
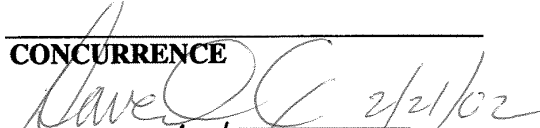
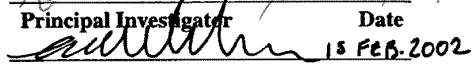




**NYE COUNTY NUCLEAR WASTE
REPOSITORY PROJECT OFFICE**

TECHNICAL PROCEDURE

TITLE: PUMPING/INJECTION TESTS OF PACKED-OFF ZONES IN UNSCREENED OPEN BOREHOLES OR IN MULTIPLE SCREEN BOREHOLES WITH OR WITHOUT OBSERVATION WELLS		Revision: 0 Date: 02-15-02 Page: 1 of 8
PROCEDURE No.: TP-10.0	SUPERSEDES: Original Issuance	
APPROVAL  Project Manager	CONCURRENCE  Principal Investigator	
Date	Date  Project Quality Assurance Officer	

1.0 PURPOSE

The purpose of this procedure is to provide instructions to NWRPO personnel for the performance of isolated zone testing in boreholes as part of the Aquifer Testing segment of Nye County's Independent Scientific Investigations Program (ISIP). As described in the ISIP aquifer testing plan (WP-4, *Aquifer Testing Plan for Nye County's Independent Scientific Investigations Program*), it is planned to test isolated intervals in a limited number of existing and future Nye County boreholes as well as selected domestic and agricultural water supply wells in Amargosa Valley. This test will be performed to provide detailed information about individual zones within larger multiple interval boreholes. These test procedures cover both multiple screen boreholes and open-hole completions. The implementation of this procedure ensures that data gathered during these tests, as part of the Nye County ISIP, meet NWRPO quality assurance (QA) requirements for scientific data.

2.0 SCOPE

2.1 APPLICABILITY

This procedure applies to the NWRPO principal investigator (PI), NWRPO Scientists/Engineers, and contractors or designated personnel performing the scientific investigation tasks listed in the above section. These individuals shall be referred to herein as NWRPO personnel.

2.2 TRAINING

NWRPO personnel shall be trained before conducting work and shall document that they have read and understand this procedure. Personnel performing the tasks described in this technical procedure shall be professional geoscientists or engineers with applicable previous experience. Personnel performing field calibrations as well as data-collection tasks shall be trained in procedures specifically applicable to the equipment used.

3.0 DEFINITIONS

- 3.1** Aquifer – Rock or sediment which is partially or fully saturated with water and is sufficiently permeable to transmit quantities of water to wells and springs.
- 3.2** Aquifer Test – A test made by pumping a well for a set period of time while observing the change in hydraulic head in the aquifer. It is used to determine hydraulic characteristics of the aquifer.
- 3.3** Caliper Log - A log which measures the diameter of the borehole vs. depth.
- 3.4** Drawdown – The difference in the water level before the well was pumped and the water level at a given time after pumping commences in a pumping well.
- 3.5** Recovery – A the rise in the water level in an aquifer after pumping ceases in a well.
- 3.6** Spinner Log - A borehole logging technique whereby a rotating impeller is lowered into a borehole to measure the velocity of the moving fluid with the borehole.
- 3.7** Transmissivity - A measure of the ability of an aquifer to transmit water through its saturated thickness.

4.0 RESPONSIBILITIES

- 4.1 The project QA Officer shall be responsible for the coordination of the internal review of this technical procedure.
- 4.2 The Nye County On-Site Geotechnical Representative will designate a Principal Investigator (PI) to oversee all aquifer testing activities and an on-site NWRPO Scientist/Engineer to direct aquifer test activities in the field.
- 4.3 The PI shall be responsible for the preparation and modification of this procedure, preparation of borehole specific testing instructions (test plans) and analysis of the test results.
- 4.4 The NWRPO Scientist/Engineer will carry out these instructions and supply the PI with the data for analysis and interpretation.

5.0 PROCESS

This procedure concerns the activities performed by NWRPO personnel related to the performance of isolated zone pumping/injection tests in designated boreholes as part of the aquifer testing phase of the ISIP. Any deviation from this procedure shall be documented in the Scientific Notebook.

The performance of the tasks specified in this procedure shall be documented in Scientific Notebooks. All documentation shall meet the requirements of QAP-3.2, *Procedures for Documentation of Scientific Investigations*.

5.1 BACKGROUND

Isolated zone testing is a specialized case of the general aquifer testing presented in TP-9.5, *Variable Scale Pumping Tests in Unscreened Open Boreholes or in Screened Boreholes with and without Observation Wells*. Due to the expense and mechanical risk associated with running tool assemblies with multiple packers in conjunction with electric submersible pumps, the use of this test will be limited to special cases where detailed hydrologic information is required for a zone that cannot be obtained with conventional test procedures. The test procedures are similar for both isolated zone testing within an open-hole completion and testing a single screened interval within a multiple screen completed borehole. However, the cased hole test requires fewer packers and involves substantially less operational risk.

The criteria for selection of test intervals will depend on the relative significance of the producing zone, and budgetary and time constraints. The geologic logs will be used to understand the formations that are intersected by the borehole. The borehole will be divided into a series of conceptual hydrogeologic units. The geophysical logs will be used to differentiate these hydrogeologic units based on their porosity and productivity. Spinner logs, thermal logs, and possibly hydrophysical logs (depending on the budget and schedule) will be evaluated to estimate the depths of the producing zones. These evaluations will be qualitative, and procedures for selection of intervals may vary from borehole to borehole.

5.2 CALIBRATION OF EQUIPMENT

Flow meters utilized during the pumping test should be checked in the field against manual measurements made by the timed-volume method (e.g. with a 55-gallon barrel and a stopwatch). If flow meter measurements are within 5% of manual measurement values, the flow meter shall be considered calibrated. If flow meter measurements do not meet these criteria, the flow meter will be considered out of calibration, and manual barrel and stopwatch methods will be used to monitor flow rates.

A stable flow condition is defined as when the change in flow rate from the outflow tube is less than five percent of the total flow rate. For example, if the borehole is being pumped at 100 gpm, a 5-gpm fluctuation in the pumping rate over a five-minute interval will be acceptable. Pumping will be continued until satisfactory conditions are reached or until the PI decides that the larger fluctuations are acceptable.

Detailed procedures for the performance and documentation of both field and laboratory calibrations of pressure and temperature probes are contained in TP-9.2, *Instrument Calibration and Collection and Processing of Data from Boreholes*. Additional information is contained in QAP-12.1, *Procedures for Control of Measuring and Testing Equipment*. Care should be taken to document probe serial numbers and calibration status in the Scientific Notebooks. Copies of all calibration files and appropriate metadata will be transmitted to the NWRPO QARC after completion of the test.

5.3 PROCEDURE FOR PERFORMING AN ISOLATED ZONE TEST

The exact procedures and equipment required to run an isolated zone test vary depending on test objectives, hole conditions, depth to water, desired pumping rates, etc. The procedures listed here provide a general guide for conducting an isolated zone test. The procedure for the more complicated open hole test is presented. The

procedure for a cased hole test is similar with a reduction in the size and number of redundant packer elements. In all cases, a detailed test plan for each specific well will be prepared by the PI prior to testing.

The selected intervals of interest in each borehole will be tested using a guarded packer system. This test will require good borehole conditions and competent packer seats. The competency and appropriateness of the packer seats will be decided by the NWRPO Scientist/Engineer based on evaluation of the completion, caliper and/or video logs if available. The purpose of using a packer assembly is to allow the well to be separated into three distinct intervals: the upper interval above the uppermost packer, the test interval between the packers, and the lower interval below the lowermost packer. In general, the packers should be set in a portion of the borehole that is nearly in gauge and that is in a competent section of the borehole. Packers should not be set in sections of the borehole that may be eroded during testing, and should provide an effective seal between the test interval and the intervals above and below the test interval.

All three intervals should be equipped with transducers to measure temperature and pressure. The determination of the seal effectiveness will be made using a short-term pulse test. In this pulse test, the pressure in the center zone will be perturbed. Pressure perturbation may be accomplished by pumping a small amount of water from, or injecting a small amount of water into, the test interval. (Water may be injected using a small amount of air injection, as long as the volume of air injected is small enough to ensure that air does not enter the formation.)

The contractor responsible for the packer testing should have a complete QA-technical program that covers lowering and raising, integrity and maintenance, decontamination, and assembly and disassembly of the packer system. This QA procedure should be compliant with Nye County's *NWRPO Quality Assurance Program*.

At a minimum, the pressure and temperature measurements should be done with transducers placed downhole and recorded with a datalogger that is able to transfer the data to a personal computer in an acceptable format. A flow meter should be installed at the ground-surface facility. The accuracy of the flow meter should be cross-checked with the timed filling of vessel(s) with known volume. Pressure and temperature gauges should be selected to cover the anticipated range. In addition, surface facilities should include measurements of barometric pressure and surface temperature. The test zone pressure-transducer sensitivity should be no larger than 0.1 psi.

At the discretion of the PI, offset wells and zones may be equipped with pressure transducers to monitor changes in the hydraulic head during and following the tests. All zones should have temperature probes sensitive to 0.1°C. Packer lengths should

be at least 1 m. The flow-metering device should be equipped with reducing valves to enable relatively accurate regulation of the flow rate. The objective is to obtain a stabilized pressure and flow rate in the test zone before completion of the test. The packer/pump system should be equipped with a downhole solenoid or check valve to allow rapid flow shut off.

Once the adequacy of the packer seals is tested and accepted, the testing will begin as described here. After completion of the packer seal test, the packers will be allowed to come to equilibrium for approximately 1 hr. The pump will be turned on for a pre-determined flow rate specified by the on-site NWRPO Scientist/Engineer. Pressure, temperature, and flow rates at all downhole zones and at the surface facility will be monitored at a rate specified by the on-site NWRPO Scientist/Engineer. If feasible, the test will be run for at least 4 hr. at an approximately constant flow rate. Shorter testing times may be necessary if there are budget or schedule constraints. Once an approximately steady flow and pressure are established, the flow solenoid or check valve will be closed and the pressure and temperature in all locations recorded. The length of the shut-in pressure test will be at least 1 hr. or until the pressure and temperature have reached steady-state conditions. To minimize drilling rig standby time, the recovery test may be terminated after 4 hr. if full recovery is not achieved.

6.0 DATA ACQUISITION METHODOLOGY AND LIMITATIONS

Scientific Notebooks and data collected under this Technical Procedure and Technical Procedures TP-9.2 *Instrument Calibration and Collection and Processing of Data from Boreholes* and TP-9.9, *Measurement of Groundwater Levels*. All data and associated metadata will be submitted to the NWRPO QARC following the conclusion of the test.

7.0 REFERENCES

All manuals related to the installation and operation of any zonal isolation equipment and instruments in boreholes are maintained at the Nye County Geotechnical Representative's office, including, but not limited to:

- The Westbay® field manual for operation of the MOSDAX® instrument assembly in boreholes.
- Calibration instructions for pressure and temperature probes.
- The zonal isolation completion report for each applicable borehole.

In addition, copies of the following Quality Assurance procedures should be maintained at the test location:

- TP-9.2, *Instrument Calibration and Collection and Processing of Data from Boreholes*
- TP- 9.9, *Measurement of Groundwater Levels*
- TP-9.5, *Variable Scale Pumping Tests in Unscreened Open Boreholes or in Screened Boreholes, with or without Observation Wells*
- TP-10.0, *Pumping/Injection Tests of Packed-Off Zones in Unscreened Open Boreholes or in Multiple Screen Boreholes with or without Observation Wells*

8.0 RECORDS

Copies of all electronic data files, calibration files, and associated metadata will be transmitted to the NWRPO QARC. The NWRPO will be responsible for maintaining the Scientific Notebooks on the individual wells as required by QAP-3.2, *Procedures for Documentation of Scientific Investigations*.

9.0 ATTACHMENTS

N/A

10.0 TEST CONDITIONS

The appropriateness of the test conditions shall be determined by the PI and field personnel.

11.0 PERSONNEL REQUIREMENTS

There are no specific personnel requirements other than those described in Section 2.2.

12.0 SPECIAL ENVIRONMENTAL TEST/STORAGE CONDITIONS

There are no special requirements for environmental test or storage conditions.

13.0 INSPECTION HOLD POINTS

There are no applicable inspection hold points.

14.0 ACCEPTABLE DETAIL AND ACCURACY LEVELS

Verification of calculations shall be made with a relative error of less than 1 in 1,000.