WPO 27650

CULEBRA TRANSPORT PROGRAM

TEST PLAN: HYDRAULIC CHARACTERIZATION OF THE CULEBRA DOLOMITE MEMBER OF THE RUSTLER FORMATION AT THE H-19 HYDROPAD ON THE WIPP SITE

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REVISION HISTORY

This is the original edition of this document. The purpose and content of any future changes and/or revisions will be documented and appear in this section of revised editions.

DEFINITIONS OF ACRONYMS

amsl	above mean sea level
BASys	Baker Acquisition System
CAO	Carlsbad Area Office (of DOE)
CMR	Central Monitoring Room
DAS	data-acquisition system
DOE	(United States) Department of Energy
EPA	Environmental Protection Agency
ES&H	Environmental Safety and Health
FOP	Field Operations Plan
GET	General Employee Training
gpm	gallons per minute
HTC	Hydraulic-Test Coordinator
I.D.	inside diameter
MOC	Management and Operating Contractor
MSDS	Material Safety Data Sheet
NEPA	National Environmental Policy Act
NIST	National Institute for Standards and Technology
O.D.	outside diameter
PA	Performance Assessment
PHA	Preliminary Hazard Assessment
PI	Principal Investigator
psia	pounds per square inch absolute
psig	pounds per square inch gauge
QA	Quality Assurance
QAP	Quality Assurance Procedure
QAPD	Quality Assurance Program Description
QC	Quality Control
SNL	Sandia National Laboratories
SOP	Safe Operating Procedure
SR	Sandia Representative
SWCF	Sandia WIPP Central Files
TOP	Technical Operating Procedure
WID	Waste Isolation Division (of Westinghouse)
WIPP	Waste Isolation Pilot Plant
WQSP	Water Quality Sampling Program

1. DESCRIPTION OF THE EXPERIMENT

The hydraulic testing described in this Test Plan constitutes one component of a Sandia National Laboratories (SNL) program to understand solute transport through the Culebra Dolomite Member of the Rustler Formation at the Waste Isolation Pilot Plant (WIPP) site. The overall Culebra Transport Program is discussed below, followed by a summary of the specific activities described in this Test Plan and their objectives.

1.1 Purpose of the Culebra Transport Program

The WIPP is a U.S. Department of Energy (DOE) research and development facility designed to demonstrate the safe disposal of transuranic wastes resulting from the United States' defense programs. The WIPP repository is excavated in the bedded halite of the Salado Formation, approximately 2150 ft below land surface. At the WIPP site, the Salado Formation is approximately 2000 ft thick and is overlain by the approximately 300-ft-thick Rustler Formation, the 500-ft-thick Dewey Lake Red Beds, and approximately 50 ft of surficial deposits ranging from weathered sedimentary bedrock to Quaternary eolian deposits (Figure 1-1). The 24-ft-thick Culebra Dolomite Member of the Rustler Formation is the most transmissive saturated bedrock unit above the WIPP repository and is considered to be the most likely pathway for radionuclide transport to the accessible environment in the event of a breach of the repository.

Evaluation of WIPP's compliance with 40 CFR 191B by the WIPP Performance Assessment Computational Support Department of SNL relies on a model of radionuclide transport through the Culebra. Modeling of transport through the Culebra requires, first, a conceptual model of the mechanisms and processes governing that transport and, second, quantitative estimates of the parameters required for numerical simulation of those processes. The Culebra Transport Program represents the combined efforts of the SNL Geohydrology (6115) and WIPP Chemical and Disposal Room Processes (6748) Departments to provide the conceptual understanding and data necessary to construct a numerical model for Culebra transport.

Field tracer tests are a major component of the Culebra Transport Program. Tracer tests provide data with which to evaluate different processes affecting transport and to estimate transport parameters. Interpretations of previous tracer tests conducted at the WIPP site (Jones et al., 1992) indicated that the Culebra behaves locally as a double-porosity medium in which advective flow occurs through fractures while diffusion of solutes from the fractures to the surrounding rock matrix acts to retard solute transport. Using a double-porosity transport model

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 Dolomite	7	24
				Tamarisk	26	85
				Culebra Dolomite	7	24
				unnamed	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.

TRI-6115-38-1

Figure 1-1. Stratigraphic units at the WIPP site.

based on these tracer-test interpretations, the WIPP PA Department (1993) showed that physical retardation arising from matrix diffusion makes the Culebra an effective barrier to release of radionuclides to the accessible environment.

This Test Plan supports the Culebra Transport Program by providing for the hydraulic characterization of the Culebra at a future tracer-test site, the H-19 hydropad, which has been established southeast of the WIPP surface facilities between the H-3 hydropad and observation well DOE-1 (Figure 1-2; Saulnier and Beauheim, 1995). Figure 1-3 shows the as-built pattern of the test wells at the H-19 hydropad. The activities described in this Test Plan are designed to provide information about the hydraulic connections between the wells at the H-19 hydropad. This information will be used in the design and interpretation of subsequent tracer tests. The activities will involve single- and cross-hole tests of the entire thickness of the Culebra and/or of individual layers within the Culebra. Figures 1-4 and 1-5 show the completions of the H-19 test wells. This Test Plan describes plans, procedures, and specifications for the hydraulic tests to be conducted at the H-19 hydropad. The tracer testing to be performed at the H-19 hydropad after hydraulic characterization of the Culebra is completed will be described in a separate Test Plan prepared specifically for that activity.

1.2 Purpose of Hydraulic Characterization of the Culebra at the H-19 Hydropad

Pumping tests conducted at various locations where the Culebra has been observed to be fractured (e.g., DOE-1, H-11) have shown apparent double-porosity hydraulic responses (Beauheim, 1987, 1989). That is, an initial drawdown response is observed that propagates rapidly to nearby wells, followed by a stabilization of drawdown as if the system were being recharged by some source, followed by a resumption of drawdown that continues for the duration of pumping. This pattern of responses has been interpreted to reflect initial production and associated drawdown from a high-transmissivity fracture system connecting the wells, a slowing of drawdown as the fractures become depressurized and the rock matrix begins to contribute water to the fractures, followed by continuing drawdown in both the fractures and matrix. These test responses have been successfully simulated using double-porosity continuum models that assume the fracture-matrix system can be treated as either a uniform set of horizontal fractures separated by tabular matrix blocks or as three orthogonal, equally spaced fracture sets separated by cubical matrix blocks.

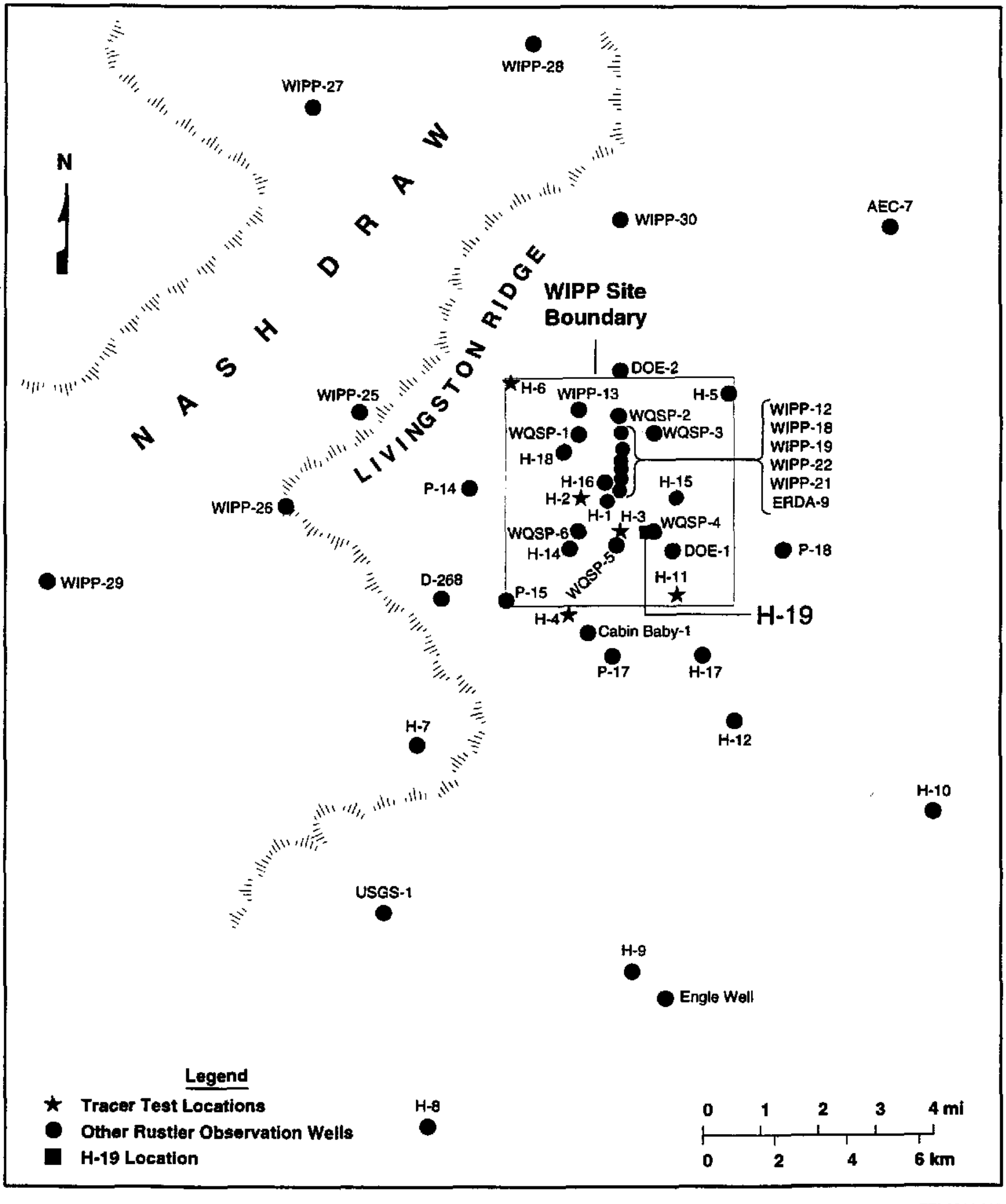

Figure 1-2. Location of H-19 hydropad with respect to other observation wells and tracer-test locations at the WIPP site.

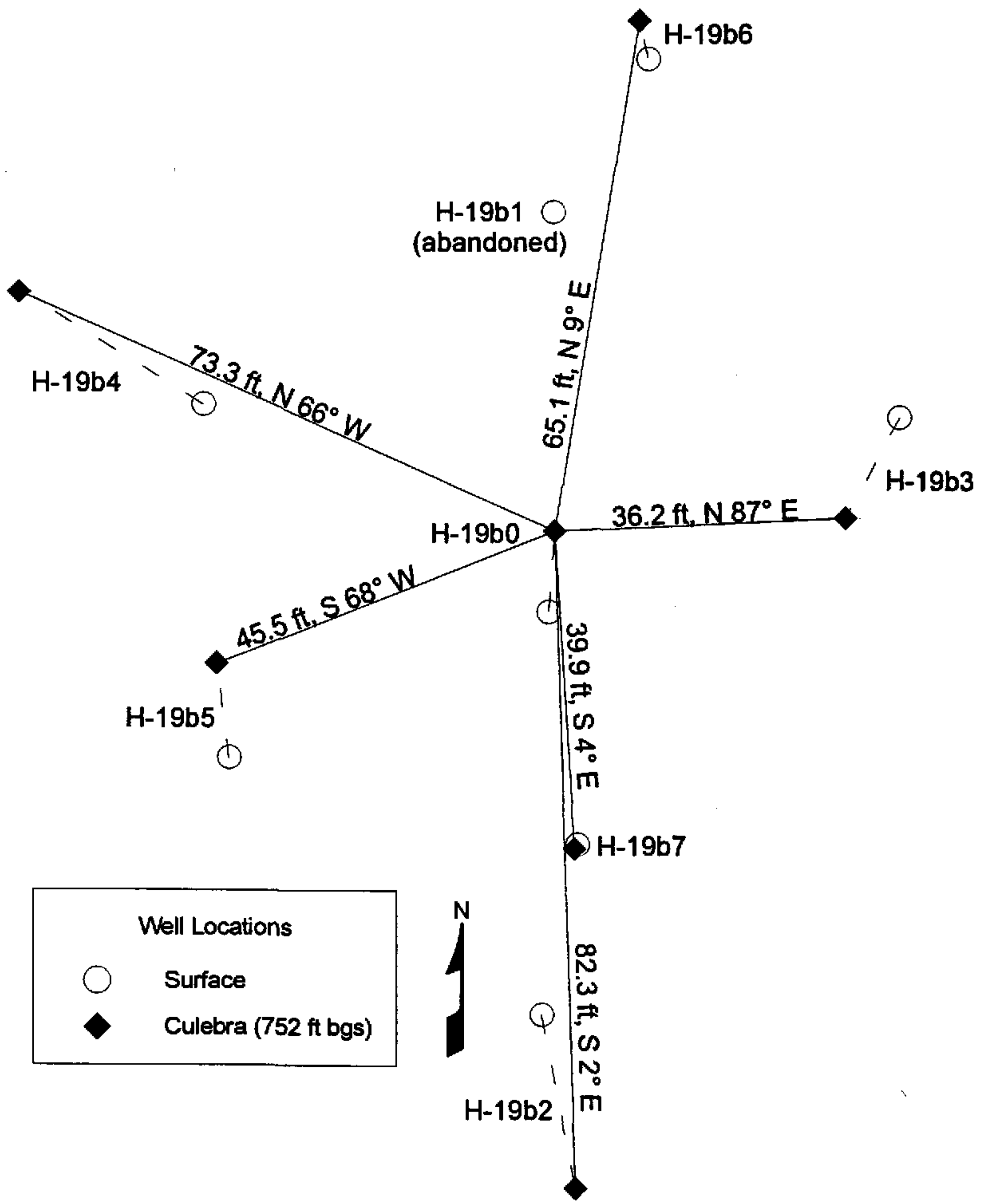

Figure 1-3. Relative positions of the wells drilled at the H-19 hydropad.

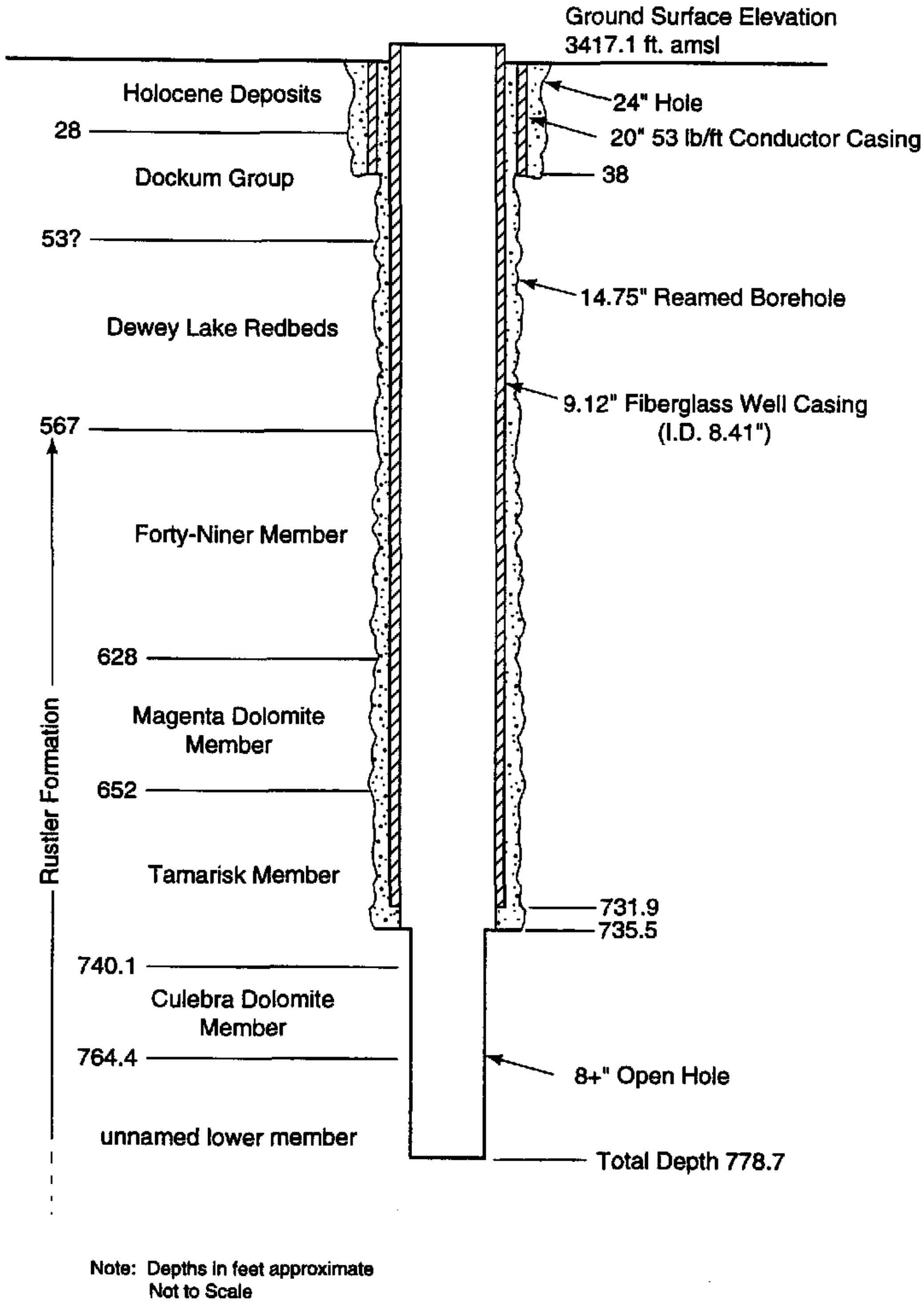

Figure 1-4. As-built configuration of well H-19b0.

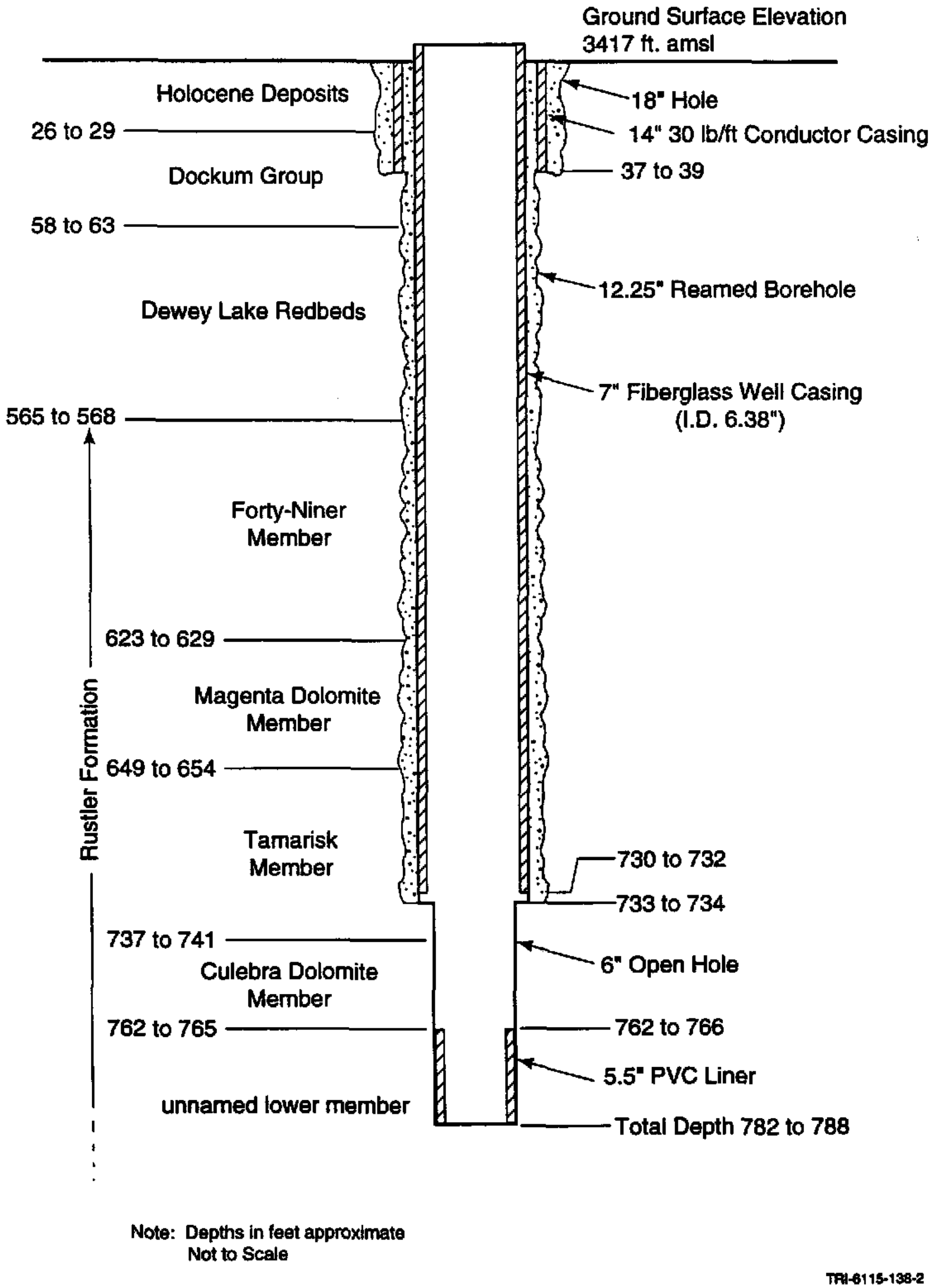

Figure 1-5. Generalized as-built configurations of wells H-19b2 through H-19b7.

The double-porosity interpretations of the pumping tests provided a conceptual starting point for interpretation of tracer tests performed in fractured regions of the Culebra. The tracer tests performed at the H-3, H-6, and H-11 hydropads were successfully simulated using double-porosity continuum models with three orthogonal fracture sets (Jones et al., 1992). The tracer-test interpretations, however, relied on an idealized model of the hydraulics of the Culebra. Specifically, the interpretations assumed that fractures were evenly spaced over the entire thickness of Culebra and that all fractures had the same aperture and were equally conductive. This uniform fracture system was assumed to be anisotropic with respect to permeability (or transmissivity), however, and the magnitude of the anisotropy and the orientation of the principal directions of permeability were determined from fitting the observed tracer-breakthrough data to calculated breakthrough curves.

The hydraulic characterization to be performed at the H-19 hydropad is designed to provide a realistic description of the hydraulics of the Culebra dolomite. It will provide defendable data on the distribution and properties of conductive features within the Culebra. It will determine whether or not the Culebra can be treated as a vertically homogeneous unit or if different layers having different hydraulic conductivities exist that must be treated individually. The testing will provide direct information on the anisotropy of the Culebra as a whole, and potentially of individual layers. This information will lead to development of a realistic and defendable hydraulic model for use in the design and interpretation of subsequent tracer tests.

2. REGULATORY AND PERMIT REQUIREMENTS

The Westinghouse Waste Isolation Division (WID) is responsible for ensuring that WIPP-site activities are conducted in accordance with applicable federal, state, and local regulatory requirements. The WID is responsible for assessing regulatory impact and compliance and for obtaining necessary permits. Appropriate National Environmental Policy Act (NEPA) checklists governing the proposed testing at the H-19 hydropad have been generated and approved. 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. The WID has obtained permits for the wells at the H-19 hydropad from the New Mexico State Engineer. These permits govern the drilling, completion, and pumping of those wells. Pumping restrictions applicable to this Test Plan are discussed below along with plans for the disposal of the pumped water.

2.1 Limitations on Pumping

The permits issued by the New Mexico State Engineer for the H-19 wells contain limitations on the allowable volumes of water that can be pumped from each well on an annual basis. The maximum allowable volume that can be withdrawn from well H-19b0 during any year is 10.0 acre-feet (3,258,288 gallons). No more than 20.0 acre-ft (6,516,576 gallons) can be withdrawn from H-19b0 through January 31, 1998, when the permit terminates. For wells H-19b2 through H-19b7, no more than 1.0 acre-ft per year (325,829 gallons) can be withdrawn from each well, and no more than 2.0 acre-ft (651,658 gallons) can be withdrawn from an individual well through January 31, 1998, when the permits terminate. Therefore, totalizing flow meters must be used on the discharge lines from each of the wells to monitor cumulative discharge during all pumping activities. The initial meter readings must be reported to the State Engineer when the meters are installed and the meter readings on the first days of January, April, July, and October of each year must be submitted to the State Engineer by the tenth days of those months. This information will be provided by the Hydraulic-Test Coordinator (HTC) or his designee to the WID NEPA Coordinator on the first working day of each applicable month. The WID NEPA Coordinator is responsible for transmitting the information to the State Engineer.

2.2 Water Disposal

All formation water produced during testing will be stored in an evaporation pond on the H-19 hydropad. No off-site disposal of water will be required.

3. COMPLIANCE JUSTIFICATION

The preliminary performance assessments of the WIPP (e.g., WIPP PA Dept., 1993) have shown that physical and/or chemical retardation occurring as radionuclides are transported through the Culebra can make a significant contribution to WIPP's compliance with 40 CFR 191B. Modeling of transport through the Culebra requires, first, a conceptual model of the mechanisms, flow geometry, and processes governing that transport and, second, quantitative estimates of the parameters required for numerical simulation of those processes. The Culebra Transport Program represents the combined efforts of the SNL Geohydrology (6115) and WIPP Chemical and Disposal Room Processes (6748) Departments to provide the conceptual understanding and data necessary to construct a numerical model for Culebra transport.

4. TEST OBJECTIVES

The success of the H-19 tracer-testing program depends on an understanding of the hydraulic behavior of the Culebra dolomite at the H-19 hydropad. The testing plans have been developed so that the information gained is of the highest possible value for both conceptual-model development and interpretation of tracer-test data. Information on hydraulic conductivity, anisotropy, layering, interconnection between layers, and heterogeneity will be valuable for tracer-test interpretation.

Given the overall need for hydraulic characterization of the Culebra at the H-19 hydropad, the hydraulic testing program, emphasizing cross-hole or interference tests, has the following objectives:

- to quantify the transmissivity and storativity of the Culebra at the H-19 hydropad;
- to determine the hydraulic anisotropy of the Culebra at the H-19 hydropad;
- to determine whether or not the hydraulic responses at the H-19 hydropad exhibit double-porosity behavior;
- to identify fracture and/or high-permeability connections among the wells at the H-19 hydropad;
- to identify and characterize hydraulically distinct layers within the Culebra and correlate those layers across the H-19 hydropad;
- to characterize the hydraulic performance of the Culebra to aid in planning for tracer tests at the H-19 hydropad; and
- to evaluate the extent to which testing of the Culebra at the H-19 hydropad affects other observation wells in the vicinity of H-19 to aid in developing a monitoring program to be implemented during the planned tracer tests.

5. EXPERIMENTAL PROCESS DESCRIPTION

The testing plan for the Culebra at the H-19 hydropad has been developed based on information, summarized here, obtained during drilling, preliminary testing, and logging of the wells on the H-19 hydropad under the Field Operations Plan prepared by Saulnier and Beauheim (1995). Preliminary interpretation of the well-development pumping tests conducted in the H-19 wells indicates the transmissivity of the Culebra is on the order of 5 ft^2/day at H-19. The observed well responses show characteristics of double porosity and heterogeneity. Maximum sustainable pumping rates in the seven wells range from about two to six gallons per minute (gpm). Examination of core from the wells shows the upper 10 ft of Culebra to be largely massive dolomite with few vugs, and the lower 14 ft to be less competent with many vugs. The lower portion of the Culebra appears to break easily during coring, making core recovery problematic. Video imagery of the borehole walls corroborates this division of the Culebra into two parts, showing that bedding, vuggy zones, and other features are continuous across the H-19 hydropad. While coring with compressed air, very little water production is observed until the holes pass through the upper 10 ft of Culebra. Similarly, Culebra fluid pressures in wells already completed on the H-19 hydropad show little response to coring of the upper 10 ft of Culebra in new wells, but rapid responses as the coring penetrates deeper. Hydrophysical logging of three of the H-19 wells also showed little flow from the upper 10 ft of Culebra and distributed flow over the lower 14 ft. From these observations, we surmise that the Culebra may act as a two-layer system, with the lower 14-ft section representing the most transmissive layer.

Based on the information currently available, we plan to isolate the two zones described above for testing. Two sets of tests will be conducted. For the first set of tests, the central well on the hydropad, H-19b0, will act as the source, or active, well while the other six wells on the hydropad will act as monitoring wells. The same two layers will be isolated in all seven wells with multipacker tools. Each layer will be individually tested in the active well while pressure responses are monitored in all layers in all wells. The upper, less-transmissive layer will be tested first. After both layers have been tested, the testing apparatus installed in the central well will be exchanged with the monitoring apparatus installed in well H-19b7, which is thought to lie closest to the fastest direction of transport as determined from the preliminary tracer test performed on the hydropad (Saulnier and Beauheim, 1995). The tests of the individual layers will be repeated using the new active well. This second set of tests will provide additional directional information on hydraulic properties and fracture connectivity, as well as aid in distinguishing heterogeneity from anisotropy.

The type(s) and duration(s) of test(s) to be performed in each layer will depend on the transmissivity of the layer. Pumping tests (constant or multi-rate; see Section 7.2.3) will be performed in any layer capable of sustaining the necessary pumping. Judging from the preliminary well-development pumping tests already performed in the wells on the H-19 hydropad, the pumping test of the most-transmissive section of the Culebra should take no more than five days. Test durations in the less-transmissive section are less certain. Drillstem tests and/or slug tests (see Sections 7.2.1 and 7.2.2) will be performed if the upper layer is incapable of sustaining pumping. The HTC will alter or complete the design of each test based on real-time evaluation of the data.

Figure 5-1 shows a flow chart of the experimental process.

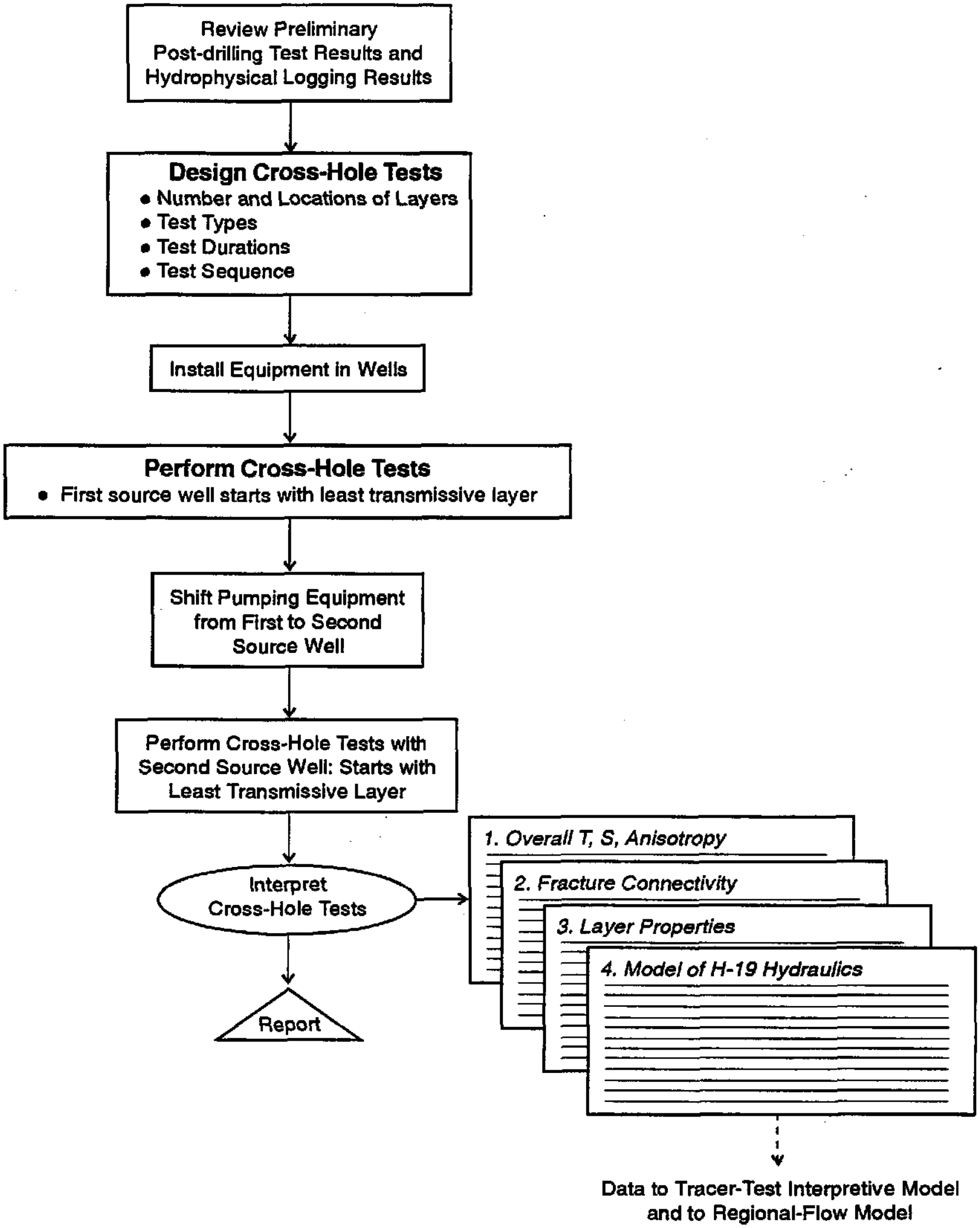

Figure 5-1. Flow chart of the elements of the H-19 hydraulic-testing program.

6. INSTRUMENTATION/TEST EQUIPMENT/FACILITIES

Equipment needed for the hydraulic testing of the wells at the H-19 hydropad will consist of equipment at land surface and downhole equipment to be installed in the wells. All equipment will consist of either "off the shelf" items ordered directly from suppliers or standard equipment provided by service companies in conducting their contracted tasks. No specially designed equipment is anticipated. All equipment used for the test, including modified standard equipment, will be documented as part of the QA records.

6.1 Surface Equipment

The H-19 hydraulic-testing program will be conducted utilizing some equipment at land surface and some equipment installed in the wells (i.e., downhole equipment). All equipment will be operated observing all relevant SNL and WID ES&H procedures and protocols. The surface equipment will consist of data-acquisition systems (DASs) to monitor the tests, a packer-inflation system, a flow-control system, an aneroid barometer, water-level sounders to observe observation wells, water-quality measurement instruments, diesel-powered generators, and storage tanks.

6.1.1 Data-Acquisition Systems

Tests conducted under the hydraulic-testing program at the H-19 hydropad will be controlled and monitored using computer-controlled DASs. The DASs will send and receive signals to/from the pressure-and-temperature measurement devices and record their responses on the computer's hard disk and on floppy diskettes. The primary DAS will be BASys (Baker Acquisition System), provided by Baker Oil Tools. The SNL PERM DAS serves as a backup DAS for the H-19 hydraulic-testing program. Data acquired from the flow-control system and downhole pressure sensors will be operationally verified using Technical Operating Procedure (TOP) 507: Installation System Verification During Gage Connection to HP-3497A Stand-Alone *Data-Acquisition Systems.*

6.1.1.1 BASYS

The primary DAS that will be utilized for the H-19 hydraulic-testing program will be BASys. BASys is a computer-controlled DAS which can monitor up to 48 input channels/gauges with real-time plotting, printing, and graphical interactive video display. The system includes a 12-bit analog to digital (A to D) converter card that observes the signal input from the various gauges and in turn inputs those signals into an IBM-type desk-top computer. The computer is used to control the rate of data collection, monitor and record data on magnetic media, and output the signal input in engineering units through an IEEE bus and graphical interface to printer, plotter, and video-display peripherals. The BASys DAS can monitor each channel/gauge at 24-msec intervals. The BASys DAS is leased from the supplier and is controlled by proprietary software. The hardware and software for the BASys DAS have undergone verification testing. Figure 6-1 is a schematic illustration of the BASys DAS.

6.1.1.2 SNL PERM DATA-ACQUISITION SYSTEM

The SNL PERM DAS is a computer-controlled DAS which will be used as a backup DAS to monitor and record the data from the H-19 hydraulic-testing program in the event the BASys DAS has technical problems or if an additional DAS is required. A schematic illustration of the PERM DAS is shown on Figure 6-2. The basic system consists of a power-excitation input to access the downhole pressure transmitters and other gauges such as the barometer and flow meter, a digital voltmeter to observe the gauges' output signals, a data-control unit to access each gauge's signal, a programmable voltage standard to verify the signal output from gauge and excitation devices, and a microcomputer to store and process the data. The PERM DAS has undergone design review by SNL and complies with Section 3 of the SNL QAPD concerning Design Control. The PERM DAS will collect and process the gauges' input signals and store the data on hard disk and on floppy disks using SNL's PERM data-acquisition software which is being qualified as a Grade A code in accordance with SNL WIPP QAP 19-1, Rev. F.

6.1.2 Packer-Inflation System

The downhole packers used in the test-tool assembly will be inflated with compressed nitrogen or compressed air. The inflation process will be performed in accordance with TOP 505: Pumping Tests. If in special cases the packers will be inflated with fluid, an intensifier pump will be used in accordance with TOP: Intensifier Pump: Operation and Use.

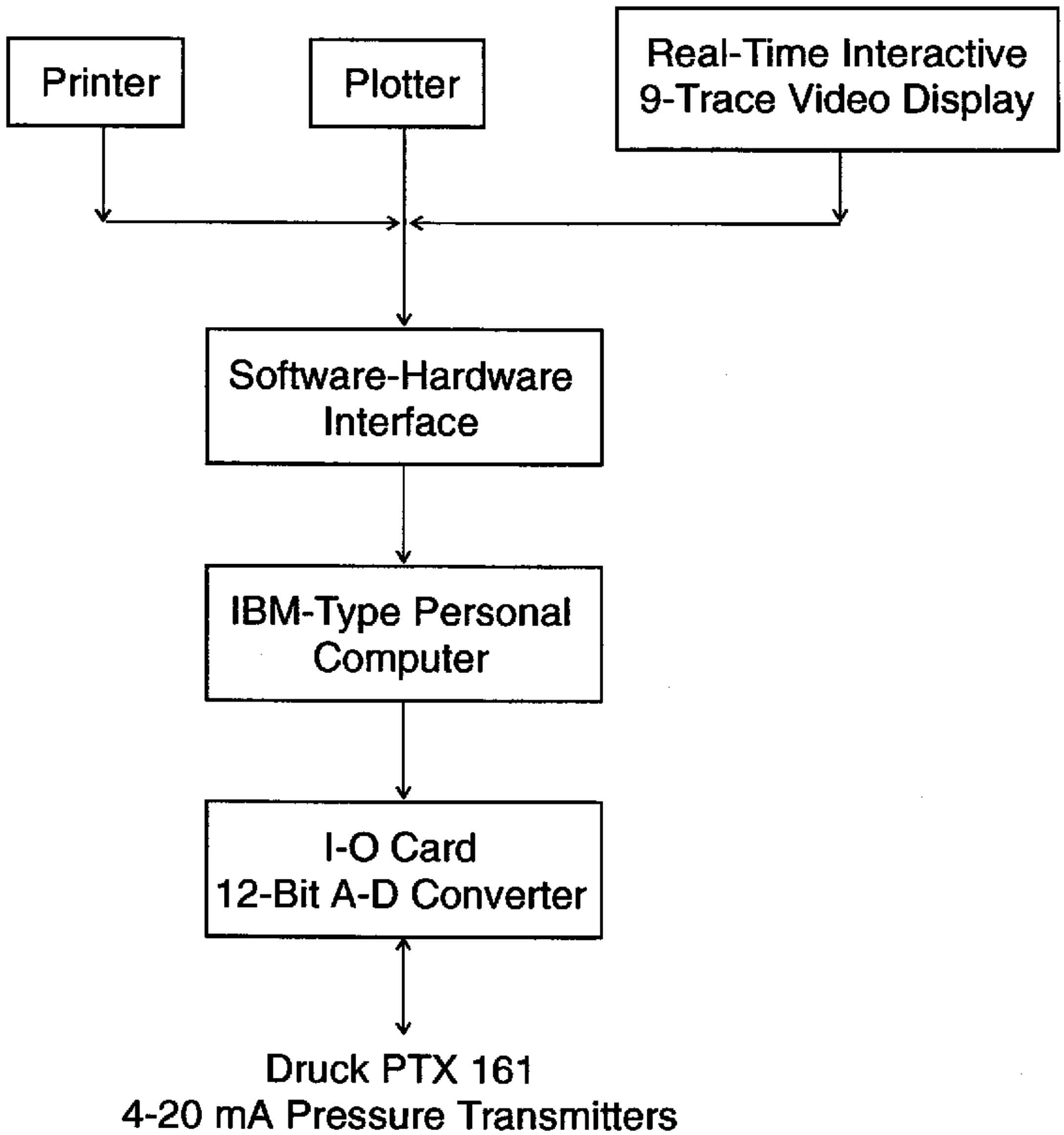

Figure 6-1. Schematic illustration of the BASys data-acquisition system.

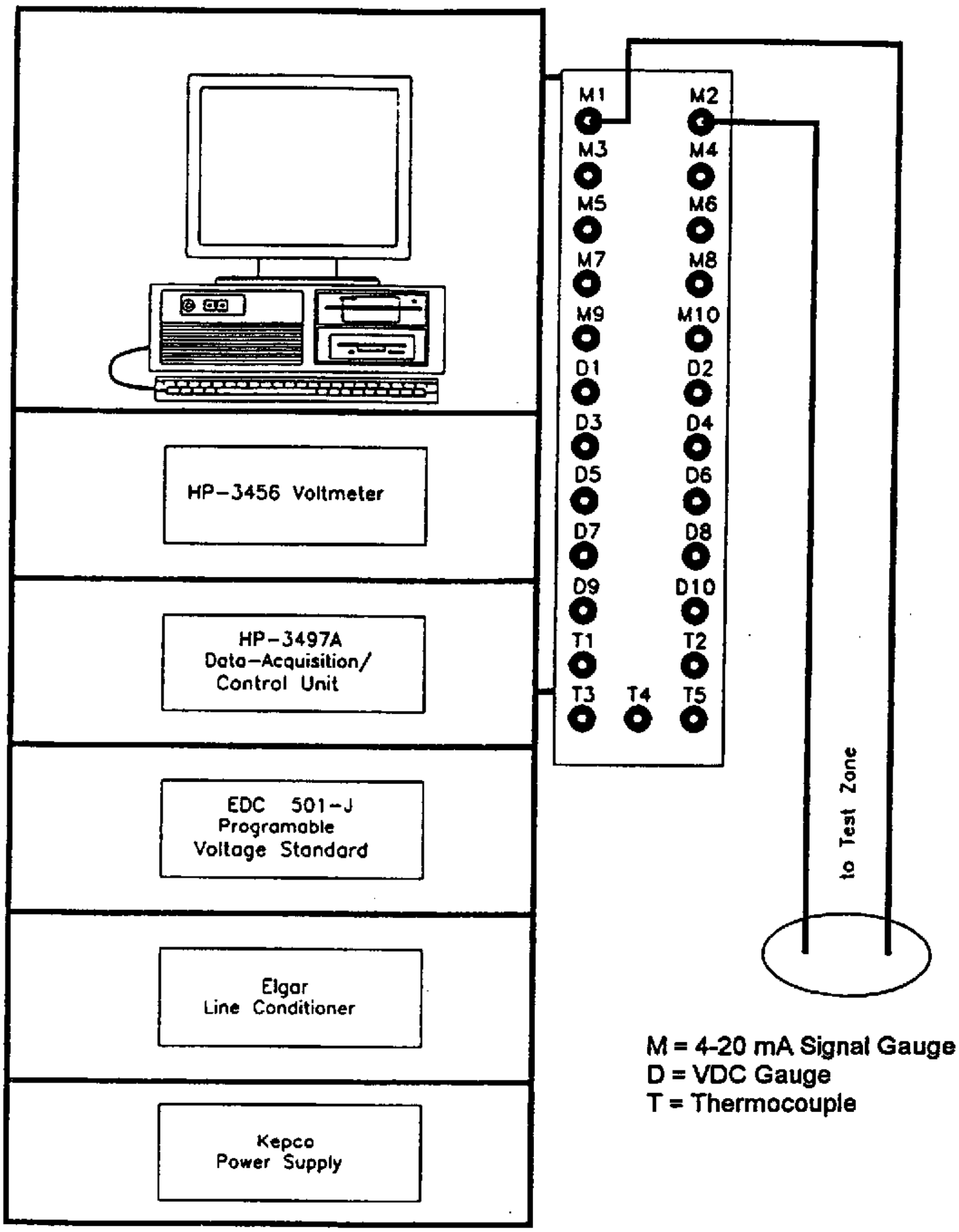

Figure 6-2. Schematic illustration of the SNL PERM data-acquisition system.

6.1.3 Flow-Control System

Production and injection rates for the hydraulic-testing program at the H-19 hydropad will be controlled using a computer-controlled flow-control system consisting of an in-line inductive flowmeter, a programmable electronic flow controller, and an electro-pneumatic valve. The flow-control system will be operated with the DAS and all flow rates will be recorded by the DAS. The components of the system are combined in a simple feedback loop. Thus, the flow-rate output from the flow meter will be used as input to the electro-pneumatic valve allowing stable flow-rate changes to be introduced from the DAS keyboard in less than 30 seconds. The setpoint can be set manually at the controller or remotely via the BASys DAS. The design control range for flow rate is 0.2 to 20 gpm.

Fluid-discharge data will be collected during all production periods. Because the different wells and/or layers may have widely varying hydraulic properties, frequent discharge measurements are necessary in order to maintain and adjust pumping rates during any constant-rate pumping tests that may be performed. The pumping-rate/discharge data will be obtained using both a totalizing flow meter and an electronic flow meter. An additional check on the discharge rate may be provided using a calibrated standpipe.

The New Mexico State Engineer requires that the cumulative volume of water produced from each well be determined during the H-19 hydraulic-testing program. Therefore, the flow-control/discharge-measurement system will also include a totalizing flow meter. The total discharge will be measured with a Carlon in-line totalizing flow meter. The Carlon flow meter has a ⅝-inch orifice, and is a brass-housed synthetic (non-corrosive) turbine flow meter designed for discharge rates of 1 to 20 gpm, with scale divisions of 0.10 gallons. The Carlon flow meter is a totalizing flow meter and monitors only the total volume of fluid pumped. If necessary, the data from the totalizing flow meter can be used to calculate the average pumping rate by observing the meter at the beginning and end of a time period. The time-and-volume data can be used to calculate the average discharge rate for the time period in question. Totalizing-flow-meter data will be documented as part of the QA records. The flow meter will be checked during each test to verify that it is performing within design specifications by timing the filling of a container of known volume.

6.1.4 Barometer

Barometric pressure during the H-19 hydraulic-testing program will be monitored using a Druck PTX 260 series 0 to 17-psia pressure transmitter mounted at the H-19 hydropad. Druck PTX transmitters have a 9 to 30 VDC input voltage with a 4 to 20-mA output signal which is converted to a voltage output and monitored by the DAS. The barometer output monitored by the DAS and converted pressure data will be recorded at the same frequency as the downhole fluid-pressure data.

6.1.5 Water-Level Sounders

Water levels in test wells will be measured before installing testing equipment. Water levels will also be measured in some observation wells during hydraulic tests at H-19. The water levels will be measured using Solinst electric water-level sounders according to TOP 512: Depth-to-Water Measurement Using Solinst Brand Electric Sounder. All measurements will be documented as part of the QA records. The Solinst meter consists of a graduated plastic tape with two wire leads, a water-level probe at the downhole end of the tape, batteries, and a signal light and buzzer mounted on a surface reel. When the water-level probe enters the water, the electrical conductivity of the water closes the electric circuit on the tape, activating the surface light and buzzer. The water level is read directly, in feet or meters, on the graduated plastic tape, at the observation-well measuring point, which will be clearly marked on the surface casing. See Section 6.2.6 regarding fluid-pressure measurements using downhole memory gauges.

6.1.6 Water-Quality Measurement Instruments

Throughout the pumping phases of the H-19 hydraulic-testing program, the electrolytic conductivity, temperature, pH, and specific gravity of the produced water will be measured on a routine basis. 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 from the H-19 wells. The electrolytic conductivity will be measured with a Yellow Springs Instruments S-C-T meter or equivalent; the temperature with a laboratory-grade mercury thermometer; pH with an Orion pH meter or equivalent; and the specific gravity with a laboratory-grade hydrometer. Measurements may be carried out in conjunction with discharge-control measurements. Measurements including unusual or rapid changes in the conductivity data will be documented as part of the QA records and the measurement frequency will be modified to accommodate documenting these changes.

6.1.7 Diesel-Powered Generators

Diesel-powered generators are needed to generate electricity for the H-19 hydraulic-testing program. Diesel-powered generators will be operated in accordance with TOP 510: Manual Start of Remote Diesel Generators. Operation of diesel generators is not a quality-affecting activity and, therefore, documentation of activities as specified in TOP 510 (e.g., Form 146) is not mandatory.

6.1.8 Storage Tanks

All groundwater produced from the H-19 wells during the hydraulic-testing program will be pumped either directly into an evaporation pond constructed on the H-19 hydropad or into storage tanks at the hydropad provided by a service company under an SNL contract. The tanks will likely be 130-barrel-capacity standard oil-field-type frac tanks. The tanks will be steam cleaned and/or sand blasted (if required). The tanks will be drained into the evaporation pond when the need for temporary storage of the water passes.

The fluid to be used for slug- or pulse-injection tests in the H-19 boreholes will be produced from the H-19 boreholes prior to the tests and stored on site in clean, portable, polyethylene tanks. Holding tanks for injection fluids will be covered to avoid evaporation and/or dilution.

6.2 Downhole Equipment

Downhole equipment will be operated from the surface and will consist of swabbing/bailing equipment to remove fluid from the borehole(s), a test tool consisting of one or more inflatable packers, a shut-in tool, a submersible pump, pressure transmitters, memory gauges, sliding sleeves, and, possibly, a Moineau downhole 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 hydropad. A secondary datum, such as the top of well casing, may be used as a reference point for depths provided that the elevation of that secondary datum relative to that of the primary datum is known and documented.

6.2.1 Swabbing/Bailing Equipment

Swabbing/bailing equipment will be used to remove fluid from the tubing above the shut-in tool as needed to conduct pulse, slug, and/or drillstem tests. The swabbing/bailing equipment will consist of artificial and/or natural rubber tubing wipers (swab cups) or downhole bailers supplied by the workover-rig contractor. All swabbing/bailing equipment will be operated from wireline cable supplied by the workover-rig contractor. If swabbing/bailing is not possible or not effective, the fluid level in the tubing may be lowered by means of air lifting whereby a hose or tubing is used to inject compressed air below the water level in the test-tool tubing at pressures and volumes sufficient to lift the fluid to land surface.

6.2.2 Inflatable-Packer Test Tools

Hydraulic testing will be conducted with downhole test tools incorporating one or more inflatable packers. Depending on the condition of the well and the test goals, the test tools may contain either a single inflatable packer for bottom-hole testing or multiple inflatable packers to isolate two or more test intervals between the packers. Standard packers to be used in observation wells will have approximately 30-inch sealing elements and a 5-inch outside diameter (O.D.) and can be inflated using water or compressed gas. For the H-19 hydraulic-testing program, compressed nitrogen or compressed air will be used to inflate the packers as described in Section 6.1.2. The standard packers to be used in the source (test) wells will be either 5⅝-inch or 3½-inch O.D. packers depending on the test well. The 7¾-inch-cored-diameter central well, H-19b0, will require the larger-diameter packer.

6.2.3 Shut-In Tool

The downhole inflatable-packer test tool will be operated downhole utilizing a Baker Oil Tools 3.5- or 5-inch, zero-displacement, pressure-operated shut-in tool to control access to the packer-isolated zones. The shut-in tool is actuated by nitrogen or compressed air through a single ¼-inch-diameter control tubing which is run alongside the test-tool string. No tubing movement or weight change to the tubing above the shut-in tool is required to operate this shut-in tool, thus minimizing test-tool-induced pressure disturbances in the test zone.

6.2.4 Sliding Sleeves

A sliding sleeve is similar to a shut-in tool in that it open and closes a downhole flow path. But whereas a shut-in tool opens and closes a vertical flow path through the tool string, a sliding sleeve opens and closes ports from the tool string into the wellbore. A sliding sleeve consists of concentric sections of pipe with circular ports passing through the wall of the pipe. In the open position, the ports on the two sections line up, allowing fluid to pass from the tool string to the well. When one of the sections slides vertically relative to the other, the ports no longer line up (closed position), and the fluid cannot pass from the tool to the well. The Baker Oil Tools sliding sleeves are pressure operated and can be controlled from the surface. Gas or hydraulic pressure is applied to a piston through a ¼-inch control line to open or close the sleeve. Separate pistons and control lines are used to open and close the sleeves. Sliding sleeves will be used between the packers of multipacker test tools to allow testing of different zones in a borehole without having to remove and reconfigure the test tools.

6.2.5 Pressure Transmitters

During pumping tests, Druck PTX 161 pressure transmitters will be used to monitor the changes in test-zone pressure and the annulus fluid level between the test-tool tubing and the well casing, or the open-hole water level. The transmitters will be strapped to the test-tool tubing at a distance above the pump motor to assure minimal electronic noise is induced by the pump-motor drive. The Druck PTX 161 pressure transmitters have a 0 to 300-psig range of operation. These pressure transmitters will be monitored with the DAS which will record both the 4- to 20-milliamp output from the gages and the converted data in the desired pressure units.

6.2.6 Downhole Memory Gauges

Troll downhole memory gauges manufactured by In-Situ Inc. will be used to monitor fluid-pressure responses to hydraulic testing at the H-19 hydropad in nearby observation wells. The gauges consist of a downhole pressure transducer and data-storage device installed at a known depth in an observation well. The pressure transducer and data-storage device are accessed from land surface by RS-485 or RS-232 cables allowing the accumulated data to be downloaded to a compatible receiver. These battery-operated devices can operate for long periods of time and provide data at any desired frequency consistent with the storage capacity of the unit. The use of the remote downhole memory gauges will allow efficient use of manpower and provide useful data at any desired data density over extended time periods.

6.2.7 Downhole Pumping Systems and Configurations

Electric submersible pumps with production capacities of one to ten gpm will likely be used for pumping tests under openhole or single-packer conditions. A 3-horsepower Goulds or Red Jacket 32BC pump will be used to provide two to five or more gpm (7.56 to 19 L/m) and a 1½-horsepower Grundfos pump will be used to provide less than two gpm. The pump will be installed with an in-line check valve to assure that the pump tubing column will be filled with fluid at the start of pumping to ensure immediate flow control and regulation. If a flow rate of less than one gpm can be expected to be sustained, a 1.8-inch O.D. air-actuated Bennett pump may be used.

Whenever pumping is required from a borehole with a multipacker tool string with sliding sleeves in place, either a submersible pump in a tapered tool string or a Moineau pump will be used. The tapered tool string will consist of a combination of 2⅞-inch tubing and 5-inch wireline drill pipe. The drill pipe will extend from ground surface to a few feet below the desired setting depth of the pump. Crossovers are used to connect the drill pipe to 2⅞-inch tubing attached to the upper packer. A 4-inch submersible pump can be set inside the drill pipe on 2⅞-inch tubing (or galvanized pipe).

A downhole Moineau pump system consists of a stator, rotor, and sucker rod string. The stator is part of the tubing string. The rotor is run into the stator on the sucker rod string, which also drives the pump. A hydraulic or electric top drive unit will be installed at the wellhead. The power supply for the top drive will be provided by a hydraulic prime drive. Bypass valves will be installed across the pump stator to avoid overpressurization of the surface flow system. Four ½-inch control lines will be ported just above and below the pump stator. Pressure-relief valves in these lines will allow the pressure to bleed off into the test string below the pump at a preset maximum system pressure.

7. TEST REQUIREMENTS/PROCEDURES

7.1 Test Requirements

The H-19 hydraulic-testing program, testing methods, and test equipment have to meet the following requirements:

Applied testing procedures must:

1. Meet the objectives of this Test Plan.
2. Allow individual hydraulic tests to be successfully accomplished with the available equipment and the available time for testing. Hydraulic tests and test procedures should be optimized to meet the tests' objectives within the allotted time for testing.
3. Provide information about the near-borehole conditions and conditions between the boreholes on the hydropad.
4. Provide information about the groundwater flow regime such as heterogeneity and anisotropy.

The test equipment used for the H-19 hydraulic tests has to:

1. Provide quality data to support test objectives.
2. Perform according to design specifications.
3. Be calibrated, as appropriate, according to standards acceptable under the SNL QAPD.

7.2 Test Procedures

A variety of different types of tests may be performed in the H-19 wells depending on the conditions actually encountered. The following sections list the different tests that may be performed and general criteria for their selection. The tests will be performed in accordance with approved TOPs, which are referenced below in Section 12.5. Pressure responses to the testing will be monitored in all isolated intervals in all monitoring wells on the hydropad.

7.2.1 Drillstem Tests

Drillstem tests, or DSTs, may be performed on individual layers that have been isolated using a multipacker test tool. DSTs may be performed when a layer is not transmissive enough to sustain a pumping test or to provide preliminary information to help design a pumping test. All DSTs will be conducted in accordance with TOP 515: Slug and Drillstem Testing, summarized here. After the multipacker test tool has been installed, the sliding sleeve connecting the layer to be tested to the tool string will be opened and the shut-in tool closed, allowing the pressure in the test layer to stabilize. Water will be swabbed or bailed from the tubing above the shut-in tool and the specific gravity of this water will be measured following TOP 513: Water-Quality Data: Measurements of Specific Gravity, Conductance, pH, and Temperature. The shut-in tool will be opened for a flow period, and closed for a buildup period when directed by the HTC. The shortest time schedule for flow and buildup periods will be determined by the HTC based on the real-time evaluation of the layer's pressure response. A minimum of two sequences of flow and buildup periods will be performed.

7.2.2 Slug Tests

Slug tests may be performed either in layers that are not transmissive enough to sustain a pumping test or to provide preliminary information to help design a pumping test. All slug tests will be conducted in accordance with TOP 515: Slug and Drillstem Testing, summarized here. After the multipacker test tool has been installed, the sliding sleeve connecting the layer to be tested to the tool string will be opened and the shut-in tool closed, allowing the pressure in the test layer to stabilize. Water will be swabbed or bailed from the tubing above the shut-in tool and the specific gravity of this water will be measured following TOP 513: Water-Quality Data: Measurements of Specific Gravity, Conductance, pH, and Temperature. The shut-in tool will be opened to initiate the slug test. The HTC will perform real-time analysis of the pressure recovery to establish the time when the test will be terminated or when the test interval may be shut-in to obtain additional data. The testing time may vary from hours to days depending on the layer's transmissivity.

7.2.3 Pumping Tests

Pumping tests may be performed over the entire thickness of Culebra and/or over individual transmissive layers. Pumping tests will be performed in preference to DSTs or slug tests in any interval capable of sustaining a pumping rate of about 0.5 gpm or more. They may be performed with a single constant pumping rate or with a cyclical series of pumping rates. All pumping tests will be conducted in accordance with TOP 505: Pumping Tests. General procedures for constant-rate and multi-rate tests are outlined below.

7.2.3.1 CONSTANT-RATE PUMPING TESTS

For a constant-rate pumping test, a pump will be turned on and operated at a predetermined constant rate to produce water from the interval to be tested. For a test of the entire thickness of Culebra, a single packer set just above the Culebra may be used to reduce wellbore storage. For a test of an individual layer within the Culebra, a multipacker test tool will be used with a sliding sleeve providing access to the desired layer. Real-time analysis of the pressure data from the monitoring wells will be used by the HTC to establish the time when the pump will be turned off and the time at which recovery monitoring will be terminated. The primary objective of any pumping test will be to determine the transmissivity and storativity between the pumping well and the monitoring wells. Testing time may vary from two to as much as ten days depending on the layer's transmissivity.

7.2.3.2 MULTI-RATE (PULSE) PUMPING TESTS

Multi-rate pumping tests will be performed over individual layers within the Culebra using multipacker test tools with sliding sleeves. The specific type of multi-rate test to be conducted involves repetitive cycling between two different pumping rates, and is referred to in the petroleum industry as a pulse test. A pulse test starts by pumping at a constant rate until wellbore-storage and any transition effects have passed and the continuing drawdown is indicative of infinite-acting radial flow. The pumping rate will then be reduced by a predetermined amount (possibly to zero) for a specified period of time. After the end of that period, the rate will be increased to its original value for another specified period of time. At the end of that period, the flow rate will again be reduced and the cycle will be repeated one or more times, keeping the flow rates and production periods the same for each cycle. The production periods at the lower flow rates should not be shorter than the production periods at the higher flow rates. The production periods are anticipated to last ten to twenty hours; the exact durations will be determined by the HTC as the tests proceed.

The oscillatory nature of the transient signal produced by a pulse test makes it easy to separate from other pressure transients that may still be active in the formation, such as recovery from previous tests or pumping at other locations. As with the constant-rate pumping tests, the primary objective of any pulse test will be to determine the transmissivity and storativity of the tested layer between the pumping well and the monitoring wells. A secondary objective will be to determine the vertical hydraulic conductivity of the Culebra by interpreting the way in which the pressure transient propagates to layers above and/or below the tested layer. Rapid and complete equilibration of pressures between layers may indicate fracture connections.

7.2.4 Modifications to Test Procedures

Modifications to test procedures may be required during testing activities. These modifications will be conducted at the direction of the HTC and will be documented in the scientific notebook as part of the QA records. Such modifications are not deviations and will not be reported as nonconformances that require corrective action.

8. DATA-ACQUISITION PLAN

Both manually and electronically collected data will be acquired during the hydraulic testing at the H-19 hydropad. The following types of data will be recorded:

- electronically collected downhole pressure and temperature data from isolated and/or tested intervals;
- 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 collected water-quality data concerning the temperature, pH, specific gravity, and electrolytic conductivity of fluid produced during pumping; and
- manually collected data on equipment and instrument configurations in the wells and at the surface.

8.1 Data-Acquisition Systems

Two DASs will be used during the course of the H-19 hydraulic-testing program as described in Sections 6.1.1.1 and 6.1.1.2. With regard to the data-sampling and storage rate, the systems can be characterized as follows:

<u>BASys</u>: Data-sampling rate once per second or better;
Data-storage rate once per second or better;
Adjustable data-sampling rate;
Adjustable data-storage rate independent of sampling rate; and
Data-storage rate controlled by function or data channel.

<u>PERM-5</u>: Data-sampling rate once per second or better;
Data-storage rate once per second or better;
Adjustable data-sampling rate;
Adjustable data-storage rate is dependent on sampling rate; and
Data-storage rate is not controlled by function or data channel.

With respect to the data-acquisition and storage rate, the following criteria can be applied:

- data set must be complete relative to the needs of the test-interpretation method;
- the volume of data available to the HTC during the test must be adequate for decision making and test control;
- the data density should be able to be adjusted to the needs of a particular test; and
- the data density should be able to be adjusted to the interpretation and data-validation methods.

The primary electronic data acquisition will be performed using BASys, shown schematically in Figure 6-1. BASys will be operated as specified in BASys documentation BASys 1.A0, February, 1995. PERM-5 will be used only in the event of a failure of BASys or to collect data at another well location during testing at H-19. The PERM DAS will be operated according to TOP 509.

During the early time of any test event (test sequence, rate change, etc.), the test operator will run the DAS at the fastest possible data-acquisition rate to control the test. The data will be displayed in text and graphically to allow real-time estimates of the performance of the test equipment and the formation response.

All electronic data files will be managed in accordance with procedures described in the SNL WIPP QAPD. File-management systems will be documented in the QA records for these tests.

8.2 Manual Data Acquisition

Manual data collection will be carried out either using forms designed specifically for each activity or data type or by other appropriate means. To minimize transcription errors and multiple documentation of the same information, the use of forms specified in the WIPP procedures is not mandatory. The HTC will determine the means of documenting manually acquired data and will ensure that all quality-affecting information is documented.

8.3 On-Site Data Validation

During the hydraulic-testing program, the HTC will monitor the data as they are acquired. The data will be diagnosed for any tool failure and/or test-procedure-induced effect that may affect the data quality. The HTC will take immediate action (if so required) to make any necessary changes to the test-equipment configuration or the test procedures to assure the data quality is consistent with the test objectives.

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

- To assure that the acquired data satisfy program plans, the HTC may use the same interpretation techniques during the data-validation process as will be used in later interpretation of these data.

- The HTC 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 HTC may use real-time analysis of the acquired data to determine the time when continuing the test or test sequence will provide no further improvement in the interpreted results within the program's time and budget constraints.

- The HTC may use real-time analysis to determine whether or not a test or test sequence can be terminated earlier than planned, and to develop a revised testing schedule as appropriate. (e.g., A constant-rate test could be changed to a multi-rate test in order to provide additional test sequences to improve the confidence of the test interpretation).

If at any time it becomes apparent that a test objective cannot be accomplished due to time constraints, or if there are problems concerning the performance of the test equipment or the suitability of initial test conditions, the HTC will consult with the SNL PI regarding termination of the test.

9. DATA-QUALITY OBJECTIVES

Meeting the test objectives outlined in Section 4 is not simply a matter of specifying the accuracy and/or precision of various measuring instruments. The hydraulic properties to be quantified (transmissivity and storativity) are adequately defined for PA purposes if known to within a factor of two or three. The presence or absence of double-porosity behavior is determined more on the basis of pressure trends in log-log space than on individual measurements of pressure. Identification of fracture connections and hydraulically distinct layers is done on the basis of observations of relative differences in response times and magnitudes. The hydraulic performance of the Culebra is adequately characterized to aid in planning tracer tests by simply determining a near-maximum pumping rate that can be sustained for four to five months. Similarly, simple measurements of water-level or pressure trends in observations wells are adequate to develop a monitoring program to be implemented during the long-term tracer tests. Thus, quantitative data-quality objectives are of minor importance in defining the details of the work to be performed under this Test Plan. Experience has shown that standard, off-the-shelf instruments provide measurements of adequate quality to meet both the quantitative and qualitative objectives of hydraulic testing in the Culebra.

The data-quality objectives for the instruments providing quantitative information that will be used in test interpretation are listed in Table 9-1.

Table 9-1. Data-quality objectives for instrumentation used in hydraulic tests.

Objective	Flow Meter	Barometer	Water-Level Sounder	Pressure Transmitter/ Transducer
Range	0.2-20 gpm	10-15 psia	0-500 ft	0-200 psig
Accuracy	±0.1 gpm	±0.5 psi	±1 ft	±2 psi
Precision	±0.05 gpm	±0.1 psi	±0.1 ft	±0.5 psi

10. DESIGN ANALYSIS

The design of the hydraulic-characterization program is reviewed as this Test Plan is reviewed. Because the testing equipment and methods, described in Sections 6 and 7, respectively, have been utilized previously as part of the preliminary testing on the H-19 hydropad (Saulnier and Beauheim, 1995), additional reviews are not needed.

11. PROVISIONS FOR SIGNIFICANT EVENTS

Any event occurring during the operations and activities performed under this Test Plan that may affect the quality and interpretation of the test data is deemed significant and must be documented in the scientific notebook. This includes both unanticipated events, such as power failures, and events that are anticipated but for which the appropriate action cannot be predetermined, such as the magnitude of a change in pumping rate. The HTC will inform the PI of any significant events that occur. Significant events include, but are not limited to:

- interruptions in the power supplied by electric generators;
- failure of testing or support/ancillary equipment;
- discovery of *in situ* conditions that preclude the conduct of tests as designed;
- changes in the planned sequence of testing events;
- changes in test parameters, such as pumping rates, that were not previously programmed or specified;
- changes to the original program of technical tasks, such as added or deleted logging, testing, or water-quality sampling; and
- unanticipated or unusual test results.

12. QUALITY ASSURANCE

12.1 Hierarchy of Documents

Several types of documents are used to control work performed under this Test Plan. If inconsistencies or conflicts exist among the requirements specified in these documents, the following hierarchy shall apply:

- Memoranda or other written instructions used to modify or clarify the requirements of the Test Plan (most recent instructions having precedence over previous instructions);
- Test Plan: Hydraulic Characterization of the Culebra Dolomite Member of the Rustler Formation at the H-19 Hydropad on the WIPP Site;
- SNL WIPP Quality Assurance Procedures (see Section 12.4); and
- Technical Operating Procedures (see Section 12.5).

SNL QA concurrence will be obtained and/or correction action reports will be written for modifications to Quality Assurance Procedures implemented for work conducted under this Test Plan.

12.2 Quality-Affecting Activities

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

- water-quality measurements as specified in TOP 513 (see Section 6.1.6);
- operation of diesel-powered generators (see Section 6.1.7);
- assistance provided by the manufacturer/contractor in the installation of tools and testing equipment;
- support services for tasks which do not involve data collection, such as roustabouts, pulling rigs, machining, welding, fishing services, fuel, earth moving, etc.; and
- water collection and disposal (see Section 2.2).

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

12.3 Quality Assurance Program Description

The SNL WIPP Quality Assurance Program Description (QAPD), Rev. R, is currently in effect and has been approved by the DOE Carlsbad Area Office (CAO) for all WIPP activities assigned to SNL. The requirements and guidance specified in the QAPD are based on criteria contained in 10 CFR 830, American Society of Mechanical Engineers (ASME) NQA-1-1989 Edition (ASME, 1989a), ASME NQA-2a-1990 addenda (Part 2.7) to ASME NQA-2-1989 Edition (ASME, 1989b), ASME NQA-3-1989 Edition (excluding Basic Requirements Section 2.1 (b) and (c)) (ASME, 1989c), DOE Order 5700.6C, and 40 CFR 191. The requirements of the SNL WIPP QAPD, and any revisions thereto, are passed down and implemented through the SNL WIPP Quality Assurance Procedures.

12.4 Quality Assurance Procedures

Quality Assurance Procedures (QAPs) will be implemented in a graded manner as appropriate for the work performed under this Test Plan. The SNL PI will be responsible for identifying and documenting the specific QA requirements that apply to this Test Plan. The SNL QA Chief (or designee) will approve the graded implementation of QA requirements prior to the beginning of data-collection activities.

12.5 WIPP Technical Operating Procedures

The WIPP Technical Operating Procedures (TOPs) that may apply to work performed under this Test Plan include:

TOP 263: Sample Tracking System

TOP 277: Engineering Sketch Control

TOP 472: Intensifier Pump: Operation and Use

TOP 505: Pumping Tests

TOP 507: Installation System Verification During Gage Connection to HP-3497A Stand-Alone Data-Acquisition Systems

TOP 509:	Operation of PERM DAS Program
TOP 510:	Manual Start of Remote Diesel Generators
TOP 512:	Depth-to-Water Measurement Using Solinst Brand Electric Sounder
TOP 513:	Water Quality Data: Measurements of Specific Gravity, Conductance, pH, and Temperature
TOP 514:	Verification of Totalizing Flow Meter Measurements Using a Verified Standpipe
TOP 515:	Slug and Drillstem Testing

Modification to these procedures may be required during testing. Such modifications are not deviations and will not be reported as nonconformances that require corrective action. However, modifications will be documented by the HTC in the scientific notebook as they occur as part of the QA records.

12.6 Data Integrity

Care will be taken throughout the performance of the operations for this Test Plan to ensure the integrity of all data collected including documentation on hard copy and data collected on magnetic media. Duplicate copies of all data will be produced no less frequently than monthly and the duplicate copies will be maintained at a location separate from the H-19 hydropad to ensure that data are not lost. Data collected during testing activities shall not be released unless and until the data are reviewed and approved by the SNL PI.

12.7 Instrument Calibration

All quality-affecting work performed by or for SNL as part of this Test Plan will be done with calibrated instruments and equipment. Measurements of specific gravity, electrical conductance, pH, and temperature as specified in TOP 513 are qualitative in nature and are used only to indicate relative changes in the quality of the fluid produced from the H-19 wells. Instruments used for electrical conductance and pH measurements should meet the data-quality objectives defined by the manufacturers' specifications, but do not require calibrations traceable to NIST or other nationally recognized standards. Hydrometers and thermometers used to perform specific-gravity and temperature measurements must be certified by the manufacturer as meeting the manufacturer's specifications.

Flow meters must be certified by the manufacturer as meeting the manufacturer's specifications. The operation of flow meters will be checked in the field prior to use as directed by the HTC. Such operational checks will be documented in the scientific notebook by the HTC as part of the QA records.

Memory gauges used in measuring fluid-pressure changes in observation wells must be certified by the manufacturer as meeting the manufacturer's specifications. The operation of memory gauges will be checked in the field prior to use as directed by the HTC. Such operational checks will be documented by the HTC in the scientific notebook as part of the QA records.

If the accuracy and/or precision of data obtained from hydrometers, thermometers, flow meters, or memory gauges becomes significant, post-test calibrations or other appropriate methods of verifying the manufacturer's certifications will be performed.

12.8 Records

Records shall be maintained as described in this Test Plan 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 HTC will ensure that the required records are maintained.

12.8.1 Required QA Records

As a minimum, the documentation of QA records will include:

- times, dates, and intervals of all hydraulic tests;
- persons performing tests;
- test procedures used;
- lists, including model and serial numbers where appropriate, of all equipment used in the tests;

- equipment-specification sheets or information;
- calibration records for all controlled equipment;
- tubing tallies and other information used to establish test depths;
- sketches of all equipment configurations, showing measured dimensions;
- photographs taken of the equipment and activities;
- a log of photographs taken of the equipment and activities;
- descriptions of activities performed;
- rationales for decisions concerning test intervals, durations, modifications to procedures, or other factors;
- manually collected data;
- data files collected by the DAS;
- a log of data files collected by the DAS;
- a log of samples collected (if any); and
- other information pertinent to the testing.

12.8.2 Miscellaneous Non-QA Records

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

- as-built diagrams of equipment supplied by contractors;
- pulling-rig and other equipment certifications;
- equipment manuals and specifications;
- drilling-history charts;
- water-quality measurements;
- information related to operation of diesel 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.

12.8.3 Submittal of Records

Records resulting from work conducted under this Test Plan, including forms and data stored on electronic media, will not be submitted to the SNL Quality Assurance Department for review and approval as specified in the WIPP procedures. Instead, the records will be assembled into a records package(s) which will be reviewed by the SNL PI and submitted to the SWCF.

13. HEALTH AND SAFETY

SNL field operations will be conducted on land controlled by the WID and the field operations team assembled for this Test Plan will follow all WID safety practices and policies. Operational safety for individual field operations will be addressed through ES&H Preliminary Hazard Assessments (PHAs) and Safe Operating Procedures (SOPs) developed by SNL. Project-specific WIPP-site safety procedures will be approved through the SNL PI, WID safety personnel, and the SNL WIPP-site Safety Advisor. ES&H SOPs applicable to the testing program include those relating to identification of potential hazards, emergency-shutdown procedures, and personnel to be contacted in case of emergencies.

13.1 Safety Requirements

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 Safety Representative for WIPP-Site Operations, or the SNL Center 6100 Pressure Safety Advisor for WIPP-site test operations.

Additional safety requirements to be observed by field personnel are:

1. appropriate use of safety shoes, safety glasses, hard hats, and protective gloves;
2. ensuring adequate fuel is available for all field vehicles, especially those traveling to remote locations;
3. proper installation and safety procedures when handling electrical submersible pumps and other electrical equipment;
4. proper procedures for operation of diesel-powered generators for on-site electric power;
5. observation of scheduled working hours and driving time;
6. familiarity with on- and off-site road conditions and driving regulations;

7. familiarity with the locations of First Aid supplies, medical support facilities, and fire extinguishers and other safety equipment;

8. familiarity with the location of lists of emergency telephone numbers and persons and offices to notify in the event of emergencies;

9. familiarity with the location of posted crew schedules; and

10. familiarity with the location of all MSDS information.

All field personnel assigned to the field operations described in this Test Plan will receive a safety briefing before the beginning of field operations. In addition, the field-site or shift supervisor will conduct daily safety meetings at the beginning of daily operations or at the beginning of each shift. All personnel receiving safety briefings are required to sign and date the safety-briefing form as part of safety-documentation procedures. 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.

13.2 Special Training

All SNL and WIPP-site contractor personnel must receive WIPP-site General Employee Training (GET) followed by annual refreshers as part of employment requirements at WIPP. No other special training requirements are anticipated in addition to the GET and the safety briefings described in Section 8.1.

14. REFERENCES

American Society of Mechanical Engineers. 1989a. *Quality Assurance Program Requirements for Nuclear Facilities*. ASME NQA-1-1989 Edition. New York, NY: ASME.

American Society of Mechanical Engineers. 1989b. *Quality Assurance Requirements for Nuclear Facility Applications*. ASME NQA-2-1989 Edition. New York, NY: ASME.

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