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ACTIVITY/PROJECT SPECIFIC PROCEDURE

SP 9-11
CALCULATION OF DENSITIES FOR GROUNDWATER IN WIPP WELLS
Revision 4

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(printed name) (signature and date)

1.0 Purpose and Scope

This procedure prescribes the Sandia National Laboratories (SNL), Waste Isolation Pilot Plant (WIPP) process for the calculation of densities for groundwater in WIPP wells. The objective of this procedure is to describe how groundwater densities in the WIPP wells are calculated. The densities are used to satisfy permit requirements which typically include the calculation of freshwater heads.

This Activity/Project Specific Procedure (SP) is intended to direct SNL technical personnel in the actions needed to obtain high-quality data that meet SNL Quality Assurance (QA) standards. All future calculated density outputs will be documented in memorandums to file that will reference this SP. This SP is governed by Nuclear Waste Management Procedure (NP) 9-1, Analyses, which directs analyses documented in routine calculations.

Acronyms and definitions for terms used in this procedure may be found in the Glossary located on the Sandia National Laboratories (SNL) WIPP Online Documents web site.

2.0 Implementation Actions

2.1 Safety

The activities described in this SP shall conform to SNL Environmental Safety and Health programs (ES&H). All activities described in this SP will be conducted in the SNL office facility.

2.2 Responsibilities

The Technical Staff are responsible for performing the calculations outlined in this procedure, documenting all required information described in this SP, and assuring the latest revision of this document is followed.

If the procedure cannot be worked as written, the user has the responsibility to stop work and resolve all concerns with the PI and/or QA, as appropriate, prior to proceeding with the work.

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2.2 Equipment

The equipment will be limited to a computer and its associated operating system. This will include a spreadsheet program, typically Excel.

2.3 Procedure for Calculating Densities

The densities of the water in the WIPP wells shall be calculated using pressure (head and barometric, where applicable) data collected by pressure transducers (PTs), the depths of the PTs, and the corresponding depth to water data. Specifically, the measured pressure values shall be divided by the PT depth minus the closest corresponding depth to water (from or adjusted to the same measurement point elevation), and that result will then be divided by 0.4335 (pressure to feet of water conversion), as depicted in the following equation:

$$PD = \left[\frac{(P_{meas*})}{Z_1 - DTW}\right]/C$$

Where,
PD = Pressure Density (grams per centimeter cubed (g/cm^3)
P_{meas*} = the measured pressure head (psia or psig)
Z_1 = installation depth of the PT (ft below reference point)
DTW = depth to water (ft below reference point)
C = conversion coefficient (0.4335 psi/ft, for fresh water)
Note: P_{meas*} is equal to P_{meas} for gauge (vented) sensors or P_{meas} minus barometric pressure (BP, psia) for absolute (non-vented) sensors.

When using absolute pressure data, the closest corresponding barometric pressure values shall be subtracted from the water pressures prior to dividing by the PT depth minus the depth to water, then the results will be divided by 0.4335. This calculation results in a density value for the date and time of the subject depth to water and the closest corresponding pressure data. Depending on data availability, densities are calculated and averaged for a final value. Ideally, attempts are made to use a consistent time period for all the wells. If available, at least four consecutive density estimates (as given by the equation above) are averaged to create a representative value. The pressure density shall then be divided by P_f, as depicted in the equation below, to obtain specific gravity values, defined as the ratio of the density of a substance to the density of a reference substance, that are representative of water at 70°F.

$$SG = PD/P_f$$

Where,
SG = Specific Gravity (dimensionless unit)
PD = Pressure Density (grams per centimeter cubed (g/cm^3)
P_f = density of freshwater at 70°F (0.998 g/cm3)

When using absolute pressure data, the closest corresponding barometric pressure values shall be subtracted from the water pressures prior to dividing by the PT depth minus the depth to water, then the results will be divided by 0.4335. This calculation results in a density value for the date and time of the subject depth to water and the closest corresponding pressure data. Depending on data availability, densities are calculated and averaged for a final value. Ideally, attempts are made to use a consistent time period for all the wells. If available, at least four consecutive density estimates (as given by the equation above) are averaged to create a representative value. The resulting specific gravities are

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used for the purposes of calculating equivalent freshwater heads for WIPP wells and for fulfilling regulatory permit requirements.

As part of the documentation process, sources and background information are provided for the data. This information will be included with future records submittals in memorandum format, and will typically consist of the following:

- Monitor Well Name
- Prior Year Average Calculated Density
- Number of Densities Averaged
- PT and Cable Type (to indicate absolute or gauge pressure values)
- Time Period of Data
- PT File Name(s)
- PT Installation Depth - in feet (ft) below reference point (i.e., below top of casing (BTOC), below top of tubing (BTOT))
- Ideal Installation Depth for the PT (ft below reference point) – mid-formation (ideally, all PTs are installed at or as close to mid-formation depth as possible)
- Date of PT Installation
- PT Installation Documentation Reference – logbook and page number
- Hard copy or reference to depth to water data, PT calibration reports, and PT file logbook entries

2.4 Data Sources

Two standard components of the calculated densities are the depth to water data and PT install depths. PT install depths are derived from mid-formation depths for each well. The SNL depth to water data and PT installation depths are located in the Records Center:

- Long-Term Monitoring Notebooks,
- WIPP Site Well Testing Notebooks, and
- Mid-depths.

The depth to water data from the Maintenance and Operations (M&O) contractor, currently Los Alamos Technical Associates (LATA), are located in the Records Center:

- LATA Depth to Water Data, submitted to SNL in monthly memoranda

All additional data sources will be provided in the memorandum submitted to the Records Center.

3.0 Records

The following records, generated through implementation of this procedure, shall be prepared and submitted to the WIPP Records Center in accordance with NP 17-1, “Records”:

QA Record

- Memorandum containing density output data and associated data references

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4.0 Appendices

There are no appendices associated with this SP.

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