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**Sandia National Laboratories**  
Waste Isolation Pilot Plant

**Test Plan TP 06-01**

**Monitoring Water Levels in WIPP Wells**

**Task 1.4.2.3**

Rev. 1

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Michael B. Hillesheim  
Repository Performance Department 6712  
Sandia National Laboratories  
Carlsbad, NM 88220

## APPROVALS

Author:	<u>Original signed by Michael B. Hillesheim</u> M. B. Hillesheim, Monitoring Team Lead Repository Performance Department 6712	<u>3-15-07</u> Date
Technical Reviewer:	<u>Original signed by Richard L. Beauheim</u> R. L. Beauheim Repository Performance Department 6712	<u>3-20-07</u> Date
SNL QA:	<u>Original signed by Shelly R. Johnsen</u> S.R. Johnsen Carlsbad Programs Group 6710	<u>3-15-07</u> Date
SNL ES&H :	<u>Original signed by Ronald T. Parsons</u> R. T. Parsons ES&H Officer, Carlsbad Programs Group 6710	<u>3-21-07</u> Date
SNL Management:	<u>Original signed by Mark Rigali</u> M. J. Rigali, Manager Repository Performance Department 6712	<u>3/21/2007</u> Date

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## 1 ABBREVIATIONS, ACRONYMS, AND INITIALISMS

CCA	Compliance Certification Application
CMP	(SNL WIPP) Compliance Monitoring Program
CMR	Central Monitoring Room
DOE	(U.S.) Department of Energy
DTW	Depth-To-Water
EPA	(U.S.) Environmental Protection Agency
ES&H	Environmental Safety and Health
FY	Fiscal Year
GET	General Employee Training
GWMP	Groundwater Monitoring Program
HA	Hazard Analysis
JHA	Job Hazard Analysis
LTM	Long-Term Monitoring
MOC	Management and Operating Contractor
MTL	Monitoring Team Lead
MT&E	Monitoring and Test Equipment
NP	(SNL WIPP) Nuclear Waste Management (QA) Procedure
PHS	Primary Hazard Screening
PI	Principal Investigator
P-T	Pressure-Temperature
QA	Quality Assurance
QAPD	Quality Assurance Program Document
SA	Scientific Advisor
SNL	Sandia National Laboratories
SRN	SNL Restricted Network
SP	(SNL WIPP) Activity/Project Specific Procedure
TP	(SNL WIPP) Test Plan
WRES	Washington Regulatory and Environmental Services
WIPP	(U.S. DOE) Waste Isolation Pilot Plant
WTL	Well Test Lead

## 2 REVISION HISTORY

The following is the first revision of this Test Plan (TP). The purpose and content of any future changes and/or revisions to the previous version of the document will be described and appear in this section of revised editions. Changes to this TP, other than those defined as editorial changes per SNL WIPP Quality Assurance (QA) procedure NP 20-1 “Test Plans”, shall be reviewed and approved by the same organization that performed the original review and approval. All TP revisions will have at least the same distribution as the original document.

Changes to this document include:

- Revision of the Training Requirements;
- Revision of the Data Validation process; and
- Modification of the review process for Scientific Notebooks

### 3 PURPOSE AND SCOPE

The activities described in this TP constitute one component of the Sandia National Laboratories (SNL) program to evaluate monitoring data collected at the Waste Isolation Pilot Plant (WIPP) site to demonstrate compliance with U.S. Environmental Protection Agency regulations (EPA 1993, 1996). The overall SNL Compliance Monitoring Program (CMP) is discussed below, followed by a summary of the objectives of this TP.

#### 3.1 SNL Compliance Monitoring Program

The WIPP is a U.S. Department of Energy (DOE) facility designed for the safe disposal of transuranic waste resulting from U.S. defense programs. The WIPP repository is excavated in bedded halite of the Salado Formation, approximately 2150 ft below land surface. At the center of the WIPP Site, the Salado is ~2000 ft thick and is overlain by the ~310-ft-thick Rustler Formation, the 500-ft-thick Dewey Lake Formation, and ~50 ft of surficial sedimentary and eolian deposits (Figure 3.1). Groundwater is found principally in three horizons above the Salado: the Culebra and Magenta Members of the Rustler and the Dewey Lake Redbeds (over the southern portion of the WIPP Site only).

In the WIPP Compliance Certification Application (CCA; U.S. DOE, 1996), the DOE made commitments to conduct a number of monitoring activities to comply with U.S. EPA (1996) and to insure that important deviations from the expected long-term performance of the repository are identified at the earliest possible time. Collection and reporting of the data from the WIPP monitoring programs are the responsibility of the WIPP Management and Operating Contractor (MOC), Washington Regulatory and Environmental Services (WRES). WRES collects data under five monitoring programs: the Geotechnical Monitoring Program, the Groundwater Monitoring Program (GWMP), the Delaware Basin Drilling Monitoring Program, the Subsidence Monitoring Program, and the WIPP Waste Information System. SNL, as the Scientific Advisor (SA) to the DOE for the WIPP project, established the CMP to evaluate the collected monitoring data against performance expectations for the disposal system.

Appendix GWMP of the CCA (U.S. DOE, 1996) commits the DOE to monitor groundwater levels in the Culebra and Magenta as well as the Dewey Lake. This monitoring is performed by WRES, which collects monthly depth-to-water (DTW) measurements from the wells that constitute the WIPP groundwater monitoring network. The groundwater monitoring network currently consists of approximately 85 wells located within and around the WIPP land-use boundary (Figures 3.2 and 3.3). The wells are typically configured to monitor one particular hydrologic unit, though there are some dual-completion wells. The wells are completed to the water-bearing horizons listed above, as well as other units of interest. The majority of wells, however, are completed to either the Culebra or Magenta (or both). New wells are being added to the network yearly while older wells are being plugged and abandoned. It is expected, however, that the total number of wells will remain relatively constant into the foreseeable future.

Information gathered from the wells is input into compliance models used in the assessment of the hydrologic system in which the WIPP is situated. Some of the data for modeling come from well tests, which provide information about hydraulic parameters [e.g., flow dimension (n), storativity (S), and transmissivity (T)], transient head responses from

observation wells during multipad pumping tests, direct measurements of the rates and directions of groundwater flow through wells, and water-quality analyses. Other data are generated by the long-term water-level monitoring activities conducted by the WRES GWMP.

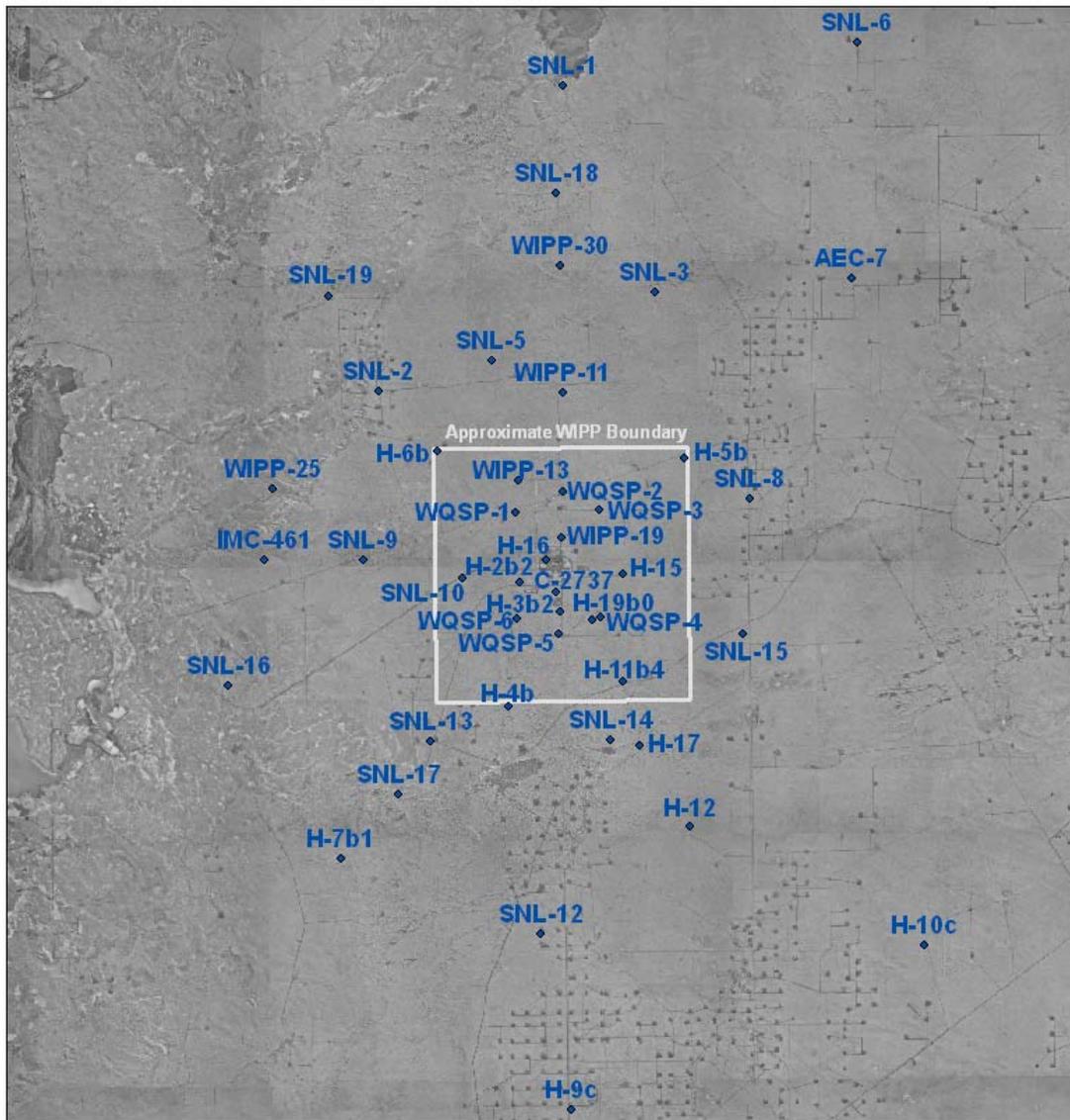
### **3.2 Purpose and Scope**

The purpose of this TP, as a component of the SNL WIPP CMP, is to outline the general strategies that will provide more detailed data, both temporally and spatially, to complement information collected by the WRES GWMP. The monthly DTW measurements collected for the GWMP provide information about long-term water-level trends; however, the temporal spacing of these DTW measurements does not allow for the study of transient/short-term variations in water level. Therefore, more detailed information is desired. To this end, SNL has installed a number of pressure-temperature (P-T) gauges into WIPP wells. The gauge is capable of recording changes in pressure head and temperature at intervals ranging from seconds to days on a continuous basis over long periods of time. By collecting high frequency, continuous pressure-head data in a specific well, or set of wells, a better understanding of the hydrologic processes that contribute to water-level fluctuations observed in WIPP wells will be achieved. This additional information will, in turn, allow SNL to better constrain estimates of T and freshwater head (h) used in compliance modeling of the WIPP.

SYSTEM/ Series		Group	Formation	Members
QUATERNARY	Holocene	Dockum	surficial deposits	
	Pleistocene		Mescalero caliche	
	Pliocene		Gatuña	
	Miocene			
TRIASSIC				
			Dewey Lake	
PERMIAN	Ochoan	Dockum	Rustler	<i>Forty-niner</i> <i>Magenta Dolomite</i> <i>Tamarisk</i> <i>Culebra Dolomite</i> <i>Los Medaños</i>
			Salado	<i>upper</i> <i>Vaca Triste Sandstone</i> <i>McNutt potash zone</i> <i>lower</i>
			Castile	
	Guadalupian	Delaware Mountain	Bell Canyon	
			Cherry Canyon	
Brushy Canyon				

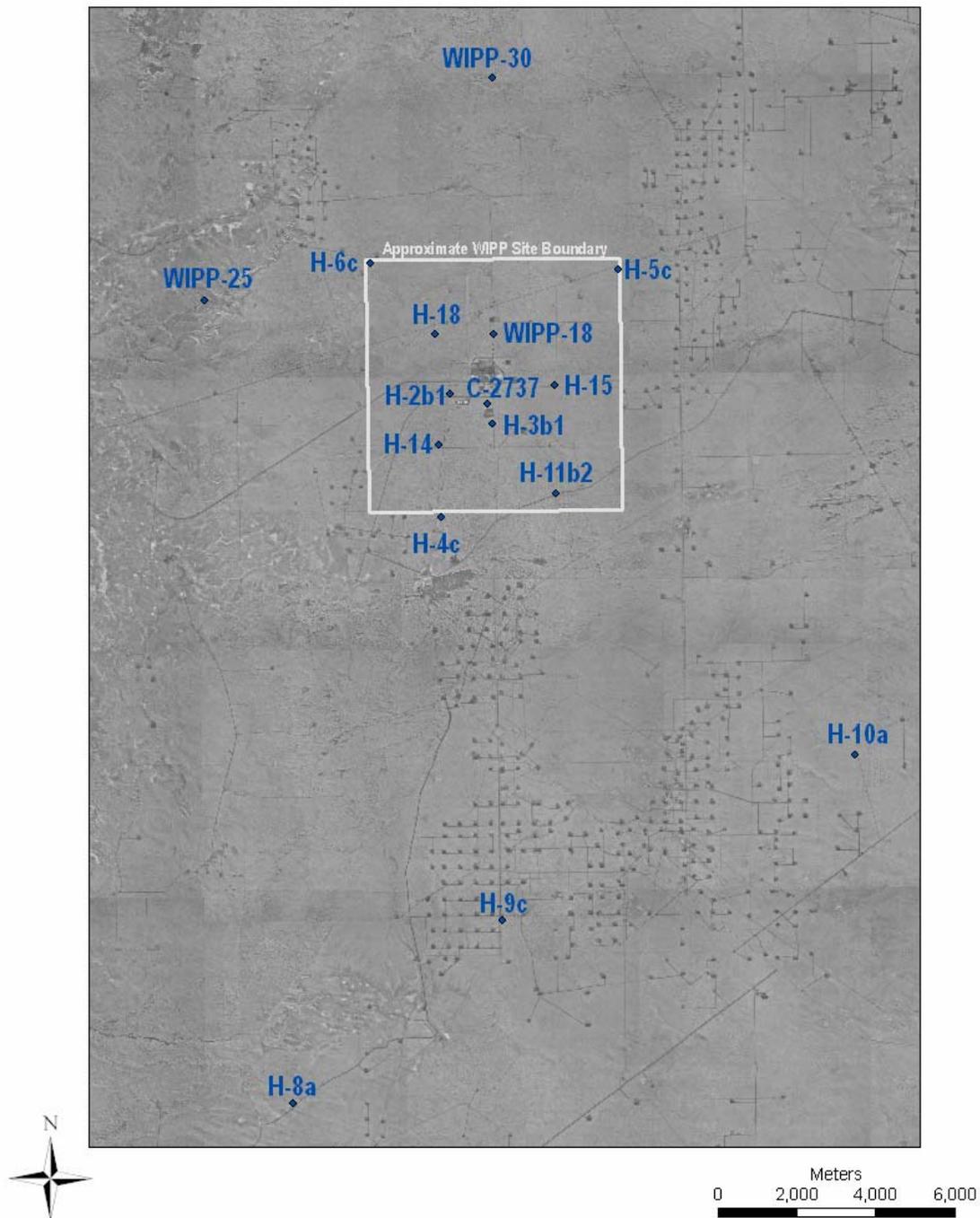
**Figure 3-1** Diagram of the general stratigraphy of the WIPP Site.

## EXPECTED WIPP CULEBRA WELL NETWORK - JUNE 2006



**Figure 3-2** Map showing the locations of current and proposed WIPP groundwater monitoring wells completed to the Culebra Member of the Rustler Formation.

## MAGENTA WELL NETWORK (CURRENT)



**Figure 3-3** Map showing the locations of current and proposed WIPP groundwater monitoring wells completed to the Magenta Member of the Rustler Formation. Wells H-9c, C-2737, H-15, WIPP-25, and WIPP-30 are dual (Culebra-Magenta) completion.

## **4 EXPERIMENTAL PROCESS RATIONALE AND DESCRIPTION**

### **4.1 Overall Strategy**

The overall strategy of the activities outlined in this TP can be defined by a series of objectives. The first objective is to collect high-quality water-level data that are relevant to the task at hand (e.g., well testing). The second objective is to collect continuous data sets that capture both short- and long-term changes in water level on various spatial and temporal scales. The third objective is to have a dynamic monitoring system in order to meet the needs of the SNL monitoring and testing programs as they change. Ultimately, these objectives will allow SNL WIPP personnel to better understand the causal mechanisms of water-level fluctuations observed around the WIPP Site.

The overall SNL WIPP CMP strategy for water-level monitoring in WIPP wells is defined by the Sandia Principal Investigator (PI). Either the PI or the SNL Monitoring Team Lead (MTL), designated by the PI, may make decisions about monitoring equipment placement, test parameters and duration, and deviations from the activities outlined in this TP.

### **4.2 Strategy Implementation**

The wells monitored under this TP include both existing and new WIPP wells to be drilled in Fiscal Year 2006 and later years. Monitoring will focus primarily on the Culebra and Magenta Members of the Rustler Formation. In the future, however, wells may be completed to other water-bearing units (e.g., Dewey Lake or Santa Rosa Formations) deemed appropriate for monitoring.

Well activities fall under two general categories: well testing and long-term monitoring (LTM). SNL WIPP monitoring activities are controlled by the MTL/PI. Monitoring of a particular well begins when a P-T gauge is placed in a well and ends when it is removed. Well testing begins when the test equipment (e.g., pump) is installed and ends when the equipment is removed; this includes any reconfiguration activities needed for the well test to work properly. During a well test, the well is under the control of the PI or Well Test Lead (WTL). After a well test is completed, monitoring typically resumes and control of the well reverts back to the MTL/PI.

SNL WIPP LTM activities are described in the next section of this TP. SNL WIPP well testing activities are described and governed by TP 03-01 "Test Plan for Testing of Wells at the WIPP Site" and TP 00-03 "Compliance Monitoring Program: Recompletion and Testing of Wells for the Evaluation of Monitoring Data from the Magenta Member of the Rustler Formation at the WIPP Site".

#### **4.2.1 Monitoring Activities**

The initiation of monitoring activities in a particular well is controlled by a number of factors that fall into two general categories: planned/unplanned human-induced stresses (e.g., pumping or slug tests) or some other, unknown or natural mechanism (e.g., recharge). Examples of factors that may initiate monitoring include, but are not limited to:

- Well testing (see TP 03-01, Section 4.3.2 for description), especially a multipad pumping test, which requires the monitoring of observation wells located at distances of up to several miles from the well that is being pumped; **Note:** During a multipad pumping test, the well being pumped is controlled by the WTL/PI, while observation wells are still under the jurisdiction of the MTL/PI; therefore, it is important that the WTL/PI and MTL/PI communicate with regards to monitoring equipment placement and frequency of data collection/download in order to assure the highest-quality data for analysis;
- review of WRES GWMP monthly DTW measurements, which may indicate a significant change in water level in a well or wells that cannot be readily explained by known well activities;
- analysis of oil and gas industry activities with regards to impact on groundwater levels in the WIPP vicinity; and/or
- a request for monitoring to be conducted in a particular well or set of wells by the customer or stakeholder.

Wells that are to be monitored are determined by the SNL MTL/PI. All quality-affecting information about activities associated with monitoring will be documented in the LTM-Scientific Notebook (SN). At the direction of the MTL/PI, monitoring equipment will be placed in wells deemed important for the task at hand. Due to budget and time constraints, not all WIPP wells will be instrumented by SNL at any given time. SNL will, however, strive to monitor as many wells as possible in response to the needs of both the SNL WIPP well monitoring and testing programs.

In addition to pressure-head monitoring, SNL will monitor atmospheric barometric pressure and temperature using a P-T gauge. At least one barometric-pressure gauge must be operating at all times at the SNL Port-a-Camp located near the WIPP facility. The barometric-pressure data collected by the gauge(s) will be used to compensate pressure-head data for barometric-induced fluctuations.

### **4.3 Monitoring Requirements and Procedures**

The activities described in this TP are designed so that the data collected are of the highest quality and are more than adequate to meet specific programmatic objectives.

#### **4.3.1 Monitoring and Test Equipment**

Monitoring and Test Equipment (M&TE) include an electric water-level sounder and programmable P-T memory gauges, and are governed by NP 12-1, "Control of Measuring and Test Equipment". The operation, maintenance, and field check of the electric water-level sounder, currently used by SNL are described in SP 12-5, "Depth-to-Water Measurement using a Solinst Brand Electric Sounder". The installation, operation, and maintenance instructions, as well as the calibration requirements, for the programmable P-T gauges currently used by SNL are outlined in SP 9-7, "WIPP Well Water-Level Monitoring".

### **4.3.2 Monitoring Requirements**

Data-collection activities described in this TP require specific initial and operational conditions for maximum success. The test equipment used for data collection must:

- provide quality data to support the monitoring objectives;
- perform according to design specifications; and
- be calibrated, as appropriate, according to NP 12-1.

### **4.3.3 Monitoring Procedures**

SNL WIPP LTM activities consist of the placement of P-T gauges at depth in wells coupled with DTW measurements, as well as installing P-T gauges to collect barometric-pressure data. In general, P-T gauges will be programmed to record data on a set time interval (e.g., hourly) ignoring intermediate readings (e.g., every 5 minutes) unless the trigger value for pressure (e.g., 0.1 psi) is exceeded. Gauges used to measure barometric pressure will be programmed to take and record a reading at least every 15 minutes, regardless of the amount of pressure change. Data files will be downloaded from the data logger memory on an approximately monthly basis in conjunction with a DTW measurement, as part of the Monthly Monitoring Run (MMR). These data, as well as those collected by the WRES GWMP, will be evaluated by the MTL/PI prior to the next MMR in order to ensure that the objectives of this TP are being met.

SNL WIPP Activity/Project Specific Procedure (SP) 9-7 “WIPP Well Water-Level Monitoring” describes, in detail, the procedures for water-level monitoring in WIPP wells. It also provides specific procedures for P-T gauge installation, test setup and termination, maintenance, and data downloads. SP 12-5 “Depth-to-Water Measurement Using a Solinst Brand Electric Sounder” provides detailed description of how to take a DTW measurement.

Modifications to monitoring procedures may be necessary during LTM activities. These modifications must be conducted at the direction of the MTL/PI or the WTL/PI and must be documented in the SN as part of the QA records. Such modifications are anticipated as normal operational procedures and will not be reported as nonconformances that require corrective action.

### **4.3.4 Data-Collection Plan**

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

- electronically collected downhole pressure data;
- electronically collected barometric-pressure data;

- electronically collected photographs of well head configuration and tools used in well configuration (i.e., bridge plugs, packers, PIPs, etc.);
- manually collected DTW measurements; and
- manually collected information on equipment and instrument configurations in the well and at the surface.

#### 4.3.4.1 Scientific Notebooks

Scientific Notebooks will be used in accordance with NP 20-2 “Scientific Notebooks” to document all activities and decisions made during LTM activities. Scientific Notebooks associated with this TP will contain the words “Long-Term Monitoring” in the title in order to differentiate them from other field Scientific Notebooks. Specific information to be recorded into the scientific notebooks includes:

- a statement of the objectives and description of the 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/serial number, and software (if applicable);
- a sketch, showing all dimensions, of tools used in well maintenance/reconfiguration;
- tubing tallies and other equipment measurements;
- manually collected DTW measurements;
- entries providing the file names, start time, and completion times of all data files; and
- discussion of the information and/or observations leading to decisions to initiate, terminate, or modify activities.

All entries in the SN 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. A monthly MTL/PI review of the SN will be conducted, while technical and QA reviews will be done every six months. When a SN is completed, the closeout process specified in the NP 20-2 “Scientific Notebooks” will be followed. This process will include final MTL/PI, technical and QA reviews. Technical reviews must be completed by an independent, technically qualified individual within three months of the

completion of the SN to verify sufficient detail has been recorded to retrace the activities and confirm results.

Manually collected water-level information may also be recorded on specially prepared forms (see SP 9-7) rather than directly into the SN when that would provide a more efficient means of data collection and tracking. Any such forms must be inserted (i.e., pasted) into the SN as they are completed.

#### 4.3.4.2 Electronic Data Acquisition

P-T memory gauges will be used for monitoring activities. Electronic data files generated by the gauges will be documented in the SN.

#### 4.3.4.3 Manual Data Acquisition

Manual data collection will be carried out using a SN. The use of forms specified in the SNL WIPP procedures is not mandatory. The MTL/PI will determine the best means of documenting manually acquired data and will ensure that all quality-affecting information is documented.

#### 4.3.4.4 Data Validation

The MTL/PI will evaluate the data prior to the next MMR, and document the results in the SN. The evaluation is done to ensure that the data are usable for interpretation, conditions can be maintained over the planned duration of the activity, and that monitoring will not be terminated before the minimum objectives for the task at hand are achieved under the given time constraints. In addition, the data will be analyzed for quality-affecting errors due to equipment failure. Data found to be of poor quality (i.e., erroneous data) will be denoted in an appropriate manner. The MTL/PI will take action (if required) to make any necessary changes to the equipment or the procedures to assure the data quality is consistent with the objectives outlined in the TP. If at any time the MTL/PI determines that an objective cannot be accomplished due to time constraints or problems concerning the performance of the equipment, the MTL/PI may terminate the activity.

### 4.4 Quality Assurance

#### 4.4.1 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 the documents, the following hierarchy (in decreasing order of authority) shall apply.

- memoranda or written instructions used to modify or clarify requirements of the TP (most recent instructions having precedence over previous instructions);
- this TP;

- SPs (i.e., SP 12-5 and SP 9-7); and
- NPs

SNL QA concurrence will be obtained and document control forms will be completed for modifications to QA procedures implemented for work conducted under this TP.

#### **4.4.2 Quality Assurance Program Description**

SNL activities are conducted in accordance with the requirements specified in the Quality Assurance Program Document (QAPD; U.S. DOE, 2006), 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), and U.S. EPA (1993). The requirements of U.S. DOE (2005) are passed down and implemented through the SNL WIPP QA procedures.

#### **4.4.3 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 collected on electronic media. Scientific Notebooks will be handled as prescribed in NP 20-2. Electronic data files collected with the gauges will be uploaded on the SNL WIPP Hydrology Group's server and placed in the appropriate directory/folder. This information, in turn, will be backed-up onto a directory, located on the SNL Restricted Network (SRN) server. Data collected shall not be released unless and until the data are reviewed and approved by the MTL/PI.

#### **4.4.4 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 MTL/PI will ensure that the required records are maintained and are submitted to the SNL WIPP Records Center according to NP 17-1, "Records".

##### **4.4.4.1 Required QA Records**

At a minimum, QA records will include:

- Scientific Notebooks;
- NPs and SPs used;
- calibration records for controlled equipment and/or equipment specification or information sheets supplied by the manufacturer; and

#### 4.4.4.2 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:

- electronic data files collected by the P-T memory gauges.
- equipment manuals and specifications; and
- photographs taken of the well heads, equipment, and activities with descriptions.

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

#### 4.4.4.3 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 MTL/PI before being submitted for QA review.

## 5 HEALTH AND SAFETY

The activities described in this TP shall conform to SNL Environmental Safety and Health (ES&H) programs. For detailed, site-specific ES&H information, refer to Carlsbad Programs Group (CPG) Hydrologic Monitoring Activities Standard Operating Procedure (SOP). This document also links to the Primary Hazard Screening (PHS) and Hazard Analysis (HA) documents developed by SNL. Because the SNL monitoring operations described in this TP are conducted on WIPP-controlled land, all activities described in this TP are also subject to ES&H requirements governed by the WIPP Industrial Safety Program and the WIPP Industrial Hygiene Program.

Additional and specific safety issues include:

- activities described in this TP performed in conjunction with other work such as well testing or maintenance using a work-over rig must be coordinated with the equipment supervisors in order to determine the appropriate personal protective equipment (PPE) needed and if any other specific safety procedures are required;
- following the appropriate SPs and equipment users manuals for well testing and monitoring equipment;
- ensuring adequate fuel is available for all field vehicles, especially those traveling to remote locations;
- familiarity with on- and off-site road conditions and driving regulations;
- awareness of biting/stinging insects that may reside in the well heads;
- familiarity with the locations of first-aid supplies, medical support facilities, and fire extinguishers and other safety equipment; and
- familiarity with the location of lists of emergency telephone numbers and persons and offices to notify in the event of emergencies.

All field personnel assigned to the operations described in this TP are required to be up-to-date with the safety procedures listed above. 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.

## 6 TRAINING

All personnel involved in the monitoring activities will be trained and qualified to their assigned work following NP 2-1. In addition, personnel should read the Hydrologic Monitoring Activities ES&H SOP (CPG-HYD-SOP-01). As required by WIPP, any personnel working in the WIPP vicinity (i.e., within the Land Withdrawal Boundary) should either have an up-to-date WIPP General Employee Training (GET) or be with someone who does.

### Applicable Documents

NPs: 12-1, 13-1, 20-2

SPs: 9-7, 12-5, 13-1

## **7 PERMITTING AND LICENSING**

WRES is responsible for ensuring that WIPP-Site activities are conducted in accordance with applicable federal, state, and local regulatory requirements. WRES is responsible for all permitting and licensing requirements associated with activities outlined in this TP. SNL will abide by all permitting and licensing rules and regulatory requirements as indicated by WRES. SNL is responsible for ensuring that all contracted experimental work performed for SNL at the WIPP Site meets all applicable federal, state, and local regulatory requirements.

## 8 REFERENCES

- ASME. 1989a. *Quality Assurance Program Requirements for Nuclear Facilities*. ASME NQA-1-1989 Ed. New York, NY: American Society of Mechanical Engineers.
- ASME. 1989b. *Quality Assurance Requirements for Nuclear Facility Applications*. ASME NQA-2-1989 Ed. New York, NY: American Society of Mechanical Engineers.
- ASME. 1989c. *Quality Assurance Program Requirements for the Collection of Scientific and Technical Information for Site Characterization of High-Level Nuclear Waste Repositories*. ASME NQA-3-1989 Ed. New York, NY: American Society of Mechanical Engineers.
- U.S. DOE. 1996. *Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant*. DOE/CAO-1996-2184. Carlsbad, NM: US DOE Waste Isolation Pilot Plant, Carlsbad Area Office.
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- U.S. EPA. 1993. "40 CFR Part 191: Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Final Rule." *Federal Register*. Vol. 58, no. 242, 66398-66416.
- U.S. EPA. 1996. "40 CFR Part 194: Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plants Compliance With the 40 CFR Part 191 Disposal Regulations: Final Rule." *Federal Register*. Vol. 61, no. 28, 5224-5245.

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