WASTE ISOLATION PILOT PLANT

FIGURES

VOLUME VIII

MARCH 1990

Prepared for the
Department of Energy
Under Contract DE-AC04-86AL31950

Westinghouse Electric Corporation
Waste Isolation Division
Carlsbad, New Mexico
Figure 1.4-1  Principal Activities and Interrelationships in the Seal System Development Program

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
Figure 1.4-1 Principal Activities and Interrelationships in the Seal System Development
Feasibility of Shaft Seal Components Evaluated
- Model Calculations Showed Crushed Salt Consolidation Rate
  Determined by Creep Closure Rate 1987
- Model Calculations & Sensitivity Analyses Established Feasibility of
  Lower Shaft Seal System 1987
- Model Calculations & Sensitivity Analyses of Upper Shaft Seal System
  Established Feasibility of Entire Shaft Seal System 1987

Constitutive Model for Isostatic Consolidation of
Crushed Salt & Density/Permeability Relationship
Determined 1987

Chemical Stability of Reference Concrete in High
Sodium Chloride Brines
Predicted from Laboratory Tests & Published Data
1987

Demonstrated Manufacture & Horizontal Emplacement
of Crushed Salt Blocks (SSSPT-C) 1987

Demonstrated Manufacture & Horizontal Emplacement
of Salt/Bentonite (SSSPT-C) 1987

Interim Results from Disturbed Rock Zone (DRZ)
Measurements Reported 1988

Seal System Preliminary Design Evaluation
Completed 1988

Seal System Reference Design Completed
11/89

Model Calculations Established Feasibility
of Panel Seal Components 1988

Preliminary Analysis Mechanical Stability
Lower Shaft Seal Components Complete 7/90

Demonstrated Vertical Emplacement of Crushed
Salt Blocks in Small-Scale Tests (SSSPT-D) 1989

Demonstrated Vertical Emplacement of Bentonite
Blocks in Small-Scale Tests (SSSPT-D) 1989

Interim Characteristic Interbeds Near Seale
Excavations at the Horizon Completed
Preliminary Interbed Ge
Sealing Requirements
Proposed 10/90

Stem Development Program
Develop Component Designs for Large-Scale Seal Test 10/90

Consolidated Crushed Salt Densities & Permeabilities Predicted from Numerical Models for Crushed Salt Seal Components 9/90

Fluid Flow & Rock Mechanics Numerical Calculations for Large-Scale Seal Test Components Completed 10/90

Mechanical Stability of Concrete Components in Shafts, Drifts, & Panels Evaluated by Numerical Analyses, Taking Into Account Gas & Liquid Pressures & Swelling Pressures of Bentonite Components 9/91

Grout/Seal Materials for Interbeds Developed & Characterized 3/91

Permeabilities & Swelling Properties Measured for Bentonite Blocks in Small-Scale In Situ Tests 1/91

Instrumentation Selected & Test Plan Developed for Large-Scale Seal Tests 11/90

Complete Seal Material Selection Report - 11/90
- Deviatoric (Shear) Behavior of Crushed WIPP Salt Seal Material Incorporated in Constitutive Model 10/90
- Sensitivity of Crushed Salt Consolidation Rate to Brine-Saturation Quantified 10/90
- Potentially Deleterious Chemical Interactions Among Seal System Materials, Host Rocks, Groundwaters, & Brines Identified 10/90

Preliminary Analysis of Technical Stability of Interbed Seal Concrete Components Completed 7/90

Bentonite Blocks in Small-Scale Components

Grout E: Interbeds Small-Scale

Start Empirical

Interbeds in the WIPP Horizon Characterized

Sealing Component

Complete Seal

- Chemical
- Chemical Environment
- Chemical Area Controls
- Grout Materials
- All Additives

Preliminary Including Materials & Define Concept
Preliminary Design Criteria, Including Materials Specifications Defined for Detailed Conceptual Design 2/91

Complete Seal Material Performance Report - 12/91
- Chemical Stability of Concrete in Upper Shaft Seal Environment Evaluated 9/91
- Chemical Stability of Swelling Clay in Groundwater, Brine, & Concrete Environment Evaluated 9/91
- Chemical Stability of Grout Materials in Groundwater, Brine, & Concrete Environment Evaluated 9/91
- Chemical Compatibility of All Seal Materials & Grouts with Waste Disposal Area Contents Evaluated 9/91
- Grout Materials for Upper Shaft Seal System Developed & Characterized 12/91
- All Additional (TBD) Materials Studies Completed, if Necessary 12/91

Grout Emplacement in Interbeds Demonstrated in Small-Scale Tests (SSSPT-F) 6/91

Emplacement Feasibility Report on Large-Scale Seal Test 1/92
- Emplacement & Initial Effectiveness of Large-Scale Concrete Components Evaluated 1/92
- Emplacement & Initial Effectiveness of Large-Scale Crushed Salt Components Evaluated 1/92
- Emplacement & Initial Effectiveness of Large-Scale Interbed Grout/Seal Emplacement Evaluated 1/92

Temporal Fluid Flow Properties of DRZ in Host Rock Salt Quantified 1/92

Interbeds Near Excavations in the WIPP Underground Facility Horizon Characterized & Grouting/Sealing Requirements Defined 8/91

Design C Material QA/QC, De Conce

Fluid Flow of Seal Comp by Model

Obtain Large-
Design Criteria, Including Materials Specifications QA/QC, Defined for Detailed Conceptual Design 2/92

Seal Component Shapes & Dimensions Chosen Using Results from Model Calculations of Mechanical Stability & Fluid Flow Properties 7/92

Detailed Conceptual Design of Seal System Completed 5/93

Fluid Flow Performance of Seal Components Predicted by Model Calculations 5/92

Seal System Performance Model Completed 7/92

Complete Seal Material Validation
- Grout, Bentonite & Concrete Compatibility 3/
- Salt Consolidation Mechanism 9/94

Obtain 1 Year Data from Large-Scale Seal Tests 6/92

Obtain 2 Year Data From Large-Scale Seal Tests 6/93

Obtain 3 Year Data From Large-Scale Seal Tests 8/94
WIPP Facility Seal Arrangement
TRI-46-1
LEGEND

- SPDV
- EXPERIMENTAL AREAS
- TRU WASTE STORAGE
- MULTICOMPONENT SEAL LOCATION

ABBREVIATIONS

SPDV - SITE & PRELIMINARY DESIGN VALIDATION
C & SH - CONSTRUCTION & SALT HANDLING
### SNL APPROVALS

<table>
<thead>
<tr>
<th>ORG</th>
<th>DATE</th>
<th>APPROVALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2-89</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>11/22/89</td>
<td>2/24/89</td>
</tr>
<tr>
<td>6</td>
<td>11-28-89</td>
<td>11-29-89</td>
</tr>
<tr>
<td>19</td>
<td>11-30-89</td>
<td>12-1-89</td>
</tr>
</tbody>
</table>

**NEXT ASSEMBLY**

**APPLICATION**

**DR C. NORTHROP**

**CHK D. L. PULLIAM 11/2**

**ENG R. JONES 11/21**

**APVD 11/20**
 Shaft Seals General Arrangement
TRI-46-2
RA RUSTLER FORMATION

CAP AND NEAR SURFACE PLUG TO BE SPECIFIED

COLLAR

PLUG TO BE SPECIFIED

WATER BEARING ZONE SEAL SYSTEM

(SEE DRAWING NUMBER TRI-46-2, SHEET 2 OF 5)

UPPER SHAFT SEAL SYSTEM

SEE DRAWING NUMBER TRI-46-2.
UPPER SHAFT SEAL SYSTEM
(SEE DRAWING NUMBER TRI-46-2,
SHEET 3 OF 5)

LOWER SHAFT SEAL SYSTEM
(SEE DRAWING NUMBER TRI-46-2,
SHEET 4 OF 5)

SALADO FORMATION
(SEE DRAWING NUMBER TRI-46-2, SHEET 4 OF 5)
NOTES

1. STRATIGRAPHY IS REPRESENTED ACCORDING TO INFORMATION IN D.W. POWERS ET AL., AUGUST 1978, GEOLOGICAL CHARACTERIZATION REPORT, WASTE ISOLATION PILOT PLANT (WIPP) SITE, SOUTHEASTERN NEW MEXICO, VOL. 1, SAND 78-1596, SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NM. STRATIGRAPHY HAS BEEN SIMPLIFIED ABOVE THE RUSTLER FORMATION IN THE SUPRA RUSTLER FORMATION.

2. SPECIFIC DIMENSIONS AND SIGNIFICANT ELEVATIONS FOR INDIVIDUAL SHAFTS CAN BE FOUND IN DWG. TRI-46-2, SHEETS 2 THROUGH 4.

3. FOR A SUMMARY OF SHAFT INFORMATION SEE DRAWING NUMBER TRI-46-2, SHEET 5 OF 5.
Shaft Seals
Water Bearing Zone
Plan and Section
TRI-46-2
GROUT, TYPICAL

(FOR DESCRIPTION OF MATERIAL SEE NOTE A6 ON DRAWING NUMBER TRI-46-5)

MEMBER

603'

627'

D

D

714'

MEMBER

NOTES

1. DEPTH MAX THE SURFACE 3.409'-0"
- 603'

- 627'

UT, TYPICAL

DESCRIPTION OF MATERIAL SEE AN ON DRAWING NUMBER TRI-46-5)

NOTES

1. DEPTH MEASUREMENTS INDICATE NUMBER OF FEET BELOW THE SURFACE. WHERE THE SURFACE EQUALS 0'-0". THE SURFACE ELEVATION THAT IS USED AS THE REFERENCE IS 3.409'-0" (USGS 1927 NORTH AMERICAN DATUM).
*NOTE:

THESE DIMENSIONS AND ANGLES ARE TYPICAL FOR ALL SHAFT CONFIGURATIONS.
SECTION B-B

WASTE SHAFT

SHATTER BACKFILL, TYPICAL
(MATERIAL TO BE DETERMINED)

42'-9"
23'-0"

IS ARE TYPICAL
CONS.
BACKFILL, TYPICAL
ERIAL TO BE DETERMINED)

23'-0"

SECTION C-C

AIR INTAKE SHAFT

SCALE IN FEET
2. All stratigraphic features are according to data compiled for Pecos Energy, October 1986. WIPP Design Report, DOE-WIPP-86-010, Bechtel, San Francisco, CA.

3. The water bearing zone seal system constructed at a depth where it between the two water-bearing zones.

4. All shaft drawings represent earth (i.e., without liners) for both ex situ construction. Liners must be replaced.

5. Shaft diameters are representative information obtained from the following sets:

*Exploratory Shaft has since been removed.

---

Section D-D

Haust Shaft

---

"INFO"
SURFACE ELEVATION THAT IS USED AS THE REFERENCE IS 3,409'-0" (USGS 1927 NORTH AMERICAN DATUM).

2. ALL STRATIGRAPHIC FEATURES ARE REPRESENTED ACCORDING TO DATA COMPILED FROM U.S. DEPARTMENT OF ENERGY, OCTOBER 1986, WIPP DESIGN VALIDATION FINAL REPORT, DOE-WIPP-86-010, BECHTEL NATIONAL INC., SAN FRANCISCO, CA.

3. THE WATER BEARING ZONE SEAL SYSTEM IS TO BE CONSTRUCTED AT A DEPTH WHERE THE SEAL IS CENTERED BETWEEN THE TWO WATER-BEARING MEMBERS.

4. ALL SHAFT DRAWINGS REPRESENT EXCAVATED DIAMETERS (i.e., WITHOUT LINERS) FOR BOTH EXISTING AND PLANNED CONSTRUCTION. LINERS MUST BE REMOVED BEFORE SEAL EMBEDMENT.

5. SHAFT DIAMETERS ARE REPRESENTED ACCORDING TO INFORMATION OBTAINED FROM THE FOLLOWING DRAWING SETS:

*EXPLORATORY SHAFT HAS SINCE BEEN CHANGED TO CONSTRUCTION & SALT HANDLING SHAFT.

"INFO ONLY"
Shaft Seals
Upper Seal Section
TRI-46-2
SHAFT BACKFILL, TYPICAL
(MATERIAL TO BE DETERMINED)

725'

19'-11"

CLAY, TYPICAL
(FOR DESCRIPTION OF MATERIAL SEE NOTE \( A_3 \) ON DRAWING NUMBER TRI-46-5)

25'-7"

851'
GROUT, TYPICAL
(FOR DESCRIPTION OF MATERIAL SEE NOTE (A5) ON DRAWING NUMBER TRI-46-5)

NOTES

1. DEPTH MEASUREMENTS AT THE SURFACE WHERE THE SURFACE ELEVATION IS 3.409'-0" (USGS 1927).

2. ALL STRATIGRAPHIC DATA ACCORDING TO DATA AND REPORT, DOE-WIPP-87-3, SAN FRANCISCO, CA.

3. THE UPPER SHAFT SECTIONS ARE DEPLETION WHERE THE BORE AND CONCRETE) RES CONTACT.

4. ALL SHAFT DRAWINGS, I.E., WITHOUT LINERS CONSTRUCTION LINE BEFORE SEAL EMPLACE.
PICAL
OF MATERIAL SEE WING NUMBER TRI-46-5)

NOTES

1. DEPTH MEASUREMENTS INDICATE NUMBER OF FEET BELOW THE SURFACE. WHERE THE SURFACE EQUALS 0'-0". THE SURFACE ELEVATION THAT IS USED AS THE REFERENCE IS 3.409'-0" (USGS 1927 NORTH AMERICAN DATUM).

2. ALL STRATIGRAPHIC FEATURES ARE REPRESENTED ACCORDING TO DATA COMPILED FROM U.S. DEPARTMENT OF ENERGY, OCTOBER 1986, WIPP DESIGN VALIDATION FINAL REPORT. DOE-WIPP-86-010. BECHTEL NATIONAL INC., SAN FRANCISCO, CA.

3. THE UPPER SHAFT SEAL SYSTEM IS TO BE CONSTRUCTED AT A DEPTH WHERE THE BOTTOM TWO COMPONENTS (I.E., CLAY AND CONCRETE) RESIDE BELOW THE RUSTLER-SALADO CONTACT.

4. ALL SHAFT DRAWINGS REPRESENT EXCAVATED DIAMETERS (I.E., WITHOUT LINERS) FOR BOTH EXISTING AND PLANNED CONSTRUCTION. LINERS AND KEYS MUST BE REMOVED BEFORE SEAL EMPLACEMENTS.
C & SH SHAFT

* NOTE:
THESE DIMENSIONS AND ANGLES ARE TYPICAL FOR ALL SHAFT CONFIGURATIONS.
WASTE SHAFT

CONCRETE, TYPICAL
(FOR DESCRIPTION OF MATERIAL
NOTE A1 ON DRAWING NUMBE

IGLES ARE TYPICAL
ATIONS.
CONCRETE, TYPICAL
(FOR DESCRIPTION OF MATERIAL SEE NOTE (A1) ON DRAWING NUMBER TRI-46-5)

AIR INTAKE SHAFT
THE KEYS ARE R:
INFORMATION OBTAINED
SETS:
A. WASTE SHAFT. USED
(BECHTEL, SAN FRAN
DRAWING 31-R-002-C
B. AIR INTAKE SHAFT. USED
(BECHTEL, SAN FRAN
DRAWING 33-R-0293
C. EXHAUST SHAFT. USED
(BECHTEL, SAN FRAN
DRAWING 35-R-002-C
D. *EXPLORATORY SHAFT
(BECHTEL, SAN FRAN
DRAWING 37-R-012

*EXPLORATORY SHAFT FOR CONSTRUCTION & SALT
THE KEYS ARE REPRESENTED ACCORDING TO INFORMATION OBTAINED FROM THE FOLLOWING DRAWING SETS:


*EXPLORATORY SHAFT HAS SINCE BEEN CHANGED TO CONSTRUCTION & SALT HANDLING SHAFT.

INFO ONLY

SALT, TYPICAL
Shaft Seals
Lower Seal Section
TRI-46-2
CONCRETE, TYPICAL

(FOR DESCRIPTION OF MATERIAL SEE NOTE A) ON DRAWING NUMBER TRI-46-5)
CLAY, TYPICAL
(FOR DESCRIPTION OF MATERIAL SEE NOTE A3 ON DRAWING NUMBER TRI-46-5)

CRUSHED WIPP SALT (Tamped), TYPICAL
(FOR DESCRIPTION OF MATERIAL SEE NOTE A4 ON DRAWING NUMBER TRI-46-5)

SEE DETAIL "A"
CRUSHED WIPP SALT (TAMPED)

(TYPICAL)

(FOR DESCRIPTION OF MATERIAL SEE NOTE A4 ON DRAWING NUMBER TRI...
D WIPP SALT (TAMPED), 

CRUSHED WIPP SALT, TYPICAL

RIPTION OF MATERIAL SEE ON DRAWING NUMBER TRI-46-5)

VACA TRISTE MB
* NOTE:
THESE DIMENSIONS AND ANGLES ARE TYPICAL FOR ALL SHAFT CONFIGURATIONS.
NOTES

1. DEPTH MEASUREMENTS INDICATE NUMBER OF FEET BELOW THE SURFACE, WHERE THE SURFACE EQUALS 0'-0". THE SURFACE ELEVATION THAT IS USED AS THE REFERENCE IS 3.409'-0" (USGS 1927 NORTH AMERICAN DATUM).

2. ALL STRATIGRAPHIC FEATURES ARE REPRESENTED ACCORDING TO DATA COMPILED FROM U.S. DEPARTMENT OF ENERGY, OCTOBER 1986. WIPP DESIGN VALIDATION FINAL REPORT, DOE-WIPP-86-010, BECHTEL NATIONAL INC., SAN FRANCISCO, CA.

3. THE TOP COMPONENTS OF THE LOWER SHAFT SEALS ARE TO BE CONSTRUCTED AT A DEPTH NO LESS THAN 9'-10" BELOW THE UPPER SHAFT SEAL SYSTEM.

4. THE MIDDLE COMPONENTS OF THE LOWER SHAFT SEALS ARE TO BE CONSTRUCTED JUST BELOW THE VACA TRISTE MARKER BED.

5. THE BOTTOM COMPONENTS OF THE LOWER SHAFT SEALS ARE TO BE CONSTRUCTED AT THE 1955'-0" LEVEL FOR ALL SHAFTS.

6. ALL SHAFT DRAWINGS REPRESENT EXCAVATED DIAMETERS FOR BOTH EXISTING AND PLANNED CONSTRUCTION. THIS PORTION OF THE SHAFT IS UNLINED.

7. SHAFT DIAMETERS ARE REPRESENTED ACCORDING TO INFORMATION OBTAINED FROM THE FOLLOWING DRAWING SETS:

*EXPLORATORY SHAFT HAS SINCE BEEN CHANGED TO CONSTRUCTION & SALT HANDLING SHAFT.
AIR INTAKE SHAFT

SCALE: 1" = 20'

EXCAVATION TOLERANCE ±6" TYPICAL

SCALE IN FEET
**EXHAUST SHAFT**

**SCALE: 1" = 20'**

---

**CRUSHED WIPP SALT (TAMPE TYPICAL)**

*(FOR DESCRIPTION OF MATERIAL SEE NOTE A4 ON DRAWING NUMBER TRI-4)*

---

**DETAIL "A"**

**NO SCALE**

---

"INFO ONLY"

---

<table>
<thead>
<tr>
<th>SNL APPROVALS</th>
<th>ORG</th>
<th>DATE</th>
<th>APPROVALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13.1</td>
<td>3/2/80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13.2</td>
<td>5/24/81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13.3</td>
<td>11/28/85</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13.4</td>
<td>11/3/88</td>
<td></td>
</tr>
</tbody>
</table>

**ORG DATE APPROVALS**

- DR W. DUMAS / C. NORTH
- CHK D. L. PULLIAM 1/2/89
- ENG R. JONES 11/21/89
- APVD = 9/23/89

**NEXT ASSEMBLY APPLICATION**
LOWER SEAL SECTION
COMPOSITE LAYOUT
SCALE: 1" = 100'

CRUSHED WIPP SALT (DRIFT BACKFILL), TYPICAL
(FOR DESCRIPTION OF MATERIAL SEE NOTE (A5) ON DRAWING NUMBER TRI-46-5)

SHFT SEALS
LOWER SEAL SECTION

D WIPP SALT (TAMPED),
RIPTION OF MATERIAL SEE ON DRAWING NUMBER TRI-46-5)

ONLY"
Shaft Seals Relevant Information
TRI-46-2
# C & SH SHAFT

## SHAFT SEAL SUMMARY

<table>
<thead>
<tr>
<th>SEAL SYSTEM</th>
<th>MATERIAL</th>
<th>MAXIMUM DIAMETER (ft)</th>
<th>SEAL INTERVAL BELOW GROUND SURFACE (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAP COLLAR, BACKFILL, AND PLUG</td>
<td>TO BE SPECIFIED</td>
<td>11.8</td>
<td>0.0 - 629.0</td>
</tr>
<tr>
<td>WATER BEARING ZONE</td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>31.6</td>
<td>629.0 - 661.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>11.8</td>
<td>661.8 - 674.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>31.6</td>
<td>674.9 - 707.7</td>
</tr>
<tr>
<td>SHAFT BACKFILL</td>
<td>TO BE SPECIFIED</td>
<td>11.8</td>
<td>707.7 - 725.0</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>31.6</td>
<td>725.0 - 757.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>11.8</td>
<td>757.8 - 770.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>31.6</td>
<td>770.9 - 803.7</td>
</tr>
<tr>
<td>UPPER SHAFT</td>
<td>CLAY BLOCKS</td>
<td>11.8</td>
<td>803.7 - 816.8</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>34.7</td>
<td>816.8 - 849.6</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>15.0</td>
<td>849.6 - 862.7</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>31.6</td>
<td>862.7 - 895.5</td>
</tr>
<tr>
<td>SHAFT BACKFILL</td>
<td>CRUSHED WIPP SALT</td>
<td>11.8</td>
<td>895.5 - 905.5</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>31.6</td>
<td>905.5 - 938.3</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>11.8</td>
<td>938.3 - 951.4</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>11.8</td>
<td>951.4 - 967.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>11.8</td>
<td>967.8 - 980.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>31.6</td>
<td>980.9 - 1013.7</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>11.8</td>
<td>1013.7 - 1349.0</td>
</tr>
<tr>
<td>LOWER SHAFT</td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>31.6</td>
<td>1349.0 - 1381.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>11.8</td>
<td>1381.8 - 1395.2</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>11.8</td>
<td>1395.2 - 1411.6</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>11.8</td>
<td>1411.6 - 1424.7</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>31.6</td>
<td>1424.7 - 1457.5</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>11.8</td>
<td>1457.5 - 1495.0</td>
</tr>
</tbody>
</table>
## WASTE SHAFT

### SHAFT SEAL SUMMARY

<table>
<thead>
<tr>
<th>SEAL SYSTEM</th>
<th>MATERIAL</th>
<th>MAXIMUM DIAMETER (ft)</th>
<th>SEAL INTERVAL BELOW GROUND SURFACE (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAP COLLAR, BACKFILL, AND PLUG</td>
<td>TO BE SPECIFIED</td>
<td>23.0</td>
<td>0.0 - 623.0</td>
</tr>
<tr>
<td>WATER BEARING ZONE</td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>42.7</td>
<td>623.0 - 655.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>23.0</td>
<td>655.8 - 668.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>42.7</td>
<td>668.9 - 701.7</td>
</tr>
<tr>
<td>SHAFT BACKFILL</td>
<td>TO BE SPECIFIED</td>
<td>23.0</td>
<td>701.7 - 718.0</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>42.7</td>
<td>718.0 - 750.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>23.0</td>
<td>750.8 - 763.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>42.7</td>
<td>763.9 - 796.7</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>23.0</td>
<td>796.7 - 809.8</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>47.2</td>
<td>809.8 - 842.6</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>27.5</td>
<td>842.6 - 885.7</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>39.7</td>
<td>885.7 - 918.5</td>
</tr>
<tr>
<td>SHAFT BACKFILL</td>
<td>CRUSHED WIPP SALT</td>
<td>20.0</td>
<td>918.5 - 927.7</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>39.7</td>
<td>927.7 - 960.5</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>20.0</td>
<td>960.5 - 973.6</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (Tamped)</td>
<td>20.0</td>
<td>973.6 - 990.0</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>20.0</td>
<td>990.0 - 1003.1</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>39.7</td>
<td>1003.1 - 1035.9</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (Tamped)</td>
<td>20.0</td>
<td>1035.9 - 1356.0</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>39.7</td>
<td>1356.0 - 1388.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>20.0</td>
<td>1388.8 - 1401.9</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (Tamped)</td>
<td>20.0</td>
<td>1401.9 - 1418.3</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>39.7</td>
<td>1418.3 - 1431.4</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>20.0</td>
<td>1431.4 - 1464.2</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>39.7</td>
<td>1464.2 - 1496.5</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (Tamped)</td>
<td>20.0</td>
<td>1496.0 - 1525.0</td>
</tr>
<tr>
<td>LOWER SHAFT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## AIR INTAKE SHAFT

### SHAFT SEAL SUMMARY

<table>
<thead>
<tr>
<th>SEAL SYSTEM</th>
<th>MATERIAL</th>
<th>MAXIMUM DIAMETER (ft.)</th>
<th>SEAL INTERVAL BELOW GROUND SURFACE (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAP. COLLAR, BACKFILL, AND PLUG</td>
<td>TO BE SPECIFIED</td>
<td>19.9</td>
<td>0.0 - 629.0</td>
</tr>
<tr>
<td>WATER BEARING ZONE</td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>39.6</td>
<td>629.0 - 661.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>19.9</td>
<td>661.8 - 674.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>39.6</td>
<td>674.9 - 707.7</td>
</tr>
<tr>
<td>SHAFT BACKFILL</td>
<td>TO BE SPECIFIED</td>
<td>19.9</td>
<td>707.7 - 725.0</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>39.6</td>
<td>725.0 - 757.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>19.9</td>
<td>757.8 - 770.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>39.6</td>
<td>770.9 - 803.7</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>19.9</td>
<td>803.7 - 816.8</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>45.3</td>
<td>816.8 - 849.6</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>25.6</td>
<td>849.6 - 888.8</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>40.0</td>
<td>888.8 - 921.6</td>
</tr>
<tr>
<td>SHAFT BACKFILL</td>
<td>CRUSHED WIPP SALT</td>
<td>20.2</td>
<td>921.6 - 931.4</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>40.0</td>
<td>931.4 - 964.2</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>20.2</td>
<td>964.2 - 977.4</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>20.2</td>
<td>977.4 - 993.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>20.2</td>
<td>993.8 - 1006.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>40.0</td>
<td>1006.9 - 1039.7</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>20.2</td>
<td>1039.7 - 1349.0</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>40.0</td>
<td>1349.0 - 1381.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>20.2</td>
<td>1381.8 - 1395.2</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>20.2</td>
<td>1395.2 - 1411.6</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>20.2</td>
<td>1411.6 - 1424.7</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT FF GROUT)</td>
<td>40.0</td>
<td>1424.7 - 1457.5</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>20.2</td>
<td>1457.5 - 1495.2</td>
</tr>
<tr>
<td>LOWER SHAFT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# EXHAUST SHAFT

## SHAFT SEAL SUMMARY

<table>
<thead>
<tr>
<th>SEAL SYSTEM</th>
<th>MATERIAL</th>
<th>MAXIMUM DIAMETER (ft)</th>
<th>SEAL INTERVAL BELOW GROUND SURFACE (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAP, COLLAR BACKFILL AND PLUG</strong></td>
<td>TO BE SPECIFIED</td>
<td>16.3</td>
<td>0.0 - 631.0</td>
</tr>
<tr>
<td><strong>WATER BEARING ZONE</strong></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>36.0</td>
<td>631.0 - 663.9</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>16.3</td>
<td>663.9 - 677.1</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>36.0</td>
<td>677.1 - 709.9</td>
</tr>
<tr>
<td><strong>SHAFT BACKFILL</strong></td>
<td>TO BE SPECIFIED</td>
<td>16.3</td>
<td>709.9 - 725.0</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>36.0</td>
<td>725.0 - 757.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>16.3</td>
<td>757.8 - 770.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>36.0</td>
<td>770.9 - 803.7</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>16.3</td>
<td>803.7 - 816.8</td>
</tr>
<tr>
<td><strong>UPPER SHAFT</strong></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>40.7</td>
<td>816.5 - 849.6</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>21.0</td>
<td>849.6 - 889.3</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1FF GROUT)</td>
<td>34.7</td>
<td>889.3 - 922.1</td>
</tr>
<tr>
<td><strong>SHAFT BACKFILL</strong></td>
<td>CRUSHED WIPP SALT</td>
<td>15.0</td>
<td>922.1 - 931.9</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>34.7</td>
<td>931.9 - 964.7</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>15.0</td>
<td>964.7 - 977.9</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>15.0</td>
<td>977.9 - 994.3</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>15.0</td>
<td>994.3 - 1007.4</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>34.7</td>
<td>1007.4 - 1040.2</td>
</tr>
<tr>
<td><strong>LOWER SHAFT</strong></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>15.0</td>
<td>1040.2 - 1354.0</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>34.7</td>
<td>1354.0 - 1386.8</td>
</tr>
<tr>
<td></td>
<td>CLAY BLOCKS</td>
<td>15.0</td>
<td>1386.8 - 1399.9</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (Tamped)</td>
<td>34.7</td>
<td>1399.9 - 1442.4</td>
</tr>
<tr>
<td></td>
<td>CONCRETE (BCT1F GROUT)</td>
<td>24.7</td>
<td>1442.4 - 1462.9</td>
</tr>
<tr>
<td></td>
<td>CRUSHED WIPP SALT (TAMPED)</td>
<td>15.0</td>
<td>1462.9 - 1500.0</td>
</tr>
<tr>
<td>LTR</td>
<td>DESCRIPTION</td>
<td>DATE</td>
<td>APPROVED</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTERVAL</th>
<th>( h )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6310</td>
<td></td>
</tr>
<tr>
<td>0.6639</td>
<td></td>
</tr>
<tr>
<td>0.6771</td>
<td></td>
</tr>
<tr>
<td>0.6999</td>
<td></td>
</tr>
<tr>
<td>0.7250</td>
<td></td>
</tr>
<tr>
<td>0.7578</td>
<td></td>
</tr>
<tr>
<td>0.7739</td>
<td></td>
</tr>
<tr>
<td>0.8037</td>
<td></td>
</tr>
<tr>
<td>0.8168</td>
<td></td>
</tr>
<tr>
<td>0.8496</td>
<td></td>
</tr>
<tr>
<td>0.8893</td>
<td></td>
</tr>
<tr>
<td>0.9221</td>
<td></td>
</tr>
<tr>
<td>0.9319</td>
<td></td>
</tr>
<tr>
<td>0.9647</td>
<td></td>
</tr>
<tr>
<td>0.9779</td>
<td></td>
</tr>
<tr>
<td>0.9943</td>
<td></td>
</tr>
<tr>
<td>1.0074</td>
<td></td>
</tr>
<tr>
<td>1.0402</td>
<td></td>
</tr>
<tr>
<td>1.3540</td>
<td></td>
</tr>
<tr>
<td>1.3868</td>
<td></td>
</tr>
<tr>
<td>1.9999</td>
<td></td>
</tr>
<tr>
<td>1.9863</td>
<td></td>
</tr>
<tr>
<td>1.4234</td>
<td></td>
</tr>
<tr>
<td>1.4824</td>
<td></td>
</tr>
</tbody>
</table>


### EXISTING SHAFT DATA

<table>
<thead>
<tr>
<th>MAJOR FEATURES</th>
<th>LEVEL BELOW SURFACE (ft.)</th>
<th>ORIGINAL EXCAVATION DIAMETER (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE</td>
<td>0.0</td>
<td>N/A</td>
</tr>
<tr>
<td>BOTTOM OF COLLAR</td>
<td></td>
<td>11.8</td>
</tr>
<tr>
<td>TOP OF MAGENTA</td>
<td>592.0</td>
<td>11.8</td>
</tr>
<tr>
<td>BOTTOM OF MAGENTA</td>
<td>627.0</td>
<td>11.8</td>
</tr>
<tr>
<td>TOP OF CULEBRA</td>
<td>710.0</td>
<td>11.8</td>
</tr>
<tr>
<td>BOTTOM OF CULEBRA</td>
<td>739.0</td>
<td>11.8</td>
</tr>
<tr>
<td>TOP OF KEY</td>
<td>842.4</td>
<td>11.8</td>
</tr>
<tr>
<td>RUSTLER SALADO CONTACT</td>
<td>851.0</td>
<td>15.0</td>
</tr>
<tr>
<td>BOTTOM OF KEY</td>
<td>880.0</td>
<td>19.2</td>
</tr>
<tr>
<td>TOP OF VACA TRISTE</td>
<td>1348.0</td>
<td>11.8</td>
</tr>
<tr>
<td>BOTTOM OF VACA TRISTE</td>
<td>1349.0</td>
<td>11.8</td>
</tr>
<tr>
<td>TOP OF STATION</td>
<td>2141.0</td>
<td>11.8</td>
</tr>
<tr>
<td>STATION</td>
<td>2162.0</td>
<td>N/A</td>
</tr>
<tr>
<td>TOP OF SUMP</td>
<td>2162.0</td>
<td>11.8</td>
</tr>
<tr>
<td>BOTTOM OF SUMP</td>
<td>2272.0</td>
<td>11.8</td>
</tr>
</tbody>
</table>
### EXISTING SHAFT DATA

<table>
<thead>
<tr>
<th>Major Features</th>
<th>Level Below Surface (ft.)</th>
<th>Original Excavation Diameter (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>0.0</td>
<td>N.A</td>
</tr>
<tr>
<td>Bottom of Collar</td>
<td>21.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Top of Magenta</td>
<td>597.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Bottom of Magenta</td>
<td>620.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Top of Culebra</td>
<td>705.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Bottom of Culebra</td>
<td>727.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Top of Key</td>
<td>839.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Rustler Salado Contact</td>
<td>844.0</td>
<td>27.5</td>
</tr>
<tr>
<td>Bottom of Key</td>
<td>902.0</td>
<td>31.0</td>
</tr>
<tr>
<td>Top of Vaca Triste</td>
<td>1349.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Bottom of Vaca Triste</td>
<td>1356.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Top of Station</td>
<td>2147.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Station</td>
<td>2160.0</td>
<td>N.A</td>
</tr>
<tr>
<td>Top of Sump</td>
<td>2160.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Bottom of Sump</td>
<td>2286.0</td>
<td>23.0</td>
</tr>
<tr>
<td>MAJOR FEATURES</td>
<td>LEVEL BELOW SURFACE (ft)</td>
<td>ORIGINAL EXCAVATION DIAMETER (ft)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>SURFACE</td>
<td>0.0</td>
<td>N A</td>
</tr>
<tr>
<td>BOTTOM OF COLLAR</td>
<td>16.0</td>
<td>19.9</td>
</tr>
<tr>
<td>TOP OF MAGENTA</td>
<td>592.0</td>
<td>19.9</td>
</tr>
<tr>
<td>BOTTOM OF MAGENTA</td>
<td>627.0</td>
<td>19.9</td>
</tr>
<tr>
<td>TOP OF CULEBRA</td>
<td>710.0</td>
<td>19.9</td>
</tr>
<tr>
<td>BOTTOM OF CULEBRA</td>
<td>739.0</td>
<td>19.9</td>
</tr>
<tr>
<td>TOP OF KEY</td>
<td>843.5</td>
<td>19.9</td>
</tr>
<tr>
<td>RUSTLER SALADO CONTACT</td>
<td>851.0</td>
<td>25.6</td>
</tr>
<tr>
<td>BOTTOM OF KEY</td>
<td>906.5</td>
<td>31.2</td>
</tr>
<tr>
<td>TOP OF VACA TRISTE</td>
<td>1348.0</td>
<td>20.2</td>
</tr>
<tr>
<td>BOTTOM OF VACA TRISTE</td>
<td>1349.0</td>
<td>20.2</td>
</tr>
<tr>
<td>TOP OF STATION</td>
<td>2135.0</td>
<td>20.2</td>
</tr>
<tr>
<td>STATION</td>
<td>2150.0</td>
<td>N A</td>
</tr>
</tbody>
</table>

EXISTING SHAFT DATA

<table>
<thead>
<tr>
<th>DRIFT BACKFILL</th>
<th>CONCRETE (BCT1F GROUT)</th>
<th>CLAY BLOCKS</th>
<th>CRUSHED WIPP SALT (Tamped)</th>
<th>CLAY BLOCKS</th>
<th>CONCRETE (BCT1F GROUT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40.0</td>
<td>20.2</td>
<td>20.2</td>
<td>20.2</td>
<td>40.0</td>
</tr>
<tr>
<td></td>
<td>1955.0</td>
<td>1987.8</td>
<td>2000.9</td>
<td>2017.3</td>
<td>2030.5</td>
</tr>
<tr>
<td></td>
<td>0.387</td>
<td>3</td>
<td>2063.3</td>
<td>2150.0</td>
<td></td>
</tr>
</tbody>
</table>

| DRIFT BACKFILL | CRUSHED WIPP SALT | 20.2 | 2063.3 | 2150.0 |
### EXISTING SHAFT DATA

<table>
<thead>
<tr>
<th>MAJOR FEATURES</th>
<th>LEVEL BELOW SURFACE (ft)</th>
<th>ORIGINAL EXCAVATION DIAMETER (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE</td>
<td>0.0</td>
<td>N/A</td>
</tr>
<tr>
<td>BOTTOM OF COLLAR</td>
<td>10.0</td>
<td>15.7</td>
</tr>
<tr>
<td>TOP OF MAGENTA</td>
<td>603.0</td>
<td>16.3</td>
</tr>
<tr>
<td>BOTTOM OF MAGENTA</td>
<td>627.0</td>
<td>16.3</td>
</tr>
<tr>
<td>TOP OF CULEBRA</td>
<td>714.0</td>
<td>16.3</td>
</tr>
<tr>
<td>BOTTOM OF CULEBRA</td>
<td>736.0</td>
<td>16.3</td>
</tr>
<tr>
<td>TOP OF KEY</td>
<td>844.0</td>
<td>16.7</td>
</tr>
<tr>
<td>RUSTLER-SALADO CONTACT</td>
<td>951.0</td>
<td>21.0</td>
</tr>
<tr>
<td>BOTTOM OF KEY</td>
<td>951.0</td>
<td>21.0</td>
</tr>
<tr>
<td>TOP OF VACA TRISTE</td>
<td>1,554.0</td>
<td>15.0</td>
</tr>
<tr>
<td>BOTTOM OF VACA TRISTE</td>
<td>1,577.0</td>
<td>15.0</td>
</tr>
<tr>
<td>TOP OF STATION</td>
<td>2,147.0</td>
<td>15.0</td>
</tr>
<tr>
<td>STATION</td>
<td>2,150.0</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### NOTES

1. TABLES THAT GENERATED THE FOLLOWING:
   - A. WASTE ...
   - B. AIR INTAKE ...
   - C. EXHAUST ...
   - D. **EXPLORATORY** DRAWING

2. ALL STRATIGRAPHY ACCORDING TO ENERGY, OCT REPORT, DOE FRANCISCO.

*EXPLORATORY CONSTRUCTION"
NOTES

1. TABLES THAT PRESENT EXISTING SHAFT DATA ARE GENERATED ACCORDING TO INFORMATION OBTAINED FROM THE FOLLOWING DRAWING SETS.

D. *EXPLORATORY SHAFT  US DOE WIPP DRAWING 37-R-010 BECHTEL. SAN FRANCISCO. CA AND US DOE WIPP DRAWING 37-R-012 BECHTEL. SAN FRANCISCO. CA.

2. ALL STRATIGRAPHIC FEATURES ARE REPRESENTED ACCORDING TO DATA COMPILED FROM U.S. DEPARTMENT OF ENERGY. OCTOBER 1986. WIPP DESIGN VALIDATION FINAL REPORT. DOE-WIPP-86-010. BECHTEL NATIONAL INC. SAN FRANCISCO. CA.

*EXPLORATORY SHAFT HAS SINCE BEEN CHANGED TO CONSTRUCTION & SALT HANDLING SHAFT

"INFO ONLY"
Drift and Panel Seals
General Arrangement
TRI-46-3
<table>
<thead>
<tr>
<th>SEAL NUMBER</th>
<th>NOMINAL WIDTH (ft)</th>
<th>NOMINAL HEIGHT (ft)</th>
<th>DRIFT BLOCK 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>E300-1</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E300-2</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E300-3</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E140-1</td>
<td>14</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>E140-2</td>
<td>25</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E140-3</td>
<td>25</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E140-4</td>
<td>25</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E0-1</td>
<td>25</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>W30-1</td>
<td>20</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>W30-2</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>W30-3</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>W170-1</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>W170-2</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>W170-3</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P1-1</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P1-2</td>
<td>20</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P2-1</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P2-2</td>
<td>20</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P3-1</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P3-2</td>
<td>20</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P4-1</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P4-2</td>
<td>20</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>P5-1</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

DRIFT DIMENSIONS AT PROPOSED SEAL LOCATIONS

*S
### DRIFT DIMENSIONS AT PROPOSED SEAL LOCATIONS

<table>
<thead>
<tr>
<th>SEAL MBER</th>
<th>NOMINAL WIDTH (ft)</th>
<th>NOMINAL HEIGHT (ft)</th>
<th>SECTION TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>300-1</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>300-2</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>300-3</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>140-1</td>
<td>14</td>
<td>18</td>
<td>B-B</td>
</tr>
<tr>
<td>140-2</td>
<td>25</td>
<td>12</td>
<td>A-A</td>
</tr>
<tr>
<td>140-3</td>
<td>25</td>
<td>12</td>
<td>A-A</td>
</tr>
<tr>
<td>140-4</td>
<td>25</td>
<td>12</td>
<td>A-A</td>
</tr>
<tr>
<td>10-1</td>
<td>25</td>
<td>12</td>
<td>A-A</td>
</tr>
<tr>
<td>30-1</td>
<td>20</td>
<td>12</td>
<td>D-D</td>
</tr>
<tr>
<td>30-2</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>30-3</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>170-1</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>170-2</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>170-3</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>31-1</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>31-2</td>
<td>20</td>
<td>12</td>
<td>D-D</td>
</tr>
<tr>
<td>32-1</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>32-2</td>
<td>20</td>
<td>12</td>
<td>D-D</td>
</tr>
<tr>
<td>33-1</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>33-2</td>
<td>20</td>
<td>12</td>
<td>D-D</td>
</tr>
<tr>
<td>34-1</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
<tr>
<td>34-2</td>
<td>20</td>
<td>12</td>
<td>D-D</td>
</tr>
<tr>
<td>35-1</td>
<td>14</td>
<td>12</td>
<td>C-C</td>
</tr>
</tbody>
</table>
LEGEND

- - - EXISTING EXCAVATION
- - - PLANNED EXCAVATION
- DRIFT SEALS
- - - WASTE DISPOSAL AREAS

NOTES

1. DRIFT BLOCK 1 CC BOUNDED BY THE P5-2, P5-1, P6-2, P6
2. DRIFT BLOCK 2 CC BOUNDED BY THE P7-2, P7-1, P8-2, P8
3. IN EACH WASTE DISPOSAL AREA TO BE COMF BACKFILLING, AND PROCEEDING WITH THE WASTE DISPOSAL BLOCK 1, AND DRIFT AREA TO BE COMF CONTINUING IN N. AFTER THE EIGHT WILL BE COMPLET THE SEALS WILL BE B: DISPOSAL AREA AT SEALS P1-1 AND P4-4 EMPLACEMENT AN E300-3, E140-4, W3 WASTE EMPLACEM
DRIFT BLOCK 1 CONSISTS OF THE INTERSECTING DRIFTS
OUNDED BY THE FOLLOWING SEALS: P3-1, P3-2, P4-1, P4-2,

DRIFT BLOCK 2 CONSISTS OF THE INTERSECTING DRIFTS
OUNDED BY THE FOLLOWING SEALS: P1-1, P1-2, P2-1, P2-2,
7-2, P7-1, P8-2, P8-1, W170-2, W30-2, E140-3, AND E300-2.

EACH WASTE DISPOSAL AREA, WASTE EMPLOYENCE,
ACKFILLING, AND SEALING WILL BE COMPLETED BEFORE
OCCEEDING WITH THOSE OPERATIONS IN THE NEXT AREA.
HE WASTE DISPOSAL AREAS ARE PANELS 1 THROUGH 8, DRIFT
LOCK 1, AND DRIFT BLOCK 2. PANEL 1 WILL BE THE FIRST
EA TO BE COMPLETED, FOLLOWED BY PANEL 2, AND
ONTINUING IN NUMERICAL SEQUENCE THROUGH PANEL 8.
FTER THE EIGHT PANELS ARE FINISHED, THE DRIFT BLOCKS
ILL BE COMPLETED; FIRST BLOCK 1 FOLLOWED BY BLOCK 2.

HE SEALS WILL BE CONSTRUCTED BETWEEN EACH WASTE
ISPOSAL AREA AND OPEN ACCESS DRIFTS. FOR EXAMPLE.
ALS P1-1 AND P1-2 WILL BE BUILT FOLLOWING WASTE
MPLACEMENT AND BACKFILLING IN PANEL 1, AND SEALS
300-3, E140-4, W30-3, AND W170-3 WILL BE BUILT FOLLOWING
ASTE EMPLACEMENT AND BACKFILLING IN DRIFT BLOCK 1.
<table>
<thead>
<tr>
<th>SEAL</th>
<th>P5-1</th>
<th>14</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P5-2</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>P6-1</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>P6-2</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>P7-1</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>P7-2</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>P8-1</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>P8-2</td>
<td>20</td>
<td>12</td>
</tr>
</tbody>
</table>

*REFER TO TRI-46-3, 2 OF 2 FOR SECTION DETAILS*
"INFO ONLY"

Sandia National Laboratories

R W DUMAS

HK J. PULLIAM 11 21 89
NG R. JONES 11 21 89
.PVD...

TITLE
DRIFT AND PANEL SEALS
GENERAL ARRANGEMENT

SIZE
D

DWG NUMBER
TRI-46-3

SCALE 1" = 300'

SHEET 1 OF 2
Drift and Panel Seals
Plan, Elevation and Section
TRI-46-3
PRECONSOLIDATED SALT,

( FOR DESCRIPTION OF MATERIAL SEE NOTE \( \text{41} \) ON DRAWING NUMBER TR...
PLAN

ELEVATION

SECTION C-C

CONCRETE (FOR DETAIL "A")

SEE DETAIL "A"

AL SEE
SER TR-46-5

ALT, TYPICAL—
CONCRETE, TYPICAL
(FOR DESCRIPTION OF MATERIAL SEE NOTE A ON DRAWING NUMBER TRI-46-5)

NOTES
1. MACHINE RIDE
THE UPPER 12" WORKING CLEAR
TAMPING

SALT BLOCKS
NOTES

1. MACHINE-FORMED BLOCKS OF CRUSHED SALT WILL BE SET IN THE UPPER PORTION OF THE DRIFT WHERE WORKING CLEARANCE IS INSUFFICIENT TO ALLOW FURTHER TAMING.
CRUSHED WIPP SALT (DRIFT BACKFILL), TYPICAL

(FOR DESCRIPTION OF MATERIAL SEE NOTE A5 ON DRAWING NUMBER TRI-46 5)

* NOTE:
THESE DIMENSIONS AND ANGLES ARE TYF FOR ALL DRIFT CONFIGURATIONS.
PLAN

SEE DETAIL "B"

ELEVATION

SECTION D-D

SCALE IN FEET

SNL AP

ORG DATE

0 20 40 60

5 4
TAMPED SALT

DETAILED "B"
PRECONSOLIDATED SALT, TYPICAL
ALL DRIFTS AND PANEL SEALS
SEE NOTE 1

EXCAVATION TOLERANCE

CRUSHED WIPP SALT (DRIFT BACKFILL), TYPICAL
(FOR DESCRIPTION OF MATERIAL SEE NOTE A5 ON DRAWING NUMBER TR1 46-5)

SNL APPROVALS

<table>
<thead>
<tr>
<th>ORG</th>
<th>DATE</th>
<th>APPROVALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DR W. DUMAS/C. NORTHROP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ENG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>APVD</td>
</tr>
</tbody>
</table>

NEXT ASSEMBLY APPLICATION
DETAIL "B"
SOLIDATED SALT, TYPICAL
RIFTS AND PANEL SEALS
SEE NOTE 1;

EXCAVATION TOLERANCE ±6" TYPICAL

DETAIL "A"
NO SCALE

INFO ONLY

Sandia National Laboratories

DR W DUMAS/C. NORTHRUP
CHK C. MILLAM 11.30.79
ENG P. JONES 11.21.89
APVD

TITLE DRIFT AND PANEL SEALS
PLAN, ELEVATION
AND SECTION

SIZE D
SCALE 1" = 20'

DWG NUMBER TRI-46-3

SHEET 2 OF 2
Alternative Concrete Component General Shapes
TRI-46-4
PRISM
DOUBLE INTERLOCK

SCALE IN FEET
OPPOSED
TRUNCATED CONES

NOTES
1. NUMERICAL ANALYSES OF PERFORMANCE WILL BE SUITABLE FOR A CONCRETE CURRENT DRAWINGS OF THE "INTERLOCK" SHAPE.

2. ALL SEAL DIMENSIONS ARE FURTHER TEST RESULTS

<table>
<thead>
<tr>
<th>ORG</th>
<th>DATE</th>
<th>APPROVALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12/27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11/27/78</td>
<td>Dr. C. E.</td>
</tr>
<tr>
<td>12</td>
<td>11/27/78</td>
<td>Chief Engineer</td>
</tr>
<tr>
<td>1384</td>
<td>11/28/89</td>
<td>1.1. T. J. 18</td>
</tr>
</tbody>
</table>
OPPOSED INTERLOCK

ANALYSES OF MECHANICAL AND FLOW WIL BE USED TO SELECT THE SHAPE BEST CONCRETE SEAL DURING CONCEPTUAL DESIGN. DISTRIBUTIONS OF THE SEAL CONCEPTS INCORPORATE "K" SHAPE.

SIONS ARE SUBJECT TO CHANGE PENDING RESULTS AND ANALYSIS.

"INFO ONLY"

Sandia National Laboratories

<table>
<thead>
<tr>
<th>DR</th>
<th>W. DUMAS / C. NORTHROP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHK</td>
<td>D. L. PULIAM 11/21/89</td>
</tr>
<tr>
<td>ENG</td>
<td>R. JONES 11/21/89</td>
</tr>
<tr>
<td>APVD</td>
<td>11/21/89</td>
</tr>
</tbody>
</table>

TITLE

ALTERNATIVE CONCRETE COMPONENT GENERAL SHAPES

SIZE D

DWG NUMBER TRI-46-4

SCALE 1" = 20' SHEET 1 OF 1
Table of Specifications
TRI-46-5
A MATERIALS IDENTIFICATION

CONCRETE

A1 LOWER SHAFT, DRIFT, PANEL, AND UPPER SHAFT SEAL COMPONENTS IN THE SALADO FORMATION

THE REFERENCE CONCRETE FORMULATION FOR LOWER SHAFT, DRIFT, AND PANEL SEALS IS AS FOLLOWS (GULICK AND WAKELEY, IN FINAL PREPARATION):

- FINE LOCAL (CARLSBAD, NM) AGGREGATE 35 WT%
- COARSE LOCAL (CARLSBAD, NM) AGGREGATE 35 WT%
- BCT-1F SALT-SATURATED GROUT 30 WT%

THE BCT-1F SALT-SATURATED GROUT FOR THIS REFERENCE CONCRETE FORMULATION WAS DEVELOPED SPECIFICALLY FOR WIPP APPLICATIONS IN THE SALADO FORMATION (GULICK, BOA, AND BUCK, 1980; GULICK AND WAKELEY, IN FINAL PREPARATION).

THE BCT-1F GROUT IS PREPARED ACCORDING TO THE FOLLOWING FORMULATION:

- CLASS H CEMENT 48.3 WT%
- CLASS C FLY ASH 16.2 WT%
- CAL SEAL (PLASTER) 5.7 WT%
- SODIUM CHLORIDE 7.9 WT%
- DISPERSANT 0.78 WT%
- DEFOAMER 0.02 WT%
- WATER 21.1 WT%

SPECIFICATIONS OF BULK MATERIAL PROPERTIES FOR THIS REFERENCE CONCRETE AFTER CURING (28 DAYS) (GULICK AND WAKELEY, IN FINAL PREPARATION) ARE:

- UNCONFINED COMPRESSIVE STRENGTH 31 MPa
- STATIC MODULUS OF ELASTICITY $2.1 \times 10^4$ MPa
- POISSONS RATIO 0.20
- RESTRAINED EXPANSION 0.09
- MAXIMUM HYDRAULIC CONDUCTIVITY OF BULK MATERIAL TO BRINE $2 \times 10^{-10}$ cm/s

A2 UPPER SHAFT SEAL COMPONENTS IN THE RUSTLER FORMATION AND WATER-BEARING-ZONE SEAL COMPONENTS

THE REFERENCE CONCRETE FORMULATION FOR UPPER SHAFT AND WATER-BEARING ZONE SEALS IS AS FOLLOWS (GULICK AND WAKELEY, IN FINAL PREPARATION):

- FINE LOCAL (CARLSBAD, NM) AGGREGATE 35 WT%
- COARSE LOCAL (CARLSBAD, NM) AGGREGATE 35 WT%
- BCT-1F GROUT 30 WT%

THE BCT-1F GROUT FOR THIS REFERENCE CONCRETE FORMULATION WAS DEVELOPED SPECIFICALLY FOR WIPP.
CRUSHED SALT

A2. SEAL COMPONENTS IN ALL LOCATIONS

MINED WIPP SALT (FROM THE CREATION OF WIPP)

MINED WIPP SALT MATERIAL TO PASS THROUGH SCREEN AND CONFORM TO THE PARTICLE SIZE GIVEN IN HOLCOMB AND HANNUM, 1982

FREE WATER CONTENT: 3 WT%, TO ACCELERATE (HOLCOMB AND SHIELDS, 1987)

INITIAL RELATIVE DENSITY: PRECONSOLIDATED INTACT WIPP HOST ROCK SALT DENSITY (NOW, 1987; ARGUIELLO, 1988)

INITIAL BULK DENSITY: 1.7 x 10³ kg/m³

MORE DETAILED SPECIFICATIONS OF COMPOSITION AND SIZE DISTRIBUTION, WATER CONTENT, AND OTHER MATERIALS AND TECHNIQUES TO BE DEVELOPED DURING FY90 AND FY91 FOR CONCEPTUAL DESIGN

MAXIMUM HYDRAULIC CONDUCTIVITY OF BULK BRINE: 3 x 10⁻¹¹ cm/s

A3. DRIFT AND PANEL BACKFILL

MINED WIPP SALT (FROM THE CREATION OF WIPP)

FREE WATER CONTENT: 0.5 TO 3.5 WT%, TO ACCELERATE CONSOLIDATION (HOLCOMB AND SHIELDS, 1987)

INITIAL RELATIVE DENSITY: APPROXIMATELY 60 MPa HOST ROCK SALT, OBTAINED BY EMBRACING WITHOUT TAMPERING OR USING BLOCKS

INITIAL BULK DENSITY: APPROXIMATELY 1.3 x 10³ kg/m³

MORE DETAILED SPECIFICATIONS OF COMPOSITION AND SIZE DISTRIBUTION, WATER CONTENT, AND OTHER MATERIALS AND TECHNIQUES TO BE DEVELOPED DURING FY90 AND FY91 FOR CONCEPTUAL DESIGN

GROUT

A6. DISTURBED ROCK ZONES (DRZ) AROUND UPPER SHAFT

MATERIALS AND TECHNIQUES TO BE DEVELOPED DRAWING ON EXISTING INFORMATION AND CHARACTERIZATION OF DRZ (E.G., PIUSCH ET AL.). PRELIMINARY RESULTS TO BE AVAILABLE DURING
EMPLACEMENT PROCEDURES

EMPLACEMENT PROCEDURES AND DEMONSTRATED IN THE SMALL SCALE IN SITU TESTS BEGINNING AT THE PARTICLE SIZE DISTRIBUTION (STORMONT, 1986; STORMONT AND HOWARD, 1987); SOME WILL BE TO ACCELERATE CONSOLIDATION

PRECONSOLIDATED TO 80% OF IT DENSITY (NOWAK AND STORMONT, 1982)

10^3 kg/m^3

IONS OF COMPOSITION, PARTICLE CONTENT, AND OTHER PARAMETERS FY90 AND FY91 FOR USE IN THE

DUCTIVITY OF BULK MATERIAL TO

E CREATION OF WIPP EXCAVATIONS)

TO 3.5 WT%, TO ACCELERATE 8 AND SHIELDS, 1987)

APPROXIMATELY 60% OF INTACT WIPP G BLOCKS

1OXIMATELY 1.3 x 10^3 kg/m^3

IONS OF COMPOSITION, PARTICLE CONTENT, AND OTHER PARAMETERS FY90 AND FY91 FOR USE IN THE

ROUND UPPER SHAFT SEALS

IS TO BE DEVELOPED AND SPECIFIED. INFORMATION AND ONGOING (E.G.; PUSCH ET AL., 1988); AVAILABLE DURING CONCEPTUAL

CRUSHED SALT

EMPLACE AND TAMPI P FILL ACCESS SPACE AT T BLOCKS TO MEET DENSIT

SHAFT SEALS

EMPLACE AND TAMPI P DRIFT BACKFILL

EMPLACE TO MEET APPR

SWELLING CLAY MATERIAL

SHAFT SEALS

STACK PREFORMED BLOCK SPECIFICATION, DEMONS PERFORMANCE TEST SEF

CONCRETE

SHAFT SEALS

EMPLACEMENT TECHNIQ SMALL SCALE SEAL PERF 1986) WITH IN SITU EMPL.vertical boreholes

PANEL, DRIFT, AND SHAFT STA
EDURES


AND SHFT STATION SEALS

AND TAMP IN PLACE TO MEET DENSITY SPECIFICATION

IS SPACE AT TOP OF DRIFT WITH CRUSHED SALT

MET DENSITY SPECIFICATION

AND TAMP IN PLACE TO MEET DENSITY SPECIFICATION

MET APPROXIMATE DENSITY SPECIFICATION

ERIAL

FORMED BLOCKS IN PLACE TO MEET DENSITY DION, DEMONSTRATED IN SMALL SCALE SEAL ONCE TEST SERIES C (STORMONT AND HOWARD, 1987)

ENT TECHNIQUES HAVE BEEN DEMONSTRATED IN SEAL PERFORMANCE TEST SERIES A (STORMONT, IN SITU EMPLACEMENTS IN 1 METER DIAMETER BOREHOLES

ND SHAFT STATION SEALS

ENT TECHNIQUES HAVE BEEN DEMONSTRATED IN SEAL PERFORMANCE TEST SERIES B (STORMONT, 1986)

PUBLICATIONS

ARGUELLO, J. G. 1988. WASTE MANAGEMENT: COMPOSITE IN\n\nEVALUATION, SAND87-25, ALBUQUERQUE, NM.

BERTRAM-HOWERY, S. G. DISPOSAL-SYSTEM CHAIN EVALUATION OF THE WA NATIONAL LABORATORIE

COONS, W. A. BERGSTROM, J. STEADMAN, B. STILLBERG, OF-THE-ART REPORT ON NUCLEAR WASTE REPOS.

FUEL AND WASTE MANAGEMENT

GERSTLE, W. H. AND A. K. SALT, BENTONITE BLOCKS, ALBUQUERQUE, NM.

GULICK, C. W. JR., J. A. BO CEMENT GROUT DEVELOPMENT LABORATORIES, ALBUQUERQUE.

GULICK, C. W., AND L. D. W. PROPERTIES OF CEMENT WASTE ISOLATION PILOT LABORATORIES, ALBUQUERQUE.

HOLCOMB, D. J., AND D. W. BACKFILL UNDER CONDITIONS SAND82-0630, SANDIA N.

HOLCOMB, D. J., AND M. SHOREHOLES WITH CRUSHED SALT WITH LABORATORIES, ALBUQUERQUE.

JACOBSON, A., AND R. PUS WASTE PRODUCTS IN RC KBS, STOCKHOLM, SWED.

KELSALL, P. C., AND D. MEYER, DESIGNS FOR PENETRATIONS IN THE PERMIAN BASIN, BMI/ONWI-563, OH.

KELSALL, P. C., J. B. CASE, SCHEMATIC DESIGNS FOR PENETRATIONS IN THE PERMIAN BASIN, BMI/ONWI-563, OH.

NOWAK, J. B., AND J. C. STC THE RECONSOLIDATION, SANDIA NATIONAL LABOR.
D PUBLICATIONS

ARGUELLO, J. G. 1988. WIPP PANEL ENTRYWAY SEAL - NUMERICAL SIMULATION OF SEAL COMPOSITE INTERACTION FOR PRELIMINARY SEAL DESIGN EVALUATION. SAND87-2804. SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NM.


GULICK, C. W. JR., J. A. BOA, AND A. D. BUCK. 1980. BELL CANYON TEST (BCT) CEMENT-GROUT DEVELOPMENT REPORT. SAND80-1328. SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NM.

GULICK, C. W., AND L. D. WAKELEY. IN FINAL PREPARATION REFERENCE PROPERTIES OF CEMENT-BASED PLUGGING AND SEALING MATERIALS FOR THE WASTE ISOLATION PILOT PLANT (WIPP). SAND87-2817. SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NM.

HOLCOMB, D. J., AND D. W. HANNUM. 1982. CONSOLIDATION OF CRUSHED SALT BACKFILL UNDER CONDITIONS APPROPRIATE TO THE WIPP FACILITY. SAND82-0530. SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NM.

HOLCOMB, D. J., AND M. SHIELDS. 1987. HYDROSTATIC CREEP CONSOLIDATION OF CRUSHED SALT WITH ADDED WATER. SAND87-1990. SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NM.

JACOBSON, A., AND R. PUSCH. 1977. DEPOSITION OF HIGH-LEVEL RADIOACTIVE WASTE PRODUCTS IN BOREHOLES WITH BUFFER SUBSTANCE. KBS REPORT 03. KBS, STOCKHOLM, SWEDEN.

KELSALL, P. C., D. MEYER, J. B. CASE, AND W. E. COONS. 1985A. SCHEMATIC DESIGNS FOR PENETRATION SEALS FOR A REPOSITORY IN THE PARADOX BASIN. BM/ONWI-563. OFFICE OF NUCLEAR WASTE ISOLATION, COLUMBUS, OH.


HORIZONALS ABOVE AND BELOW THE SEATED SALT (GULICK, BOA, AND BUCK, 1980; WAKELEY, WALLEY, AND BUCK, 1986; GULICK AND WAKELEY, IN FINAL PREPARATION); THE BCT-1FF GROUT IS PREPARED ACCORDING TO THE FOLLOWING FORMULATION:

- CLASS H CEMENT: 53.1 WT%
- CLASS C FLY ASH: 18.1 WT%
- CAL SEAL (PLASTER): 6.5 WT%
- DISPERSANT: 0.68 WT%
- DEFOAMER: 0.02 WT%
- WATER: 21.6 WT%

SPECIFICATIONS OF BULK MATERIAL PROPERTIES FOR THE REFERENCE CONCRETE AFTER CURING (28 DAYS) (GULICK AND WAKELEY, IN FINAL PREPARATION) ARE TO BE:

- UNCONFINED COMPRESSIVE STRENGTH: 69 MPa
- STATIC MODULUS OF ELASTICITY: $33 \times 10^3$ MPa
- POISSONS RATIO: 0.17
- RESTRAINED EXPANSION: 0.03
- MAXIMUM HYDRAULIC CONDUCTIVITY OF BULK MATERIAL TO BRINE: $2 \times 10^{-10}$ cm/s

**NOTE:** THE DEVELOPMENT OF CONCRETE FORMULATIONS WILL CONTINUE IN ORDER TO MEET EVOLVING CHEMICAL STABILITY, COMPATIBILITY, AND OTHER PERFORMANCE CRITERIA; NEXT-GENERATION FORMULATIONS WILL BE CHOSEN DURING CONCEPTUAL DESIGN (S. G. BERTRAM-HOWERY AND R. L. HUNTER, 1989)

---

**SWELLING CLAY**

**A3 ALL LOCATIONS**

THE REFERENCE SWELLING CLAY MATERIAL IS WYOMING (Na-RICH) BENTONITE (CONTAINING SMECTITES) (SEE COONS ET AL., 1987; AND SAWYER AND DAEMEN, 1987 FOR SUMMARY DESCRIPTIONS)

INITIAL DENSITY TAILORED TO CONTROL THE DESIRED SWELLING PRESSURE AT EACH SEAL COMPONENT LOCATION (PUSCH, 1980A; PUSCH, 1980B) (SEE COONS ET AL., 1987 FOR SUMMARY OF GENERAL SWELLING PRESSURE PROPERTIES)

MAXIMUM HYDRAULIC CONDUCTIVITY OF BULK MATERIAL TO BRINE: $1 \times 10^{-10}$ cm/s

SULTS TO BE AVAILABLE DURING CONCEPTUAL DESIGN

**VER SHAFT, DRIFT, AND PANEL SEALS**

ALS AND TECHNIQUES TO BE DEVELOPED AND COMBINED WITH MATERIALS SUCH AS WET SALT, BITUMEN, AND CEMENTOUS MATERIALS. RESULTS TO BE AVAILABLE ALONG WITH EXISTING INFORMATION (E.G., 1988). PRELIMINARY RESULTS TO BE AVAILABLE BEFORE COMMENCEMENT OF DESIGN.

**GROUT**

- **UPPER SHAFT SEAL**
- **EMPLACE GF TECHNIQUES**
- **EXISTING INFO RESULTS TO PANEL, DRIFT, AND**
- **SPECIAL TECH COMBINATIONS OF MATERIALS SUCH AS WET SALT, BITUMEN, AND CEMENTOUS MATERIALS EMPLOYED ALONG WITH EXISTING INFORMATION (E.G., 1988). PRELIMINARY RESULTS TO BE AVAILABLE**

**EQUIPMENT FOR CRUSHED SALT AND ERCAL: EXISTING EQUIPMENT MANUFACTURED BY ALBUQUERQUE, NM (GERSTLE AND JONES, 1986; GRAF, 1987) REPRESENTS A PRELIMINARY EQUATION: ADDITIONAL EVALUATION OF BLOCKMENT TO BE CARRIED OUT TO ASSURE BEHOLDER RATE CAPABILITY AND COMPATIBILITY WITH £S FOR BLOCKS

**MATERIALS**

- **RING CONCEPTUAL DESIGN**
- **UNDER OR PNEUMATIC STOWING EQUIPMENT FOR EMPLACEMENT**
- **AIR-DRIVEN MECHANICAL TAMING EQUIPMENT FOR SALT**
- **EMPLACEMENT EQUIPMENT (EQUIPMENT TYPES STROMONT, 1986, STROMONT AND HOWARD, 1986)**
- **CEMENT EQUIPMENT (SOME EQUIPMENT TYPES IN PUSCH ET AL., 1988)**
- **CHANICAL MINER FOR ADDITIONAL EXCAVATIONS**
- **EQUIPMENT FOR SHAFT TBD**
AND HOWARD, 1986) WITH IN SITU EMPLACEMENTS IN 1 METER DIAMETER HORIZONTAL BOREHOLES.

**UPPER SHAFT SEALS**

- Emplace grout under pressure at seal locations.
- Techniques to be developed and specified: drain panels, drift, and shaft station seals.
- Special techniques to be developed and specified: combinations of materials such as wet crushed WIPP salt, bitumen, and cementitious materials to be considered along with existing information (e.g., Pusch et al., 1988); preliminary results to be available during conceptual design.

**STORAGE AND TRANSPORTATION**

- Practice: Emplace grout under pressure at seal locations.
- Techniques to be developed and specified: drain panels, drift, and shaft station seals.
- Special techniques to be developed and specified: combinations of materials such as wet crushed WIPP salt, bitumen, and cementitious materials to be considered along with existing information (e.g., Pusch et al., 1988); preliminary results to be available during conceptual design.

---

**INFO ONLY**

<table>
<thead>
<tr>
<th>Application</th>
<th>Date</th>
<th>Org. Date</th>
<th>Approval</th>
<th>SNL Approvals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next Assembly</td>
<td>ENG</td>
<td>CHK</td>
<td>APVD</td>
<td>C. Northrup</td>
</tr>
</tbody>
</table>

---

SNL APPROVALS

- AND HOWARD, 1986) WITH IN SITU EMPLACEMENTS IN 1 METER DIAMETER HORIZONTAL BOREHOLES.
<table>
<thead>
<tr>
<th>TABLE OF SPECIFICATIONS</th>
</tr>
</thead>
</table>

**Size** | **DWG NUMBER** |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>TRI-46-5</td>
</tr>
</tbody>
</table>

**Scale** | **Sheet 1 of 1**
Figure 7.2-8
Well Control Base Map
Data for this Township is Presented on an Enlarged Figure (Fig. 17)
FIGURE 7.2-8
WELL CONTROL BASE MAP
Figure 7.2-9
Isopach Bottom of Vaca Triste to Bottom MB 123/124
Data for this Township is Presented on an Enlarged Figure (Fig. 18)
FIGURE 7.2-9
ISOPACH BOTTOM OF VACA TRISTE TO BOTTOM MB 123/124
(SEE FIGURE 7.2-8 FOR BOREHOLE IDENTIFIERS)
Figure 7.2-10
Top of Salado to Top of Vaca Triste Isopach
Data for this Township is Presented on an Enlarged Figure (Fig. 19)
This area only partially contoured

CONTOUR INTERVAL=50 FT

--- DASHED CONTOURS REPRESENT AREAS OF LIMITED STRATIGRAPHIC CONTROL
Data for this Township is Presented on an Enlarged Figure (Fig. 19)
FIGURE 7.2-10
TOP OF SALADO TO TOP OF VACA TRISTE ISOPACH
(SEE FIGURE 7.2-8 FOR BOREHOLE IDENTIFIERS)
Figure 7.2-11
Isopach Bottom Union - Top MB123
Data for this Township is Presented on an Enlarged Figure (Fig. 21)
CONTOUR INTERVAL - 10 FT

DASHED CONTOURS REPRESENT AREAS OF LIMITED STRATIGRAPHIC CONTROL

This area is partially contoured
Data for this Township is Presented on an Enlarged Figure (Fig. 21)
FIGURE 7.2-11
ISOPACH BOTTOM UNION–TOP MB123
(SEE FIGURE 7.2-8 FOR BOREHOLE IDENTIFIERS)
Figure 7.2-12
Isopach MB109 Base to Top VT
This area not contoured
Data for this Township is Presented on an Enlarged Figure (Fig. 22)

This area only partially contoured
This area only partially contoured.

Contour interval: 20 ft.

Dashed contours represent areas of limited stratigraphic control.
Data for this Township is Presented on an Enlarged Figure (Fig. 22)

This area only partially contoured
FIGURE 7.2-12
ISOPACH MB109 BASE TO TOP VT
(SEE FIGURE 7.2-8 FOR BOREHOLE IDENTIFIERS)
Figure 7.1-13
Isopach Salado Top - Base MB103
Data for this Township is Presented on an Enlarged Figure (Fig. 25)
Data for this Township is Presented on an Enlarged Figure (Fig. 25)
FIGURE 7.2-13
ISOPACH SALADO TOP–BASE MB103
(SEE FIGURE 7.2-8 FOR BOREHOLE IDENTIFIERS)
Figure 7.2-14
Structure Contour on Top of Salado
Data for this Township is Presented on an Enlarged Figure (Fig. 4.28)

2 MILES

AL-100 FT

*S REPRESENT D STRATIGRAPHIC CONTROL
FIGURE 7.2-14
STRUCTURE CONTOUR ON TOP OF SALADO
(SEE FIGURE 7.2-8 FOR BOREHOLE IDENTIFIERS)
END

DATE FILMED

9/12/4/1993