NYE COUNTY NUCLEAR WASTE REPOSITORY PROJECT OFFICE

WORK PLAN

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APPROVAL

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5/28/08

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1.0 INTRODUCTION

This work plan (WP) describes the requirements and procedures for the collection, testing, and management of samples during Phase VI of the Nye County Nuclear Waste Repository Project Office (NWRPO) Independent Scientific Investigations Program (ISIP) Early Warning Drilling Program (EWDP). This WP addresses sample management for boreholes NC-EWDP-4PC, 2P, 33PA, and 8P.

The NWRPO Geoscience Manager and the managing contract geologist will be the Principal Investigators (PIs) for the geologic sampling described in this WP. A separate contractor, referred to as the "groundwater sampling and analysis PI," will serve as the PI for groundwater sampling; contractors performing all other activities described in this WP are referred to as "NWRPO" or "NWRPO personnel."

2.0 PURPOSE

This WP details the actions necessary to manage all borehole samples (e.g., rock or fluid) collected during the EWDP, and includes tables of sample depth intervals, required field analyses, and laboratory tests. Specific NWRPO quality assurance (QA) procedures to be used for sample collection, logging, storage, and chain of custody are listed herein. All referenced WPs, technical procedures (TPs), test plans (TPNs), and quality administrative procedures (QAPs) shall be the most current versions of those documents.

3.0 BACKGROUND

The EWDP is a part of the ongoing NWRPO scientific investigations related to the construction and operation of a high-level radioactive waste repository at Yucca Mountain, Nevada. Basic geologic and hydrologic data gaps exist for a large area near Yucca Mountain. Past studies conducted by the U.S. Department of Energy (DOE) have concentrated on characterizing the conditions in the immediate vicinity of the repository. The data collected to date indicate that there is significant spatial variability in hydraulic properties, water levels, temperatures, and water chemistry in the aquifers near, and downgradient from Yucca Mountain.

According to the information presented in the *Total System Performance Assessment-Site Recommendation 2001* (DOE, 2001), water level, aquifer test, and water chemistry data are not available for a large area of southern Jackass Flats, southern Crater Flat, Oasis Valley, Rock Valley, and the northern Amargosa Desert. Quantitative hydrologic data are needed to define the conditions in these areas to identify and evaluate the risk associated with long-term waste disposal at the repository; the EWDP is designed to meet the need for these additional data.

4.0 SCOPE OF WORK

Two general sample types will be collected from new EWDP Phase VI boreholes: drill cuttings and water samples.

EWDP Phase VI boreholes will be drilled using methods described in WP-5.0, *Drilling and Well Construction*. Drilling activities will be carried out in accordance with TP-7.0, *Drill Site Management*.

Drill cuttings samples will be handled and geologically logged according to TP-8.0, *Field Collection, Logging, and Processing of Borehole Geologic Samples*. Water samples will be collected and handled according to TP-8.1, *Field Collection and Handling of Water Samples*.

4.1 Drill Cuttings Sample Management

Prior to drilling, the onsite geologist will ensure that 1) all labels and sample documentation have been generated and are available for drill cuttings samples and 2) all necessary containers (e.g., boxes and bags) and other packing, marking, and preservation materials are available.

The types and numbers of drill cuttings samples, including splits, are summarized in Table 1. Drill cuttings sample collection will be limited to new EWDP Phase VI boreholes drilled by dual-wall reverse-circulation methods. Continuous geologic drill cuttings samples will be collected using 5-gallon plastic buckets at 5-foot intervals in all geologic materials.

Samples will be homogenized and split using cone and quarter, rotating wet splitter or equivalent methods. Three split samples will be collected from each depth interval: two for the NWRPO and one for the DOE. In the event that sample return is insufficient to accommodate this split, the entire sample will be retained by the NWRPO. One NWRPO split will be subsampled to prepare a logging subsample and for chip tray samples for future reference. The remainder of this sample split will be designated for archival and will be placed in labeled canvas or olefin sample bags and shipped to the SMF under appropriate chain of custody. Gravel, sand, silt, and clay percentages are estimated on the logging subsample collected from both unsaturated and saturated alluvium. The NWRPO split and the DOE split will be collected for archival at the DOE Yucca Mountain Project (YMP) Sample Management Facility (SMF). The second NWRPO split will be collected for laboratory testing of alluvial materials. The NWRPO laboratory split will be placed in labeled and sealed double plastic bags and shipped to the NWRPO testing laboratory under appropriate chain of custody. All splits should weigh approximately 5 pounds or less. The laboratory tests to be conducted on drill cuttings samples are summarized in Table 1. The methods used to conduct these tests are summarized in Table 2. Wet sieve analysis will be conducted for all alluvial samples; hydrometer, specific gravity, and Atterberg limits measurements will be made on a selected ten percent of the samples.

All laboratory analyses will be submitted to the NWRPO Quality Assurance Records Center (QARC), along with all supporting documentation and metadata, immediately after data checking and reduction.

Strict chain of custody will be maintained for the drill cuttings samples at all times. The samples will be held in view of the current responsible holder of the samples or secured in locked storage. The distribution of drill cuttings sample splits will be controlled and documented using the NWRPO Transfer of Custody Form found in TP-8.0.

The NWRPO split of the drill cuttings transferred to the SMF will be maintained under institutional chain of custody and sample management controls. Drill cuttings samples will be stored in sample bags inside standard core boxes. Boxes of drill cuttings will be stored inside SMF buildings under the same environmental conditions maintained for other SMF inventory.

4.2 Water Sample Management

Several organizations other than the NWRPO (e.g., the University of Nevada, Las Vegas Harry Reid Center for Environmental Studies; Los Alamos National Laboratory; and the U.S. Geological Survey) will collect water samples during Phase VI. The NWRPO will have the authority to approve access to well sites and sampling plans for these organizations.

NWRPO personnel will ensure that EWDP water samples are collected according to TP-8.1. Prior to sampling, NWRPO personnel will ensure that all necessary bottles and other packing, marking, and preservation materials are available, as well as the necessary calibrated instrumentation and equipment. All equipment will be calibrated according to QAP-12.1, *Control of Measuring and Test Equipment*, and will be documented in the field geochemistry scientific notebook according to QAP-3.2, *Documentation of Technical Investigations*. Water samples will be maintained under strict chain of custody at all times.

4.2.1 First Water Samples

First water will be measured, developed, and documented as described in WP-5.0. The preferred method of sample collection is bailing; however, airlifting is acceptable if bailing is not practical. If directed by the PI(s), the water will be sampled for field measurements of temperature, pH, and electrical conductivity; samples may also be collected for laboratory analysis.

4.2.2 Additional Water Sampling

When the borehole has been advanced to the water table, subsequent water level measurements and sampling may be done at the direction of the PI. Field measurements of temperature, pH, and electrical conductivity will be made; samples may also be collected for laboratory analysis. Field measurements and samples collected for possible laboratory analysis will be documented in the field scientific notebook according to QAP-3.2.

4.2.3 Post-Development Water Sampling and Analysis

After well development at all new EWDP Phase VI wells, at least two groundwater samples will be collected from each well screen for the chemical analysis of a comprehensive suite of analytes. Field measurements may include pH, temperature, electrical conductivity, alkalinity, dissolved oxygen, and oxidation-reduction potential; these field parameters will be recorded according to TP-8.1. Possible laboratory analyses and testing laboratories are summarized in Table 3. Field data forms and original laboratory analyses will be submitted to the QARC upon receipt by the groundwater sampling and analysis PI, along with any processed QA data and associated metadata.

5.0 MANAGEMENT

The project QA Officer is responsible for the coordination of the internal review of this WP and verifying compliance with its requirements. Geologic and groundwater sampling and analysis PIs are responsible for the preparation and modification of this WP, as well as oversight of its performance. NWRPO personnel are responsible for carrying out field sampling and testing.

Equipment used to measure temperature, pH, and electrical conductivity in the field will be calibrated according to QAP-12.1. Laboratory analyses of EWDP water samples will be performed by facilities certified to use methods and procedures consistent with industry standards and U.S. Environmental Protection Agency-approved methods and procedures. The NWRPO testing laboratory will follow industry-standard methods when measuring hydraulic parameters.

To ensure that the work will be quality-controlled and accomplished in accordance with the scope and objectives of the NWRPO, the following training and documentation will be accomplished before conducting the activities described in this WP. All individuals performing these activities will be trained in the applicable QA procedures listed below and will document that they have read and understand the procedures before conducting work.

- QAP-3.2, *Documentation of Technical Investigations.*
- QAP-12.1, *Control of Measuring and Test Equipment.*
- TP-7.0, *Drill Site Management.*
- TP-8.0, *Field Collection, Logging, and Processing of Borehole Samples.*
- TP-8.1, *Field Collection and Handling of Water Samples.*
- WP-5.0, *Phase VI Drilling and Well Construction.*

6.0 REFERENCES

DOE, 2001. *Yucca Mountain Total System Performance Assessment – Site Recommendation.* Washington, D.C.: U.S. Department of Energy. TDR-WIS-PA-00001, MDL-WIS-PA-00001.

QAP-3.2. *Documentation of Technical Investigations.* Quality Administrative Procedure. Nye County Nuclear Waste Repository Project Office (NWRPO). Pahrump, Nevada.

_QAP-12-1. *Control of Measuring and Test Equipment.*

TP-7.0. *Drill Site Management.* Technical Procedure. Nye County NWRPO. Pahrump, Nevada.

_TP-8.0. *Field Collection, Logging and Processing of Borehole Geologic Samples.*

_TP-8.1, *Field Collection and Handling of Water Samples.*

WP-5.0. *Phase VI Drilling and Well Construction*. Work Plan. Nye County NWRPO. Pahrump, Nevada.

Table 1
Drill Cuttings Sampling, Splitting, and Field/Laboratory Testing Summary

Borehole (NC-EWDP-)[a]	Geologic Material Description[b]	Estimated Thickness of Material (feet)	Drill Cuttings Sample Interval (feet)	Total Number of Drill Cuttings Sample Intervals	Number of NWRPO[c] Field Measurements		Number of Drill Cuttings Samples							
							Splits (5-pound Bags)			10-gallon Return Samples	NWRPO Laboratory Analysis			
					Percent Gravel/Sand/Fines Estimates	NWRPO Logging and Chip-Tray Split	NWRPO SMF[d] Split	DOE/YMP[e] SMF Split	NWRPO Laboratory Split		Specific Gravity	Atterberg Limits	Particle Size	
													Wet Sieve	Hydro-meter
4P	Unsaturated alluvium	300	5	60	60	60	60	60	60	15	6	6	60	6
	Saturated alluvium	700	5	140	140	140	140	140	140	35	14	14	140	14
	Other unsaturated rock types	0	5	0	0	0	0	0	0	0	0	0	0	0
	Other saturated rock types	1,000	5	200	0	200	200	200	0	0	0	0	0	0
2P	Unsaturated alluvium	300	5	60	60	60	60	60	60	15	6	6	60	6
	Saturated alluvium	370	5	74	74	74	74	74	74	18	8	8	74	8
	Other unsaturated rock types	0	5	0	0	0	0	0	0	0	0	0	0	0
	Other saturated rock types	1,330	5	266	0	266	266	266	0	0	0	0	0	0
33PA	Unsaturated alluvium	195	5	39	39	39	39	39	39	8	4	4	39	4
	Saturated alluvium	0	5	0	0	0	0	0	0	0	0	0	0	0
	Other unsaturated rock types	10	5	2	0	2	2	2	0	0	0	0	0	0
	Other saturated rock types	1,795	5	359	0	359	359	359	0	0	0	0	0	0

[a]Official prefix of all Nye County wells.
[b]Alluvium is defined as all unconsolidated sediments.
[c]Nuclear Waste Repository Project Office.
[d]Sample Management Facility.
[e]U.S. Department of Energy Yucca Mountain Project.

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							Splits (5-pound Bags)			10-gallon Return Samples	NWRPO Laboratory Analysis			
					Percent Gravel/Sand/Fines Estimates	NWRPO Logging and Chip-Tray Split	NWRPO SMF[d] Split	DOE/YMP[e] SMF Split	NWRPO Laboratory Split		Specific Gravity	Atterberg Limits	Particle Size	
													Wet Sieve	Hydro-meter
8P	Unsaturated alluvium	250	5	50	50	50	50	50	50	13	5	5	50	5
	Saturated alluvium	0	5	0	0	0	0	0	0	0	0	0	0	0
	Other unsaturated rock types	100	5	20	0	20	20	20	0	0	0	0	0	0
	Other saturated rock types	1,650	5	330	0	330	330	330	0	0	0	0	0	0
TOTALS				**1,600**	**423**	**1,600**	**1,600**	**1,600**	**423**	**104**	**43**	**43**	**423**	**43**

Table 2
Laboratory Test Methods for Drill Cuttings Samples

Laboratory Test	Method
Specific gravity (grain density)	ASTM D-854-02. Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer. In: 2003 *Annual Book of ASTM Standards,* Vol. 04.08, American Society for Testing and Materials.
Wet sieve analysis	ASTM D-1140-00. Standard Test Methods for Amount of Material in Soil Finer Than the No. 200 (75 um) Sieve (Method B for wet sieve analysis). In: 2003 *Annual Book of ASTM Standards,* Vol. 04.08, American Society for Testing and Materials.
Hydrometer analysis (i.e., silt/clay break starting with No. 4 sieve)	ASTM D-422-63 (Reapproved 1998). Standard Test Method for Particle Size Analysis of Soils. In: 2003 *Annual Book of ASTM Standards,* Vol. 04.08, American Society for Testing and Materials.
Atterberg limits	ASTM D-4318-00. Standard Test Methods for Liquid Limit, Plastic Limit, and plasticity Index of Soils. In: 2003 *Annual Book of ASTM Standards,* Vol. 04.08, American Society for Testing and Materials.

Table 3
Summary of Groundwater Analyses and Testing Laboratories

Laboratory Analyses	Testing Laboratory
Indicator parameters (i.e., pH, electrical conductivity, total dissolved solids, and alkalinity) anions (i.e., chloride, fluoride, and sulfate), nutrients (i.e., nitrate, nitrite, and phosphate), and metals	ACZ Laboratories, Steamboat Springs, CO
Gross alpha and beta and tritium	Radiation Safety, Chandler, AZ
Stable isotope ratio analysis (SIRA) of oxygen and hydrogen in water and SIRA of nitrogen in nitrate	Coastal Science Laboratories, Austin, TX
SIRA of carbon in total dissolved inorganic carbon and radiocarbon-14	Beta Analytic, Miami, FL