date: January 13, 2010

to: Records Center

from: Patricia Johnson, SNL Contractor

subject: 2009 Calculated Densities

The groundwater densities for the WIPP Culebra monitoring wells were calculated for 2009 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. Although the density for WIPP-25 was calculated and is presented, it is not considered reliable and should not be used to calculate freshwater head.

1. Calculation Process:
As stated in SP 9-11, for each calculation, the measured pressure value minus the closest corresponding barometric pressure 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 (pressure to feet of water conversion at 4°C, at which temperature the density of pure water is 1.000 g/cm$^3$). The individual calculated density results for each well were then averaged for a final density value.

The density data are included in the 2009 Calc Densities.xls spreadsheet file created in Excel. Within that spreadsheet, the worksheet 2009 Calc Dens summarizes the resulting density values and supporting information for the calculated densities and the worksheet 2009 Calc Dens Formulas provides the formulas in the worksheet. 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 – Monitor Well – Well name
- B – 2009 Avg Calc Dens (g/cm$^3$) – Average Calculated Density Value for 2009
- C – 2008 Avg Calc Dens (g/cm$^3$) – Average Calculated Density Value for 2008
- D – 2009 - 2008 Diff – Difference between 2009 and 2008 densities (Column C - Column B)
- E – 2007 Avg Calc Dens (g/cm$^3$) – Average Calculated Density Value for 2007
- F – # of Dens Averaged – number of density values averaged to get the final value
- G – Troll – Mini or Level/Vented (v) or Non-Vented (nv) – the type of Troll and cable used to collect pressure measurements
- H – Timeframe of Data – Time period for pressure data used in calculations
2. Identification/Listing of Input, Input sources, and Output:

   - Excel spreadsheet including the data – 2009 Calc Densities.xls
      - Worksheet 1 – 2009 Calc Dens (printed copy attached)
      - Worksheet 2 – 2009 Calc Dens Formulas (printed copy attached)
      - Worksheet 3 – Baro Data 11064
      - Worksheet 4 – Baro Data 10532
      - Worksheet 5 – AEC-7
      - Worksheet 6 – C-2737
      - Worksheet 7 – ERDA-9
      - Worksheet 8 – H-2b2
      - Worksheet 9 – H-3b2
      - Worksheet 10 – H-4bR
      - Worksheet 11 – H-5b
      - Worksheet 12 – H-6bR
      - Worksheet 13 – H-7b1
      - Worksheet 14 – H-9c
      - Worksheet 15 – H-10c
      - Worksheet 16 – H-11b4
      - Worksheet 17 – H-12
      - Worksheet 18 – H-15R
      - Worksheet 19 – H-16
      - Worksheet 20 – H-17
      - Worksheet 21 – H-19b0
      - Worksheet 22 – IMC-461
      - Worksheet 23 – SNL-1
      - Worksheet 24 – SNL-2
      - Worksheet 25 – SNL-3
      - Worksheet 26 – SNL-5
      - Worksheet 27 – SNL-6
      - Worksheet 28 – SNL-8
      - Worksheet 29 – SNL-9
3. Data Qualification for Compliance Decision Analysis:
Data sources provided in Column I (Troll File Name(s)), Column N (Installation Logbook Page), and in the References Section.

4. Software Used:
Microsoft Office Excel 2003 SP2, Intel Pentium 2 Quad CPU processor under Microsoft Windows XP

5. Reviews:
Technical: Richard Beauheim, 6712
QA: Shelly Johnsen, 6710

6. References:
- Troll installation data and SNL water level data from the following logbooks:
  Long-Term Monitoring Notebook (LTM)-8 (package ERMS 543277)
  Long-Term Monitoring Notebook (LTM)-9 (package ERMS 543277)
  Long-Term Monitoring Notebook (LTM)-10 (package ERMS 543277)
  Long-Term Monitoring Notebook (LTM)-11 (package ERMS 543277)
  Long-Term Monitoring Notebook (LTM)-12 (package ERMS 543277)
  WIPP Site Well Testing (WSWT)-13 (package ERMS 540244)
- WRES Water Level Data submitted to SNL in monthly memoranda (package ERMS 546636)
- Johnson, Patricia B., Culebra Center Depths for Use in Calculating Equivalent Freshwater Heads of the Culebra Dolomite Member of the Rustler Formation near the WIPP Site, Revision 2, August 7, 2008 (ERMS 549564)

7. List of Attachments:
1. Printout of Excel file worksheet 2009 Calc Dens.xls
2. Printout of Excel file worksheet 2009 Calc Dens Formulas.xls
3. CD including the Excel file and memorandum
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<th>D</th>
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Reference in logbook is to top of environmental casing, which is 1.18' tell above top of reference casing.

Notes:
- Midd Level - depth level of installation.
- Vented - whether the well was vented (y/n).
- Date of Install - date when the well was installed.
- Installation Logbook Page - page number of the installation logbook.

Logging Company: Well Completion Services

Logging Description:
- BTOC/T - Below Total Oil Capping Point
- ERMS - Estimated Rock Mass Strength

Logging Method:
- AEC-7
- C-2737
- ERDA-9
- H-262
- H-362
- H-46R
- H-5b
- H-46R
- H-7b1
- H-9c
- H-10c
- H-11b
- H-11bD
- H-12
- H-15R
- H-17
- H-19b
- M-C21
- SNL-1
- SNL-2
- SNL-3
- SNL-5
- SNL-6
- SNL-8
- SNL-9

Logging Notes:
- SNL-1: Well was not drilled to the depth indicated.
- SNL-2: Well was not drilled to the depth indicated.
- SNL-3: Well was not drilled to the depth indicated.
- SNL-5: Well was not drilled to the depth indicated.
- SNL-6: Well was not drilled to the depth indicated.
- SNL-8: Well was not drilled to the depth indicated.
- SNL-9: Well was not drilled to the depth indicated.
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<th>2009 - 2008 Diff (g/cm³)</th>
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Notes:
- Attempts have
- BTOC = test
- BTOT = level
- v = vented
- Barometric dat

(v) = non-vented
NA = not applicable/available
LTM = Long-Term Monitoring
WSWT = WIPP Well Site Testing

Value not reliable and should not be used, min/Troll not at optimal depth for pressure readings, packer and well testing.