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**Sandia National Laboratories**

Operated for the U.S. Department of Energy

by

**Sandia Corporation**

Carlsbad, New Mexico 88220

*date:* May 9, 2012

*to:* Records Center

*from:* Patricia Johnson, SNL Contractor

A handwritten signature in black ink, appearing to read 'Patricia Johnson'.

*subject:* 2003 Calculated Densities

The groundwater densities for the WIPP Culebra monitoring wells were calculated for 2003 as described in the Activity/Project Specific Procedure (SP) 9-11 *Calculation of Densities for Groundwater in WIPP Wells*. The derivation of the data is explained in the following sections and the supporting data are attached.

### 1. Calculation Process:

As stated in SP 9-11, for each calculation the observed water pressure is divided by the height of the water column. Specifically, the measured pressure value was divided by the Troll depth minus the closest corresponding depth to water (from or adjusted to the same measurement point elevation), and that result was then divided by 0.4335 (psi to feet of fresh water conversion at 4°C, at which temperature the density of pure water is 1.000 g/cm<sup>3</sup>). The individual calculated density results for each well were then averaged for a final density value.

The density data are included in the *2003 Calc Dens.xlsx* spreadsheet file created in Excel. Within that spreadsheet, the worksheet *2003 Calc Dens* summarizes the resulting density values and supporting information for the calculated densities. In addition, the Excel file contains individual well worksheets that include the data used for the calculations and plots of the Troll pressure data. The columns in the worksheets and their contents are described below:

- A – Well ID – Well name
- B – 2003 Avg Calc Dens (g/cm<sup>3</sup>) – Average Calculated Density Value for 2003
- C – # of Dens Averaged – number of density values averaged to get the final value
- D – Timeframe of Data – Time period for pressure data used in calculations
- E – Troll File Name(s) – File names for pressure data
- F – Troll Install Depth (ft BTOC/T) – Depth below primary measuring point at which the Troll was installed, below top of casing or tubing
- G – Date of Install – Date the Troll was installed into the well

WIPP:1.4.2.3:TD:QA-L:RECERT:541153

Information Only

- H – Installation Logbook Page – Reference to the logbook and page where the Troll installation was documented
- I – Comments/Explanations – Comments and/or explanations regarding data

The spreadsheet entries were verified by Dale O. Bowman II, Organization 6212.

## 2. Identification/Listing of Input, Input sources, and Output:

- Excel spreadsheet including the data – 2003 Calc Dens.xlsx
  - Worksheet 1 – 2003 Calc Dens (printed copy attached)
  - Worksheet 2 – C-2737
  - Worksheet 3 – Cabin Baby-1
  - Worksheet 4 – H-6b
  - Worksheet 5 – H-7b1
  - Worksheet 6 – H-9c
  - Worksheet 7 – P-17
  - Worksheet 8 – SNL-2
  - Worksheet 9 – SNL-3
  - Worksheet 10 – SNL-9
  - Worksheet 11 – SNL-12
  - Worksheet 12 – WIPP-13
  - Worksheet 13 – WIPP-25
  - Worksheet 14 – WIPP-26
  - Worksheet 15 – WIPP-30

## 3. Data Qualification for Compliance Decision Analysis:

Data sources provided in Column E (Troll File Name(s)), F (Troll Install Depth (ft BTOC/T)), G (Date of Install), and H (Installation Logbook Page), and in the References Section.

## 4. Software Used:

Intel® Xeon® CPU, Microsoft Windows 7, Microsoft Office Professional Plus 2010 Excel

## 5. Reviews:

Technical: Dale O. Bowman II, 6212

QA: Shelly Nielsen, 6210

## 6. References:

- Troll file names, installation data, and SNL water level data are from the following scientific notebooks (package ERMS 543277):
  - Troll Logbook 1 – Troll-1
  - Troll Logbook 2 – Troll-2
  - Troll Logbook 3 – Troll-3
  - Magenta Hydrology Notebook 3 – Magenta-3
  - WIPP Site Well Testing 1 – WSWT-1

- WRES Water Level Data submitted to SNL in monthly memoranda (package ERMS 525178)

**7. List of Attachments:**

1. Printout of Excel file worksheet 2003 Calc Dens.xlsx
2. CD including the Excel file and memorandum

**2003 Calculated Densities**

| A            | B                                       | C                  | D                 | E  | F                               | G               | H                         | I  |
|--------------|---|--------------------|-------------------|--|---------------------------------|-----------------|---------------------------|--|
| Well ID      | 2003 Avg Calc Dens (g/cm <sup>3</sup> ) | # of Dens Averaged | Timeframe of Data | Troll File Name(s)   | Troll Install Depth (ft BTOC/T) | Date of Install | Installation Logbook Page | Comments/Explanations  |
| C-2737       | 0.988                                   | 7                  | Feb - May 2003    | SN07861 2003-02-03 090017 C-2737(C).bin  | 499                             | 2/3/2003        | Troll #1 - 144            |  |
| Cabin Baby-1 | 1.037                                   | 1                  | May 2003          | SN01038 2003-04-02 124850 CB-1.bin   | 344                             | 4/2/2003        | Magenta #3 - 111          |  |
| H-6b         | 1.048                                   | 6                  | July - Dec 2003   | SN11306 2003-05-08 094818 H-6b.bin   | 394.6                           | 5/8/2003        | Troll #2 - 42             |  |
| H-7b1        | 1.079                                   | 8                  | Apr - Sept 2003   | SN00564 2002-10-17 140542 H-7-B1.bin   | 199.0                           | 4/5/2002        | Troll #1 - 73             |  |
| H-9c         | 1.010                                   | 10                 | Mar - Dec 2003    | SN11336 2003-03-03 145838 H-9C(C-4).bin  | 550.0                           | 3/3/2003        | Magenta #3 - 95           |  |
| P-17         | 1.099                                   | 10                 | Mar - Dec 2003    | SN00568 2002-10-17 090750 P-17.bin   | 385.0                           | 10/17/2002      | Troll #3 - 4              | Troll install depth recorded for following installation because 10/17/02 depth of Troll not recorded |
| SNL-2        | 1.024                                   | 6                  | Oct - Nov 2003    | SN13562 2003-10-22 123239 SNL2-pump(C-1).bin, SN13562 2003-10-27 114528 SNL2-pump(C-2).bin, SN13562 2003-11-13 113738 SNL2(C3).bin | 474.8                           | 10/22/2003      | WSWT #1 - 99              |  |
| SNL-3        | 1.073                                   | 5                  | Oct - Dec 2003    | SN13474 2003-10-07 142353 SNL3.bin, SN13474 2003-11-21 093628 SNL3.bin   | 545.0                           | 10/7/2003       | Troll #2 - 109            |  |
| SNL-9        | 1.039                                   | 8                  | Oct - Dec 2003    | SN04580 2003-09-17 140541 SNL9.bin, SN13590 2003-11-19 120134 SNL9(C2).bin   | 424                             | 9/17/2003       | Troll #2 - 101            |  |
|              |   |                    |                   |  | 565.89                          | 11/17/2003      | WSWT #1 - 144             |  |
| SNL-12       | 1.013                                   | 9                  | Aug - Dec 2003    | SN04558 2003-08-20 142424 SNL12.bin  | 490.0                           | 8/20/2003       | WSWT #1 - 42              |  |
| WIPP-13      | 1.051                                   | 5                  | Oct - Dec 2003    | SN00819 2003-10-07 111336 WIPP-13.bin  | 446                             | 10/7/2003       | Troll #2 - 109            |  |
| WIPP-25      | 1.012                                   | 6                  | Oct - Dec 2003    | SN00565 2003-10-07 160536 WIPP-25.bin  | 350.5                           | 10/7/2003       | Troll #2 - 111            |  |
| WIPP-26      | 1.043                                   | 3                  | Dec 2003          | SN08276 2003-12-02 155517 WIPP-26.bin  | 165.0                           | 12/2/2003       | Troll #2 - 137            |  |
| WIPP-30      | 1.024                                   | 8                  | May - Dec 2003    | SN00608 2003-04-02 151511 WIPP-30.bin  | 392.0                           | 4/2/2003        | Magenta #3 - 113          |  |

Notes:  
ft BTOC = feet below top of casing      NA = not applicable/available  
ft BTOT = feet below top of tubing      LTM = Long-Term Monitoring  
BGS = below ground surface      WSWT = WIPP Well Site Testing  
All Troll depths are presented as documented in the SN, compensations for Troll depth measurement to sensor have not been made  
All Trolls utilized were Mini Trolls on Vented Cables

# Information Only