NYE COUNTY NUCLEAR WASTE REPOSITORY PROJECT OFFICE

TEST PLAN

TITLE: **Groundwater Sampling and Analysis of Groundwater Evaluation Program Wells**	Revision: **1** Date: **10/19/2012** Page: **1 of 9**
TEST PLAN NUMBER: **TPN-11.6**	SUPERSEDES: **Rev. 0, 04-26-11**
APPROVAL Project Manager 10/22/12 Date	CONCURRENCE Geoscience Manager 22 Oct 2012 Date Principal Investigator 11-15-12 Date Quality Assurance Officer 10/19/12 Date

1.0 INTRODUCTION

This test plan (TPN) provides detailed groundwater sampling and analysis instructions specific to a Nye County Nuclear Waste Repository Project Office (NWRPO) groundwater sample collection session planned for Groundwater Evaluation (GWE) wells. This TPN supplements work plan (WP) WP-11, *Groundwater and Surface Runoff Water Chemistry Sampling and Analysis* and technical procedure (TP) TP-8.1, *Field Collection and Handling of Water Samples*, identifies testing laboratories, and provides detailed guidance for the maintenance and preparation of field measurement equipment and sample collection, preservation, storage, and shipping.

2.0 ANALYTICAL LABORATORIES

2.1 ACZ Laboratories

ACZ Laboratories (ACZ) in Steamboat Springs, Colorado, will analyze all groundwater samples, referred to in this plan as water samples, for indicator parameters, major anions and cations, trace metals, and nutrients (i.e., nitrate plus nitrite, phosphate, and ammonium). ACZ will also analyze field blanks. The ACZ point of contact, mailing address, telephone number, and email address are listed in the following.

Tony Antalek, Project Manager
ACZ Laboratories, Inc.
2773 Downhill Dr.
Steamboat Springs, CO 80487
970-879-6590 ext. 107
TonyA@acz.com

2.2 Isotech Laboratories, Inc.

Isotech Laboratories, Inc., in Champagne, Illinois, will analyze all water samples except field blanks, for stable isotope ratio analysis (SIRA) of nitrogen in nitrate and SIRA of oxygen and hydrogen in water ($\delta^{18}0$, $\delta^{2}H$). The Isotech point of contact, mailing address, telephone number, and email address are listed in the following.

Steve Pelphry
1308 Parkland Court
Champaign, IL 61821
(877)-362-4190
steve@isotechlabs.com

2.3 Radiation Safety Engineering, Inc.

Radiation Safety Engineering, Inc. (RSE), in Chandler, Arizona, will analyze water samples except field blanks, for gross alpha and beta counts. The RSE points of contact, mailing address, telephone number, and email address are listed in the following.

Michael Meglemre
Radiation Safety Engineering, Inc.
3245 North Washington St.
Chandler, AZ 85225
480-897-9459
mmetzger@radsafe.com

2.4 University of Arizona, Tucson

University of Arizona in Tucson, AZ will analyze water samples for tritium. The University of Arizona point of contact, mailing address, telephone number, and email address are listed in the following:

Chris Eastoe
Department of Geosciences
1040 E. Fourth St., Room 208
University of Arizona
Tucson, AZ 85721-0077
eastoe@email.arizona.edu

2.5 Beta Analytic, Inc.

Beta Analytic, Inc. will analyze water samples for SIRA of carbon in total dissolved inorganic carbon (C-13/C-12) and radiocarbon (C-14/C-13). The Beta Analytic, Inc. point of contact, mailing address, telephone number, and email address are listed in the following.

Darden Hood
Beta Analytic, Inc.
4895 SW 74 Court
Miami, FL 33155
(305)-667-5167
dhood@radiocarbon.com

3.0 PORTABLE FIELD MEASUREMENT EQUIPMENT MAINTENANCE AND PREPARATION

Instruments for measuring field indicator parameters include the Oakton 300 pH/CON meter and Orion 3 Star Plus Optical Dissolved Oxygen meter or equivalent meter. Manuals or manufacturers' instructions should be available at all times when using this equipment.

3.1 Oakton 300 pH/CON Meter

Before the start of sampling, the Oakton meter will be prepared for use according to the following steps:

- Check all probes for signs of wear and corrosion.
- Condition pH and conductivity probes
- Perform a calibration check to verify pH, conductivity, and temperature accuracy.

Before the start of sampling calibrate pH range on the Oakton meter using 7.00, 4.01 and 10.01 pH standards then read the standards as samples and record the readings in the scientific notebook. Also immediately prior to sampling calibrate the conductivity range on the Oakton meter using a 1413 µS/cm standard then read the standard as a sample and record the reading in the scientific notebook. If calibration is successful, proceed with measurement of water sample parameters as water samples are taken. If calibration is unsuccessful, repeat the maintenance and calibration steps as directed. If calibration is

still unsuccessful, notify the PI or designee, and contact Oakton Technical Support by phone at 949-757-0353, by fax at 949-757-0363.

3.2 Orion 3 Plus Optical Dissolved Oxygen Meter

Before the start of sampling verify the Orion 3 Plus meter calibration by wetting the sponge in the calibration sleeve with distilled water, turn the meter on, and then press the calibrate button. When properly calibrated against water saturated air the meter will read 100.0 % (+/- 0.2%) dissolved oxygen (DO). Calibration of the meter is current for one year at which time the sensor cap must be changed. However, the calibration must be verified prior to use. If calibration verification is successful proceed with measurement of dissolved oxygen in the water samples as they are taken. If calibration verification is unsuccessful, and repeat maintenance and calibration steps as directed. If calibration problems continue, notify the PI or designee, and contact Geotech sales and service at 800-833-7958, by fax at 303-322-7242.

4.0 LABORATORY AND FIELD ANALYSES

4.1 Laboratory Analyses

A summary of water chemistry analyses to be conducted on samples during the sampling session is presented in Table 1.

4.2 Water Chemistry Monitoring and Data Collection

Calibrate all portable field equipment before data collection as indicated above.

Monitor field water chemistry parameters and fill out Attachment A: NWRPO Groundwater Sample Collection Form and assess the stability of the measurements relative to the amount of water purged from the well. Electrical conductivity (EC), and pH should stabilize as the well is purged. DO and temperature of the purged water may not stabilize, due to changes in air temperature, atmospheric pressure, or the heating of sampling equipment on the ground surface by radiant energy from the sun.

After purging of a minimum of three well volumes is complete at each well, collect a sample for field measurement of pH, conductivity, and DO. If purging of the well is not possible, field measurements should be taken before the start of sampling.

5.0 SAMPLE COLLECTION

Samples will be collected from each of the wells for the laboratory analyses listed in Table 1. In addition, quality assurance (QA) samples will be collected as follows: blind field duplicate samples and blanks from approximately once per week, or at a frequency specified by the PI. The PI or designee will determine the specific well to be sampled for QA samples. Detailed QA sample collection instructions will be given in the field by the PI or designee and recorded in the GWE pumping and sampling scientific notebook.

Blind field duplicates will be analyzed for all analytes listed in Table 1; field blank samples will be analyzed only for nutrients (i.e., nitrate plus nitrite, phosphate, and ammonium), metals, major anions and cations, and indicator parameters.

6.0 SAMPLE FILTERING, BOTTLING, AND PRESERVATION

Table 2 summarizes sample filtration, bottling, and preservation requirements for major analyte groups for ACZ, Isotech, RSE, University of Arizona, and Beta. Filtering and bottle labeling methods are described in TP-8.1. Specific bottle type, size, and numbers are listed on Table 2. Sample bottles are to be filled to the levels indicated in Table 2. ACZ will provide bottles and preservatives for samples being sent to its laboratory.

The sampling work area (i.e., table or bench tops) should be thoroughly cleaned before sampling and kept as clean as possible during sample collection to minimize sample contamination. When filling sample bottles, note sources of contamination and minimize these sources when possible. Use new, clean tubing to fill sample bottles for each well. Ensure that at least two volumes of the sample fluid pass through each new tubing/filter combination before collecting samples.

Rinse bottles and caps that are not acid pre-preserved with sample water three times unless bottles have been baked. Fill the bottle to the required level, and add preservatives when required, ensuring that all preservative is added. Note: analytes requiring preservation for analysis by ACZ are taken in bottles provided by ACZ that are pre-preserved. Adding preservatives as a last step, as indicated in the Sample Collection Sheet – Table 2, helps to ensure that the work area is not contaminated with acids and that the sample is preserved properly. Process samples requiring preservatives last to minimize the chance of contaminating gross chemistry and nutrient samples with acids.

Have one person add preservatives and put on new gloves before changing preservative types. It is important to handle preservatives carefully to ensure that they are not spilled in the work area. Preservatives pose a potential safety risk and can easily contaminate samples with nitrate, sulfate, or other ions. If acid preservatives are spilled on the work area, neutralize the acid with a solution of water and sodium bicarbonate, rinse with bottled tap water, and wipe the area dry with paper towels.

7.0 SAMPLE STORAGE

In the field, minimize the exposure of samples to heat and direct sunlight, and transport samples to the NWRPO at the end of each sampling day. When possible, store samples in the field in coolers with ice packs.

When the samples have been transported to the NWRPO, store them as indicated in Table 2.

8.0 SAMPLE SHIPPING

Ship all samples to the appropriate testing laboratory within 7 days of sampling in coolers with NWRPO chain-of-custody forms and any forms required by the lab. Any samples with an EC less than 1500 µS/cm must be labeled with "DO NOT DILUTE SAMPLES, IF DILUTION IS NECESSARY CONTACT [Levi Kryder]" on the chain-of-custody form for ACZ only. Place all samples in the coolers with the caps up; do not place them on their sides. Pack all bottles in packing material. Pad the sides of the cooler with packing material and pack samples so that they are held snugly in place. Use additional packing material to

prevent the samples from moving during shipping; pack the top of the cooler with packing material so that samples cannot move vertically.

Pack all refrigerated and frozen samples with blue ice or some form of cold pack. If possible, pack all refrigerated and frozen samples together to ensure they remain cold for a longer period of time. Do not use free ice in the coolers; the water from melted ice can wash labels off, contaminate samples, and remove labeling tape. Ensure that coolers are securely closed and will not open during shipping.

Referring to Table 2, collate analyte groups for each laboratory and ship coolers containing samples from groups 1, 2, 6, 7, and 9, to ACZ, groups 3 and 5 to Isotech, group 4 to University of Arizona, group 8 to RSE, and group 10 to Beta Analytic. Ship all samples by overnight carrier (i.e., Federal Express) to the addresses as indicated in section 2.0. Do not ship samples on Friday.

Table 1
Summary of Possible Water Chemistry Analytes

Analyte	Detection Limit
Aluminum	0.03 milligrams per liter (mg/L)
Antimony	0.0004 mg/L
Arsenic	0.0005 mg/L
Barium	0.003 mg/L
Beryllium	0.002 mg/L
Boron	0.01 mg/L
Cadmium	0.005 mg/L
Calcium	0.2 mg/L
Chromium	0.01 mg/L
Cobalt	0.01 mg/L
Copper	0.01 mg/L
Iron	0.02 mg/L
Lead	0.0001 mg/L
Lithium	0.02 mg/L
Magnesium	0.2 mg/L
Manganese	0.005 mg/L
Molybdenum	0.01 mg/L
Nickel	0.01 mg/L
Potassium	0.3 mg/L
Selenium	0.001 mg/L
Silica	0.2 mg/L
Silver	0.00005 mg/L
Sodium	0.3 mg/L
Strontium	0.00005 mg/L
Thallium	0.0001 mg/L
Titanium	0.005 mg/L
Uranium	0.0001 mg/L
Vanadium	0.005 mg/L
Zinc	0.01 mg/L
Alkalinity as CaCO3	2 mg/L
Bromide	0.1 mg/L
Chloride	1 mg/L
Conductivity at 25 degrees centigrade (°C)	1 micromhos per centimeter (µmho/cm)
Fluoride	0.1 mg/L
Nitrate/Nitrite as N	0.02 mg/L
Nitrogen, ammonia	0.05 mg/L
pH (laboratory)	0.1 units
Phosphorus	0.01 mg/L
Sulfate	10 mg/L
Residue, filterable (total dissolved solids [TDS]) at180 °C	10 mg/L
Gross alpha	0.4 picocuries per liter (pCi/L)
Gross beta	0.1 pCi/L
Tritium	365 pCi/L
Radiocarbon (C-14)	300 micrograms carbon/liter (µg C/L) as DIC[a]
SIRA[b] of carbon in TDIC[c]	300 µg C/L as DIC
SIRA of oxygen and hydrogen in water	N/A
SIRA of nitrogen in nitrate	N/A

[a] Detection limit of total dissolved inorganic carbon in groundwater to obtain both ^{14}C and $^{13}C/^{12}C$.
[b] Stable isotope ratio analysis.
[c] Total dissolved inorganic carbon.

Table 2
Sample Collection, Storage, and Shipping Information

Wells to be Sampled:										
Analyte Group	**Sample Type**	**Filter (Yes/ No)**	**Fill Level**	**Preservative**	**Bottle Type**	**Bottle Size**	**Bottles per Sample**	**Type of Storage**	**Laboratory**	**Special Shipping Instructions**
1	Alkalinity, electrical conductivity (EC) pH	No	Fill completely	No	HDPE[a]	50ml	1	Refrigerate.	ACZ	Ship with cold packs.
2	Wet chemistry-unfiltered	No	Fill completely	No	HDPE	500ml	1	Refrigerate.	ACZ	Ship with cold packs.
3	SIRA of oxygen and hydrogen in water.	No	Fill completely	No	Glass[b]	250 ml	1	Cool, dry, and unexposed to sunlight.	Isotech	None.
4	Tritium	No	To the neck	No	HDPE	500 ml	1	Cool, dry, and unexposed to sunlight.	Univ. of AZ.	None.
5	SIRA[c] of nitrogen in nitrate	No	85%	No	HDPE	1,000	1	Frozen	Isotech	Ship with cold packs, tape seal around cap.
6	N-NH3, NO3-NO2, total P	No	To the neck	Yes (H2SO4)[d]	HDPE	250	1	Refrigerate.	ACZ	Ship with cold packs.
CHANGE GLOVES										
7	Wet chemistry-filtered	Yes	Fill completely	No	HDPE	250	1	Refrigerate.	ACZ	Ship with cold packs.
CHANGE GLOVES										
8	Gross alpha and beta	Yes	To the neck	Yes (HNO3)[e]	HDPE	1,000	4	Cool, dry, and unexposed to sunlight.	RSE	Wrap in bubble wrap.
9	Dissolved metals	Yes	Fill completely	Yes (HNO3)	HDPE	250	1	Cool, dry, and unexposed to sunlight.	ACZ	None.
CHANGE GLOVES										
10	SIRA of carbon in total dissolved inorganic carbon ;Radiocarbon (C-14/C-13)	Yes	To the neck	Yes (NaOH)[f]	Amber glass[b]	1,000 ml	1	Refrigerate.	Beta Analytic	Ship with cold packs.

[a] High density polyethylene.
[b] Precleaned and baked.
[c] Stable Isotope Ratio Analysis.
[d] Sulfuric Acid.
[e] Nitric Acid.
[f] Sodium Hydroxide.

Attachment A
Groundwater Sample Collection Form

Well Data

Sheet ____ of ____

Sampling Episode Description	Sandpack Interval(s) (ft bgs)		Depth to Water (ft bgs)	
			Total Depth (ft bgs)	
Well ID	Water Level before Purging (ft bgs)	Water Level After Purging (ft bgs)	Casing Diameter (ID, ft)	
Sampler			Water-filled Casing Volume (ft^3)	Water-filled Casing Volume (gallons)

Purging Data

Initials	Date	Clock Time	Elapsed Time (min, sec)	Purge Volume Calculations/Measurements				Field Water Quality Parameters			
				Pump Rate (gpm)	Purge Volume (gallons)	Number of Casing Volumes	Cumulative Number of Casing Volumes	Temp (°C)	pH	EC (µmhos/ cm)	Comments

Groundwater Sample Collection Data

Initials	Sample Number	Analyte Group	Testing Laboratory	Bottle	Filtered (yes/no)	Preservative	Analyte Group	Testing Laboratory	Bottle	Filtered (yes/no)	Preservative