesian

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

well. All wells completed in the Magenta and Culebra Members of the Rustler Formation are considered artesian.

1.2.2 New Mexico OSE Rules and Regulations

Article 1-1 Filing

This Article defines the necessary action for filing an application to drill, repair, plug or abandon wells in the state of New Mexico. Prior to repair/reconfiguration activities the OSE must be notified through the application process of WIPP's intent to repair/reconfigure the monitoring wells at the site.

Article 4-16 Casing-Cementing-Testing

This Article describes the cementing and cement testing approval requirements for emplacing cement plugs in wells and boreholes. This is the only regulation that prescribes types of cement, mixture ratios, and additive requirements. It is primarily for casing cementation during well installation, but is also acceptable for plugging.

This article specifies pump and plug methodology. The primary specification in this Article is the use of Class C neat cement at a density of fifteen pounds per gallon.

This Article also specifies that cementing/P&A programs shall be witnessed and approved by an authorized representative of the State Engineer.

Article 4-19 Artesian Wells - Repair

This article provides specifications that are most applicable to the P&A program. Prior to commencement of repairs (i.e., reconfiguration), a representative of the State Engineer must inspect the well to "determine if the condition of the well is such that it may be repaired." Additionally, "the hole shall be open to allow the entrance of equipment for well logging and leakage measurement," which implies a degree of well integrity testing (e.g., cement bond log, ultrasonic imaging log).

Article 4-19.1 Plugging

This section prescribes that "All work shall be done under the supervision of the State Engineer or his representative, or a representative of the appropriate Artesian Conservancy District who shall designate the amount of cement to be used and the depths at which cement plugs shall be set."

Article 4-20 Test or Exploratory Wells

Article 4-20 contains the rules for test or exploratory wells, which all the monitoring wells qualify. However, for P&A (Article 4-20.2) of these wells the regulations defer to the artesian specifications contained in Article 4-19. Additionally, this section further states "Such wells shall be plugged in accordance with Article 4-19.1 so that fluids will be

Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1

permanently confined to the specific strata in which they were originally encountered, thus preventing the commingling of water bearing zones."

**1.2.3 State of New Mexico Energy, Minerals, and Natural Resources Department
Oil Conservation Commission (Order No. R-111-P)**

These regulations are designed to protect mineral resources from commingling or leaking water sources. The primary concern here is the potash area and protection of the salt section and any water bearing horizon. The regulations state:

1. "All wells heretofore and hereafter drilled within the potash area shall be plugged in a manner and in accordance with the general rules or field rules established by the Division that will provide a solid cement plug through the salt section and any water-bearing horizon and prevent liquids or gasses from entering the hole above or below the salt section."
2. "The fluid used to mix the cement shall be saturated with the salts common to the salt section penetrated and with suitable proportions but not more than three (3) percent of calcium chloride by weight of cement being considered the desired mixture possible."

This regulation was discussed with the Oil Conservation Commission and BLM regarding applicability to cementing for reconfiguration. It was determined through this discussion that it applied to drilling of wells and not the reconfiguration application for this program.

2.0 WELL RECONFIGURATION

Well CB-1 was reconfigured during January and February 2004 to monitor only the Bell Canyon Formation. The purpose of this reconfiguration was twofold. First, when the well was drilled, the completion was not compliant with OSE and BLM in that water bearing formations were possibly commingling and the Salado Formation was not sealed off with well casing and/or cement. Second, water levels in the upper Culebra section of this well had been rising over the years for reasons unknown, yet possibly due to failed packer elements.

Figure 1-2 shows the configuration of well CB-1, as built in 1999, prior to this reconfiguration. The center of the shallow packer was set at a depth of 608 ft bgs, while the center of the deeper packer isolating the Bell Canyon Formation was set at 4,290 ft bgs (Appendix A). Available data for these packers indicated they were Baker Atlas water-inflatable packers with a shear pressure of 20,000 pounds per square inch (psi).

The new configuration for CB-1 was planned to monitor only the Bell Canyon Formation. To do this the existing packers and tubing needed to be removed from the borehole, the casing needed to be prepared for geophysical logging, new tubing and packers needed to be installed, and the well cemented from the packer to the surface. The following sections describe the reconfiguration process for CB-1.

2.1 Removal of Packers and Tubing

Removal of the packers and tubing took place during the period of January 21-23, 2004. Removal involved connecting the drill rig elevator to the existing tubing and applying enough pressure to break the shear pin and drain the packer fluid, thus relieving the pressure, then pulling the remaining packer mandrel assembly and element from the hole. The shallow packer sheared at 50,000 psi after several attempts to release it. The packer was allowed to sit and drain for 15 minutes prior to attempting to release the deeper packer.

After a period to allow the shallow packer to drain an attempt was made to release the lower packer from the hole. Several attempts at tension pressures exceeding 60,000 psi were made to release the shear pin on the lower packer, without success. The decision was made to use a free-point indicator tool to determine the percent of the packer that was bound in the hole. The free-point indicator tool measures the amount of stretch in the tubing when force is applied. The free-point indicator tool determined the lower 70% of the deep packer was bound up. At this point it was determined to use a perforating tool to assist in releasing the packer. Following discussions with Washington Regulatory and Environmental Services Site Environmental Compliance regarding use of shot, a single charge was detonated at a depth of 4,021 ft bgs. After detonation the drill rig pulled on the tubing string once again, and after several attempts, the packer released from the hole and the tubing string with both packers were removed (Appendix A).

2.2 Casing Preparation and Geophysical Logging

Casing preparation and geophysical logging took place during the period of January 24-28, 2004. Following the removal of the tubing and packers, the casing was scraped to remove debris and significant pitting from the casing surface in preparation for geophysical logging. Baker Atlas, a division of Baker Hughes performed the geophysical logging. The types of geophysical logs performed were 3-Arm Caliper Log, Segment Cement Bond Log, and Profile Caliper Log.

The 3-Arm Dialog Profile Caliper Log was performed to provide information regarding the diameter of the borehole, and by inference, the condition of the open-hole section of the borehole. These data provided the degree of halite dissolution and/or creep in the borehole, other formation stability, and the ability to determine optimum packer placement and preliminary concrete volumes for plugging the open sections between the casing and the new packer. The greatest measured borehole diameter was in excess of 18 inches at depths of 660 ft bgs and 3,804 ft bgs, in the Rustler Formation and between the Halite I (HI) and the Anhydrite I (AI) units of the Castile Formation, respectively. Other than these locations, the open hole appeared to be stable. Based on the logs it was determined the best location to install the center of the reconfiguration packer in the AI at a depth of 4,015 ft bgs. This log also confirmed the total depth of the borehole to be 4,290 ft bgs.

Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration DOE/WIPP-04-3306, Rev. 1

The Segment Cement Bond Log was performed to evaluate the integrity of the cement bond with the casing and with the adjacent formation to assure there is no ability for interstitial commingling of groundwater between water bearing zones (i.e., Magenta and Culebra Members). The bond log was run from the top of the casing to a depth of 616 ft bgs. It was not run into the casing shoe to avoid the possibility of getting the tool stuck in the hole. According to the Baker Atlas logging Engineer, Charles Childers, the resulting analysis from this log indicated the cement bond is excellent with no indications of channeling and that there is bonding to both the casing and formation (Appendix B).

The Profile Caliper Log was performed to measure the wall thickness of the casing to determine if detrimental corrosion had occurred since installation that would require corrective action prior to full well reconfiguration. According to the Baker Atlas logging Engineer, Charles Childers, the quality of the pipe is very good and did not appear to be damaged (Appendix B). Copies of all logs are contained in the project files at the WIPP site.

2.3 Reconfiguration and Cement Emplacement

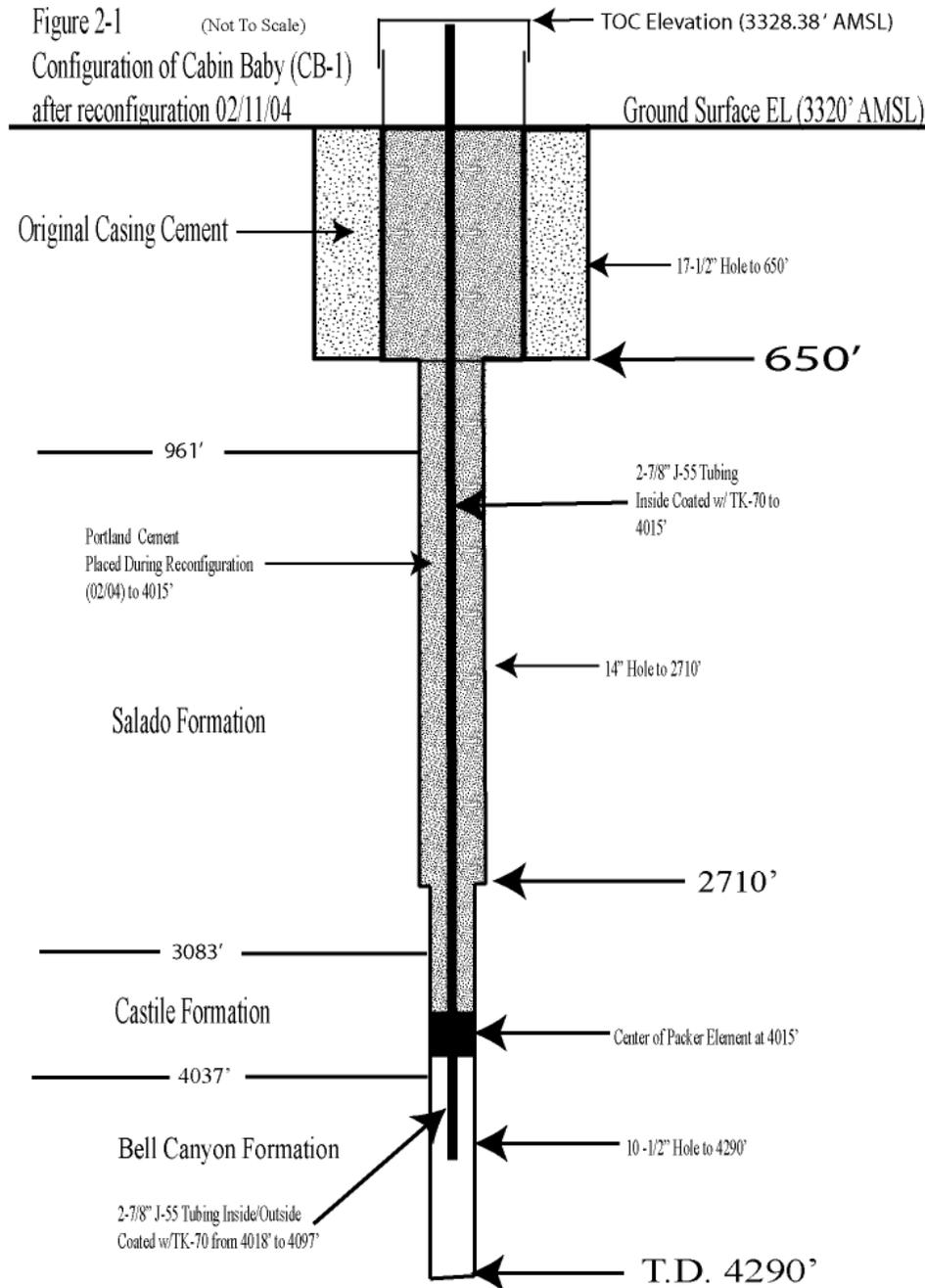
After geophysical logging and determining the packer placement, the tubing and packer were installed in the borehole during February 3-5, 2004. Materials consisted of 2.875-inch, 6.5#, J-55 tubing coated with Tube-Kote 70 (TK-70) manufactured by Tuboscope®. TK-70 is a thick film, epoxy coating especially suited for harsh environments. TK-70 resists hydrocarbons and provides outstanding protection of the steel tubing. TK-70 resists most mechanical damage normally experienced in the field while retaining a high level of corrosion resistance. TK-70 was used on the tubing to provide a longer life of the monitor well than typical steel tubing would. This material was used because this well is used to monitor the hydrostatic head in the Bell Canyon Formation, and due to the corrosive nature of the aqueous chemistry of this formation, it was important to impede the reaction with bare steel. For this application, 79 ft of tubing that is below the packer and submersed in the Bell Canyon was coated both on the inside and the outside with TK-70. The remaining tubing from the top of the packer to the surface was coated only on the inside to prevent corrosion from contact with Bell Canyon water and with ambient air (Figure 2-1).

Figure 2-1 shows the as-built construction of CB-1 after reconfiguration. Tubing coated on the inside with TK-70 was installed from the surface to the top of the packer at approximately 4,007 ft bgs. Tubing coated on the inside and outside was installed from the bottom of the packer to a depth of 4,097 ft bgs. The same deep packer removed from CB-1 was redressed and used for the new configuration. The packer was redressed by Weatherford Tool Company. It is a 10.375-inch open hole Baker Atlas inflatable packer (Appendix A) with the center of the packer set at 4,015 ft bgs.

Following installation of the tubing and packer the well was prepared for cementing. Tremie pipe was placed into the hole to a depth of 3,997 ft bgs, 10 ft above the top of the packer. Portland cement was prepared at the Lafarge materials plant in Carlsbad,

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

New Mexico, and trucked to the well pad for emplacement. Cement from the trucks was poured into a tub at ground surface and pumped by tremie pipe into the borehole in lifts.



The first lift created a 100-ft column of cement on top of the packer. This column was allowed to cure overnight before more lifts were emplaced. A total of 2,687 cubic ft of cement was used to complete the configuration as presented in Figure 2-1. Cement was emplaced in the well over the course of five days (February 6-10, 2004) and four lifts. Lifts consisted of 95, 864, 648, and 1,080 cubic ft of cement, respectively.

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

2.4 Other Background

Well work-over services were performed by Stewart Brothers Drilling Company, 306 Airport Road, Milan, New Mexico, under contract with Washington TRU Solutions LLC. Their New Mexico Water Well Driller License number is WD-331. Fishing tool services and packers were provided by Weatherford, 2117 N. French Drive, Hobbs, New Mexico 88241. Geophysical logging was conducted by Baker Atlas, 11717 County Road 125 West, Midland, Texas 79711. Mike Stapleton of the New Mexico OSE witnessed cement emplacement.

3.0 WASTE MANAGEMENT

During the emplacement of cement during plugging activities the brine water in the borehole was displaced to the surface. The water was captured from the wellhead casing through a right-angle discharge pipe at the surface, then a transfer pump moved the water from the trough into a 500-barrel fractionation tank for storage prior to disposal. The captured water was characterized for disposal by analysis using Toxicity Characteristic Leaching Procedures. The analyses were performed for Resource Conservation and Recovery Act metals. All analyses indicated the brine water nonhazardous. Following receipt of the analytical results the brine water collected at CB-1 was disposed in the lined H-19 evaporation pond. A total of 500 barrels were disposed in the H-19 evaporation pond.

Analytical reports and disposal records are retained onsite in the site compliance records. These records may be obtained upon request.

4.0 SUMMARY

Well CB-1 was originally drilled in 1974 and 1975 as a petroleum wildcat well by the M.P. Grace Company. It was drilled to a depth of 4,150 ft bgs in the Bell Canyon Formation. M.P. Grace abandoned the well in 1974 after it was proved to be a "dry hole" (Beauheim 1983). From 1983 through 1999, SNL set up the well with variations of bridge plugs and PIP configurations for monitoring both the Rustler and Bell Canyon Formations. In 1999, SNL installed a final PIP and bridge plug configuration for multi-zone monitoring.

Due to BLM requirements and uncertainty in water level measurements, the well was reconfigured to only monitor the hydrostatic head in the Bell Canyon Formation. The reconfiguration efforts took place during January 20 through February 10, 2004, and consisted of, in order, removal of packers, scraping the casing, performing geophysical logging, installation of a packer and tubing and emplacing cement from the packer to surface.

5.0 REFERENCES

Beauheim, R. L., B. W. Hassinger, J. A. Klaiber, Basic Data Report for Borehole Cabin Baby-1 Deepening and Hydrologic Testing. 1983.

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

Appendix A - Photographs



Removed Packers from CB-1
Packer on Left is the Deep Packer (Figure 1-2)
Packer on Right is the Shallow Packer (Figure 1-2)

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

Appendix A - Photographs



Casing Scraper at CB-1

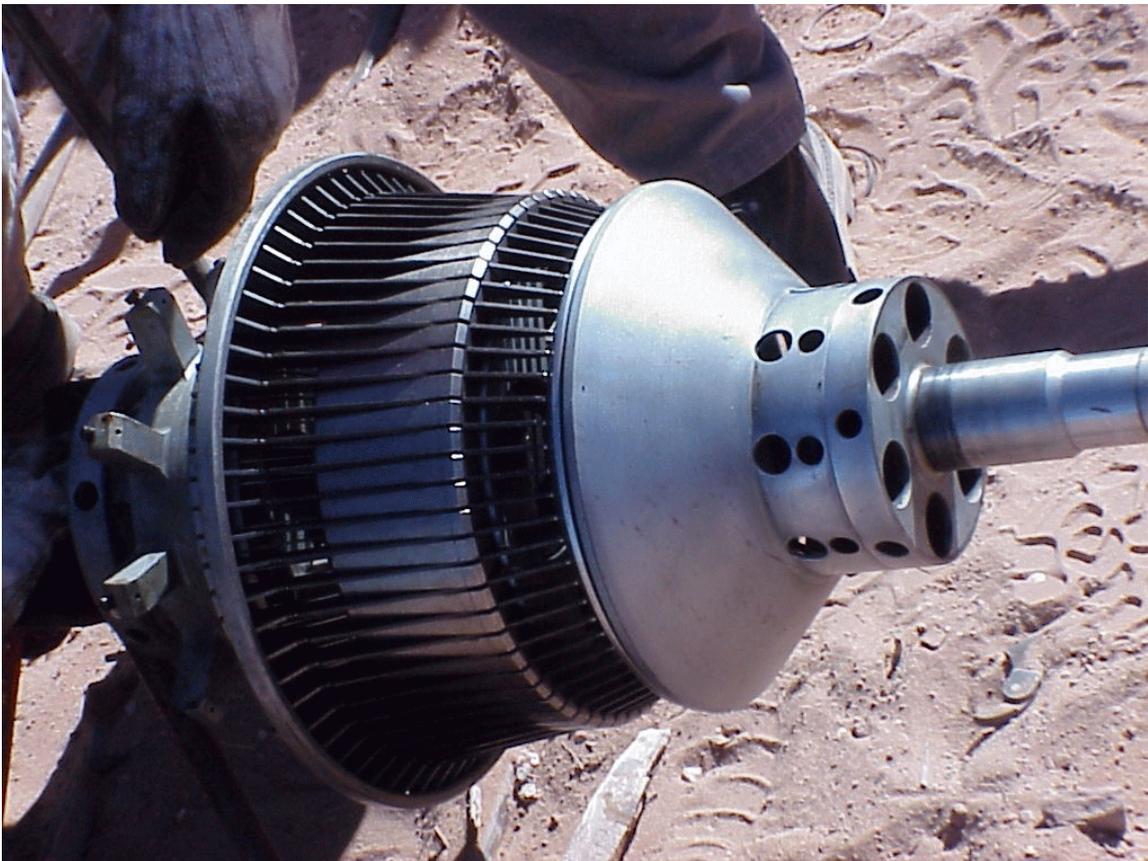
**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

Appendix A - Photographs



3-Arm Caliper Logging Tool

Appendix A - Photographs



Casing Caliper Tool at CB-1

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

Appendix A - Photographs



Installing Tremie Pipe for Cementing

**Basic Data Report for Monitor Well Cabin Baby 1 (CB-1) Reconfiguration
DOE/WIPP-04-3306, Rev. 1**

Appendix B - Field Report by Baker Atlas Logging Engineer Charles Childress

Log Analysis of the Cabin Baby 1

The cement bond quality is excellent with no indications of channeling. There is bonding to both the pipe and the formation.

The Profile caliper log measures wall thickness of the casing. The quality of the pipe overall is very good.

The 3-arm caliper log is self-explanatory. It shows the borehole diameter in inches.

The Tools

The Segment cement bond log tool is the conventional low frequency acoustic bond tool. This tool can only be used for the overall quality of the cement. It will indicate channels but will not output a map of the channels.

The casing inspection tool used was a high frequency acoustic tool. This tool arrives at the thickness by the frequencies returning to the receivers. It obtains the internal diameter from the travel time of the sonic signal. This tool is only designed for an overall quality of the pipe. It is unlikely to determine small holes since it is not taking readings on 100% of the pipe.

The caliper tool is a 3-armed caliper tool which takes readings to measure the borehole diameter. This tool does not calculate hole volumes.

Charles Childers
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Permian Cased Hole
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