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**Sandia National Laboratories**
**Waste Isolation Pilot Plant**

# Test Plan TP 14-01

# Test Plan for Age Dating Sampling at the WIPP Site

**Task 4.4.2.3.1**

**Revision 0**

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## 1. ABBREVIATIONS, ACRONYMS, AND INITIALISMS

| | |
|---|---|
| A | ampere |
| CBFO | (U.S. DOE) Carlsbad Field Office |
| DAS | data-acquisition system |
| DOE | (U.S.) Department of Energy |
| EPA | (U.S.) Environmental Protection Agency |
| ES&H | environmental safety and health |
| FY | fiscal year |
| gal | gallons |
| gpm | gallons per minute |
| GWMP | Groundwater Monitoring Program |
| HA | hazard analysis |
| HMI | Human Machine Interface |
| HP | horsepower |
| M&O | management and operations |
| NMOSE | New Mexico Office of the State Engineer |
| NP | (SNL WIPP) Nuclear Waste Management (QA) Procedure |
| OLE | Object Linking and Embedding |
| OPC | OLE for Process Control |
| PHS | primary hazard screening |
| PI | Principal Investigator |
| PID | Proportional, Integral, and Derivative |
| PIP | production injection packer |
| psia | pounds per square inch absolute |
| psig | pounds per square inch gauge |
| QA | quality assurance |
| QAPD | Quality Assurance Program Document |
| RTD | resistance temperature detector |
| RTU | remote terminal unit |
| SN | Scientific Notebook |
| SNL | Sandia National Laboratories |
| SNS | Scientific Notebook Supplement |
| SP | (SNL WIPP) Activity/Project Specific Procedure |
| SSW | Shallow Subsurface Water |
| SMN | SSW Monitoring Network |
| TP | (SNL) test plan |
| VAC | volt alternating current |
| VDC | volt direct current |
| VFD | variable frequency drive |
| WIPP | (U.S. DOE) Waste Isolation Pilot Plant |
| WMN | WIPP Monitoring Network |
| WTL | (SNL) Well-Testing Lead |

## 2. REVISION HISTORY

This is the original version of this test plan (revision 0).

## 3. PURPOSE AND SCOPE

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) facility designed for the safe disposal of transuranic wastes resulting from U.S. defense programs. In order to demonstrate compliance with U.S. Environmental Protection Agency (EPA), 1993) and (EPA, 1996), models of groundwater flow and transport around the WIPP are needed. These models must:

- demonstrate an understanding of the hydrologic systems within which WIPP exists,
- identify radionuclide flowpaths through the biosphere from the WIPP repository, due to possible inadvertent human intrusion,
- simulate groundwater flow and radionuclide transport along the important flow paths in the event that human intrusion of the repository occurs.

Development of these models requires both head (pressure) and tracer data from wells completed to all units within the hydrologic system. The collection of pressure testing data for calibration and validation of groundwater models is considered in Sandia Test Plan 03-01 (Schuhen, 2010). This test plan considers the collection of natural and man-made tracer data from WIPP wells and geologic strata to better constrain the calibration and validation of flow models at the WIPP. The tracer data include, but are not limited to:

- general water-quality analyses (e.g., total dissolved solids and major cations and anions) that may be useful in classifying water types and inferring flow directions and fluid sources (i.e., Domski & Beauheim (2008) and Domski et al. (2011)),
- natural tracers that undergo radioactive decay and can be used to provide an indication of the age of the groundwater, or time since the water was in contact with the atmosphere based on relative concentrations of two different isotopes (e.g., carbon-14, chlorine-36, or krypton-81),
- natural stable isotopic tracers which give information on fluid provenance, chemical and physical interactions during flow such as dissolved noble gases, stable isotopes of water, carbon and nitrogen,
- ubiquitous man-made tracers that may be used to determine possible contamination of samples with recent water (e.g, chlorofluorocarbons or tritium).

Additionally, the data generated from testing can be used by the DOE in support of operating permits supplied by the regulatory agencies for WIPP. This includes the discharge permit (DP) issued by the State of New Mexico, which requires the monitoring of anthropogenically derived water found perched at the Santa Rosa-Dewey Lake contact below the WIPP facility (NMED, 2010).

This TP describes the methods that will be used to obtain the data needed for hydrologic and geochemical modeling at the WIPP.

## 4. EXPERIMENTAL PROCESS RATIONALE AND DESCRIPTION

The overall strategy and scope of water quality sampling in WIPP wells is defined by the Sandia Principal Investigator (PI). Either the PI or the Sandia Well-Test Lead (WTL) designated by the PI may make decisions about specific types of samples to be collected, sample parameters, durations of sampling or purging events, tool placements, instrumentation, sampling criteria, etc., and authorize deviations from the procedures outlined in this TP.

Wells that constitute the WIPP groundwater monitoring network are completed to the Santa Rosa-Dewey Lake Formation, the Culebra and Magenta Dolomite Members of the Rustler Formation, and the Bell Canyon Formation (Figures 4-1 and 4-2). Though many of these wells have been sampled for general water quality properties, most wells require testing for specific age-dating or transport-related constituents. The PI, in consultation with the WTL, will decide upon which wells need to be tested or sampled for water quality on a fiscal year (FY) basis.

| System | Series | Group | Formation | Member | Approximate Thickness* ( m | ft ) |
|---|---|---|---|---|---|---|
| Recent | Recent | | Surficial Deposits | | 3 | 10 |
| Quaternary | Pleistocene | | Mescalero Caliche | | 10 | 30 |
| | | | Gatuña | | | |
| Triassic | | Dockum | Undivided | | 3 | 10 |
| Permian | Ochoan | | Dewey Lake Redbeds | | 150 | 500 |
| | | | Rustler | Forty-niner | 18 | 60 |
| | | | | Magenta | 7 | 24 |
| | | | | Tamarisk | 26 | 85 |
| | | | | Culebra Dolomite | 7 | 24 |
| | | | | Los Medaños | 37 | 120 |
| | | | Salado | | 600 | 2000 |
| | | | Castile | | 400 | 1300 |
| | Guadalupian | Delaware Mountain | Bell Canyon | | 310 | 1000 |
| | | | Cherry Canyon | | 335 | 1100 |
| | | | Brushy Canyon | | 550 | 1800 |

* At center of WIPP site.

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Figure 4-1. Stratigraphic units at the WIPP Site

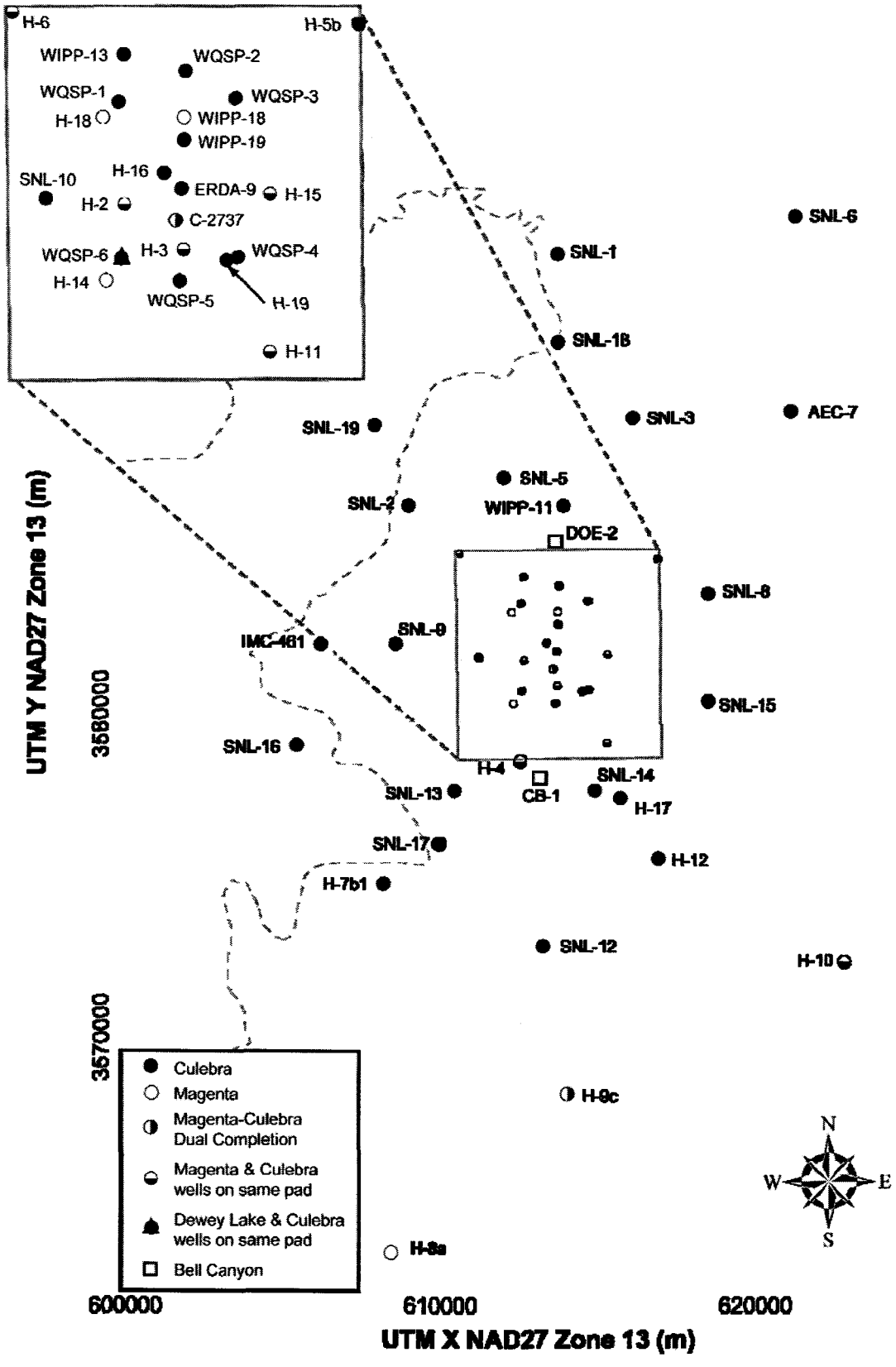


Figure 4-2. The WIPP groundwater monitoring network

### 4.1 Sampling Activities

In each well to be sampled, the following activities will occur:

1. The SNL WTL or PI will evaluate the existing data from previous sampling or well-development events to design a purging and sampling strategy that meets the objectives for the location and interval being tested and the analyte being sampled. When the WTL/PI has determined the type and duration of the hydraulic pumping that will be conducted in an individual well, an appropriate purging and sampling tool will be installed in the well. The type and configuration of purging and sampling tools will vary between formations, locations, and analytes based on:

- productivity or permeability of the formation being sampled (e.g., can the well sustain 40 or 0.4 gpm, or must fluids be laboratory-extracted from core samples?);
- pumping and sampling history of the location (has the well been pumped recently?);
- well existence or configuration (single-interval completion or dual-interval completion);
- requirements of the analyte (typically representative "formation water" is needed, but some analytes require more stringent controls on sample handling or entrained air from pumping).

Due to the inherent variability in sampling-tool configurations that will be necessary to complete hydraulic testing in all wells successfully, no standard configuration is provided in this TP. Each sampling-tool configuration will be documented in the scientific notebook and will be submitted as part of the final records package. The placement of the sampling tool within the borehole will be determined by the WTL/PI. After it has been verified the sampling tool has been properly emplaced and representative water is produced from the formation, an appropriate sample will be collected in accordance with the procedures given in Subsection 4.3.

2. Regardless of the type of samples collected, the WTL/PI will evaluate data collected on a real-time basis (e.g., well pressure, flowrate, general mineral/general physical, pH, and water temperature) in order to ensure the objectives of the sampling event are being met prior to the collection of the sample, as well as to ensure the tests are conducted with the maximum efficiency possible. The reader is referred to Subsections 4.3.2, 4.4.1, and 4.4.4 for additional information regarding the real-time data analysis associated with the various types of hydraulic tests.

3. All test equipment will be removed from the well, and the well will be configured for long-term monitoring.

This will complete SNL sampling activities in the well. The WIPP management and operations (M&O) contractor will also incorporate the well into its Groundwater Monitoring Program (GWMP; WTS, 2003) and, if deemed necessary, SNL will incorporate the well into its long-term monitoring program (described in TP 06-01, *Monitoring Water Levels in WIPP Wells*).

### 4.2 Measuring and Test Equipment

Equipment needed for the hydraulic testing and data-collection activities will consist of equipment at the land surface and downhole equipment to be installed in the wells. Equipment will consist of

either "off-the-shelf" items ordered directly from qualified suppliers or standard equipment provided by qualified service companies. No specially designed equipment is anticipated. All equipment used will follow the supplier's operation and calibration specifications and will be documented as part of the QA records and controlled following NP 12-1, *Control of Measuring and Test Equipment*.

#### *4.2.1 SURFACE EQUIPMENT*

The surface equipment will include water-quality measurement instruments, a flow measurement device, a power source, and storage tanks. A data-acquisition system (DAS) will typically be used to monitor and record real-time data during purging before sampling. For constant-rate flow sampling, the DAS will also control the flow rate of the pumping system. Equipment will be operated observing relevant SNL and M&O contractor environmental safety and health (ES&H) procedures and protocols.

##### *4.2.1.1 Water-Quality Measurements*

To quantify the stability water being purged from the well, standard mineral and physical properties of the water will be field tested through time. During the pumping and purging phases of the sampling, the specific conductance, temperature and pH of the produced water will be measured by the DAS or by manually read instruments and on a frequency determined by the WTL/PI. Specific gravity will be measured manually during purging, or as directed by the WTL/PI. The same suite of measurements may also be performed on water bailed, swabbed, or airlifted from wells final sampling. With the exception of specific gravity, these data will be considered qualitative in nature and will not be used for interpretation, but only to indicate relative changes in the quality of the fluid produced.

The specific conductance and pH will be measured with commercial off-the-shelf sensors (or equivalent) with measurement sensitivity of ± 0.025 pH and conductance sensitivity of ± 5% of full scale. Specific gravity will be measured with a laboratory-grade hydrometer. Measurements will be documented as part of the QA process and noted in the applicable scientific notebook (SN).

##### *4.2.1.2 Mechanical Or Electrical Flow Measurement Device*

A totalizing mechanical or electrical flow meter may be used to measure the cumulative discharge during the pumping period. If necessary, the data from the totalizing flow meter can be used to calculate the average pumping rate by observing the volume of water discharged through the meter over a given time period. Totalizing-flow-meter data will be documented as non-QA records. The performance of the flow meter used will be verified consistent with the requirements identified in NP 12-1, *Control of Measuring and Test Equipment.*

As a secondary means of verifying flow meter performance, the flow rate can be estimated by determining the time required to fill a container of known volume in a specific time period; these secondary checks may be documented in the scientific notebook for the corresponding pumping activity as non-QA records.

#### *4.2.1.3 Power Source(s)*

Diesel- or gas-powered generators are typically used to generate electricity for the test equipment and pumps. If a generator is used, it will be operated in accordance with the instructions provided by the manufacturer. Operation of generators is not a quality-affecting activity and, therefore, documentation of activities associated with the generators is not mandatory. It is also appropriate that all DAS and computer equipment be powered through an Uninterruptible Power Supply (UPS) which provides for the continued collection of data in the event the primary power source fails.

#### *4.2.1.4 Storage Tanks*

Groundwater produced from the wells during purging activities will be stored in appropriate tanks at the well pad until such time that the M&O contractor disposes of the produced water by appropriate means. Water storage is not a quality-affecting activity and, therefore, documentation of activities associated with the storage amounts is not mandatory.

#### *4.2.1.5 Data-Acquisition System*

The DAS consists of one or more control panels and a computer system. The control panels, computer system, and all hardware components are developed using off-the-shelf items. The control panels house the programmable logic controller (PLC), data acquisition Input/Output (I/O), analyzers for pH and specific conductance, and the power supplies for most of the instrumentation. The DAS is designed around a processor supplied by Sixnet Corporation. The Sixnet DAS will be programmed using the ISaGFAF programming software supplied by Sixnet. The DAS program will be capable of controlling the test equipment for the purposes of maintaining a fixed flow rate and the DAS will scale the raw analog signals to their engineering unit equivalents using the calibration coefficients. The engineering units for the instrumentation will be displayed on the human-machine interface (HMI) software running on the system computer. The HMI is interfaced with the primary DAS computer through an Ethernet hub or switch.

The control panels can also contain the variable frequency drive (VFD), motor starter, and circuit protection devices for downhole submersible pumps. Pump control includes setting the pump motor speed using a 4 to 20-mA command signal to a VFD. This generally applies to pumps that are 15 HP and less. For pumps greater than 15 HP, the control panels are not usually used and the pump is run directly from the power source and the flow is regulated using manual valves.

For very low flow applications where a steady flow regime may not be possible, such as those expected in low-permeability formations or the WIPP Shallow Subsurface Water (SSW), the controls maybe condensed into a simplified sampling pump setup without a DAS attached. The pumping test will primarily focus on collection of water quality samples using this configuration and data will be collected by downhole pressure transducers, if possible. The WTL/PI will identify the test equipment configuration that best accomplishes the objectives of collecting both water quality sample collection and testing of hydraulic properties within low flow boreholes.

Flow through the hydraulic system is measured by in-line analog and digital flowmeters located near the upstream end of the hydraulic line and is controlled using the VFD to adjust power delivered to the pump in the well. Water quality (pH and specific conductance) is measured near the downstream

end of the hydraulic line that is also equipped with a valve port to collect water samples for laboratory analyses, if required. A resistive temperature detector (RTD) located in the flow line between the water-quality sensors is used to measure water temperature.

The data-acquisition computer system should at a minimum have the software described in Table 4-1 installed as part of the overall system. These software products are used to configure the system hardware and to communicate between the hardware and the computer. Both ISaGRAF and Wonderware provide the capability to develop applications using their programming functions. For the SNL DAS, separate ISaGRAF and Wonderware programs were developed. These programs perform the math functions that convert raw data to engineering values and also control the pump motor speed and valve position using Proportional, Integral, and Derivative (PID) logic. The Wonderware HMI application was developed to interface with the Sixnet DAS and provide a user-friendly HMI from which the system operator could control and monitor a test.

The software and system performance is verified following the steps identified in AP-115 or AP-148. The activities described in these analysis plans are performed whenever the software or DAS hardware configuration is significantly modified. The results of the AP-115 or AP-148 activities will be documented in a data report for the system. The DAS is calibrated at a frequency determined by the WTL\PI following the process identified in SP 12-4, *Sixnet DAS Calibration.*

#### *4.2.1.6 Additional Sampling Requirements*

Additional requirements of other sampling systems may not be met by the setup described above. For example, sampling for dissolved gasses requires using an inline flow-through apparatus that removes air from pumped water. These additional apparatus are analyte and test specific, and typically provided by the sampling laboratory or cooperating organization.

Table 4-1. Software Utilized in WIPP Hydrology DAS.

| Software Name | Version | Function | Comment |
|---|---|---|---|
| ISaGRAF | 3.47 or newer | Program Sixnet remote terminal unit (RTU) (Processor) | ISaGRAF is an IEC61131-compliant, off-the-shelf programming package used to develop a program in the RTU which converts the raw values to engineering units and controls pump speed and valve position |
| Sixnet I/O Tool Kit | 3.0 or newer | Configure Sixnet Hardware | Sixnet I/O Tool Kit is an off-the-shelf software package that is used to configure the Sixnet hardware. This capability includes configuration of I/O channels, ports, addressing, etc. |
| Wonderware by Intouch | 8.0, SP1 or newer | Human Machine Interface Software | Wonderware is an off-the-shelf software package that can be used to develop a custom operator interface consisting of computer screens that allow the user to view and input parameters to the program running in the Sixnet RTU. |
| InSQL by Intouch | 8.0, SP1 or newer | Database | InSQL is an off-the-shelf database product capable of interfacing with the HMI (Wonderware) to collect and store the data being collected by the DAS |
| KepWare | 4.100.239 or newer | OPC Data Exchange | KepWare is device-driver software used during data exchange between the Wonderware HMI software and the Sixnet using Object Linking and Embedding Process Control (OPC) client protocol. |
| Active Factory | 8.0 or newer | Query Tool for Data extraction from InSQL | Active Factory is an add-on tool for Microsoft Excel that allows users to perform simple query functions to extract the data from the InSQL database. |

#### *4.2.1.7 Flow-Control*

When constant-rate flow conditions are needed for a purging or sampling, the DAS will measure the output signal from an inline inductive flow meter and control a variable-speed pump motor to maintain a consistent flow rate throughout the testing period. The flow-rate output from the flow meter will be used as the process variable to set the control variable, specifically the speed of a variable-speed pump. The user-selected set point will be set manually at the controller or remotely via the DAS. The design control range for flow rate is variable and dependent upon the conditions encountered or anticipated.

### *4.2.2 DOWNHOLE EQUIPMENT*

Downhole equipment will be operated from the surface and may consist of bailing and swabbing equipment to remove fluid from the borehole(s), inflatable packers, a sliding-sleeve shut-in tool, pressure transducer, or submersible pump. The depths of all equipment installed in a well will be measured and documented relative to a known permanent datum, such as a survey marker established on the well pad. A secondary datum, such as the top of the well casing, may be used as a reference point for depths provided that the elevation of the secondary datum relative to that of the primary datum is known and documented. SNL will provide technical direction and assistance, as needed, to the WIPP M&O contractor in installing all downhole equipment.

#### *4.2.2.1 Bailing And Swabbing Equipment*

Bailing and swabbing equipment will be used to remove fluid as needed to sample specific intervals. The bailing and swabbing equipment will consist of artificial and/or natural rubber tubing wipers

(swab cups) or downhole bailers supplied and operated by the pump-truck contractor. If bailing or swabbing is not possible or ineffective, the fluid level in the tubing string may be lowered by means of air lifting, whereby a hose or pipe is used to inject compressed air below the water level in the tubing string at pressures and volumes sufficient to lift the fluid to land surface.

#### *4.2.2.2 Inflatable Packers*

Sampling of specific subintervals of one or more screened intervals in a well may be conducted with a production-injection packer (PIP) set above the perforations or screen associated with the formation of interest on tubing or pipe. Compressed nitrogen or compressed air will be used to inflate the packers. The packers to be used will have un-inflated diameters consistent with the diameter of the casing in each well. In addition, sampling conducted in wells that have dual completions (i.e., C-2737) will require the use of PIPs to reconfigure the wellbore in such a way as to allow the pressure to be monitored in multiple formations simultaneously within the same borehole.

#### *4.2.2.3 Pressure Sensors*

SNL employs pressure sensors to collect downhole pressure-head data during purging and sampling. For sampling, pressure data are useful to determine sustainable pumping rates and can be used to assess the nature of the well completion (e.g., confined vs. unconfined). They will typically be programmable pressure-temperature transducers with onboard memory and pressure transmitters that are directly linked to a DAS, which is programmed to collect and store the data. The installation of the pressure sensors in a well is dependent upon test type and well configuration.

The primary downhole data-acquisition instrument during purging and sampling is a programmable pressure-temperature transducer, which is programmed to collect pressure-head data throughout the testing period. Pressure transducers can also be used to monitor the pressure response in nearby well(s), if any, and to collect barometric-pressure data at the surface. The operation and maintenance of the transducers currently used by SNL is described in SP 9-7, *WIPP Well Water-Level Monitoring*.

In some cases it may prove beneficial to also use pressure transmitters (e.g., Druck PTX 1830). These pressure transmitters will be monitored with the DAS (Subsection 4.2.1.5), which will record the output signal from the sensor and convert it to the desired pressure units.

#### *4.2.2.4 Submersible Pumps*

In most cases, an electric submersible pump will be used for groundwater sampling. The pump will be installed with one or more in-line check valve(s) to ensure that water will not drain back through the pump when the pump is turned off. Pumps will be installed on a tubing string at a depth determined by the WTL/PI, typically as deep in the well as is practical. The installation depth and configuration, including pressure sensor depth, will be documented in the applicable SN.

### 4.3 Test Requirements and Procedures

The activities discussed in this TP have been designed so that the samples and supporting data collected are of the highest possible value, and are more than adequate to meet specific program objectives.

#### 4.3.1 TEST REQUIREMENTS

The testing elements of the data-collection activities require specific initial and operational conditions for maximum success. The test equipment used for the data-collection activities has to:

- provide quality data to support test objectives;
- perform according to design specifications; and
- be calibrated, as appropriate, according to standards acceptable under NP 12-1, *Control of Measuring and Test Equipment*.

#### 4.3.2 SAMPLING PROCEDURES

The following subsections discuss the different types of water-quality sampling events that may be performed in wells and geologic formations at WIPP. Each subsection also describes the general methodology for selection and execution of each type of event.

##### 4.3.2.1 General Mineral/Physical Water-Quality Sampling

All new wells and wells to be tested will be pumped to allow water samples representative of the completion formation to be collected. Some older wells not needing testing will also be pumped to provide groundwater samples. The wells will be pumped until water-quality parameters (electrical conductivity and specific gravity) are stable within approximately 5% while two wellbore volumes are pumped, or as directed by the WTL/PI. When stable conditions have been reached, water samples will be collected for laboratory analysis of major ions (Na, Mg, $SO_4$, Cl, K, Ca, and alkalinity), or other analyses as directed by the WTL/PI. Water-quality sampling will provide baseline information and allow inferences to be made regarding the origins and flow paths of the groundwater. Samples will be collected and controlled in accordance with NP 13-1, *Control of Samples and Standards*. The chain of custody for the samples when they are transferred to the analytical laboratory will be established using procedure SP 13-1, *Chain of Custody* and SP 13-3, *Field Water Quality Measurements*.

Water samples will be collected in pretreated bottles supplied by the analytical laboratory. After collection, water samples will be chilled or refrigerated until they can be delivered to the analytical laboratory, which should occur as soon as is practical. Environmental tracer samples will be collected in the fashion required for the preservation of a given tracer using sample containers provided by the analytical laboratory. Sampling protocol will be supplied by the analytical lab for a given tracer species. Specific field parameters needed to calculate the concentration for a specific tracer type, such as total dissolved gas pressure, temperature, pH and salinity, will be collected immediately prior to sample collection. Once collected, samples will be preserved in the method recommended by the analyzing laboratory and delivered to the analytical laboratory as quickly as

practical.

In the case of extremely low yielding formations (e.g., the Salado Formation or low-permeability portions of the Rustler Formation), and for assessing fracture-matrix interaction, rock core samples may collected and preserved for major ion, isotopic and environmental tracer concentration. In these cases, the sample collection technique, sample container and preservation technique will be directed by the analyzing laboratory and/or the PI in consultation with the laboratory.

#### *4.3.2.2 Modifications To Test Procedures*

Modifications to test procedures may be required during testing activities. These modifications will be conducted at the direction of the WTL/PI and will be documented in the scientific notebook as part of the QA records as well as any supporting records and reports. Such modifications are anticipated as normal operational procedures and will not be reported as nonconformances that require corrective action.

### *4.4 Data-Acquisition Plan*

Both manually and electronically collected data will be acquired during the hydraulic testing activities. The following types of data will be recorded:

- electronically collected downhole pressure data;
- electronically and/or manually collected pumping rate and volume data from wells being pumped;
- electronically collected barometric-pressure data;
- manually collected water-level data;
- manually and electronically collected water-quality data concerning the temperature, pH, specific gravity, and specific conductance of fluid produced during pumping, bailing and/or swabbing; and
- manually collected data on equipment and instrument configurations in the wells and at the surface.

#### *4.4.1 SCIENTIFIC NOTEBOOKS*

Scientific notebooks will be used in accordance with NP 20-2, *Scientific Notebooks* to document all activities and decisions made during the hydraulic-testing activities. Specific information to be recorded in the scientific notebooks includes:

- a statement of the objectives and description of work to be performed at each well, as well as a reference to this TP;
- a list, with sample signatures and initials, of all personnel authorized to enter information into the SN;
- a written account of all activities associated with each well;

- a list of all equipment used at each well, including make, model, and operating system (if applicable);
- a description of standards used for on-site instrument calibration and calibration results;
- traceable references to calibration information for instruments calibrated elsewhere;
- a sketch, showing all dimensions, of each downhole equipment configuration;
- tubing tallies and other equipment measurements;
- manually collected water-level measurements;
- manually collected water-quality data concerning the specific conductance, specific gravity, pH, and temperature of fluid produced during pumping, bailing and/or swabbing;
- entries providing the names, starting times, and completion times of all data files created with the DAS software or WinSitu, as well as tables showing the configuration information (pressure transmitter serial number, calibration coefficients, etc.) entered into the DAS to initiate each data file; and
- discussion of the information and/or observations leading to decisions to initiate, terminate, or modify activities.

All entries in the scientific notebooks will be signed or initialed and dated by the person making the entry. Continuous blocks of entries by the same individual do not all need to be initialed and dated, but the first entry on every page must always be initialed and dated. Technical and QA reviews of the applicable scientific notebook entries will be completed as required by NP 20-2, *Scientific Notebooks* or at an increased frequency as directed by the WTL/PI. When scientific notebooks are completed, the closeout process specified in NP 20-2, *Scientific Notebooks* will be followed. This process will include final PI, technical, and QA reviews. Technical reviews must be completed by an independent, technically qualified individual within three months of the completion of the scientific notebook to verify that sufficient detail has been recorded to retrace the activities and confirm the results.

Manually collected water-quality data and water-level measurements may also be recorded on specially prepared forms rather than in the scientific notebooks when that would provide a more efficient means of data collection and tracking. Any such forms will be placed in a Scientific Notebook Supplement (SNS) identified in the scientific notebook, and submitted as QA records.

### *4.4.2 ELECTRONIC DATA ACQUISITION*

Pressure sensors (Subsection 4.2.2.3) will be used for monitoring and testing activities. The DAS described in Subsection 4.2.1.5 will be used at locations where pumping tests are performed. Electronic data file-management systems will be documented in the scientific notebooks for these activities. These electronic data files will be submitted as QA records according to NP 17-1, *Records*.

### *4.4.3 MANUAL DATA ACQUISITION*

Manual data collection will be carried out using either scientific notebooks or forms designed

specifically for each activity or data type. To minimize transcription errors and multiple documentation of the same information, the use of forms specified in the WIPP procedures is not mandatory. The WTL/PI will determine the means of documenting manually acquired data and will ensure that all quality-affecting information is documented.

#### *4.4.4 ON-SITE DATA VALIDATION*

During the field activities, the WTL/PI will evaluate the data as they are acquired. The data will be diagnosed for any tool failure and/or procedure-induced effect that may affect the data quality. The WTL/PI will take immediate action (if required) to make any necessary changes to the equipment configuration or the procedures to assure the data quality is consistent with the objectives of these activities. Data associated with these testing activities provided by entities other than SNL will be checked for accuracy and adequacy by the WTL/PI and documented in the scientific notebook as such. Any deficiencies will be noted. This on-site real-time data evaluation will be documented in the scientific notebook.

The WTL/PI will use real-time evaluation of the acquired data during any given activity to assure that the data are usable in a detailed interpretation, the conditions can be maintained over the planned duration of the activity, and that an activity will not be terminated before the minimum objectives can be achieved under the given time constraints. The WTL/PI may utilize some or all of the following procedures and analytical tools:

- To assure that the acquired data satisfy program plans, the WTL/PI may use the same interpretation techniques during the data-validation process as will be used in later interpretation of these data.
- The WTL/PI may use specialized plots to interpret the formation response and to identify the time domain of that response, such as the wellbore storage, transition, stabilization, or other response phase.
- The WTL/PI may use real-time analysis of the acquired data to determine the time when continuing the activity will provide no further improvement in the interpreted results within the program's time and budget constraints.
- The WTL/PI may use real-time analysis to determine whether an activity can be terminated earlier than planned, and to develop a revised schedule as appropriate.

If at any time the WTL/PI determines that an activity objective cannot be accomplished due to time constraints, problems concerning the performance of the equipment, or unsuitability of initial conditions, the WTL/PI may terminate the activity. The WTL/PI will document all real-time evaluation of data in the scientific notebook.

### *4.5 Quality Assurance*

#### *4.5.1 HIERARCHY OF DOCUMENTS*

Several types of documents will be used to control work performed under this TP. If inconsistencies or conflicts exist among the requirements specified in these documents, the following hierarchy (in

decreasing order of authority) shall apply:

- memoranda or other written instructions used to modify or clarify the requirements of the TP (most recent instructions having precedence over previous instructions),
- this TP,
- NPs, and
- SPs.

SNL QA concurrence will be obtained and/or corrective action requests will be written for modifications to QA procedures implemented for work conducted under this TP.

### 4.5.2 QUALITY-AFFECTING ACTIVITIES

Activities performed under this TP are quality-affecting with the following exceptions:

- water-quality measurements, not including specific gravity (see Subsection 4.2.1.1);
- operation of generators (see Subsection 4.2.1.3);
- assistance provided by the manufacturer/contractor in the installation of tools and equipment;
- support services for tasks that do not involve data collection, such as pump trucks, machining, welding, fishing services, fuel, etc.; and
- water storage and disposal.

Activities that are not quality-affecting are not subject to the requirements of the SNL QA program.

### 4.5.3 QUALITY ASSURANCE PROGRAM DOCUMENT

SNL activities are conducted in accordance with the requirements specified in the Quality Assurance Program Document (QAPD) (U.S. DOE, 2010), or subsequent revisions of this document. The requirements and guidance specified in the QAPD are based on criteria contained in American Society of Mechanical Engineers (ASME) (1989a), ASME (1989b), ASME (1989c), or U.S. EPA (1993). The requirements of U.S. DOE (2005) are passed down and implemented through the SNL WIPP QA procedures.

### 4.5.4 DATA INTEGRITY

Care will be taken throughout the performance of the operations for this TP to ensure the integrity of all data collected including documentation on hard copy and data recorded on electronic media. Data collected shall not be released unless and until the data are reviewed and approved by the WTL/PI.

### 4.5.5 RECORDS

Records shall be maintained as described in this TP and applicable QA implementing procedures. These records may consist of bound scientific notebooks, loose-leaf pages, forms, printouts, or information stored on electronic media. The WTL/PI will ensure that the required records are

maintained and are submitted to the SNL WIPP Records Center according to NP 17-1.

#### *4.5.5.1 Required QA Records*

As a minimum, QA records will include:

- scientific notebooks;
- NPs and SPs used;
- calibration records for all controlled equipment;
- equipment-specification sheets or information;
- all forms containing manually collected data;
- a log of all samples collected;
- copies of all permits obtained; and
- reports (e.g., gamma and perforation logs) provided by contractors.

#### *4.5.5.2 Miscellaneous Non-QA Records*

Additional records that are useful in documenting the history of the activities but are considered non-QA records may be maintained and submitted to the SNL WIPP Records Center. These records include:

- safety briefings
- photographs,
- data files collected by pressure transducers and/or the DAS, with a log listing the files and defining their contents;
- as-built diagrams of equipment supplied by contractors,
- pump-truck and other equipment certifications,
- totalizing flow meter data,
- equipment manuals and specifications,
- information related to operation of generators,
- equipment manifests, and
- cost and billing information regarding contracted services.

These records do not support performance assessment or regulatory compliance and, therefore, are not quality-affecting information.

#### *4.5.5.3 Submittal of Records*

Records resulting from work conducted under this TP, including forms and data stored on electronic media, will not be submitted to the SNL QA staff for review and approval individually. Instead, the

records will be assembled into a records package or packages, which will be reviewed by the WTL/PI before being submitted for QA review.

## 5. TRAINING

All SNL and WIPP-Site contractor personnel are required to take and pass WIPP General Employee Training (GET) followed by annual refreshers to work at the WIPP Site. All personnel that perform work on US DOE WIPP-related property must read and acknowledge receipt of the WIPP Site User's Guide (WTS, 2006). All personnel who will perform quality-affecting activities under this TP must have training in the SNL QA program (Form NP 2-1-1), must view the current QA training, and must read NP 12-1, NP 13-1, NP 20-2, and SP 13-1. They must also read the procedures outlined in this TP, the Primary Hazard Screening (PHS), and all applicable NPs and SPs, but no additional training in those procedures is required. No other special training requirements are anticipated in addition to the GET and the safety briefings described in Section 6.

Existing procedures implemented in the field cannot be expected to anticipate every possible event affecting the tests. Therefore, the WTL/PI is expected to implement appropriate measures during the conduct of the tests. These technical decisions will be documented in the scientific notebook.

## 6. HEALTH AND SAFETY

SNL field operations will be conducted on land controlled by the WIPP M&O contractor and the field operations team assembled for this TP will follow all M&O safety practices and policies. Operational safety for individual field operations will be addressed through an ES&H PHS (SNL2A00137-001) and a Job Safety Analysis (JSA) developed by SNL approved through the WTL/PI. If the work is within the secure area of the Managing and Operating Contractor (MOC) at WIPP, the JSA and other safety documents must be reviewed and approved by the MOC. All activities will be performed in accordance with the requirements of WP12 FP.01, WP12 IS.01, and WP12 IH.02.

All equipment will be operated in accordance with the appropriate allowable operating pressures and in accordance with the SNL ES&H pressure-safety manual. Pressure ratings for individual parts such as valves and pressure tubing will be either marked by the manufacturer with the maximum allowable operating pressure or such information will be made available in written documentation according to guidelines of the SNL Center 6700 ES&H Coordinator.

Additional and specific safety concerns and requirements to be observed by field personnel will be addressed and documented in the daily safety briefing conducted prior to any field activities. Some of these issues include:

- appropriate use of safety shoes, safety glasses, chemical goggles, hard hats, and protective gloves;
- ensuring adequate fuel is available for all field vehicles, especially those traveling to remote locations;
- proper installation and safety procedures when handling electrical submersible pumps and other electrical equipment;

- proper procedures for operation of diesel- and gas-powered generators for on-site electric power;
- proper procedures for inflation of downhole packers;
- familiarity with on- and off-site road conditions and driving regulations;
- familiarity with the locations of first-aid supplies, medical support facilities, and fire extinguishers and other safety equipment;
- familiarity with the location of lists of emergency telephone numbers and persons and offices to notify in the event of emergencies; and
- familiarity with the location of Material Safety Data Sheets.

All field personnel assigned to the field operations described in this TP will receive a safety briefing before the beginning of field operations at each well site. All work locations will maintain a mobile communication system. In case of accident, injury, or sudden illness, the WIPP Central Monitoring Room (CMR) will be notified immediately. The CMR will coordinate emergency response activities.

## 7. PERMITTING AND LICENSING

Permitting and licensing requirements are discussed in Subsection 8.3.

## 8. ROLES AND RESPONSIBILITIES

The work described in this TP will involve purging and sometimes reconditioning existing wells, to ensure representative samples are collected. Throughout this multiyear field program, wells will be purged and sampled, water levels monitored, and well water chemistry will be observed. SNL intends to collaborate with the M&O contractor and/or its corporate affiliates to ensure integration of program efforts, to see that this work is done in accordance with all applicable technical and regulatory standards, and that data generated are fully qualified under SNL's WIPP QA program for use in assessing the long-term performance of the repository.

### *8.1 SNL Responsibilities*

SNL's responsibilities are:

- Identify which monitoring wells will need to be reconditioned and work with the M&O contractor to identify by what means those wells will be made ready for scientific endeavor.
- Identify which wells will need to be sampled and identify the types of pumping or purging required for sampling.
- Provide water-level and water-chemistry monitoring equipment, when appropriate, for placement in new (replacement) and/or reconditioned wells.
- Provide all equipment, both downhole and surface, necessary to perform sampling in new and reconditioned wells.
- Monitor water levels and water chemistry in wells of interest to SNL, or have levels and chemistry monitored.

- Perform all purging and sampling in wells in collaboration with the site M&O contractor (Subsection 8.2).
- Analyze and interpret hydrological monitoring data and laboratory result of sampling acquired.
- Identify locations of new wells to be drilled and develop the technical specifications for the drilling activity.
- Process and handle core samples collected during the drilling program.

### *8.2 Site M&O Contractor Responsibilities*

The WIPP M&O contractor will assume the following responsibilities in support of the activities discussed in this TP:

- Recondition (or have reconditioned) any existing wells to be tested.
- For wells to be pumped, purged, and sampled, provide (or have provided) the requisite capabilities, including (but not limited to) pump-setting trucks or pulling rigs and crews to install hydraulic testing equipment, "kill" trucks to inflate packers (when required), and appropriately licensed, authorized, and experienced electrician(s) to wire and hook up pumps (as needed).
- Provide necessary oversight personnel at well sites to allow SNL to conduct well-testing operations on a 24-hr/day, 7-day/week basis, as needed. In turn, SNL will provide to the site M&O contractor as much advance notice as possible of the need for specific operations outside normal daytime work hours.
- Dispose of any waste water or other waste materials generated during sampling and well reconditioning operations in accordance with all applicable environmental and regulatory standards (including chemical analysis of produced waste water, as appropriate).
- Facilitate compliance with the applicable WIPP Site environment, health, safety, and security requirements as they relate to program activities.
- Participate in water-level and water-chemistry monitoring and data gathering to the degree that SNL and the site M&O contractor jointly determine is needed.

### *8.3 Responsibility for Permitting and Licensing*

The WIPP M&O contractor is responsible for ensuring that WIPP-Site activities are conducted in accordance with applicable federal, state, and local regulatory requirements. The M&O contractor is responsible for all permitting and licensing requirements associated with drilling, coring, logging, reconditioning, testing, and waste disposal necessary to complete the activities outlined within this test plan. SNL will abide by all of the permitting and licensing rules and regulatory requirements as indicated by the site M&O contractor. SNL is responsible for ensuring that all contracted experimental work performed by SNL contractors at the WIPP Site meets all applicable federal, state, and local regulatory requirements.

## 9. REFERENCES

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