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MOORE RANCH URANIUM PROJECT

RESPONSES TO:

NRC

JULY 27, 2009 - AUGUST 18, 2009

SAFETY EVALUATION REPORT

OPEN ISSUES

ENERGYMETALS

CORPORATION US

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MOORE RANCH

NRC SER OPEN ISSUES

JULY-AUGUST 2009

July 27, 2009
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Radiological Open Issue No.1
Air particulate sampling for less than 12 months
July 27 2009 Teleconference

Open Issue discussion:

The NRC staff notes that the air particulate and radon samples do not represent a minimum of 12 consecutive months of data as recommended by Regulatory Guide 4.14. Particulate and air samples do not represent one full year. It is noted that 10 CFR Part 40, Appendix A, Criterion 7, requires one full year of data prior to any major site construction. Table 2.9-12, presents two quarters of radon data.

Answer:

Data from Air particulate monitoring is presented in Section 2.9.6 of the original License Application, October 2007. Supplemental monitoring data was submitted as Addendum 2.9A – Supplemental Analytical Monitoring Data, in the Technical Report RAI response dated July 2008. Air particulate data was collected from four locations (MRA-1, MRA-2, MRA-3 and MRA-4) at the Moore Ranch site. Data collection began at all four sites on February 6, 2007. Data was collected from February 6, 2007, to November 28, 2007 (MRA-1) and January 9, 2008 (MRA-2, MRA-3, and MRA-4). To meet the recommendations of Regulatory Guide 4.14, Uranium One in consultation with Doug Mandeville, NRC Project Manager, has committed to reestablish all four stations at the Moore Ranch site to collect air particulate data during the months of December 2009, through February 1, 2010. Data will be submitted to NRC as a revised Addendum 2.9-A of the Technical Report.

Table 2.9.5.2.2(s) of Addendum 2.9A submitted in July 2008 presents four quarters of radon data.

Proposed Revisions to License Application

None at this time, Addendum 2.9 A, of Section 2.9 of the Technical Report will be revised with additional air particulate monitoring data during the second quarter 2010.

Radiological Open Issue No. 2
Lack of livestock sampling not justified
July 27 2009 Teleconference

Open Issue discussion:

The staff notes that the applicant did not report the range, population, residence time, or habitat of livestock within the license area and surrounding 2.0-mile radius as provided in Figure 2.2-1 of the Technical Report. The applicant concluded that the potential for bioaccumulation of radionuclides in these animals would be limited but provided no data or justification for this statement.

Answer:
As stipulated in Section 2.8.2 of the Technical Report the regional setting for the license area is on all private lands used for sheep grazing as the principle land use in the region. Discussions with the land owner indicated that population and residence time for grazing animals is 700 sheep year round and an additional 150 sheep during the period from April 1st through November 1st of each year. Of these approximately 650 feeder lambs are harvested each year for human consumption.

Based on this information EMC will collect baseline samples from three lambs. Samples will be collected and analyzed for the parameters specified in Regulatory Guide 4.14. Results from this sampling will be included in the Technical Report, Section 2.9.11 Food Sampling.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

None at the time

Radiological Open Issue No. 3
Lack of crop sampling not justified
July 27 2009 Teleconference

Open Issue discussion:

The staff notes that the applicant did not address the collection of crop samples or provide a justification for not collecting crop samples.

Answer:

Discussions with the land owner confirm that no crops have been raised or harvested at the Moore Ranch property for over 20 years. The last pasture land that was utilized for hay harvesting was conducted in the late 1980's. All pastureland is presently utilized for grazing/foraging by livestock specifically sheep.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

2.2.2 Land Use

Land use within the Moore Ranch License Area and a 2.0-mile review area around the License Area is illustrated on Figure 2.2-1. Table 2.2-1 describes the land use types depicted on Figure 2.2-1.

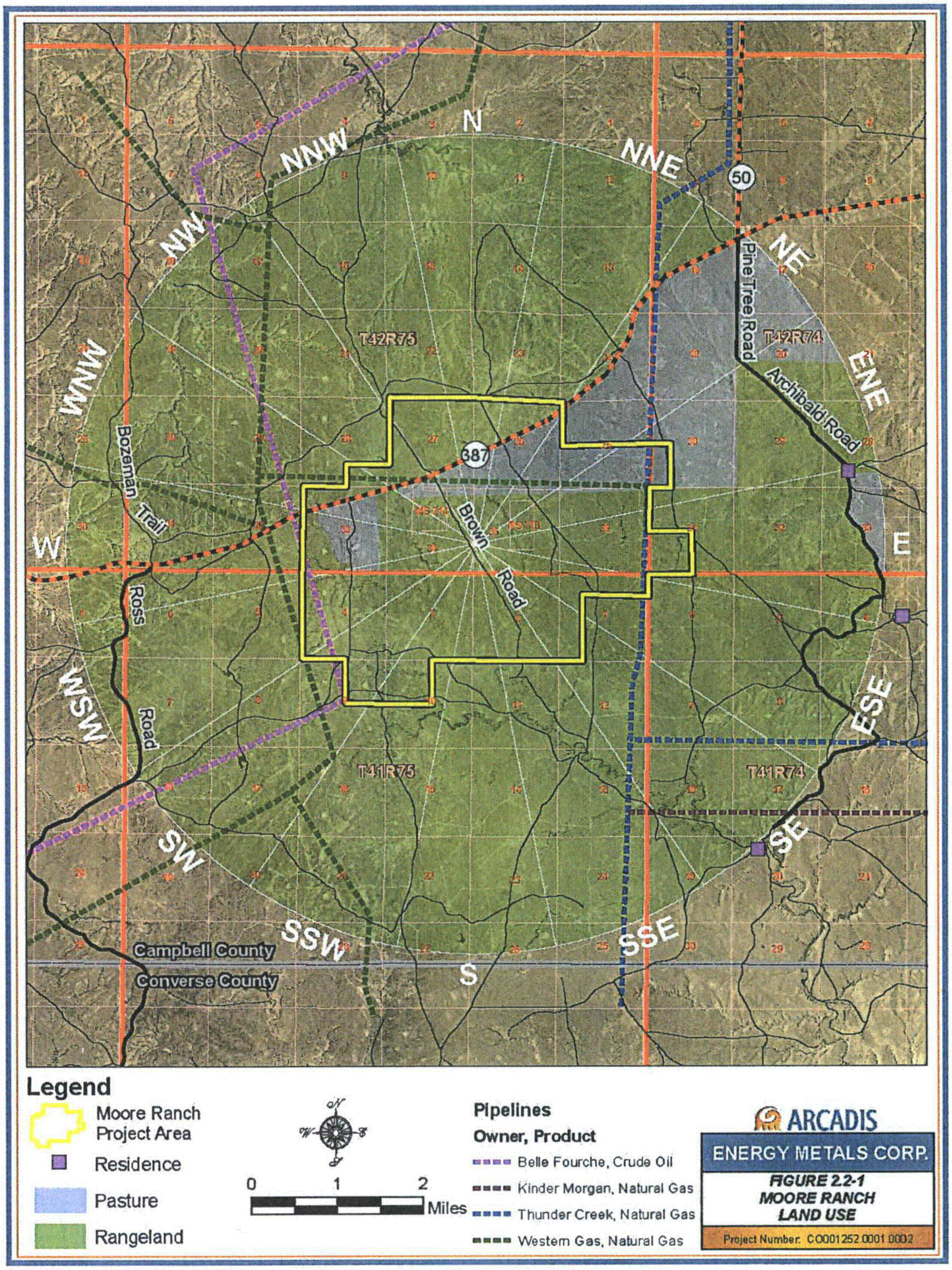
Table 2.2-2 presents land uses in 22 1/2° sectors centered on each of the 16 compass points. These sectors radiate out from the geographic center of the License Area. The total areas of the sectors vary because of the irregular site boundary. Rangeland is the primary land use within the License Area and within the surrounding 2.0-mile area. Oil and gas production facilities and infrastructure are located on rangeland land uses throughout the review area. The review area also contains pastureland to the west of the License Area. There are no other land uses that occur within the License Area and the surrounding 2.0-mile area.

Table 2.2-1 Land Use Definitions

Land Use	Definition
Pastureland (P)	Land used primarily for the long-term production of adapted, domesticated forage

	plants to be grazed by livestock or occasionally cut and cured for livestock feed.
Rangeland (R)	Land, roughly west of the 100th meridian, where the natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs; which is used wholly or partially for the grazing of livestock. This category includes wooded areas where grasses are established in clearings and beneath the overstory.

Crop sampling was not performed at the Moore Ranch Uranium Project because there are no crops currently being raised within the project area. Discussions with the land owner confirmed that crops have not been raised on pasture lands located within the project area since the late 1980's.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NNW
T42R75
T42R74
T41R75
T41R74
Pine Tree Road
Archibald Road
Brown Road
Bozeman Trail
Ross Road
387
50
Campbell County
Converse County
Legend
Moore Ranch Project Area
Residence
Pasture
Rangeland
0 1 2 Miles
Pipelines
Owner, Product
Belle Fourche, Crude Oil
Kinder Morgan, Natural Gas
Thunder Creek, Natural Gas
Western Gas, Natural Gas
ARCADIS
ENERGY METALS CORP.
FIGURE 2.2-1
MOORE RANCH
LAND USE
Project Number: CO001252.0001.0002

Table 2.2-2 Land Use of the Proposed Moore Ranch License Area and within a 2.0-Mile (3.3-km) Radius of the License Area Boundary

Compass Sector	Land Use within License Area (in acres)		Land Use within 2.0-Mile Buffer Surrounding License Area (in acres)		Total
	P	R/I	P	R/I	
NORTH	95.7	266.0	0.0	2,473.6	2,835.3
NNE	208.7	199.3	0.5	2,426.7	2,835.3
NE	287.9	89.6	2,083.7	374.1	2,835.3
ENE	328.5	347.9	805.7	1,353.2	2,835.3
EAST	0.0	678.7	218.4	1,938.3	2,835.3
ESE	0.0	368.6	0.0	2,466.6	2,835.3
SE	0.0	357.1	0.0	2,478.2	2,835.3
SSE	0.0	277.0	0.0	2,558.3	2,835.3
SOUTH	0.0	233.1	0.0	2,602.2	2,835.3
SSW	0.0	452.5	0.0	2,382.8	2,835.3
SW	0.0	618.4	0.0	2,216.8	2,835.3
WSW	11.6	599.8	0.0	2,223.9	2,835.3
WEST	198.9	316.7	0.0	2,319.6	2,835.3
WNW	93.5	345.8	0.0	2,396.0	2,835.3
NW	54.6	240.9	0.0	2,539.8	2,835.3
NNW	64.7	357.1	0.0	2,413.5	2,835.3
TOTAL	1,344.0	5,748.7	3,108.2	35,163.7	45,364.7

[1]22 $^{1}/_{2}$° sectors centered on each of the 16 compass points
[2]See Table 2.2-1 for an explanation of land use types: P = pastureland; R = rangeland.

Industrial and Mining land uses are sub-categories of the dominant rangeland land use within the License Area and the surrounding 2.0-mile review area. The Industrial and Mining land use sub-categories consists of ongoing oil and natural gas production facilities located throughout rangeland that is also used for grazing.

In 2006, an average of 50,000 livestock were reported for Campbell County (NASS 2007). Native grasslands are used for grazing within the License Area and the surrounding 2.0-mile area, and for cut hay in the northeast part of the review area. In 2005, cash receipts for livestock sales totaled $99.8 million in Campbell County. Table 2.2-3 shows the 2006 livestock inventory for Campbell County.

Table 2.2-3 2006 Livestock Inventory for Campbell County

Type of Livestock	Number	Percent of Total	Animal Units [a] Pounds (000s)	Percent
Beef Cows	49,950	39.0	49,950	47.3
Cows	50,000	39.1	50,000	47.4
Breeding Sheep & Lambs	28,000	21.9	5600	5.3
Total animals	127,950	100.0	105,550	100.0

Notes:
[a] Animal unit conversions:
1 cow = 1,000 lb.
1 sheep = 200 lb.
1 animal unit = 1,000 lb.
Source: USDA 2006.

Recreational lands also are present in Campbell, Natrona, Johnson, Converse, Niobrara, and Weston Counties within 50-miles of the License Area (Table 2.2-4). Recreational opportunities provided by federal and state lands in the county have become an increasingly important component of the local economy. The regional setting of the License Area provides broad, panoramic prairie landscapes, which provide a setting for a variety of outdoor recreational activities. Major attractions include the Thunder Basin National Grassland, several state historic sites, and the historic Bozeman Trail.

There is no recreational use of the License Area or the surrounding 2.0-mile area, as all of the land is privately owned; however, opportunities for developed and dispersed recreation exist on federal and state lands throughout the five counties that are within the 50-mile radius of the License Area. Developed recreational facilities, such as campgrounds, are generally limited to private lands in or near to larger communities within the 50-mile radius. These communities provide a variety of municipal and private recreational facilities including golf courses, rodeo grounds, ball parks, and swimming pools.

The region within the 50-mile radius of the License Area includes several special recreation management areas on public and private lands (Table 2.2-4). Limited developed recreation facilities are also located in special management areas on Bureau of Land Management (BLM)-administered public lands.

Table 2.2-4 Recreational Areas within 50-miles of the Moore Ranch License Area

Name of Recreational Facility	Managing Agency	Distance From Moore Ranch License Area (miles)
South Bighorn/Red Wall Back Country Byway	Wyoming Department of Transportation	41.0
Bozeman Trail	Various agencies	1.0
Thunder Basin National Grassland	US Forest Service	14.0
Pumpkin Buttes	BLM – Buffalo Field Office	10.0
Fort Reno Historic Site	Wyoming State Parks and Cultural Resources Department	27.0

Source: DeLorme Maps, 2003

Based on a site reconnaissance conducted in May 2007 and a 2006 aerial photo of the License Area, there are no occupied housing units in the License Area. Table 2.2-5 shows the distance to the nearest residence and to the nearest site boundary from the center of the site for each 22 1/2° sector centered on each of 16 compass points for the License Area. The nearest resident is 4.3 miles to the east of the License area as shown on Figure 2.2-1.

Table 2.2-5 Distance to Nearest Residence and Site Boundary from Center of Moore Ranch License Area for Each Compass Sector within the 2.0-Mile Radius

Compass Sector[1]	Nearest Residence (miles)	Nearest Site Boundary (feet/mile)
North	14.2	8,050/1.5
North-Northeast	8.5	8,700/1.6
Northeast	9.0	7,730/1.5
East-Northeast	15.0	9,180/1.7
East	4.3	10,620/2.0
East-Southeast	25.0	10,300/2.0
Southeast	5.0	7,407/1.4
South-Southeast	9.3	8,700/1.6
South	8.3	7,730/1.5
South-Southwest	9.0	8,050/1.5
Southwest	26.5	11,100/2.1
West-Southwest	8.5	11,300/2.1
West	8.0	10,600/2.0
West-Northwest	12.0	7,400/1.4
Northwest	10.2	8,050/1.5
North-Northwest	8.0	9,000/1.7

1 $22^1/_2$° sectors centered on each of the 16 compass points

Radiological Open Issue No. 4
Baseline groundwater sampling for less than 12 months
July 27 2009 Teleconference

Open Issue discussion:

The staff notes that the applicant collected less than one full year of groundwater samples. However, 10 CFR 40 Appendix A, Criterion 7, requires that prior to any major site construction, a preoperational monitoring program covering one full year must be conducted to provide complete baseline data at a milling site and its environs.

Answer:

In consultation with NRC (July 28, 2009 telephone conversation with Doug Mandeville) Uranium One will collect samples to fill in any ground water data gaps on a quarterly basis. The primary ground water data gaps identified were in the first Quarter. Monitoring wells will be sampled in the first Quarter of 2010 to fulfill the requirement of one full year of data. Table 2.7.3-19 of the Technical Report will be revised to include these data and will be provided to the NRC prior to any major site construction. Uranium One anticipates the revised data will be submitted to NRC at the end of the March 2010.

Proposed Revisions to License Application

Table 2.7.3-19 will be revised to include the first quarter ground water sample results and submitted to NRC at the end of March 2010.

Radiological Open Issue No. 5
Baseline surface water sampling for less than 12 months
July 27 2009 Teleconference

Open Issue discussion:

The staff notes that the applicant collected less than one full year of surface water samples. However, 10 CFR 40 Appendix A, Criterion 7, requires that prior to any major site construction, a preoperational monitoring program covering one full year must be conducted to provide complete baseline data at a milling site and its environs.

Answer:

One full year of surface water quality data has been collected at twelve surface water sites for the Moore Ranch project. Tables 2.7.3-1 through 2.7.3-9 have been revised to include updated water quality data. Tables 2.7.3-10 (Surface Water – Seasonal Averages) and 2.7.3-11 (Surface Water – Average Concentrations) will be updated and relabeled as 2.7.3-11b and 2.7.3-11c. In the original Technical Report (October 2007), no flow was recorded at surface water sites MRSW -10 and MRSW-11, therefore no tables were provided in the document. Additional monitoring has yielded samples from MRSW-10 and MRSW-11, thus tables 2.7.3-10 and 2.7.3-11 are included for these two sites. One new surface water site (MRSW-12) was added to the monitoring network at the request of the WDEQ-LQD District III, data for this site is presented in Table 2.7.3-11a.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Table 2.7.3-1 Water Quality Data from MRSW-1

	MRSW-1										
Parameters	**11/3/2006**	**3/23/2007**	**6/15/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/27/2009**	**Average**
Bicarbonate as HCO3, mg/L	1140	814	391				187	269	290	514	515
Carbonate as CO3, mg/L	19	43	50				8	18	168	208	73
Chloride, mg/L	10	3	3				<1	<1	2	7	4
Conductivity, umhos/cm	1940	1260	714				308	434	914	1280	979
Fluoride, mg/L	0.5	0.7	0.4				0.1	0.2	0.4	0.6	0.4
pH, s.u.	8.48	9.06	9.44				8.64	8.76	9.88	9.74	9.14
Solids, Total Dissolved TDS @ 180 C, mg/L	1160	772	472			78	221	270	590	771	542
Solids, Total Suspended TSS @ 105 C, mg/l		19.3		9	4	46	5	20	11	16	16
Sulfate, mg/L	39	<1.0	2				3	3	<1	3	7
Turbidity, NTU				15.5	8.1	22.3	9.2	23.5	17.5	14.1	15.7
Gross Alpha, pci/L (dissolved)	6.8	1					<1.6	4.5	<4.3	<7.8	4.3
Gross Beta, pci/L (dissolved)	21.8	10.3					4.2	4.9	8.7	12.2	10.4
Lead 210, pci/L (dissolved)	170*	<1.0	1				<2.8	<3.1	<2.2	**	2
Polonium 210, pci/L (dissolved)	<1.0	<1.0	<1.0				<0.7	<0.8	<0.8	<0.6	<0.84
Radium 226, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.12	<0.13	0.32	<0.22	<0.20
Radium 228, pci/L (dissolved)	<1.0	<1.0	<1.0				<1.5	<1.3	<1	<2.2	<1.3
Thorium 230, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.5	<0.6	<0.4	<0.2	<0.4
Nitrogen, Ammonia as N, mg/L	0.15	0.08	0.12				<0.05	<0.05	<0.05	0.07	0.08
Nitrogen, Nitrate+Nitrite as N, mg/L	0.8	<0.1	<0.1				<0.05	<0.05	0.02	<0.1	<0.17
Aluminum, mg/L (dissolved)		<0.1	1.1				<0.1	0.4	0.4	<0.1	0.31
Arsenic, mg/L (dissolved)	0.002	0.002	0.006				0.002	0.002	0.008	0.006	0.004
Barium, mg/L (dissolved)	0.5	0.5	0.1				0.2	0.3	0.1	0.2	0.3
Boron, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	43	13	7				12	18	9	10	16
Chromium, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	<0.05	<0.05
Copper, mg/L (dissolved)	<0.01	<0.01	<0.01				0.01	<0.01	<0.01	<0.01	<0.01
Iron, mg/L (dissolved)	0.07	0.07	0.6				0.05	0.26	0.22	0.08	0.19
Lead, mg/L (dissolved)	<0.05	<0.001	<0.001				<0.001	<0.001	<0.001	<0.001	<0.05
Magnesium, mg/L	56	35	14				9	13	23	33	26
Manganese, mg/L (dissolved)	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01
Mercury, mg/L (dissolved)	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	<0.001	<0.001

Table 2.7.3-1(cont.) Water Quality Data from MRSW-1

	MRSW-1										
Parameters	**11/3/2006**	**3/23/2007**	**6/15/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/27/2009**	**Average**
Molybdenum, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	17	11	7				7	5	11	12	10
Selenium, mg/L (dissolved)	<0.001	<0.001	<0.002				<0.001	<0.001	<0.001	<0.001	<0.001
Silica, mg/L	4.7	2.3	8.4				4.3	5.2	6.5	0.5	4.6
Sodium, mg/L	355	243	133				43	68	186	273	186
Uranium, mg/L (dissolved)	0.0052	0.0007	0.0006				0.0003	<0.0003	0.0004	0.0008	0.0012
Vanadium, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L (dissolved)	<0.01	<0.01	<0.01				<0.01	0.03	<0.01	<0.01	<0.01
Iron, TOTAL mg/L	0.26	0.38	1.31				0.36	1.62	0.96	0.54	0.78
Manganese, TOTAL mg/L	0.01	0.02	0.04				<0.01	0.03	0.03	<0.01	0.02
Lead 210, suspended pci/L	<2.0	<1.0	<1.0				<3.9	<5.7	<3.8	**	<2.7
Polonium 210 suspended, pci/L	<2.0	<1.0	<1.0				<0.5	<0.4	<0.5	<0.3	<0.9
Radium 226 suspended, pci/L	<0.4	<0.2	<0.2				<0.3	0.2	<0.09	<0.1	<0.2
Thorium 230 suspended, pci/L	<0.4	<0.2	<0.2				<0.3	<0.3	<0.05	0.05	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003				0.0003	0.0004	<0.0003	0.0036	<0.0003

* Anomalous value considered analytical error.

** 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Table 2.7.3-2 Water Quality Data from MRSW-2

	MRSW-2										
Parameters	**10/25/2006**	**3/23/2007**	**6/15/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/27/2009**	**Average**
Bicarbonate as HCO3, mg/L	1010	748	532				283	180	107	78	420
Carbonate as CO3, mg/L	52	22	33				6	6	68	86	39
Chloride, mg/L	9	3	2				2	<1	1	2	3
Conductivity, umhos/cm	1520	1120	870				448	274	401	439	725
Fluoride, mg/L	0.7	0.6	0.4				0.2	0.1	0.2	0.2	0.3
pH, s.u.	8.96	8.8	9.13				8.61	8.59	10	10.6	9.24
Solids, Total Dissolved TDS @ 180 C, mg/L	996	672	520			119	308	167	279	274	417
Solids, Total Suspended TSS @ 105 C, mg/L		20		8	24	14	5	8	57	36	22
Sulfate, mg/L	1	<1.0	10				3	1	5	12	5
Turbidity, NTU				10.1	14.3	6.7	5.1	4.9	29.7	43.3	16.3
Gross Alpha, pci/L (dissolved)	3	1.5					<2.0	4.4	<2.2	<2.7	2.6
Gross Beta, pci/L (dissolved)	14	9.7					6.6	4.9	6.1	4.5	7.6
Lead 210, pci/L (dissolved)	<1.0	<1.0	<1.0				<2.8	<3.1	<2.2	**	<1.9
Polonium 210, pci/L (dissolved)	<1.0	<1.0	<1.0				0.8	<0.5	<0.4	<1.3	<1.0
Radium 226, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.12	<0.12	0.28	<0.16	<0.2
Radium 228, pci/L (dissolved)	<1.0	<1.0	<1.0				<1.7	<1.2	<1.1	<1.4	<1.2
Thorium 230, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.2	<0.3	<0.3	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.17	<0.05	<0.05				<0.05	<0.05	0.06	<0.05	<0.07
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1				<0.05	<0.05	0.02	<0.1	<0.07
Aluminum, mg/L (dissolved)		<0.1	0.1				<0.1	<0.1	0.4	1.3	0.35
Arsenic, mg/L (dissolved)	0.002	0.002	0.003				0.003	<0.001	0.006	0.008	0.004
Barium, mg/L (dissolved)	0.8	0.5	0.1				0.2	0.2	<0.1	<0.1	0.3
Boron, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	18	22	11				15	15	9	8	14
Chromium, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	<0.05	<0.05
Copper, mg/L (dissolved)	<0.01	0.05	<0.01				0.01	<0.01	<0.01	<0.01	<0.02
Iron, mg/L (dissolved)	0.07	0.15	0.11				0.08	0.06	0.29	0.76	0.22
Lead, mg/L (dissolved)	<0.05	0.007	<0.01				0.003	<0.001	<0.001	0.001	<0.012
Magnesium, mg/L	43	28	20				10	7	7	6	17
Manganese, mg/L (dissolved)	0.01	0.02	<0.01				<0.01	<0.01	<0.01	0.02	<0.02

** 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Table 2.7.3-2 (cont.) Water Quality Data from MRSW-2

	MRSW-2										
Parameters	**10/25/2006**	**3/23/2007**	**6/15/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/27/2009**	**Average**
Mercury, mg/L (dissolved)	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	14	10	7				9	4	7	14	9
Selenium, mg/L (dissolved)	<0.001	<0.001	<0.002				<0.001	<0.001	<0.001	<0.001	<0.001
Silica, mg/L	3.8	3	0.9				5.9	5.7	7.5	0.6	3.9
Sodium, mg/L	349	208	157				75	47	67	75	140
Uranium, mg/L (dissolved)	0.0003	0.0005	0.0006				<0.0003	<0.0003	0.0004	0.0005	0.0005
Vanadium, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L (dissolved)	<0.01	0.02	0.02				<0.01	0.02	<0.01	<0.01	0.02
Iron, TOTAL mg/L	0.07	0.04	0.36				0.2	0.21	2.4	1.63	0.70
Manganese, TOTAL mg/L	<0.01	0.02	0.02				0.01	<0.01	0.04	0.03	0.02
Lead 210, suspended pci/L	<1.0	<1.0	<1.0				<4.1	5.8	<4.0	**	<2.8
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0				<0.5	<0.5	<0.4	1.8	<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2				<0.4	<0.2	<0.1	<0.1	<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2				<0.3	<0.2	<0.05	0.05	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003				0.0006	<0.0003	<0.0003	0.0006	<0.0004

** 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Table 2.7.3-3 Water Quality Data from MRSW-3

	MRSW-3										
Parameters	**10/25/2006**	**3/22/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/22/2009**	**Average**
Bicarbonate as HCO3, mg/L	358	92	33				69	71	15	DRY	125
Carbonate as CO3, mg/L	8	9	4				<1	<1	11		5
Chloride, mg/L	11	2	<1.0				<1	<1	5		3
Conductivity, umhos/cm	928	544	609				168	125	1260		475
Fluoride, mg/L	0.9	0.2	0.4				<0.1	<0.1	0.2		0.3
pH, s.u.	8.6	9.25	9.45				7.82	7.99	10.5		8.62
Solids, Total Dissolved TDS @ 180 C, mg/L	560	364	414			96	161	95	924		373
Solids, Total Suspended TSS @ 105 C, mg/L		5.5		5	118	10	<1	<4	8		22
Sulfate, mg/L	214	189	254				20	14	562		138
Turbidity, NTU		(Deleted)		4.2	16.2	8.2	3	5.6	6.8		7.3
Gross Alpha, pci/L (dissolved)	12.7	7.9					2.1	3.9	4.8		6.3
Gross Beta, pci/L (dissolved)	13.5	9.7					3.6	5.6	7.8		8.1
Lead 210, pci/L (dissolved)	<1.0	<1.0	<1.0				<2.8	<3.1	<2.2		<1.9
Polonium 210, pci/L (dissolved)	<1.0	<1.0	<1.0				<0.6	<0.5	<0.7		<1.0
Radium 226, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.12	<0.11	0.47		<0.2
Radium 228, pci/L (dissolved)	<1.0	<1.0	1.9				<1.4	<1.1	<1.3		<1.1
Thorium 230, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.3	<0.4	<0.5		<0.3
Nitrogen, Ammonia as N, mg/L	0.09	0.06	0.09				<0.05	<0.05	<0.05		0.07
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1				<0.05	<0.05	<0.01		<0.1
Aluminum, mg/L (dissolved)		<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Arsenic, mg/L (dissolved)	0.002	0.002	0.003				<0.001	<0.001	0.003		0.002
Barium, mg/L (dissolved)	0.1	<0.1	<0.1				<0.1	<0.1	0.1		<0.1
Boron, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005		<0.005
Calcium, mg/L	42	60	48				18	124	111		58
Chromium, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05		<0.05
Copper, mg/L (dissolved)	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01		<0.01
Iron, mg/L (dissolved)	0.16	<0.03	0.05				0.07	0.1	<0.03		0.08
Lead, mg/L (dissolved)	<0.05	<0.001	<0.001				<0.001	<0.001	<0.001		<0.05
Magnesium, mg/L	18	13	18				4	34	20		17
Manganese, mg/L (dissolved)	<0.01	<0.01	<0.01				0.01	<0.01	<0.01		<0.01

Table 2.7.3-3 (cont.) Water Quality Data from MRSW-3

	MRSW-3										
Parameters	**10/25/2006**	**3/22/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/22/2009**	**Average**
Mercury, mg/L (dissolved)	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	DRY	<0.001
Molybdenum, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05		<0.05
Potassium, mg/L	8	8	4				8	4	10		6
Selenium, mg/L (dissolved)	<0.001	0.001	<0.001				<0.001	<0.001	<0.001		<0.001
Silica, mg/L	2.9	8.3	3.2				3.2	4.2	0.2		4.4
Sodium, mg/L	173	32	46				7	17	113		55
Uranium, mg/L (dissolved)	0.013	0.0119	0.0043				0.0014	0.0013	0.0028		0.0064
Vanadium, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Zinc, mg/L (dissolved)	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01		<0.01
Iron, TOTAL mg/L	0.33	0.1	0.12				0.11	0.3	0.39		0.23
Manganese, TOTAL mg/L	0.01	0.03	0.01				0.03	<0.01	0.04		0.02
Lead 210, suspended pci/L	<1.0	<1.0	<1.0				<4.0	6	<3.9		<2.8
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0				<0.4	<0.5	<0.3		<0.7
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2				<0.4	0.2	<0.1		<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2				<0.3	<0.1	<0.04		<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003				<0.0003	<0.0003	0.0006		<0.0004

Table 2.7.3-4 Water Quality Data from MRSW-4

	MRSW-4										
Parameters	**10/25/2006**	**3/22/2007**	**6/13/2007**	**7/8/2008**	**10/23/2008**	**2/9/2008**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/26/2009**	**Average**
Bicarbonate as HCO3, mg/L	363	156	77				119	238	124	269	192
Carbonate as CO3, mg/L	24	23	15				<1	<1	67	47	25
Chloride, mg/L	23	7	2				2	6	8	13	9
Conductivity, umhos/cm	1500	792	968				324	700	811	1050	878
Fluoride, mg/L	0.6	0.5	0.4				0.1	0.1	0.2	0.3	0.3
pH, s.u.	9.06	9.41	9.63				8	8.22	9.82	9.18	9.05
Solids, Total Dissolved TDS @ 180 C, mg/L	984	504	644			170	277	447	840	681	568
Solids, Total Suspended TSS @ 105 C, mg/l		17		6	5	10	2	7	16	<4	8
Sulfate, mg/L	461	230	360				72	175	175	242	245
Turbidity, NTU				2.5	6.9	9.6	4.5	3.2	3.7	7.3	5.4
Gross Alpha, pci/L (dissolved)	5.6	2.5					1.9	7	<3.3	6.1	4.4
Gross Beta, pci/L (dissolved)	11.9	7.6					6.6	7.6	7.6	12.2	8.9
Lead 210, pci/L (dissolved)	<1.0	<1.0	<1.0				<2.8	<3.1	<2.2	**	<1.9
Polonium 210, pci/L (dissolved)	<1.0	<1.0	<1.0				4.6	<0.7	<0.7	<1.1	<1.5
Radium 226, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.13	<0.11	0.22	0.5	<0.3
Radium 228, pci/L (dissolved)	<1.0	<1.0	<1.0				<1.6	<1.1	<1.1	<1.4	<1.2
Thorium 230, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.3	<0.3	<0.3	<0.2	<0.3
Nitrogen, Ammonia as N, mg/L	0.52	0.2	0.09				<0.05	<0.05	<0.05	<0.05	0.14
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1				<0.05	<0.05	0.02	<0.1	<0.08
Aluminum, mg/L (dissolved)		<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic, mg/L (dissolved)	0.006	0.006	0.005				0.003	0.002	0.007	0.004	0.005
Barium, mg/L (dissolved)	0.2	<0.1	<0.1				<0.1	0.1	<0.1	<0.1	<0.1
Boron, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	24	26	27				24	56	18	26	29
Chromium, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	<0.05	<0.05
Copper, mg/L (dissolved)	<0.01	<0.01	<0.01				<0.01	0.34	<0.01	<0.01	<0.06
Iron, mg/L (dissolved)	0.32	0.03	<0.03				0.19	0.06	0.04	<0.03	0.10
Lead, mg/L (dissolved)	<0.05	<0.001	<0.001				<0.001	0.075	<0.001	<0.001	<0.019
Magnesium, mg/L	25	18	24				9	22	29	37	23
Manganese, mg/L (dissolved)	0.02	0.02	0.02				0.08	<0.01	0.04	<0.01	0.03
Mercury, mg/L (dissolved)	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1

** 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Table 2.7.3-4 (cont.) Water Quality Data from MRSW-4

	MRSW-4										
Parameters	**10/25/2006**	**3/27/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2008**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/26/2009**	**Average**
Nickel, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	10	8	7				10	8	12	14	10
Selenium, mg/L (dissolved)	<0.001	<0.001	<0.001				<0.001	0.001	<0.001	<0.001	<0.001
Silica, mg/L	3.8	12.8	3.7				7.9	14.4	0.5	0.6	6.2
Sodium, mg/L	320	114	133				31	62	114	151	132
Uranium, mg/L (dissolved)	0.0069	0.0034	0.0028				0.0016	0.0036	0.0024	0.0041	0.0035
Vanadium, mg/L(dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L (dissolved)	<0.01	<0.01	<0.01				0.02	1.72	<0.01	<0.01	<0.30
Iron, TOTAL mg/L	0.4	0.07	0.11				0.31	0.28	0.11	0.32	0.26
Manganese, TOTAL mg/L	0.02	0.12	0.05				0.15	0.07	0.1	0.03	0.08
Lead 210, suspended pci/L	<1.0	<1.0	<1.0				<4.2	7.1	<3.8	**	<3.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0				<0.5	<0.5	<0.3	<0.3	<0.7
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2				<0.3	<0.2	<0.1	<0.1	<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2				<0.3	<0.2	<0.05	0.1	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003				0.0004	<0.0003	<0.0003	0.0038	<0.0008

** 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Table 2.7.3-5 Water Quality Data from MRSW-5

	MRSW-5										
Parameters	**11/3/2006**	**3/22/2007**	**6/15/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/27/2009**	**Average**
Bicarbonate as HCO3, mg/L	1410	924	858	DRY	DRY		240	233	DRY	DRY	733
Carbonate as CO3, mg/L	155	24	11				<1	12			41
Chloride, mg/L	6	7	10				<1	4			6
Conductivity, umhos/cm	2560	1450	1520				397	638			1313
Fluoride, mg/L	1.2	0.5	0.4				0.2	0.2			0.5
pH, s.u.	9.29	8.66	8.46				8.35	8.51			8.65
Solids, Total Dissolved TDS @ 180 C, mg/L	1590	890	998			172	270	384			717
Solids, Total Suspended TSS @ 105 C, mg/l		9.5				10	88	68			44
Sulfate, mg/L	9	20	157				5	134			65
Turbidity, NTU						7.4	41.4	51.9			34
Gross Alpha, pci/L (dissolved)	11	2.4					<1.8	7.8			5.6
Gross Beta, pci/L (dissolved)	32.7	11					4	4.1			13
Lead 210, pci/L (dissolved)	9.9	<1.0	<1.0				<2.8	<3.1			<3.6
Polonium 210, pci/L (dissolved)	<1.0	<1.0	<1.0				<0.4	<0.7			<1.0
Radium 226, pci/L (dissolved)	<0.2	1.5	2.3				<0.12	0.15			0.85
Radium 228, pci/L (dissolved)	<1.0	<1.0	<1.0				<1.9	<1.2			<1.2
Thorium 230, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.8	<0.2			<0.3
Nitrogen, Ammonia as N, mg/L	0.27	0.15	0.19				<0.05	<0.05			0.14
Nitrogen, Nitrate+Nitrite as N, mg/L	0.9	<0.1	<0.1				<0.05	<0.05			<0.24
Aluminum, mg/L (dissolved)		<0.1	<0.1				<0.1	<0.1			<0.1
Arsenic, mg/L (dissolved)	0.008	0.003	0.004				0.004	0.002			0.004
Barium, mg/L (dissolved)	0.5	0.5	0.3				0.2	0.4			0.4
Boron, mg/L (dissolved)	0.1	<0.1	<0.1				<0.1	<0.1			<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005	<0.005				<0.005	<0.005			<0.005
Calcium, mg/L	9	45	41				26	50			32
Chromium, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05			<0.05
Copper, mg/L (dissolved)	<0.01	<0.01	<0.01				<0.01	0.05			<0.01
Iron, mg/L (dissolved)	0.92	0.05	0.08				0.06	0.09			0.24
Lead, mg/L (dissolved)	<0.05	<0.001	<0.001				<0.001	0.007			<0.05
Magnesium, mg/L	73	39	50				10	26			40
Manganese, mg/L (dissolved)	0.02	<0.01	0.03				0.14	<0.01			0.04
Mercury, mg/L (dissolved)	<0.001	<0.001	<0.001				<0.001	<0.001			<0.001
Molybdenum, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1			<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05			<0.05

Table 2.7.3-5 (cont.) Water Quality Data from MRSW-5

	MRSW-5										
Parameters	**11/3/2006**	**3/22/2007**	**6/15/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/27/2009**	**Average**
Potassium, mg/L	22	12	13	DRY	DRY		7	5	DRY	DRY	12
Selenium, mg/L (dissolved)	<0.001	<0.001	0.004				<0.001	<0.001			<0.002
Silica, mg/L	9.3	5.2	8.1				13	7			8.5
Sodium, mg/L	559	255	230				41	55			228
Uranium, mg/L (dissolved)	0.001	0.0029	0.0027				0.0031	0.0026			0.0025
Vanadium, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1			<0.1
Zinc, mg/L (dissolved)	<0.01	<0.01	0.01				0.01	0.12			0.03
Iron, TOTAL mg/L	1.11	0.11	0.12				1.65	2.72			1.14
Manganese, TOTAL mg/L	0.05	0.01	0.06				0.33	0.14			0.12
Lead 210, suspended pci/L	<2.0	<1.0	<1.0				<4.8	<5.0			<2.6
Polonium 210 suspended, pci/L	<2.0	<1.0	<1.0				1.5	0.5			1.2
Radium 226 suspended, pci/L	<0.4	<0.2	<0.2				<0.4	0.3			<0.3
Thorium 230 suspended, pci/L	<0.4	<0.2	<0.2				<0.3	<0.2			<0.3
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003				<0.0003	<0.0003			<0.0003

Table 2.7.3-6 Water Quality Data from MRSW-6

	MRSW-6									
Parameters	**3/22/2007**	**6/15/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/23/2009**	**10/26/2009**	**Average**
Bicarbonate as HCO3, mg/L	351	563		DRY		804	635	752	DRY	621
Carbonate as CO3, mg/L	7	114				12	35	240		82
Chloride, mg/L	2	3				4	4	8		4
Conductivity, umhos/cm	538	1140				1240	1020	1850		1158
Fluoride, mg/L	0.3	0.7				0.4	0.4	0.6		0.5
pH, s.u.	8.52	9.64				8.57	8.65	9.54		8.98
Solids, Total Dissolved TDS @ 180 C, mg/L	326	754			78	740	591	1250		623
Solids, Total Suspended TSS @ 105 C, mg/L	46		6		10	14	10	128		36
Sulfate, mg/L	10	2				2	1	49		13
Turbidity, NTU			4.2		5.9	6.8	2.4	127		29.3
Gross Alpha, pci/L (dissolved)	1.1					<4.2	9.8	<8.6		5.9
Gross Beta, pci/L (dissolved)	6.9					7.1	5.1	14.3		8.4
Lead 210, pci/L (dissolved)	<1.0	<1.0				<5.6	<3.1	<2.3		<2.6
Polonium 210, pci/L (dissolved)	<1.0	<1.0				<0.7	<0.7	<0.6		<0.8
Radium 226, pci/L (dissolved)	<0.2	1.5				0.14	0.16	<0.18		0.43
Radium 228, pci/L (dissolved)	<1.0	<1.0				<2.0	<1.2	<1.1		<1.3
Thorium 230, pci/L (dissolved)	<0.2	<0.2				<0.8	<0.2	<0.6		<0.4
Nitrogen, Ammonia as N, mg/L	0.13	0.15				<0.05	<0.05	<0.05		0.09
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1				<0.05	<0.05	0.02		<0.1
Aluminum, mg/L (dissolved)	0.4	1				<0.1	<0.1	0.3		0.4
Arsenic, mg/L (dissolved)	0.002	0.006				0.002	0.002	0.003		0.003
Barium, mg/L (dissolved)	0.4	0.2				1.2	0.6	0.3		0.54
Boron, mg/L (dissolved)	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005				<0.005	<0.005	<0.005		<0.005
Calcium, mg/L	26	9				55	29	15		31
Chromium, mg/L (dissolved)	<0.05	<0.05				<0.05	<0.05	<0.05		<0.05
Copper, mg/L (dissolved)	<0.01	<0.01				<0.01	<0.01	<0.01		<0.01
Iron, mg/L (dissolved)	0.21	0.44				<0.03	<0.03	0.14		0.17
Lead, mg/L (dissolved)	<0.001	0.001				<0.001	<0.001	<0.001		<0.001
Magnesium, mg/L	10	15				26	22	46		24
Manganese, mg/L (dissolved)	<0.01	0.02				<0.01	<0.01	<0.01		<0.02
Mercury, mg/L (dissolved)	<0.001	<0.001				<0.001	<0.001	<0.001		<0.001
Molybdenum, mg/L (dissolved)	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05				<0.05	<0.05	<0.05		<0.05

Table 2.7.3-6 (cont.) Water Quality Data from MRSW-6

	MRSW-6									
Parameters	**3/22/2007**	**6/15/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/23/2009**	**10/26/2009**	**Average**
Molybdenum, mg/L (dissolved)	<0.1	<0.1				<0.1	<0.1	<0.1	DRY	<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05				<0.05	<0.05	<0.05		<0.05
Potassium, mg/L	7	6		DRY		11	8	17		10
Selenium, mg/L (dissolved)	<0.001	<0.002				<0.001	<0.001	<0.001		<0.002
Silica, mg/L	9.5	5.6				17.7	18.4	10.4		12.3
Sodium, mg/L	77	232				198	167	436		222
Uranium, mg/L (dissolved)	<0.0003	0.0003				0.0005	<0.0003	<0.0003		0.0003
Vanadium, mg/L (dissolved)	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Zinc, mg/L (dissolved)	<0.01	0.01				<0.01	0.06	<0.01		0.02
Iron, TOTAL mg/L	0.51	0.72				0.19	0.21	3.9		1.11
Manganese, TOTAL mg/L	0.02	0.04				<0.01	0.01	0.05		0.03
Lead 210, suspended pci/L	<1.0	<1.0				<4.1	<3.9	<3.6		<2.7
Polonium 210 suspended, pci/L	<1.0	<1.0				<0.4	<0.2	0.7		<1.0
Radium 226 suspended, pci/L	<0.2	0.4				<0.3	<0.2	0.2		0.3
Thorium 230 suspended, pci/L	<0.2	<0.2				<0.3	<0.2	0.08		<0.2
Uranium suspended, pci/L	<0.0003	<0.0003				0.0005	<0.0003	<0.0003		0.0003

Water present at 10/25/06 sampling event however to muddy to get access to pond to collect sample.

Table 2.7.3-7 Water Quality Data from MRSW-7

	MRSW-7										
Parameters	**10/25/2006**	**3/23/2007**	**6/13/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/23/2009**	**10/22/2009**	**Average**
Bicarbonate as HCO3, mg/L	809	DRY	520				DRY	DRY	DRY	DRY	665
Carbonate as CO3, mg/L	12		22								17
Chloride, mg/L	9		2								6
Conductivity, umhos/cm	1120		837								979
Fluoride, mg/L	0.5		0.5								0.5
pH, s.u.	8.42		8.96								8.69
Solids, Total Dissolved TDS @ 180 C, mg/L	706		586			508					600
Solids, Total Suspended TSS @ 105 C, mg/L				13	7	42					21
Sulfate, mg/L	23		3								13
Turbidity, NTU				2.3	1.6	7.6					3.8
Gross Alpha, pci/L (dissolved)	5.4										5.4
Gross Beta, pci/L (dissolved)	13.1										13.1
Lead 210, pci/L (dissolved)	<1.0		<1.0								<1.0
Polonium 210, pci/L (dissolved)	<1.0		<1.0								<1.0
Radium 226, pci/L (dissolved)	<0.2		<0.2								<0.2
Radium 228, pci/L (dissolved)	<1.0		<1.0								<1.0
Thorium 230, pci/L (dissolved)	<0.2		<0.2								<0.2
Nitrogen, Ammonia as N, mg/L	0.1		0.08								0.09
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1		<0.1								<0.1
Aluminum, mg/L (dissolved)			0.5								0.5
Arsenic, mg/L (dissolved)	0.003		0.004								0.004
Barium, mg/L (dissolved)	0.5		0.3								0.4
Boron, mg/L (dissolved)	<0.1		<0.1								<0.1
Cadmium, mg/L (dissolved)	<0.005		<0.005								<0.005
Calcium, mg/L	27		15								21
Chromium, mg/L (dissolved)	<0.05		<0.05								<0.05
Copper, mg/L (dissolved)	<0.01		<0.01								<0.01
Iron, mg/L (dissolved)	0.7		0.59								0.65
Lead, mg/L (dissolved)	<0.05		<0.001								<0.001
Magnesium, mg/L	18		10								14
Manganese, mg/L (dissolved)	0.02		0.01								0.02
Mercury, mg/L (dissolved)	<0.001		<0.001								<0.001
Molybdenum, mg/L (dissolved)	<0.1		<0.1								<0.1
Nickel, mg/L (dissolved)	<0.05		<0.05								<0.05

Table 2.7.3-7 (cont.) Water Quality Data from MRSW-7

	MRSW-7										
Parameters	**10/25/2006**	**3/23/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/23/2009**	**10/22/2009**	**Average**
Selenium, mg/L (dissolved)	<0.001	DRY	<0.001				DRY	DRY	DRY	DRY	<0.001
Potassium, mg/L	10		7								9
Silica, mg/L	8.4		7.5								8
Sodium, mg/L	263		173								218
Uranium, mg/L (dissolved)	0.0006		0.0004								0.0005
Vanadium, mg/L (dissolved)	<0.1		<0.1								<0.1
Zinc, mg/L (dissolved)	<0.01		<0.01								<0.01
Iron, TOTAL mg/L	0.64		0.73								0.69
Manganese, TOTAL mg/L	<0.01		0.04								0.03
Lead 210, suspended pci/L	<1.0		<1.0								<1.0
Polonium 210 suspended, pci/L	<1.0		<1.0								<1.0
Radium 226 suspended, pci/L	<0.2		<0.2								<0.2
Thorium 230 suspended, pci/L	<0.2		<0.2								<0.2
Uranium suspended, pci/L	0.0007		<0.0003								<0.0003

Table 2.7.3-8 Water Quality Data from MRSW-8

	MRSW-8										
Parameters	**10/25/2006**	**3/23/2007**	**6/13/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/9/2009**	**4/22/2009**	**7/27/2009**	**10/27/2009**	**Average**
Bicarbonate as HCO3, mg/L	420	458	327		DRY		458	327	225	DRY	369
Carbonate as CO3, mg/L	1670	44	26				7	21	170		323
Chloride, mg/L	21	2	<1.0				<1	<1	2		5
Conductivity, umhos/cm	3220	796	569				710	611	918		1137
Fluoride, mg/L	2.2	0.6	0.4				0.4	0.3	0.6		0.8
pH, s.u.	9.65	9.32	9.23				8.59	8.68	10.1		9.26
Solids, Total Dissolved TDS @ 180 C, mg/L	2190	508	354			266	493	345	1040		853
Solids, Total Suspended TSS @ 105 C, mg/L		24		84		34	12	53	259		78
Sulfate, mg/L	10	<1.0	14				4	16	18		11
Turbidity, NTU				155		13.7	12.6	35.9	540		151.4
Gross Alpha, pci/L (dissolved)	4.3	2.4					<3.0	5.1	21.7		7.3
Gross Beta, pci/L (dissolved)	20.9	10.1					7.2	5.1	21.5		13
Lead 210, pci/L (dissolved)	<1.0	<1.0	<1.0				<2.8	<4.1	<2.2		<2.1
Polonium 210, pci/L (dissolved)	<1.0	<1.0	<1.0				<0.6	<0.7	<1.1		<1.0
Radium 226, pci/L (dissolved)	<0.2	<0.2	<0.2				0.12	0.11	1.4		0.36
Radium 228, pci/L (dissolved)	<1.0	<1.0	<1.0				<1.5	<1	<1.2		<1.0
Thorium 230, pci/L (dissolved)	<0.2	<0.2	<0.2				<0.2	<0.2	0.7		<0.3
Nitrogen, Ammonia as N, mg/L	0.86	0.09	<0.05				0.13	<0.05	<0.05		0.21
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1				0.08	<0.05	0.03		<0.08
Aluminum, mg/L (dissolved)		0.1	0.2				<0.1	<0.1	0.6		0.2
Arsenic, mg/L (dissolved)	0.025	0.005	0.004				0.003	0.002	0.019		0.01
Barium, mg/L (dissolved)	0.6	0.1	0.1				0.2	0.1	<0.1		0.2
Boron, mg/L (dissolved)	0.1	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005		<0.005
Calcium, mg/L	6	13	11				20	17	9		13
Chromium, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05		<0.05
Copper, mg/L (dissolved)	<0.01	<0.01	<0.01				<0.01	<0.01	0.01		<0.01
Iron, mg/L (dissolved)	0.48	0.09	0.39				0.08	0.09	0.78		0.32
Lead, mg/L (dissolved)	<0.05	<0.001	<0.001				<0.001	0.001	0.002		<0.009
Magnesium, mg/L	53	15	11				12	9	9		18
Manganese, mg/L (dissolved)	0.02	<0.01	<0.01				<0.01	<0.01	0.02		<0.02
Mercury, mg/L (dissolved)	<0.001	<0.001	<0.001				<0.001	<0.001	<0.001		<0.001
Molybdenum, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05		<0.05

Table 2.7.3-8 (cont.) Water Quality Data from MRSW-8

	MRSW-8										
Parameters	**10/25/2006**	**3/23/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/27/2009**	**Average**
Potassium, mg/L	19	10	7				9	7	9	DRY	10
Selenium, mg/L (dissolved)	0.002	0.001	0.001		DRY		<0.001	<0.001	<0.001		0.001
Silica, mg/L	6.1	7.1	3.7				7.8	5.5	7.5		6.3
Sodium, mg/L	842	158	106				121	97	198		254
Uranium, mg/L (dissolved)	0.004	0.0009	0.001				0.0006	<0.0003	0.0014		0.0014
Vanadium, mg/L (dissolved)	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1		<0.1
Zinc, mg/L (dissolved)	<0.01	<0.01	<0.01				0.11	0.05	0.01		0.03
Iron, TOTAL mg/L	0.2	0.86	0.63				0.58	1.69	24.1		4.68
Manganese, TOTAL mg/L	<0.01	0.01	0.02				0.02	0.02	0.27		0.09
Lead 210, suspended pci/L	6.3	<1.0	<1.0				<6.1	<3.9	<4.3		<3.8
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0				<0.9	<0.3	0.8		<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2				<0.5	<0.1	0.5		<0.3
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2				<0.4	<0.2	0.3		<0.3
Uranium suspended, pci/L	0.0004	<0.0003	<0.0003				0.0004	0.0003	0.0004		0.0004

Table 2.7.3-9 Water Quality Data from MRSW-9

	MRSW-9									
Parameters	**3/22/2007**	**6/13/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/22/2009**	**Average**
Bicarbonate as HCO3, mg/L	131	67		DRY		45	71	DRY	DRY	79
Carbonate as CO3, mg/L	15	12				<1	<1			7
Chloride, mg/L	<1.0	<1.0				<1	<1			<1
Conductivity, umhos/cm	259	148				75	96			145
Fluoride, mg/L	0.2	0.2				<0.1	<0.1			0.2
pH, s.u.	9.32	9.16				7.39	8.94			9
Solids, Total Dissolved TDS @ 180 C, mg/L	148	96			88	74	64			94
Solids, Total Suspended TSS @ 105 C, mg/L	8		67		12	2	<4			19
Sulfate, mg/L	2	5				3	5			4
Turbidity, NTU			99.4		7.5	4.6	6			29.4
Gross Alpha, pci/L (dissolved)	1.7					<1.2	3.7			2.2
Gross Beta, pci/L (dissolved)	3.9					<2.7	2.8			3.1
Lead 210, pci/L (dissolved)	8.6	<1.0				<2.8	<3.1			3.9
Polonium 210, pci/L (dissolved)	<1.0	<1.0				<0.7	<0.6			<1.0
Radium 226, pci/L (dissolved)	<0.2	<0.2				<0.13	<0.17			<0.2
Radium 228, pci/L (dissolved)	<1.0	<1.0				<1.7	<1.3			<1.3
Thorium 230, pci/L (dissolved)	<0.2	<0.2				<0.4	<0.3			<0.3
Nitrogen, Ammonia as N, mg/L	0.05	<0.05				<0.05	<0.05			<0.05
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1				<0.05	<0.05			<0.1
Aluminum, mg/L (dissolved)	<0.1	0.3				<0.1	<0.1			<0.2
Arsenic, mg/L (dissolved)	0.002	0.002				0.001	0.001			0.002
Barium, mg/L (dissolved)	<0.1	<0.1				<0.1	<0.1			<0.1
Boron, mg/L (dissolved)	<0.1	<0.1				<0.1	<0.1			<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005				<0.005	<0.005			<0.005
Calcium, mg/L	13	15				6	12			12
Chromium, mg/L (dissolved)	<0.05	<0.05				<0.05	<0.05			<0.05
Copper, mg/L (dissolved)	<0.01	<0.01				<0.01	<0.01			<0.01
Iron, mg/L (dissolved)	0.03	0.19				<0.03	0.03			0.07
Lead, mg/L (dissolved)	<0.001	<0.001				<0.001	<0.001			<0.001
Magnesium, mg/L	5	4				2	3			4
Manganese, mg/L (dissolved)	<0.01	<0.01				<0.01	<0.01			<0.01
Mercury, mg/L (dissolved)	<0.001	<0.001				<0.001	<0.001			<0.001
Molybdenum, mg/L (dissolved)	<0.1	<0.1				<0.1	<0.1			<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05				<0.05	<0.05			<0.05

Table 2.7.3-9 (cont.) Water Quality Data from MRSW-9

	MRSW-9									
Parameters	**3/21/2007**	**6/13/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/22/2009**	**Average**
Potassium, mg/L	6	3		DRY		5	3	DRY	DRY	4
Selenium, mg/L (dissolved)	<0.001	<0.001				<0.001	<0.001			<0.001
Silica, mg/L	6.9	3.4				3.3	4.4			4.5
Sodium, mg/L	36	8				4	8			14
Uranium, mg/L (dissolved)	0.0016	0.0018				<0.0003	0.0006			0.0011
Vanadium, mg/L (dissolved)	<0.1	<0.1				<0.1	<0.1			<0.1
Zinc, mg/L (dissolved)	<0.01	<0.01				<0.01	<0.01			<0.01
Iron, TOTAL mg/L	0.08	0.89				0.26	0.28			0.38
Manganese, TOTAL mg/L	<0.01	0.08				0.01	<0.01			0.03
Lead 210, suspended pci/L	<1.0	<1.0				<4.1	<3.8			<2.5
Polonium 210 suspended, pci/L	<1.0	<1.0				<0.3	<0.4			<1.0
Radium 226 suspended, pci/L	<0.2	<0.2				<0.4	<0.1			<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2				<0.2	<0.2			<0.2
Uranium suspended, pci/L	<0.0003	<0.0003				<0.0003	0.0005			<0.0004

Table 2.7.3-10 Water Quality Data from MRSW-10

	MRSW-10										
Parameters	**10/25/2006**	**3/23/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/27/2009**	**10/22/2009**	**Average**
Bicarbonate as HCO3, mg/L	DRY	DRY	DRY		DRY		DRY	DRY	DRY	DRY	
Carbonate as CO3, mg/L											
Chloride, mg/L											
Conductivity, umhos/cm											
Fluoride, mg/L											
pH, s.u.											
Solids, Total Dissolved TDS @ 180 C, mg/L						85					85
Solids, Total Suspended TSS @ 105 C, mg/L				160		14					87
Sulfate, mg/L											
Turbidity, NTU				130		7.8					68.9
Gross Alpha, pci/L (dissolved)											
Gross Beta, pci/L (dissolved)											
Lead 210, pci/L (dissolved)											
Polonium 210, pci/L (dissolved)											
Radium 226, pci/L (dissolved)											
Radium 228, pci/L (dissolved)											
Thorium 230, pci/L (dissolved)											
Nitrogen, Ammonia as N, mg/L											
Nitrogen, Nitrate+Nitrite as N, mg/L											
Aluminum, mg/L (dissolved)											
Arsenic, mg/L (dissolved)											
Barium, mg/L (dissolved)											
Boron, mg/L (dissolved)											
Cadmium, mg/L (dissolved)											
Calcium, mg/L											
Chromium, mg/L (dissolved)											
Copper, mg/L (dissolved)											
Iron, mg/L (dissolved)											
Lead, mg/L (dissolved)											
Magnesium, mg/L											
Manganese, mg/L (dissolved)											
Mercury, mg/L (dissolved)											
Molybdenum, mg/L (dissolved)											
Nickel, mg/L (dissolved)											

Table 2.7.3-10 (cont.) Water Quality Data from MRSW-10

	MRSW-10										
Parameters	**10/25/2006**	**3/23/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**4/27/2009**	**10/22/2009**	**Average**
Potassium, mg/L	DRY	DRY	DRY		DRY		DRY	DRY	DRY	DRY	
Selenium, mg/L (dissolved)											
Silica, mg/L (dissolved)											
Sodium, mg/L											
Uranium, mg/L (dissolved)											
Vanadium, mg/L (dissolved)											
Zinc, mg/L (dissolved)											
Iron, TOTAL mg/L											
Manganese, TOTAL mg/L											
Lead 210, suspended pci/L											
Polonium 210 suspended, pci/L											
Radium 226 suspended, pci/L											
Thorium 230 suspended, pci/L											
Uranium suspended, pci/L											

Table 2.7.3-11 Water Quality Data from MRSW-11

	MRSW-11										
Parameters	**10/25/2006**	**3/23/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/23/2009**	**10/26/2009**	**Average**
Bicarbonate as HCO3, mg/L	DRY	DRY	DRY	DRY	DRY		67	147	492	451	289
Carbonate as CO3, mg/L							<1	<1	<5	<5	<3
Chloride, mg/L							<1	<1	3	4	<3
Conductivity, umhos/cm							131	211	742	683	442
Fluoride, mg/L							<0.1	<0.1	0.1	0.2	<0.2
pH, s.u.							7.77	7.9	7.99	8.09	7.94
Solids, Total Dissolved TDS @ 180 C, mg/L						134	136	159	532	390	270
Solids, Total Suspended TSS @ 105 C, mg/L						28	8	6	6	30	16
Sulfate, mg/L							3	2	1	15	5
Turbidity, NTU						13.6	2.9	1.6	12.3	17	9.5
Gross Alpha, pci/L (dissolved)							<1.3	5.7	<4.5	<4.8	<4.1
Gross Beta, pci/L (dissolved)							7.6	9.3	20.5	17.4	13.7
Lead 210, pci/L (dissolved)							<2.8	<5.6	<2.3	**	<3.6
Polonium 210, pci/L (dissolved)							<0.9	<0.6	<0.6	<0.7	<0.7
Radium 226, pci/L (dissolved)							<0.12	<0.17	0.2	<0.18	<0.2
Radium 228, pci/L (dissolved)							<1.5	<1.3	<1.2	<1.5	<1.4
Thorium 230, pci/L (dissolved)							<0.4	<0.2	<0.4	<0.2	<0.3
Nitrogen, Ammonia as N, mg/L							<0.05	<0.05	0.05	<0.05	<0.05
Nitrogen, Nitrate+Nitrite as N, mg/L							<0.05	<0.05	0.02	<0.1	<0.04
Aluminum, mg/L (dissolved)							<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic, mg/L (dissolved)							<0.001	0.001	0.007	0.003	0.003
Barium, mg/L (dissolved)							<0.1	<0.1	<0.1	<0.1	<0.1
Boron, mg/L (dissolved)							<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/L (dissolved)							<0.005	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L							13	35	110	79	59
Chromium, mg/L (dissolved)							<0.05	<0.05	<0.05	<0.05	<0.05
Copper, mg/L (dissolved)							<0.01	0.01	<0.01	<0.01	<0.01
Iron, mg/L (dissolved)							0.04	<0.03	0.11	0.05	0.06
Lead, mg/L (dissolved)							<0.001	0.004	<0.001	<0.001	<0.002
Magnesium, mg/L							3	5	29	31	17
Manganese, mg/L (dissolved)							<0.01	<0.01	0.75	0.06	<0.21
Mercury, mg/L (dissolved)							<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L (dissolved)							<0.1	<0.1	<0.1	<0.1	<0.1

** 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Table 2.7.3-11(cont.) Water Quality Data from MRSW-11

	MRSW-11										
Parameters	**10/25/2006**	**3/23/2007**	**6/14/2007**	**7/8/2008**	**10/23/2008**	**2/9/2009**	**3/11/2009**	**4/22/2009**	**7/23/2009**	**10/26/2009**	**Average**
Nickel, mg/L (dissolved)							<0.05	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L							9	9	25	22	16
Selenium, mg/L (dissolved)	DRY	DRY	DRY	DRY	DRY		<0.001	<0.001	<0.001	<0.001	<0.001
Silica, mg/L							6.6	15.4	28.8	9.4	15.1
Sodium, mg/L							2	4	6	7	5
Uranium, mg/L (dissolved)							<0.0003	<0.0003	0.0005	0.0023	<0.0009
Vanadium, mg/L (dissolved)							<0.1	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L (dissolved)							<0.01	0.22	<0.01	<0.01	<0.07
Iron, TOTAL mg/L							0.11	0.06	1.62	0.51	0.58
Manganese, TOTAL mg/L							0.02	0.05	0.93	0.08	0.27
Lead 210, suspended pci/L							<4.2	<3.8	<3.6	**	<3.8
Polonium 210 suspended, pci/L							<0.4	<0.4	<0.4	<0.3	<0.4
Radium 226 suspended, pci/L							<0.4	<0.1	<0.07	0.2	<0.2
Thorium 230 suspended, pci/L							<0.2	<0.1	<0.07	<0.06	<0.2
Uranium suspended, pci/L							<0.0003	<0.0003	<0.0003	<0.0003	<0.0003

** 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Table 2.7.3-11a Water Quality Data from MRSW-12

	MRSW-12						
Parameters	**7/8/2008**	**10/23/2008**	**2/9/2009**	**4/22/2009**	**7/23/2009**	**10/22/2009**	**Average**
Bicarbonate as HCO3, mg/L	101	524	43	61	561	DRY	258
Carbonate as CO3, mg/L	<1	41	<1	<1	70		23
Chloride, mg/L	<1	9	<1	1	15		5
Conductivity, umhos/cm	182	935	38	318	1090		513
Fluoride, mg/L	<0.1	0.7	<0.1	<0.1	0.9		0.4
pH, s.u.	6.49	8.85	7.07	7.51	8.93		7.77
Solids, Total Dissolved TDS @ 180 C, mg/L	170	542	70	199	697		336
Solids, Total Suspended TSS @ 105 C, mg/L	242	17	12	<4	46		64
Sulfate, mg/L	1	3	7	111	8		26
Turbidity, NTU	64.1	7	5.8	1.8	29.8		22
Gross Alpha, pci/L (dissolved)	<1.1	4	<1.1	5.1	<5.0		<3.3
Gross Beta, pci/L (dissolved)	12.6	3.9	5.1	3.6	13.4		7.7
Lead 210, pci/L (dissolved)	<9.2	<4.8	<3.6	<3.1	<2.3		<4.6
Polonium 210, pci/L (dissolved)	<1.0	<1.0	<0.7	<0.6	<0.6		<0.8
Radium 226, pci/L (dissolved)	<0.1	1.3	<0.3	<0.16	<0.23		<0.4
Radium 228, pci/L (dissolved)	<1.1	<1.3	<1.5	<1.2	<1.5		<1.3
Thorium 230, pci/L (dissolved)	<0.2	<0.2	<0.5	<0.3	<0.8		<0.4
Nitrogen, Ammonia as N, mg/L	<0.05	0.06	<0.05	<0.05	<0.05		<0.05
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.05	0.7	0.12	<0.05	0.01		0.19
Aluminum, mg/L (dissolved)	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Arsenic, mg/L (dissolved)	0.002	<0.001	0.002	<0.001	0.004		0.002
Barium, mg/L (dissolved)	<0.1	0.5	<0.1	<0.1	0.4		0.2
Boron, mg/L (dissolved)	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Cadmium, mg/L (dissolved)	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
Calcium, mg/L	18	26	9	30	19		20
Chromium, mg/L (dissolved)	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05
Copper, mg/L (dissolved)	<0.01	<0.01	<0.01	0.12	<0.01		<0.03
Iron, mg/L (dissolved)	0.9	<0.03	0.06	0.07	0.18		0.25
Lead, mg/L (dissolved)	<0.001	<0.001	<0.001	0.026	<0.001		<0.006
Magnesium, mg/L	5	17	2	14	19		11
Manganese, mg/L (dissolved)	0.35	<0.01	<0.01	0.03	0.02		0.08
Mercury, mg/L (dissolved)	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Molybdenum, mg/L (dissolved)	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Nickel, mg/L (dissolved)	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05

Table 2.7.3-11a (cont.) Water Quality Data from MRSW-12

	MRSW-12						
Parameters	**7/8/2008**	**10/23/2008**	**2/9/2009**	**4/22/2009**	**7/23/2009**	**10/22/2009**	**Average**
Potassium, mg/L	18	8	5	4	15	DRY	10
Selenium, mg/L (dissolved)	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Silica, mg/L	22.5	7.1	6.5	5.4	1.3		8.6
Sodium, mg/L	2	172	1	13	237		85
Uranium, mg/L (dissolved)	<0.0003	<0.0003	0.0004	0.0019	0.0024		0.0011
Vanadium, mg/L (dissolved)	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Zinc, mg/L (dissolved)	<0.01	0.01	0.06	0.76	<0.01		0.17
Iron, TOTAL mg/L	4.16	0.44	0.29	0.34	0.87		1.22
Manganese, TOTAL mg/L	0.4	<0.01	<0.02	0.04	0.03		0.1
Lead 210, suspended pci/L	<11.2	<7.3	<5.8	<3.9	<3.7		<6.4
Polonium 210 suspended, pci/L	1.7	<0.2	1.1	<0.3	<0.3		<0.8
Radium 226 suspended, pci/L	0.7	<0.5	0.8	<0.1	0.07		0.4
Thorium 230 suspended, pci/L	0.6	<0.2	0.2	0.2	<0.07		<0.3
Uranium suspended, pci/L	<0.0003	<0.0003	0.0005	<0.0003	<0.0003		<0.0003

Table 2.7.3-11b Water Quality Data - Surface Water - Seasonal Averages

Parameter	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Bicarbonate as HCO3, mg/L	333	295	296	612
Carbonate as CO3, mg/L	13	20	89	194
Chloride, mg/L	2	2	5	10
Conductivity, umhos/cm	589	621	908	1431
Fluoride, mg/L	0.3	0.3	0.4	0.7
pH, s.u.	8.51	8.78	9.25	9.08
Solids, Total Dissolved TDS @ 180 C, mg/L	301	398	702	904
Solids, Total Suspended TSS @105 C, mg/L	18	18	63	26
Sulfate, mg/L	32	67	91	86
Turbidity, NTU	9.8	14	70	14
Gross Alpha, pci/L (dissolved)	2.3	5.7	6.2	6.2
Gross Beta, pci/L (dissolved)	6.9	5.3	12.5	14.8
Lead 210, pci/L (dissolved)	2.6	2.3	3.0	2.8 *
Polonium 210, pci/L (dissolved)	1.0	0.8	0.7	1.0
Radium 226, pci/L (dissolved)	0.2	0.3	0.4	0.3
Radium 228, pci/L (dissolved)	1.4	1.1	1.2	1.2
Thorium 230, pci/L (dissolved)	0.3	0.3	0.5	0.2
Nitrogen, Ammonia as N, mg/L	0.08	0.07	0.05	0.20
Nitrogen, Nitrate+Nitrite as N, mg/L	0.08	0.07	0.03	0.28
Aluminum, mg/L (dissolved)	0.1	0.3	0.2	0.3
Arsenic, mg/L (dissolved)	0.003	0.003	0.007	0.006
Barium, mg/L (dissolved)	0.3	0.2	0.2	0.4
Boron, mg/L (dissolved)	0.1	0.1	0.1	0.1
Cadmium, mg/L (dissolved)	0.005	0.005	0.005	0.005
Calcium, mg/L	23	33	35	27
Chromium, mg/L (dissolved)	0.05	0.05	0.05	0.05
Copper, mg/L (dissolved)	0.01	0.04	0.01	0.01
Iron, mg/L (dissolved)	0.08	0.15	0.21	0.25
Lead, mg/L (dissolved)	0.001	0.007	0.001	0.030
Magnesium, mg/L	14	17	21	34
Manganese, mg/L (dissolved)	0.02	0.01	0.14	0.02
Mercury, mg/L (dissolved)	0.001	0.001	0.001	0.001
Molybdenum, mg/L (dissolved)	0.1	0.1	0.1	0.1
Nickel, mg/L (dissolved)	0.05	0.05	0.05	0.05
Potassium, mg/L	9	6	14	14
Selenium, mg/L (dissolved)	0.001	0.001	0.001	0.001
Silica, mg/L	7.3	6.8	9.5	4.8
Sodium, mg/L	91	92	151	295
Uranium, mg/L (dissolved)	0.0017	0.0014	0.0012	0.0033
Vanadium, mg/L (dissolved)	0.1	0.1	0.1	0.1
Zinc, mg/L (dissolved)	0.02	0.16	0.01	0.01
Iron, TOTAL mg/L	0.35	0.67	4.3	0.54
Manganese, TOTAL mg/L	0.05	0.04	0.21	0.02
Lead 210, suspended pci/L	3.0	3.0	3.8	2.7 *
Polonium 210 suspended, pci/L	0.8	0.7	0.6	1.0
Radium 226 suspended, pci/L	0.3	0.2	0.3	0.2
Thorium 230 suspended, pci/L	0.2	0.2	0.1	0.2
Uranium suspended, pci/L	0.0004	0.0003	0.0003	0.0009

* 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Table 2.7.3-11c Water Quality Data - Surface Water - Average Concentrations

Parameter	Overall Average
Bicarbonate as HCO3, mg/L	384
Carbonate as CO3, mg/L	79
Chloride, mg/L	5
Conductivity, umhos/cm	887
Fluoride, mg/L	0.4
pH, s.u.	8.91
Solids, Total Dissolved TDS @ 180 C, mg/L	576
Solids, Total Suspended TSS @ 105 C, mg/L	31
Sulfate, mg/L	69
Turbidity, NTU	27
Gross Alpha, pci/L (dissolved)	5.1
Gross Beta, pci/L (dissolved)	9.9
Lead 210, pci/L (dissolved)	2.6 *
Polonium 210, pci/L (dissolved)	0.9
Radium 226, pci/L (dissolved)	0.3
Radium 228, pci/L (dissolved)	1.2
Thorium 230, pci/L (dissolved)	0.3
Nitrogen, Ammonia as N, mg/L	0.10
Nitrogen, Nitrate+Nitrite as N, mg/L	0.12
Aluminum, mg/L (dissolved)	0.2
Arsenic, mg/L (dissolved)	0.005
Barium, mg/L (dissolved)	0.3
Boron, mg/L (dissolved)	0.1
Cadmium, mg/L (dissolved)	0.005
Calcium, mg/L	30
Chromium, mg/L (dissolved)	0.05
Copper, mg/L (dissolved)	0.02
Iron, mg/L (dissolved)	0.17
Lead, mg/L (dissolved)	0.010
Magnesium, mg/L	22
Manganese, mg/L (dissolved)	0.05
Mercury, mg/L (dissolved)	0.001
Molybdenum, mg/L (dissolved)	0.1
Nickel, mg/L (dissolved)	0.05
Potassium, mg/L	10.8
Selenium, mg/L (dissolved)	0.001
Silica, mg/L	7.1
Sodium, mg/L	157
Uranium, mg/L (dissolved)	0.0019
Vanadium, mg/L (dissolved)	0.1
Zinc, mg/L (dissolved)	0.05
Iron, TOTAL mg/L	1.47
Manganese, TOTAL mg/L	0.08
Lead 210, suspended pci/L	3.3 *
Polonium 210 suspended, pci/L	0.8
Radium 226 suspended, pci/L	0.3
Thorium 230 suspended, pci/L	0.2
Uranium suspended, pci/L	0.0005

* 10-27-09 Lead 210 results not available from lab as of 12-10-09.

Radiological Open Issue No. 6
Surface water sampling results not identified as suspended or dissolved
July 27 2009 Teleconference

Open Issue discussion:

The staff notes that the applicant did not delineate between suspended and dissolved water sample results as recommended by Regulatory Guide 4.14. EMC stated that all surface water samples are dissolved, with the exception of a few parameters that meet guideline 8 as required by WDEQ.

Answer:

Surface water quality results are reported in revised Tables 2.7.3-1 through 2.7.3-11c (presented in the July Radiological Open Item # 4 response). Radiological parameters are identified and reported in these tables as dissolved and suspended as recommended by Regulatory Guide 4.14.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER Open Issue. Table's 2.7.3-1 through 2.7.3-11c have been revised to distinguish between suspended and dissolved results. The revised tables are presented in SER Open Item # 4 response, and will be inserted in the revised Technical Report.

Radiological Open Issue No. 6a
Quantity of radioactive material released to unrestricted areas
July 27 2009 Teleconference

Open Issue discussion:

Regulatory Guide 3.59 addresses methods, models, data, and assumptions acceptable to the NRC staff for estimating airborne emissions of radioactive and toxic materials from uranium milling. The applicant did not provide sufficient information regarding the manner in which it will calculate or measure effluent releases from monitored release points. Additionally, the applicant has not provided sufficient information regarding how it plans to meet the requirement in 10 CFR 40.65 for reporting the quantity of each of the principal radionuclides released to unrestricted areas.

Answer:

Run MILDOS with more receptor points including public access areas within the permitted area (unrestricted areas) - monitor these locations during operations with radon Trac Etch cups, TLD/OSDs and collect soil samples (U, Ra)

Proposed Revisions to License Application

Add these locations to Figure 5.7 -2. Add sentence or two in each media paragraph of section 5.7.7 that explains what we will do during operations to monitor radioactive material releases to unrestricted areas.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 6b
Gaseous effluent controls
July 27 2009 Teleconference

Open Issue discussion:

The applicant also did not address how the requirements of 10 CFR 40, Appendix A, Criterion 8, and 10 CFR 20.1101(d) regarding ALARA effluent levels for radon and uranium particulates.

Answer to Open Item 6b addressed in Open Issue 6e answer.

Radiological Open Issue No. 6c
Dryer effluent controls
July 27 2009 Teleconference

Open Issue discussion:

According to the applicant, the bag house is an air and vapor filtration unit mounted directly above the drying chamber so that dry solids collected on the bag filter surfaces can be batch discharged back to the drying chamber. The bag house will be heated to prevent condensation and will be kept under negative pressure. The condenser will be located downstream of the bag house and will be water cooled. Uranium particulates that pass through the bag filters will be wetted and entrained in the condensing moisture within this unit. The applicant did not demonstrate the efficiency of this process or identify the point of discharge. EMC stated that the point of discharge is in the central processing plant. EMC indicated that section 3 of the application has a good description of the vacuum dryer.

Answer to Open Item 6c addressed in Open Issue 6e answer.

Radiological Open Issue No. 6d
Dryer effluent controls
July 27 2009 Teleconference

Open Issue discussion:

The applicant stated that during routine operations, the air pressure differential gauges for other emission control equipment will be observed and documented at least once per shift during dryer operations. 10 CFR 40, Appendix A, Criterion 8, states that checks must be made and logged hourly of all parameters (e.g., differential pressures and scrubber water flow rates) that determine the efficiency of yellowcake stack emission control equipment operations.

Answer to Open Item 6d addressed in Open Issue 6e answer.

Radiological Open Issue No. 6e
Dryer effluent controls
July 27 2009 Teleconference

Open Issue discussion:

10 CFR 40 Appendix A, Criterion 8, requires milling operations to be conducted so that all airborne effluent releases are reduced to levels ALARA. The primary means of accomplishing this must be by means of emission controls. The applicant plans to discharge gaseous effluents outside the plant building through the plant stack, but has not demonstrated how the gaseous effluents will be monitored and reduced to levels ALARA.

Answer:

Open issues 6b, 6c, 6d, and 6e have been combined into a single discussion on airborne effluent releases from the Moore Ranch project and why the design meets the ALARA requirements of 10 CFR Part 40, Appendix A, Criterion 8 and 10 CFR 20.1101(d).

Air Particulate Effluents:

NUREG-6733, "A Baseline Risk-Informed, Performance-Based Approach for In Situ Leach Uranium Extraction Licensees" (NRC, 2001) discusses the available technologies for drying and packaging yellowcake:

> *"Two kinds of yellowcake dryer are used: multihearth dryers and vacuum dryers. Older plants use gas-fired multihearth dryers. These dryers typically dry the yellowcake at about 400 to 620 degrees C (750 to 1,150 degrees F)...The offgas discharge from the dryer is scrubbed with a high intensity venturi scrubber that has a 95 to 99 percent efficiency for removal of uranium particulates prior to release to the atmosphere. Solutions from the scrubber are normally returned to the precipitation circuit and are processed to recover any uranium particulates. As a result, the stack discharge normally contains only water vapor and quantities of uranium fines that are well below regulatory limits".*

NUREG-6733 then describes the offgas emission control systems for vacuum dryers:

> *"First, vapor passes through a bag filter to remove yellowcake particulates with an efficiency exceeding 99 percent. Any captured particulates are returned to the drying chamber. Then, any water vapor exiting the drying chamber is cooled and condensed. This process is designed to capture virtually all escaping particles.*

The impact analysis contained in NUREG-1910, "Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities" (NRC, 2009) as it relates to impacts from airborne radioactive effluents was based on the analysis in NUREG-6733. NUREG-1910 determined that air quality impacts due to the release of radiological effluents would be SMALL.

10 CFR Part 40, Appendix A, Criterion 8 states:

> *Milling operations must be conducted so that all airborne effluent releases are reduced to levels as low as is reasonably achievable. The primary means of accomplishing this must be by means of emission controls".*

10 CFR §20.1101(d) states:

> *To implement the ALARA requirements of § 20.1101 (b), and notwithstanding the requirements in §20.1301 of this part, a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established by licensees other than those subject to §50.34a, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in § 20.2203 and promptly take appropriate corrective action to ensure against recurrence.*

Uranium One has proposed the use of vacuum drying technology for the Moore Ranch project. As noted in NUREG-6733, vacuum dryer technology provides an emission control approach to ALARA at the source that exceeds the 95 to 99 percent efficiency of multihearth dryers and "*is designed to capture virtually all escaping particles*". Furthermore, it is also of importance to note that NUREG 1910 (NRC 2009), section 4.2.11.2.1 explains " radon gas is emitted from ISL well fields and processing facilities during operations and is the only radiological airborne effluent for those facilities that use vacuum dryer technology". Therefore, the use of a vacuum dryer as an emission control method is by definition as low as reasonably achievable and complies with the requirements of 10 CFR Part 40, Appendix A, Criterion 8 and 10 CFR 20.1101(d).

Uranium One noted during the teleconference with NRC that the condenser discharge would be located within the Central Process Plant Building. The CPP will be routinely monitored for air particulate concentrations as discussed in Section 5 of the Technical Report. However, since the vacuum dryer design assures that the emission control system captures "virtually all escaping particles", the constraint in 10 CFR §20.1101(d) to limit the dose to an individual member of the public to 10 mrem per year will be met.

Uranium One agrees with Open Issue 6 d concerning the requirements for monitoring dryer emission control equipment and will revise the application as discussed below.

Radon Effluents:

The Moore Ranch design includes the use of pressurized downflow ion exchange columns. NUREG-1910 (NRC, 2009) in section 2.7.1 notes:

Pressurized processing systems may contain most of the radon in solution; however, radon may escape from the processing circuit in the central uranium processing facility through vents or leaks, during well field operations, or during resin transfer when remote ion exchange is used. For open air activities, the gas quickly disperses into the air. In closed processing areas, the building ventilation systems are designed to limit indoor radon concentrations.

As noted, pressurized ion exchange systems contain most of the radon gas present in the lixiviant. In these systems, radon gas may be released during venting and resin transfer operations. These releases of radon gas are collected in vessel venting systems and directed outside the plant through blowers and discharge stacks to maintain radon and progeny concentrations within the plant to levels that are ALARA relative to potential worker exposure. Plant buildings are ventilated through the use of general area ventilation to remove any radon and progeny present from leaks in an effort to further reduce worker exposure.

The alternative to pressurized downflow ion exchange columns typically employed for ISL mining is upflow atmospheric ion exchange columns. These columns release virtually all of the radon gas present in the lixiviant. The radon gas is usually collected at the ion exchange columns and exhausted outside the plant through ventilation systems and stacks.

The use of pressurized downflow ion exchange columns at Moore Ranch will reduce the radon gas emissions relative to other ion exchange technologies and represents an emission control method that reduces emissions to levels that are as low as reasonably achievable and complies with the requirements of 10 CFR Part 40, Appendix A, Criterion 8. Further, the use of these ion exchange systems coupled with tank and area ventilation systems ensures that worker exposure to radon and it's progeny is maintained ALARA through the use of engineering controls. The effectiveness of these controls may be seen in the results of additional MILDOS modeling performed by Uranium One in response to Open Issue No. 6a.

Operational experience as previously documented by NRC supports the above conclusions. Throughout the 30 + years of ISR operational experience in the US there is no evidence of public exposure from radon releases in excess of public exposure criteria. For example, NUREG 1910 (NRC 2009) - Table 4.2-2 presents 9 dose estimates to offsite receptors solely from radon releases from ISR facilities, all of which are ≤ 40 mrem/yr. Further, section 4.2.11.2.1 states " all doses reported are well within the 10 CFR 20 annual radiation dose limit for the public of 1 mSv/yr (100 mrem/yr)" and "...radiological doses from normal operations are expected to have a SMALL impact on the general public."

Accordingly, the process design and emission control methods described above are considered technically prudent, sufficiently protective and compliant with ALARA requirements of 10 CFR 40, Appendix A, Criterion 8, and 10 CFR 20.1101(d).

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

4.1 GASEOUS AND AIRBORNE PARTICULATES

The primary radioactive airborne effluent at the Moore Ranch Facility will be radon-222 gas. Radon-222 is found in the pregnant lixiviant that comes from the wellfield into the facility for separation of uranium. The uranium will be separated from the groundwater by passing the solution through fixed bed ion exchange (IX) units operated in a pressurized downflow mode. NUREG-1910 (NRC, 2009) in section 2.7.1 notes that pressurized ion exchange systems contain most of the radon gas present in the lixiviant. In these systems, radon gas may be released during venting and resin transfer operations. The alternative to pressurized downflow ion exchange columns typically employed for ISL mining is upflow atmospheric ion exchange columns. These columns release virtually all of the radon gas present in the lixiviant. The use of pressurized downflow ion exchange columns at Moore Ranch will reduce the radon gas emissions relative to other available ion exchange technologies and represents an emission control method that reduces emissions to levels that are as low as reasonably achievable and complies with the requirements of 10 CFR Part 40, Appendix A, Criterion 8. Further, the use of these ion exchange systems coupled with tank and area ventilation systems ensures that worker exposure to radon and its progeny is maintained ALARA through the use of engineering controls.

Vessel vents from the individual IX vessels will be directed to a manifold that is exhausted to atmosphere outside the building via an induced draft fan. Venting any released radon-222 gas to atmosphere outside the plant minimizes employee exposure. Small amounts of radon-222 may be released via solution spills, filter changes, IX resin transfer, reverse osmosis (RO) system operation during groundwater restoration, and maintenance activities. These are minimal radon gas releases on an infrequent basis. The exhaust system in the plant will further reduce employee exposure. The air in the plant is sampled for radon daughters (see Section 5.0) to assure that concentration levels of radon and radon daughters are maintained as low as reasonably achievable (ALARA).

This section describes the gaseous effluent control systems that will be installed in the Moore Ranch Facility.

4.1.1 Gaseous Effluents-Tank and Process Vessel, and Work Area Ventilation Systems

A separate ventilation system will be installed for all indoor non-sealed process tanks and vessels where radon-222 or process fumes would be expected. The system will consist of an air duct or piping system connected to the top of each of the process tanks. Redundant exhaust fans will direct collected gases to discharge piping that will exhaust fumes to the outside atmosphere. The design of the fans will be such that the system will be capable of limiting employee exposures with the failure of any single fan. Discharge stacks will be located on the leeward side of the building and ventilation intakes will be on the upwind side of the building to ensure exaustedexhausted radon is not taken back into the facility from prevailing winds. as recommended in Regulatory Guide 8.31-. Airflow through any openings in the vessels will be from the process area into the vessel and into the ventilation system, controlling any releases that occur inside the vessel. Separate ventilation systems may be used as needed for the functional areas within the plant. Tank ventilation systems of this type have been successfully utilized at other ISR facilities and have proven to be an effective method for minimizing employee exposure.

The work area ventilation system will be designed to force air to circulate within the plant process areas. The ventilation system will exhaust outside the building, drawing fresh air in. The work area ventilation system will consist of 4 fans with a capacity 10,000 cfm each. 2 fans will be located in the ion exchange area, one fan will be located in the resin transfer area, and one fan will be located in the precipitation area. The air exchange rate of the four fans is approximately 1.25 air exchanges per hour. During favorable weather conditions, open doorways and convection vents in the roof will provide satisfactory work area ventilation. During extreme cold outdoor temperatures, the ventilation system will provide adequate work area ventilation if doorways need to be shut. Buildings will be heated during winter months to maintain temperatures in the plant area. The design of the ventilation system will be adequate to ensure that radon daughter concentrations in the facility are maintained below 25 percent of the derived air concentration (DAC) from 10 CFR Part 20.

Other emissions to the air are limited to exhaust and dust from limited vehicular traffic. Impacts from potential emissions from process chemicals that will be used at the plant is described in Section 7. There are no significant combustion related emissions from the process facility as commercial electrical power is available at the site.

4.1.2 Air Particulate Effluents

Potential radiological air particulate effluents consist primarily of dried yellowcake in the drying and processing areas of the central plant. The yellowcake drying facilities at the Moore Ranch Central Plant will be comprised of vacuum dryers. By design, vacuum dryers do not discharge any uranium when operating. The vacuum drying system is proven technology, which is being used successfully in several ISR sites where uranium oxide is being produced. As noted in NUREG-6733, vacuum dryer technology provides an emission control approach to ALARA at the source that exceeds the 95 to 99 percent efficiency of multihearth dryers and "is designed to capture virtually all escaping particles". Therefore, the use of a vacuum dryer is an emission control method that reduces emissions to levels that are as low as reasonably achievable and complies with the requirements of 10 CFR Part 40, Appendix A, Criterion 8. Air particulate controls of the vacuum drying system include a bag house, condenser, vacuum pump, and packaging hood.

The bag house is an air and vapor filtration unit mounted directly above the drying chamber so that any dry solids collected on the bag filter surfaces can be batch discharged back to the drying chamber. The bag house is heated to prevent condensation of water vapor during the drying cycle. It is kept under negative pressure by the vacuum system.

The condenser unit is located downstream of the bag house and is water cooled. It is used to remove the water vapor from the non-condensable gases coming from the drying chamber. The gases are moved through the condenser by the vacuum system. Any particulates that pass through the bag filters are wetted and entrained in the condensing moisture within this unit.

The vacuum pump is a rotary water sealed unit that provides a negative pressure on the entire system during the drying cycle. It is also used to provide ventilation during transfer of the dry powder from the drying chamber to fifty-five (55) gallon drums. The water seal of the rotary vacuum pump captures entrained particulate matter remaining in the gas streams.

The packaging system is operated on a batch basis. When the yellowcake is dried sufficiently, it is discharged from the drying chamber through a bottom port into drums. A level gauge, a weigh scale, or other suitable device will be used to determine when a drum is full. Particulate capture is provided by a sealed hood that fits on the top of the drum, which is vented through a sock filter to the condenser and the vacuum pump system when the powder is being transferred.

The system will be instrumented sufficiently to operate automatically and to shut itself down for malfunctions such as heating or vacuum system failures. The system will alarm if there is an indication that the emission control system is not performing within operational specifications. If the system is alarmed due to the emission control system, the operator will follow standard operating procedures to recover from the alarm condition, and the dryer will not be unloaded as part of routine operations, if currently loaded, or reloaded, if currently empty, until the emission control system is returned to service within specified operational conditions.

To ensure that the emission control system is performing within specified operating conditions, instrumentation will be installed that signal an audible alarm if the air pressure (i.e. vacuum level) falls below specified levels, and the operation of this system ~~is~~will be checked and documented during dryer operations. ~~In the event this system fails~~During dryer operations, the operator will perform and document checks of the differential pressure or vacuum every ~~four (4)~~ hours in accordance with 10 CFR Part 40, Appendix A, Criterion 8. ~~Additionally, during routine operations, the air pressure differential gauges for other emission control equipment is observed and documented at least once per shift during dryer operations.~~

Radiological Open Issue No. 6f
Dryer effluent controls
July 27 2009 Teleconference

Open Issue discussion:

The applicant stated that the ventilation system will exhaust air from within the plant to outside the plant building; however, the applicant has not demonstrated how the gaseous effluents will be monitored.

Answer:

Other than the discussions on the vacuum dryer off gas system for issues 6b,c.e, there are no other "emission controls" for radon nor for any "particulate" picked up by local exhaust systems or general plant HVAC. Perhaps we combine this with the 6b,c, e response since a major focus of that response is that effluents are ALARA by design (from dryer and off gas system) per 10 CFR 40, App A, 8.

We could calculate a radon emission rate (Curies / hr) from plant – assume an annual source term (NRC GEIS and/or NMA GER, could be pulled out of MILDOS?), give me approx. volume (dimensions) of plant and air exchange rate (section 4.1.1 = 1.25/ hr but may not include consideration of local exhaust from vessels?) - then compare this rate to natural emissivity (flux) from surface of earth. Also, MILDOS results will support claim that dose is projected to be so small as to constitute "ALARA"

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Add results of this analysis to discussion in section 4.1

EXTERNAL RADIATION EXPOSURE MONITORING PROGRAM

Radiological Open Issue No. 7
Adequacy of monitoring program to detect and control gamma radiation from uranium decay products
July 27 2009 Teleconference

Open Issue discussion:

The applicant stated that the external gamma survey meters will have a detection range of 100 uR/hr to 5 mR/hr. The applicant also stated that radiation dose rates may exceed 5 mrem per hour. The staff cannot verify if the external radiation exposure monitoring program is sufficient to detect and control gamma radiation from uranium decay products.

Answer:

The minimum specifications discussed in Section 5.7.2.1 will be revised to ensure that external gamma survey meters are used that will be capable of detecting radiation dose rates in excess of 5 mrem per hour.

The instruments described in Section 5.7.2.1 to conduct general beta/gamma surveys are a Ludlum Model 3 survey meter and Ludlum 44-38 probe or equivalent. The Model 3 is a general purpose survey meter with a meter scale of 0 to 2 mrem/hr and with scale multiplier adjustments of X 0.1, X 1.0, X 10, and X 100. Accordingly, the effective range of this survey meter and probe is 0 to 200 mrem/hr. The model 44-38 probe is a thin walled GM detector with beta shield and is appropriate for measurement of both gamma and beta + gamma fields.

Radiological Open Issue No. 8
Information on lower limits of detection on beta and gamma radiation survey instruments
July 27 2009 Teleconference

Open Issue discussion:

The applicant identifies several types of portable radiation meters to conduct beta and gamma surveys. The staff cannot verify if the monitoring equipment has a lower limit of detection that allows measurement of 10% of the applicable limits.

Answer:

For general gamma/beta dose rate surveys, the Ludlum Model 44-38 and 44-6 sidewall GM detectors (or equivalent) are specified in sections 5.7.2.1 and 5.7.2.2 of the application. The manufacturer specifications (Ludlum Instruments Catalogue 2008) for both the model 44-6 and model 44-38 indicate a sensitivity of 1200 cpm per mrem/hr and backgrounds of 20 cpm (beta shield closed) and 25 cpm open. Accordingly, the MDL for these instruments would be approximately 30 μR/hr at twice background.

For alpha contamination surveys, section 5.7.6 specifies use of Ludlum Model 43-65 or 43-5 alpha scintillation probes. The manufacturer specifications for these alpha probes indicate a background of < 3 cpm alpha with efficiencies of 13-17% (Pu-239, Th-230) Accordingly, the MDL for these instruments at twice background should be approximately 30 – 40 dpm alpha across their active windows of 63-76 cm^2. Human performance (proximity to surface, survey speed, etc) potentially has a significant effect on the MDL. However, this is the case with any hand held survey instruments.

Radiological Open Issue No. 9
Frequency of beta surveys
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that they will perform beta surveys at least once for each operation and whenever there is a change in procedures or equipment that may affect the beta dose. The staff cannot determine what is meant by “at least once for each operation”.

Radiological Open Issue No. 19
Beta surveys of operations involving direct handling of large quantities of aged yellowcake
July 27 2009 Teleconference

Open Issue discussion:

The applicant does not address how it plans to conduct beta surveys in the plant and what action levels will be taken to protect personnel working in potential beta and gamma radiation fields.

Answer:

Beta exposure rate surveys will be performed at the specific operations that involve direct handling of large quantities of aged yellowcake. This would include in plant areas associated with precipitation, dewatering (filter press) and drying/packaging. Surveys will be performed with a Ludlum 44-6 sidewall GM detector or equivalent. These surveys will be performed near the surface of the material (e.g., within 10 cm) so as to be representative of beta exposure rates to workers' hands and skin during the handling of the material. Surveys will be performed at initiation of operations and subsequent surveys and/or beta evaluations will be performed whenever procedural and/or equipment changes could affect the beta levels to which employees may be exposed. Any beta exposure rate evaluations for these operations that are performed in lieu of instrument surveys will use the information provided in Regulatory Guide 8.30 Figures 1 and 2.

Beta contamination surveys will similarly be performed in these same plant areas initially and whenever procedural and/or equipment change may increase risk of beta contamination. These surveys will be performed with a Ludlum 43-1-1 alpha – beta phoswich scintillation probe or equivalent. This probe has an active window area of 83 cm^2, rated efficiencies of 30% alpha (Pu^{239}) and 30% beta (Sr^{90} / Y^{90}) and typical backgrounds of 3 cpm alpha and < 300 cpm beta.

If it is determined that beta exposure rates to which workers could be exposed could result in shallow dose equivalents to the skin or the skin of extremities that are ≥ 10% of the limits from 10 CFR §20.1201 (a)(2), provisions for personnel beta monitoring (e.g., ring and/or wrist badges) will be provided.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to these Open Issues. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

5.7.2.1 Gamma Surveys

External gamma radiation surveys will be performed routinely at the Moore Ranch Uranium Project. The required frequency will be ~~quarterly~~ monthly in designated Radiation Areas and semiannually in all other areas of the plant. Surveys will be performed at worker occupied stations and areas of potential gamma sources such as tanks and filters. EMC will establish and post as a Radiation Area any area, accessible to workers, in which radiation levels could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour~~if the survey indicates that gamma radiation levels exceed the action level of 5.0 mRem per hour for worker occupied stations~~. An investigation will be performed to determine the probable source and survey frequency for areas exceeding 5.0 mRem per hour is increased to ~~quarterly~~monthly. Records will be maintained of each investigation and the corrective action taken. If the results of a gamma survey identified areas where gamma radiation is in excess of levels that delineate a "radiation area", access to the area will be restricted and the area will be posted as required in 10 CFR §20.1902 (a).

External gamma surveys will be performed with survey equipment that meets the following minimum specifications:

1. Range - Lowest range not to exceed 1200 microRoentgens per hour (µR/hr) full-scale with the highest range to read at least 5100 milliRoentgens per hour (mR per hour) full scale;

2. Battery operated and portable;

Examples of satisfactory instrumentation that meets these requirements are the Ludlum Model 3 survey meter with a Ludlum 44-38 probe or equivalent. The Model 3 is a general purpose survey meter with a meter scale of 0 to 2 mrem/hr and scale multiplier adjustments of X 0.1, X 1.0, X 10, and X 100. Accordingly, the effective range of this survey meter and probe is 0 – 200 mrem/hr. The model 44-38 has a sensitivity of 1,200 cpm per mrem/hr and backgrounds of 20 cpm (beta shield closed) and 25 cpm open. Accordingly, the MDL for this instrument is approximately 30 µR/hr at twice background. Gamma survey instruments will be calibrated at the manufacturer's suggested interval or at least annually and will be operated in accordance with the manufacturer's recommendations. Instrument checks will be performed each day that an instrument is used.

5.7.2.2 Beta Surveys

Beta surveys of specific operations that involve direct handling of large quantities of aged yellowcake are recommended in USNRC Regulatory Guide 8.30, Section 12.4. The beta dose rate on the surface of yellowcake just after separation from ore is negligible. Over a period of several months, the beta dose from aged yellowcake increases due to the ingrowth of protactinium-234 and thorium-234. EMC plans to ship yellowcake on a schedule that minimizes the dose from aged yellowcake.

EMC will perform -beta exposure rate surveys at specific operations that involve direct handling of large quantities of aged yellowcake. This includes operations in plant areas associated with precipitation, dewatering (filter press) and drying/packaging.will perform beta surveys at least once for each operation and whenever there is a change in procedures or equipment that may affect the beta dose. Surveys will be performed at the initiation of operations and subsequent surveys and/or beta evaluations will be performed whenever procedural and/or equipment changes could affect the beta levels to which employees may be exposed. Surveys will be performed near the surface of the material (e.g., within 10 cm) so as to be representative of beta exposure rates to workers' hands and skin during the handling of the material. Beta contamination surveys will be performed using a Ludlum Model 2224 portable scaler/ratemeter with a Ludlum 43-1-1 alpha/beta scintillator probe or equivalent. Beta dose rate surveys will be performed with a Ludlum Model 44-6 sidewall G-M detector or equivalent. The model 44-6 has a sensitivity of 1,200 cpm per mrem/hr and backgrounds of 20 cpm (beta shield closed) and 25 cpm open. Accordingly, the MDL for this instrument is approximately 30 µR/hr at twice background. If it is determined that beta exposure rates to which workers could be exposed could result in shallow dose equivalents to the skin or the skin of extremities that are ≥ 10% of the limits from 10 CFR §20.1201 (a)(2), provisions for personnel beta monitoring (e.g., ring and/or wrist badges) will be provided.

Beta contamination surveys will also be performed in these same plant areas initially and whenever procedural and/or equipment change may increase risk of beta contamination. These surveys will be performed using a Ludlum Model 2224-1 portable scaler/ratemeter with a Ludlum 43-1-1 alpha – beta phoswich scintillation probe or equivalent. This probe has an active window area of 83 cm2, rated efficiencies of 30% alpha (Pu 239) and 30% beta (Sr 90 / Y 90) and typical backgrounds of 3 cpm alpha and < 300 cpm beta.

As discussed in Regulatory Guide 8.30, beta evaluations may be substituted for surveys using radiation survey instruments based on two figures provided in the Regulatory Guide. These beta evaluations are based on curves that represent the increase of the beta dose rate over time due to the ingrowth of protactinium-234 and thorium-234 (Regulatory Guide 8.30, Figure 1) and the decrease of beta dose as the distance from the source increases (Regulatory Guide 8.30, Figure 2).

Radiological Open Issue No. 8
Information on lower limits of detection on beta and gamma radiation survey instruments
July 27 2009 Teleconference

Open Issue discussion:

The applicant identifies several types of portable radiation meters to conduct beta and gamma surveys. The staff cannot verify if the monitoring equipment has a lower limit of detection that allows measurement of 10% of the applicable limits.

Answer:
For general gamma/beta dose rate surveys, the Ludlum Model 44-38 and 44-6 sidewall GM detectors (or equivalent) are specified in sections 5.7.2.1 and 5.7.2.2 of the application. The manufacturer specifications (Ludlum Instruments Catalogue 2008) for both the model 44-6 and model 44-38 indicate a sensitivity of 1200 cpm per mrem/hr and backgrounds of 20 cpm (beta shield closed) and 25 cpm open. Accordingly, the MDL for these instruments would be approximately 30 μR/hr at twice background.

For alpha contamination surveys, section 5.7.6 specifies use of Ludlum Model 43-65 or 43-5 alpha scintillation probes. The manufacturer specifications for these alpha probes indicate a background of < 3 cpm alpha with efficiencies of 13-17% (Pu-239, Th-230) Accordingly, the MDL for these instruments at twice background should be approximately 30 – 40 dpm alpha across their active windows of 63-76 cm^2. Human performance (proximity to surface, survey speed, etc) potentially has a significant effect on the MDL. However, this is the case with any hand held survey instruments.

Proposed Revisions to License Application

See Open Issue 7

Radiological Open Issue No. 9
Frequency of beta surveys
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that they will perform beta surveys at least once for each operation and whenever there is a change in procedures or equipment that may affect the beta dose. The staff cannot determine what is meant by "at least once for each operation".

Answer:

See response to Open Item 19

Proposed Revisions to License Application

See response to Open Item 7

Open Issues 7,8,9, and 19 have been combined

Radiological Open Issue No. 10
Adequacy of beta personnel monitoring
July 27 2009 Teleconference

Open Issue discussion:

The applicant plans to conduct beta surveys in the plant but does not identify personnel monitoring for beta. The staff cannot verify if the monitoring program is adequate to protect workers from the hazards of beta radiation.

Answer:

Section 5.7.4.3 of the application states that "occupational exposure to external gamma and beta radiation will be measured using personnel dosimeters such as Thermoluminescent Dosimeters (TLD) or Optically Stimulated Dosimeters (OSL)". Which type will be used has not as yet been determined. Determination of the potential for beta exposure of personnel (hands and skin) is discussed in response Radiological Open Issue No. 9 from the July 27, 2009 teleconference.

Proposed Revisions to License Application

No changes are proposed to the license application in response to this Open Issue.

Radiological Open Issue No. 11
Alternative action levels based on quarterly rather than monthly bioassay sampling
July 27 2009 Teleconference

Open Issue discussion:

The applicant indicated that it will follow the corrective actions in Table 1 of Regulatory Guide 8.22. This is a corrective action program based on monthly urinary uranium results. The applicant indicates that will conduct quarterly sampling. The staff cannot verify if the proposed bioassay program is consistent with Regulatory Guide 8.22.

Answer:

The bioassay program for Moore Ranch will be conducted in accordance with Regulatory Guide 8.22, *Bioassay at Uranium Mills*, Revision 1, August 1988 and NUREG 0874, *Internal Dosimetry Model for Application to Bioassay at Uranium Mills* (1986). NUREG-0874 provides the technical basis for Regulatory Guide 8.22. In fact, frequencies of sampling based on solubility characteristics, associated action levels and recommended actions specified in Tables 1 and 2 of Regulatory Guide 8.22 are taken directly from NUREG-0874. NRC has noted that they have simplified some of the detail from NUREG-0874 for ease of implementation using the official guidance in Regulatory Guide 8.22 (see NUREG 0874, Section 6, which compares the action levels and bioassay frequencies of Regulatory Guide 8.22 versus those contained in NUREG-0874). Any proposals for deviations in the Moore Ranch bioassay program from the technical positions in Regulatory Guide 8.22 will be justified based on data derived from NUREG-0874 or appropriate updates (see below).

Although there is some uncertainty at present regarding the applicability of TGLD solubility Class D versus Class W for Moore Ranch uranium products, the solubility characteristics of the less soluble Class W compounds are well within the range of dissolution half times defined by NUREG-0874 for "low temperature drying" (see NUREG 0874, Table 1-3). Additionally, data from the technical literature (as discussed in the response to Radiological Open Issue No. 12) indicates that the UO_3, UO_4 and associated hydrates produced in modern ISR facilities are soluble. Accordingly, a monthly sampling frequency for yellowcake workers as recommended in Regulatory Guide 8.22 is appropriate and will be used at Moore Ranch.

Although Regulatory Guide 8.22 recommends routine bioassays for yellowcake workers at suspected inhalation exposures of $\geq 1E^{-10}$ µCi/l (1/3 the Class W DAC), all workers potentially exposed to dry yellowcake will be included in the routine bioassay program and will be sampled on a monthly urinalysis frequency. The action levels and associated recommended actions specified in Regulatory Guide 8.22 Table 1 and 2 will be used. It will be our intention as practical to have employees deposit and submit their monthly urine samples following 1 - 2 days off from work to allow for clearance and elimination of uranium that does not become systemic and absorbed by the kidneys. Standard practice for routine urinalysis programs is to assume the exposure/intake occurred on the day or days immediately following the previous sample collection. Accordingly, the action levels and actions of Regulatory Guide 8.22 Table 1 are appropriate based on a monthly sampling frequency.

However, special, ad hoc samples, in addition to routine monthly samples, may be needed in response to situations such as potentially elevated airborne concentrations, as required by radiation work permits, whenever respiratory protection devices are found to be internally contaminated following use, in response to positive nasal and/or mouth swabs, etc. In such cases, it will be assumed that the exposure/intake occurred at a specific time related to the activities causing the potential intake and Figure 2 of Regulatory Guide 8.22 will be used to establish action levels.

Radiological Open Issue No. 13
Urinalysis as the sole bioassay technique
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that it will use urinalysis as the method of bioassay due to the high solubility of the chemical form of yellowcake. The applicant has not provided justification for using the Class "D" inhalation for uranium in air. Regulatory Guide 8.22 recommends that for exposures to Class "W" or Class "Y" material, in vivo lung counting or alternate sampling times and action levels should be considered.

Answer:

As indicated in the response to Radiological Open Issue No. 12 and above, it will be initially assumed that the Moore Ranch UO_3/UO_4 uranium product is TGLD Class W although much or most of it will likely be Class D based upon the proposed drying temperatures. Nonetheless, as discussed above, NUREG-0874 and therefore Regulatory Guide 8.22 considers such material to be "low fired yellowcake". Additionally, it must be recognized that there are only a few in vivo lung counting facilities in the United States with the appropriate equipment, software and experience to measure pulmonary deposition of natural uranium at the required detection limits (e.g. 9 nCi total pulmonary) and these few facilities have been historically used for this purpose in response to suspected "significant" intakes as based on confirmed urinalysis results. (Note that at facilities with insoluble uranium products, e.g., high fired oxides at fuel fabrication and/or nuclear weapon plants) fecal sampling is also used as "trigger" for in vivo analysis). However, it is important to note that the metabolic model used in ICRP 54, *Individual Monitoring for Intakes of Radionuclides by Workers,* assumes 100% of systemic uranium is eliminated via the urine. For the past 30 years, routine urinalysis has been and continues to be the practical and appropriate method of routine bioassay at uranium recovery facilities. We note that footnote b of Table 1 of Regulatory Guide 8.22 defers to NUREG-0874 Section 6 for considerations of in vivo lung counting to detect intakes of more insoluble, high fired materials. The NUREG recommends that in vivo capabilities should be available "to guard against the unlikely, but possible, contingency that large intakes of Class W or Y transportability might go undetected". In vivo capabilities as follow-up to confirmed urinalysis results in excess of action levels as specified in Regulatory Guide 8.22 Table 1 will be accessed as necessary. However, as discussed above and in the response to Radiological Open Issue No. 12, the Moore Ranch uranium products will almost certainly exhibit transportability characteristics typical of soluble, low-fired yellowcake and the contingency alluded to in NUREG 0874 will likely not be applicable to the Moore Ranch uranium products.

Radiological Open Issue No. 15
Acceptable method for evaluating positive bioassays
July 27 2009 Teleconference

Open Issue discussion:

The applicant does not discuss a method for assigning a dose for positive bioassay results. The applicant needs to provide a technical basis for how the uptake will be converted to a dose and assigned to the individual in accordance with 10 CFR 20 Subpart C. The staff indicated that Regulatory Guide 8.22, "Bioassay at Uranium Mills" is still available.

Answer:

As discussed in response to Open Issue No. 13, the actions specified in Table 1 of Regulatory Guide 8.22 will be taken and documented in response to the stated action levels (or as may be derived from Regulatory Guide 8.22 Figure 2 and/or NUREG 0874).

Internal exposure assessment and resultant dose assignment is usually based on air sampling results ("DAC hrs" and/or intake (μCi) with the CEDE estimated from DAC-hrs of exposure relative to 2000 DAC- hrs /yr or 1 ALI = 5 Rem CEDE (e.g., Regulatory Guide 8.30, Regulatory Guide 8.34). However, 10 CFR 20.1204 (c) allows calculation of CEDE based on specific information on physical and biochemical properties of the radionuclide(s) of interest. Accordingly, bioassay results, accrued through approved methods, can be used for purposes of dosimetry (see also 20.1204 (b)). Although air sampling results will be the usual method of calculating and assigning dose to workers as referenced above and described in Section 5.7.4.1 of the application, bioassay results may be used in circumstances in which confirmed intakes are estimated to result in an annual CEDE > 500 mrem (i.e., 10 percent of the occupational exposure limit) and/or when such confirmed results suggest exposures greater than that estimated from air sampling results and time studies. The basic dosimetry model and guidance in NUREG-0874 will be used for this purpose as modified by more recent elimination/retention functions (e.g., ICRP 54) and guidance in Regulatory Guide 8.9 and Regulatory Guide 8.34. The dosimetry model used by NUREG-0874 is the historical TGLD metabolic model (see NUREG 0874 Figure 1) which assumes 67% of uranium entering the blood is excreted via urine in the first day without appreciable uptake to tissues; kidney uptake = 11% subsequently excreted; systemic uptake = 22% which is subsequently released to blood from which 67% excreted / day, 11% absorbed by kidney and 22% reabsorbed back to tissues.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to these Open Issues. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

5.7.5 BIOASSAY PROGRAM

EMC will implement a urinalysis bioassay program at the Moore Ranch Uranium Project that meets the guidelines contained in USNRC Regulatory Guide 8.22. The primary purpose of the program will be to detect uranium intake in employees who are ~~regularly~~ potentially exposed to airborne uranium and to confirm the results of the airborne uranium particulate monitoring program (discussed in Section 5.7.3.1) and the internal exposure determination (discussed in Section 5.7.4.1). The bioassay program will consist of the following elements:

1. Prior to assignment to the facility, all new employees will be required to submit a baseline urinalysis sample. Upon termination, an exit bioassay will be required from all employees.

2. During operations, urine samples will be collected from workers on a quarterly basis. Employees who have the potential for exposure to dried yellowcake will submit bioassay samples on a monthly basis or more frequently as determined by the RSO.

3. Special urine samples may be obtained based on circumstances as determined by the RSO. These circumstances may include known or suspected ingestion, failure of engineering controls, or damage or failure of respiratory protection equipment.

4. Samples will be analyzed for uranium content by a contract analytical laboratory. Blank and spiked samples will also be submitted to the laboratory with employee samples as part of the Quality Assurance program. The minimum measurement sensitivity for the analytical laboratory will be 5 μg/l.

5. Action levels for urinalysis collected on a monthly frequency will be established based upon Table 1 in USNRC Regulatory Guide 8.22. Action levels for urinalysis collected on a quarterly frequency will be based on Table 2 in USNRC Regulatory Guide 8.22. Action levels for special, non-routine urinalysis will be based on the assumed time between the initiating event and sample collection using Table 2 in USNRC Regulatory Guide 8.22.

6\. Routine determination of internal exposure will be performed using the results of air monitoring to estimate uranium intake as discussed in Section 5.7.4.1. In the event that positive bioassay results confirm an intake, the RSO will conduct an investigation into the circumstances and make a determination whether internal exposure for an individual should be determined based on bioassay results. 10 CFR 20.1204(c) allows calculation of the committed effective dose equivalent (CEDE) based on specific information on the physical and biochemical properties of the radionuclide(s) of interest. Accordingly, bioassay results, accrued through approved methods, can be used for purposes of dosimetry. Bioassay results may be used in circumstances in which confirmed intakes are estimated to result in an annual CEDE > 500 mrem (i.e., 10 percent of the occupational exposure limit) and/or when such confirmed results suggest exposures greater than that estimated from air sampling results and time studies. The basic dosimetry model and guidance in NUREG-0874 will be used for this purpose as modified by more recent elimination/retention functions (e.g., ICRP 54) and guidance in Regulatory Guide 8.9 and Regulatory Guide 8.34.Internal exposure determinations based on bioassay results will be performed based on the guidance in USNRC Regulatory Guide 8.9.

7.6.

Elements of the quality assurance requirements for the Bioassay Program will be based upon the guidelines contained in USNRC Regulatory Guide 8.22. These elements include the following:

1. Each batch of samples submitted to the analytical laboratory will be accompanied by two blind control samples. The control samples will be from persons that have not been occupationally exposed and are spiked to a uranium concentration of 10 to 20 μg/l and 40 to 60 μg/l. Alternatively, synthetic control samples may be used. The results of analysis for these samples are required to be within ± 30% of the spiked value

2. The analytical laboratory spikes 10 to 30% of all samples received with known concentrations of uranium and the recovery fraction is determined. Results will be reported to EMC.

Radiological Open Issue No. 12
Basis for use of Class D for DAC
July 27 2009 Teleconference

Open Issue discussion:

In Section 5.7.4 of the technical report, the applicant states that exposures to airborne uranium will be compared to the Derived Air Concentration for the "D" class for natural uranium from Appendix B of 10 CFR 20. This is 5.0 E^{-10} µCi/ml. The applicant has not provided a technical basis for selecting the Class "D" for airborne uranium. The staff cannot verify if the proper classification and DAC is being used to show compliance with 10 CFR 20 Subpart C. NRC staff commented on EMC's assumption that NRC does not accept the Cogema paper (Health Physics, March 1997, 418-422). NRC staff made it clear that it accepts for review all information submitted by an applicant or licensee and perform its own independent analysis of those submittals.

EMC asked how it could proceed with its application without knowing the inhalation class of the yellowcake. NRC staff responded that applicants need to take all forms of uranium in the plant into consideration and that one possible approach would be to assume a conservative value until a site-specific value for its operations could be determined. Staff further responded that assuming an inhalation class W would be adequately conservative for radiation dose calculations. However, assuming an inhalation class W would not be considered conservative for the purpose of protecting the kidney in accordance with 10 CFR 20.1201(e).

Answer:

Uranium will be present at the facility exclusively in relatively soluble forms i.e., uranyl carbonates, (various forms) uranyl trioxide (UO_3), uranyl peroxide (UO_4) and their hydrates. The lixiviant uses oxygen and carbonate to dissolve and mobilize the uranium minerals in situ. Accordingly, the uranium goes into solution as a carbonate. If the uranyl carbonates formed were not very soluble, the in situ mining process could not work.

However, when acid is added to the precipitation cell the carbonate complexes are destroyed and disassociate to form uranyl ions. When hydrogen peroxide is added to the precipitation vessel, the uranium is oxidized further to form uranyl peroxide (UO_4*nH_2O). When dried by the vacuum drier at relatively low temperature, a combination of UO_4 and UO_3 and their hydrates will result.

Although specific studies and references on solubility (e.g., in vitro solubility studies in simulated lung fluids, historical animal studies, etc.) for UO_4 are sparse (a few specific references are provided below), numerous references appear in the literature over 30 + years regarding general solubility characteristics of industrial uranium compounds (representative list also provided below). The UO_4 and UO_3 products should be ICRP 19 class D or W (most or moderately soluble), which is equivalent to ICRP 66 class F or M (fast or medium dissolution). See ICRP 19, Task Group on Lung Dynamics *Metabolism* *of the Compounds of Plutonium and Other Actinides* (1974) and ICRP 66 *Human Respiratory Tract Model for Radiological Protection (1994).* It is also of note that ICRP 54, *Individual Monitoring for Intakes of Radionuclides by Workers*, which assigns Class W to UO_3 indicates "...there is evidence from animal studies that industrial uranium trioxide may behave more like a class D material ". The issue of assumed solubility class is critical in establishing the appropriate DAC for defining air-monitoring parameters for worker airborne exposure control and dose assessment.

The following provides support for a Class D or W designation for UO_4:

- RG 8.30 calls out UO_4 specifically: "Yellowcake dried at low temperature, which is predominantly composed of ammonium diuranate, or in the new processes uranyl peroxide, both are more soluble in body fluids than yellowcake dried at higher temperature; and a relatively large fraction is rapidly transferred to kidney tissues" *(Refs. 9 to 11).* Note that these references are included in the general list below.

- Reference: *Proposed Standards for Acute Exposure to Low Enriched Uranium for Compliance with 10 CFR 70.61*, Kathren R.L and Burklin R.K., Operational Radiation Safety, V. 95.2. August 2008 Page S123 – "...the more soluble compounds of uranium such as.... and UO4 are more quickly absorbed into the blood and therefore exhibit toxic effects in moderate doses (ASTDR 1999, Stannard 1988). Note that these references are also included the general list below.

- Reference: Solubility Characteristics of Airborne Uranium From an In Situ Uranium Processing Plant. Metzger R, Wichers D. et al. Health Physics 72.3, March 1997 p 418. Results indicated airborne U in wet process area = 97% with dissolution $T_{1/2}$ = 0.3 days; airborne U in drum load out area = 97% with dissolution $T_{1/2}$ = 0.25 days. NRC staff makes reference to this study in context of a "split DAC". However, the results of this study indicated airborne U in both the wet process and drum load out areas of 97 % dissolution with half times <0.5 day. These results are clearly indicative of a TGLD Class D or ICRP 66 Class F compound. Several of the published studies referenced below do in fact present results suggesting "di" (2) or "tri" (3) phased dissolution patterns indicative of mixtures of uranium compounds of differing solubility classes (U_30_8 plus UO_3, e.g.). However, based on reported results, the study referenced here is clearly a single-phase dissolution pattern, i.e. single solubility class, single DAC and it is Class D.

Examples of some additional studies and references published over the last 30 + years that specifically address solubility and solubility class of uranium mill and related uranium fuel cycle uranium compounds are provided below:

1. *Preliminary Study of Uranium Oxide Dissolution in Simulated Lung Fluid.* R.C. Scipsick, et al, Los Alamos National Laboratory report LA – 10268-m, UC-41, Jan, 1985

2. *The Solubility of Some Uranium Compounds in Simulated Lung Fluid*, N. Cook and B Holt, Health Physics 27, 69-77,1974
3. *In Vitro Solubility of Yellow Cake Samples from Four Uranium Mills and Implications for Bioassay Interpretation*", A, Eidson and J. Mewhinney, Health Physics 39, 893-902, 1980
4. *Toxicological profile for uranium (Update).* Prepared by Research Triangle Institute for U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. September 1999.
5. *Biokinetics model for uranium inhalation/excretion of uranium mill workers.* Alexander R.E In: Moore RH, Ed. Biokinetics and analysis of uranium in man. United States Uranium Registry Report USUR-05, HEHF-47, 1984.
6. *Dissolution Fractions and Half Times of Single Source Yellowcake in Simulated Lung Fluids.* M. Blauer, J Kent and N Dennis, Health Physics 42, 469-477, 1982
7. *Characterization of Yellowcake and Implications for Uranium Mill Bioassay.* S Brown and M. Blauer, proceedings of Conference on Analytical Chemistry and Bioassay, Ottawa, October, 1980
8. *Physical and Chemical Parameters Affecting the Dissolution Characteristics of Yellowcake in Simulated Lung Fluids.* M. Blauer and S. Brown, Abstracts of the 25^{th} Annual Meeting of Health Physics Society, Seattle, Paper # 177, Pergamon Press 1980
9. *Biokinetics and Analysis of Uranium in Man.* Proceedings of Colloquium held at Richland, Washington, August, 1984, United States Uranium Registry, R Moore ed., USUR – 05 HEHF-47

<u>Conclusion</u>

Although evidence suggests that both the wet process UO_4 and dried UO_3 products of modern ISRs in general and Moore Ranch specifically will be ICRP 19 Class D or ICRP 66 Class F compounds, we will assume them to be Class W / Class M for purposes of establishing the initial DAC upon plant startup. Studies on Moore Ranch products involving dissolution studies in simulated lung fluids may be performed in accordance with the established protocols (well documented in the literature – examples above) to establish if Class D / Class F may be more appropriate. This is appropriate to define not only the relevant DAC, but also the appropriate sampling frequencies and action levels for the plant uranium bioassay program as discussed in Responses to the July Radiological Open Issues 11, 13 and 15.

Radiological Open Issue No. 14
No discussion of limiting soluble uranium intake to 10 mg per week
July 27 2009 Teleconference

Open Issue discussion:

The staff notes that 10 CFR 20.1201(e) requires a limit of 10 mg/week of uranium in consideration of the chemical toxicity. The applicant does not address this limit.

Answer: Intake of soluble uranium will be limited to 10 mg per week per 10 CFR 20.1201(e). Accordingly, at an assumed specific activity of 0.67 μCi/gram for Unat (10 CFR 20, Appendix B, footnote 3), the weekly soluble intake limit is 6.7 E-3 μCi. Initially, solubility Class W will be used to establish the appropriate ALI of 0.8 μCi and DAC of 3 E-10 μCi/ml for U natural (10 CFR 20, App B, Table 1). Assuming a 40 hour work week and average breathing rate of 20 liters/min, the average concentration at the soluble weekly intake limit is approximately equal to 50% of the DAC. Compliance to this requirement will be documented by recording of worker airborne exposure in DAC – hrs, whenever long lived particulate concentrations in air are determined to be ≥ 10 % DAC and an action level of 25% DAC will be established requiring RSO investigation and potential corrective actions. Assignments of positive airborne exposures will be reviewed weekly. Accordingly, any exposures to soluble uranium > 5 % of the 10 mg/week limit will in fact be recorded (as DAC –hrs) and controlling exposure to 25% of DAC ensures both that the 10 mg / week limit is not exceeded and ALARA.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to these Open Issues. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Technical Report Section 5.7.3.1:

5.7.3.1 Airborne Uranium Particulate Monitoring

Airborne particulate levels at solution mines that employ vacuum dryers are very low since there are no emissions. The primary potential source of airborne uranium is during yellowcake packaging. This operation will be confined to the dryer room. The room will be closed and posted as an airborne radioactivity area during packaging. The proposed airborne uranium sampling locations for the Moore Ranch Central Plant are shown on Figure 5.7-1. Samples will be obtained using area samplers on a monthly frequency. <u>At air concentrations >10% DAC, sampling will be performed weekly.</u>

Area samples will be taken in accordance with standard operating procedures. These procedures will implement the guidance contained in USNRC Regulatory Guide 8.25. Samples will be taken with a glass fiber filter and a regulated air sampler such as an Eberline RAS-1 or equivalent. Sample volume will be adequate to achieve the lower limits of detection (LLD) for uranium in air. Samplers will be calibrated at the manufacturer's suggested interval or semiannually with a digital mass flowmeter or other primary calibration standard.

Breathing zone sampling will be performed to determine individual exposure to airborne uranium during certain operations. Sampling will be performed with a lapel sampler or equivalent. The air filters will be counted and compared to the Derived Air Concentration (DAC) using the same method used for area sampling. Air samplers will be calibrated at the manufacturer's recommended frequency or at least every six months using a primary calibration standard. Air sampler calibration will be performed in accordance with standard operating procedures.

Measurement of airborne uranium will be performed by gross alpha counting of the air filters using an alpha scaler such as a Ludlum Model 2000 or equivalent. The DAC for moderately soluble (DW classification) natural uranium of 53x10-10 µCi/ml from Appendix B to 10 CFR §§20.1001 - 20.2401 will initially be used at the Moore Ranch project until in vitro solubility studies can be performed on the uranium compounds present. This is a conservative method because the gross alpha results include Uranium-238 and several of its daughters (notably Ra-226 and Th-230), which are also alpha emittersapproach because the available literature indicates that the wet process UO4 and dried UO3 products of modern ISRs in general will be ICRP 19 Class D (or ICRP 66 Class F) compounds. EMC will assume them to be Class W (or ICRP 66 Class M) for purposes of establishing the initial DAC upon plant startup. Should in vitro solubility studies indicate that Class D or a "mixed" DAC (i.e., a combination of the Class D and Class W DACs) is appropriate for the Moore Ranch material, the DAC will be adjusted accordingly using a standard sum of fractions rule. An action level of 25% of the DAC for soluble natural uranium will be established at the Moore Ranch Plant. If an airborne uranium sample exceeds the DACaction level, the RSO will investigate the cause and evaluate the need for corrective action.

The results of airborne uranium particulate monitoring will be used to determine the committed effective dose equivalent (CEDE) or internal exposure as described in detail in Section 5.7.4.1.

Technical Report Section 5.7.4.1:

5.7.4 EXPOSURE DETERMINATION AND RECORDS

Employee exposure to radiation will be monitored and recorded in accordance with 10 CFR §20.15021001 andto §20.12012401 and Regulatory Guides 8.30 and 8.34. Routine employee external exposures are determined and recorded for those employees likely to receive more than 10% of the allowable occupational dose limit (i.e., 0.5 rem). External exposures will be determined using personnel dosimetry as discussed in Section 5.7.2.3. Routine employee internal exposures will be determined and recorded for those employees likely to receive more than 10% of the Annual Limit of Intake (ALI) for internal exposure from radon daughters or uranium.

Following is a discussion of the exposure determination methods and documentation of results.

5.7.4.1 Natural Uranium Internal Exposure

Exposure calculations for airborne natural uranium will be performed using the intake method from USNRC Regulatory Guide 8.30, Section 2. The intake is calculated using the following equation:

$$I_u = b\sum_{i=1}^{n}\frac{X_i \times t_i}{PF}$$

where:

I_u = uranium intake, µg or µCi

t_i = time that the worker is exposed to concentrations X_i (hr)

X_i = average concentration of uranium in breathing zone, µg/m^3, µCi/m^3

b = breathing rate, 1.2 m^3/hr

PF = the respirator protection factor, if applicable

n = the number of exposure periods during the week or quarter

The intake for uranium will be calculated and recorded. The intakes will be totaled and entered onto each employee's Occupational Exposure Record.

Intake of soluble uranium will be limited to 10 mg per week per 10 CFR 20.1201(e). Accordingly, at an assumed specific activity of 0.67 µCi/gram for natural uranium (10 CFR 20, Appendix B, footnote 3), the weekly soluble intake limit is 6.7 E-3 µCi. Initially, solubility Class W will be used to establish the appropriate ALI of 0.8 µCi and DAC of 3 E-10 µCi/ml for U natural (10 CFR 20, App B, Table 1). Assuming a 40 hour work week and average breathing rate of 20 liters/min, the average concentration at the soluble weekly intake limit is approximately equal to 50% of the DAC. Compliance to this requirement will be documented by recording of worker airborne exposure in DAC–hrs, whenever long lived particulate concentrations in air are determined to be ≥ 10 % DAC and an action level of 25% DAC will be established requiring RSO investigation and potential corrective actions. Assignments of positive airborne exposures will be reviewed weekly. Accordingly, any exposures to soluble uranium > 5 % of the 10 mg/week limit will in fact be recorded (as DAC –hrs) and controlling exposure to 25% of DAC ensures both that the 10 mg / week limit is not exceeded and ALARA.

The data required to calculate internal exposure to airborne natural uranium will also include the following: ~~be determined as follows:~~

Time of Exposure Determination

The results of periodic time studies for each classification of worker or 100% occupancy time will be used to determine routine worker exposures. In general, 100% occupancy time will be used to determine exposures. Using this method, each classification of worker is assumed to have spent their entire work shift in the survey area(s). Note that the length of work shifts may vary by worker classification. Plant operators will generally be working on a shift schedule to provide full time coverage and this may result in some variation from the standard 40-hour week schedule. Maintenance, wellfield, and part-time workers may not spend a full shift in the restricted area(s). The occupancy time determinations will be based on the actual scheduled time in the restricted area for each occupational group.

This approach generally results in a conservative (i.e., higher than actual) estimate of internal exposure to airborne natural uranium because it does not account for time the employee may have spent outside the work area, such as during breaks and meals. Alternatively, the RSO may perform a time study to determine the average time of exposure for each classification of worker. Under this approach, the RSO will have a representative population of each classification of worker track their time spent in different areas of the facility. The time study will be performed for an extended period (usually one month) and will provide the RSO with a percentage of time spent in each area for each classification of worker. If time studies are employed to determine time of exposure, they will be updated annually to account for any changes. Exposures during non-routine work (i.e., work requiring an RWP) will be based upon actual time.

Airborne Uranium Activity Determination

Airborne uranium activity will be determined from surveys performed as described in Section 5.7.3.1.

Exposures to airborne uranium will initially be compared to the DAC for the "~~D~~W" solubility class for natural uranium from Appendix B of 10 CFR §§20.1001 - 20.2401 (i.e., ~~5~~3x10^{-10} μCi/ml). As noted in Section 5.7.3.1, EMC may perform in vitro solubility studies on the uranium compounds present at Moore Ranch after facility startup to determine the solubility class of the material *present.*

Radiological Open Issue No. 13
Urinalysis as the sole bioassay technique
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that it will use urinalysis as the method of bioassay due to the high solubility of the chemical form of yellowcake. The applicant has not provided justification for using the Class "D" inhalation for uranium in air. Regulatory Guide 8.22 recommends that for exposures to Class "W" or Class "Y" material, in vivo lung counting or alternate sampling times and action levels should be considered.

Answer:

As indicated in the response to Radiological Open Issue No. 12 and above, it will be initially assumed that the Moore Ranch UO_3/UO_4 uranium product is TGLD Class W although much or most of it will likely be Class D based upon the proposed drying temperatures. Nonetheless, as discussed above, NUREG-0874 and therefore Regulatory Guide 8.22 considers such material to be "low fired yellowcake". Additionally, it must be recognized that there are only a few in vivo lung counting facilities in the United States with the appropriate equipment, software and experience to measure pulmonary deposition of natural uranium at the required detection limits (e.g. 9 nCi total pulmonary) and these few facilities have been historically used for this purpose in response to suspected "significant" intakes as based on confirmed urinalysis results. (Note that at facilities with insoluble uranium products, e.g., high fired oxides at fuel fabrication and/or nuclear weapon plants) fecal sampling is also used as "trigger" for in vivo analysis). However, it is important to note that the metabolic model used in ICRP 54, *Individual Monitoring for Intakes of Radionuclides by Workers,* assumes 100% of systemic uranium is eliminated via the urine. For the past 30 years, routine urinalysis has been and continues to be the practical and appropriate method of routine bioassay at uranium recovery facilities. We note that footnote b of Table 1 of Regulatory Guide 8.22 defers to NUREG-0874 Section 6 for considerations of in vivo lung counting to detect intakes of more insoluble, high fired materials. The NUREG recommends that in vivo capabilities should be available "to guard against the unlikely, but possible, contingency that large intakes of Class W or Y transportability might go undetected". In vivo capabilities as follow-up to confirmed urinalysis results in excess of action levels as specified in Regulatory Guide 8.22 Table 1 will be accessed as necessary. However, as discussed above and in the response to Radiological Open Issue No. 12, the Moore Ranch uranium products will almost certainly exhibit transportability characteristics typical of soluble, low-fired yellowcake and the contingency alluded to in NUREG 0874 will likely not be applicable to the Moore Ranch uranium products.

Proposed Revisions to License Application

See response July Open Issue 11

Radiological Open Issue No. 14
No discussion of limiting soluble uranium intake to 10 mg per week
July 27 2009 Teleconference

Open Issue discussion:

The staff notes that 10 CFR 20.1201(e) requires a limit of 10 mg/week of uranium in consideration of the chemical toxicity. The applicant does not address this limit.

Answer: Intake of soluble uranium will be limited to 10 mg per week per 10 CFR 20.1201(e). Accordingly, at an assumed specific activity of 0.67 μCi/gram for Unat (10 CFR 20, Appendix B, footnote 3), the weekly soluble intake limit is 6.7 E-3 μCi. Initially, solubility Class W will be used to establish the appropriate ALI of 0.8 μCi and DAC of 3 E-10 μCi/ml for U natural (10 CFR 20, App B, Table 1). Assuming a 40 hour work week and average breathing rate of 20 liters/min, the average concentration at the soluble weekly intake limit is approximately equal to 50% of the DAC. Compliance to this requirement will be documented by recording of worker airborne exposure in DAC – hrs, whenever long lived particulate concentrations in air are determined to be ≥ 10 % DAC and an action level of 25% DAC will be established requiring RSO investigation and potential corrective actions. Assignments of positive airborne exposures will be reviewed weekly. Accordingly, any exposures to soluble uranium > 5 % of the 10 mg/week limit will in fact be recorded (as DAC –hrs) and controlling exposure to 25% of DAC ensures both that the 10 mg / week limit is not exceeded and ALARA.

Proposed Revisions to License Application

See response to July Open Issue 12

Radiological Open Issue No. 15
Acceptable method for evaluating positive bioassays
July 27 2009 Teleconference

Open Issue discussion:

The applicant does not discuss a method for assigning a dose for positive bioassay results. The applicant needs to provide a technical basis for how the uptake will be converted to a dose and assigned to the individual in accordance with 10 CFR 20 Subpart C. The staff indicated that Regulatory Guide 8.22, "Bioassay at Uranium Mills" is still available.

Answer:

As discussed in response to Open Issue No. 13, the actions specified in Table 1 of Regulatory Guide 8.22 will be taken and documented in response to the stated action levels (or as may be derived from Regulatory Guide 8.22 Figure 2 and/or NUREG 0874).

Internal exposure assessment and resultant dose assignment is usually based on air sampling results ("DAC hrs" and/or intake (μCi) with the CEDE estimated from DAC- hrs of exposure relative to 2000 DAC- hrs /yr or 1 ALI = 5 Rem CEDE (e.g., Regulatory Guide 8.30, Regulatory Guide 8.34). However, 10 CFR 20.1204 (c) allows calculation of CEDE based on specific information on physical and biochemical properties of the radionuclide(s) of interest. Accordingly, bioassay results, accrued through approved methods, can be used for purposes of dosimetry (see also 20.1204 (b)). Although air sampling results will be the usual method of calculating and assigning dose to workers as referenced above and described in Section 5.7.4.1 of the application, bioassay results may be used in circumstances in which confirmed intakes are estimated to result in an annual CEDE > 500 mrem (i.e., 10 percent of the occupational exposure limit) and/or when such confirmed results suggest exposures greater than that estimated from air sampling results and time studies. The basic dosimetry model and guidance in NUREG-0874 will be used for this purpose as modified by more recent elimination/retention functions (e.g., ICRP 54) and guidance in Regulatory Guide 8.9 and Regulatory Guide 8.34. The dosimetry model used by NUREG-0874 is the historical TGLD metabolic model (see NUREG 0874 Figure 1) which assumes 67% of uranium entering the blood is excreted via urine in the first day without appreciable uptake to tissues; kidney uptake = 11% subsequently excreted; systemic uptake = 22% which is subsequently released to blood from which 67% excreted / day, 11% absorbed by kidney and 22% reabsorbed back to tissues.

Proposed Revisions to License Application

See response July Open Issue 11

CONTAMINATION CONTROL PROGRAM

Radiological Open Issue No. 16
Detection of surface contamination by Ra-226 and other naturally occurring daughter products
July 27 2009 Teleconference

Open Issue discussion:

The applicant stated that it will perform surface contamination surveys of operating and clean areas of the facility. The applicant plans to use 25% of the removable contamination as defined in Table 2 of Regulatory Guide 8.30. This represents 250 dpm/100 cm2. The removable contamination limit for Ra-226 is 20 dpm/100 cm2. The applicant has not provided sufficient information regarding the ability to account for and detect Ra-226, as defined in Enclosure 2 to Policy and Guidance Directive 83-23, as well as other possible contaminants that may be present as a result of the uranium recovery operations.

Answer: This issue was addressed by NRC at the November 17, 2009 licensing workshop held in Denver, Colorado. As an action item, NRC stated that they would review the appropriate release limits under the guidance currently contained in USNRC Regulatory Guide 8.30 and would clarify this issue with industry. Therefore, no response is provided at this time. Until clarified by NRC, the limits and approach defined in RG 8.30 (1987 "Guidelines for release of ..." Which was an update to Enclosure 2 of FC 83-23) as currently in place and approved NRC guidance, will be used. It is understood that NRC intends to revise Regulatory Guide 8.30.

Radiological Open Issue No. 17
Detection of Ra-226 and other naturally occurring daughter products during personnel monitoring
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that any gross alpha contamination on the skin or clothing will be considered removable and will be subject to the limit of 1000 dpm/100 cm2. The removable contamination limit for Ra-226 is 20 dpm/100 cm2. The applicant does not provide sufficient information regarding its ability to account for and detect Ra-226 as defined in Enclosure 2 to Policy and Guidance Directive 83-23, as well as other possible contaminants that may be present as a result of the uranium recovery operations.

Answer: This issue was addressed by NRC at the November 17, 2009 licensing workshop held in Denver, Colorado. As an action item, NRC stated that they would review the appropriate release limits under the guidance currently contained in USNRC

Regulatory Guide 8.30 and would clarify this issue with industry. Therefore, no response is provided at this time.

Radiological Open Issue No. 18
Contamination monitoring of hand carried items
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that hand carried items used in the well fields and controlled areas will also be monitored for surface contamination. The applicant needs to define the contamination control program in more detail and what action limits will be used to control contamination. For example, will hand-carried items be monitored at the central processing facility or will they be monitored in the field? If the applicant plans to check the hand-carried items in the field, what instruments will be used?

Answer:

In accordance with 10 CFR §20.1003, controlled areas can be established by the licensee for any purpose. At Moore Ranch, controlled areas will be established to minimize the opportunity for public access related to physical security, to prevent inadvertent contact with licensed material by the general public, and in the general interest of public and worker safety. An example of controlled areas at Moore Ranch would be wellfield areas. Quantities and/or concentrations of radioactive materials potentially in these areas would not be expected to exceed licensed quantities and therefore these areas will not need to be restricted for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials as required in 10 CFR §20.1003.

It is recognized that small hand tools and similar items may come in contact with solutions and/or materials in restricted areas (e.g., the Central Process Plant) and may become contaminated at low levels above background. These items may be needed for tasks in the controlled areas. For instance, clipboards and portable radios are routinely carried between the restricted and controlled areas. Survey of these items by personnel prior to entering controlled areas from the restricted area is appropriate in the interest of ALARA. As stated in section 5.7.6 of the Technical Report, personnel will be allowed to conduct contamination monitoring of small, hand-carried items as long as all surfaces can be reached with the instrument probe and the item does not originate in yellowcake areas. These surveys will be performed at the contamination control point(s) located for the restricted area boundary using the equipment specified in section 5.7.6 and will be properly documented. As further stated in the Technical Report, surveys of materials, equipment, instruments, etc. intended for release from the restricted and controlled areas to unrestricted areas will only be performed by the RSO, the radiation safety staff, or properly trained employees.

All employees will have received basic radiation safety training as radiation workers (see Technical Report section 5.5.1.3) and those working in wellfield and similar controlled areas will be specifically trained as radiation workers by the RSO in basic survey procedures. Action limits for release of all equipment and materials from the restricted area to controlled areas will be consistent, regardless of where on site the equipment may have originated. However, for personal items, it is standard practice to apply personnel contamination limits to them.

Radiological Open Issue No. 20
Qualifications of individuals performing contamination surveys for release from restricted and controlled areas
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that the Radiation Safety Officer (RSO), the radiation safety staff, or properly trained employees perform surveys of all items removed from the restricted areas with the exception of small, hand-carried items described in open issue 19. The staff is looking for EMC to define the term "properly trained."

Answer:

During the teleconference discussing this Open Issue, NRC staff referenced NRC Inspection and Enforcement Circular 81-07, issued May 14, 1981, which provides guidance in response to events reported in Information Notice No. 80-22 at nuclear power reactor facilities regarding the release of radioactive contamination to unrestricted areas by trash disposal and sale of scrap metal. The circular establishes acceptable contamination limits for beta-gamma emitters at nuclear power reactor facilities and defines qualifications for personnel conducting contamination surveys per USNRC Regulatory Guide 1.8, *Qualification and Training of Personnel at Nuclear Power Plants.* However, I & E Circular 81-07 states: "Because of the limitations of the technical analysis supporting this guidance, this circular is applicable only to nuclear power reactor facilities".

All personnel conducting contamination surveys for release of equipment and materials to unrestricted areas, including resin trucks on off hours, will have been trained as radiation workers in accordance with guidance in USNRC Regulatory Guide 8.31, section 2.5, *Radiation Safety Training* and as described in the Moore Ranch Technical Report section 5.5.1.3. Radiation worker training includes instruction on the use of portable survey instrumentation for assessment of contamination on personnel and equipment.

In general, the RSO or radiation safety staff will perform all surveys required for unrestricted release of equipment and materials. However, this can prove problematic for resin shipments due to the continuous nature of the operation. The RSO and radiation safety staff are typically on site during regular working hours. Ion exchange (IX) resin must be transferred from the satellite IX columns or central plant elution columns to the transport vehicle at the time it is determined to be fully loaded (satellite plant) or elution is complete (central plant). To prevent the need to call the RSO or a member of the radiation safety staff out to the remote satellite or central plant location and/or store multiple trailers loaded with IX resin on site, it has been industry practice to train selected individuals (usually the plant operator) to perform release surveys on resin shipments containing loaded and barren IX resin for shipment between facilities during the evenings and weekend hours. In order to accomplish this, these individuals receive specific training for surveys of resin shipments in accordance with NRC and Department of Transportation (DOT) requirements. This training includes specific procedural requirements contained in Standard Operating Procedures, instrument use and limitations, and documentation of release surveys. Training is documented in the individual's training records. The records of this training and release surveys have been inspected by NRC at current licensees and found to be acceptable.

NRC has assessed the potential impact associated with the transportation of such resins and has determined that it neither does nor pose any significant potential impacts. NUREG – 6733, page 4 -53 states" resin will be transported in tank trucks within the ISL (ISR) facility and from satellite plants to the main (central) processing plant. The hazards associated with these activities were analyzed previously by NRC for both a generic uranium mill ...and the proposed ISL (ISR) facility at Crown Point which was based on the earlier generic analysis" (see NUREG 0706, *Final GEIS on Uranium Milling, 1980* and NUREG 1508, *Final EIS to Construct and Operate the Crown Point Solution Mining Project, 1997*).

Most recently, NRC issued a performance based, multi site license to R.M.D Operations LLC for treatment of drinking water sources for removal of uranium. In its evaluation, NRC concluded, "some treatment media (IX resins) and the residual water could spill on the ground. However, the treatment media will retain the uranium and prevent contamination of soils at the accident site.... Such a spill will only spread a limited distance and will be easily recovered...Thus, the risk of potential accidents on the environment from such accidents is negligible" (see National Mining Association, *Generic Environmental Report in Support of NRC's GEIS for In Situ Uranium Recovery Facilities,* Katie Sweeney, NMA to Larry Camper, USNRC, Nov 30 2007 @ 4-7)

Proposed Revisions to License Application

The following changes are proposed to the license application in response to these Open Issues. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

5.7.6 CONTAMINATION CONTROL PROGRAM

EMC will perform surveys for surface contamination in operating and clean areas of the Moore Ranch Plant in accordance with the guidelines contained in USNRC Regulatory Guide 8.30. Surveys for total alpha contamination in clean areas will be conducted weekly. In designated clean areas, such as lunchrooms, offices, change rooms, and respirator cabinets, the target level of contamination is nothing detectable above background. If the total alpha survey indicates contamination that exceeds 250 dpm/100 cm^2 (i.e., 25% of the removable limit) a smear survey will be performed to assess the level of removable alpha activity. If smear test results indicate removable contamination greater than 250 dpm/100 cm^2, the area will be promptly cleaned and resurveyed.

All personnel leaving the restricted area will be required to perform and document alpha contamination monitoring. In addition, personnel who could come in contact with potentially contaminated solutions outside a restricted area such as in the wellfields will be required to monitor themselves prior to leaving the area. All personnel will receive training in the performance of surveys for skin and personal contamination. Although no detectable contamination above background is considered the ALARA objective, a~~A~~ll contamination on skin and clothing is considered removable, so the limit of 1,000 dpm/100 cm^2 will be applied to personnel monitoring. Personnel will also be allowed to conduct contamination monitoring of small, hand-carried items for use in ~~wellfield and~~ controlled areas (e.g., wellfields) as long as all surfaces can be reached with the instrument probe and the item does not originate in yellowcake areas. All other items and items intended for unrestricted release from the Moore Ranch project will be surveyed by the RSO, the radiation safety staff, or properly trained employees ~~are surveyed~~ as described below.

Employees that enter a restricted area will be required to sign in on an access log and note their name and the time entered. Upon leaving the restricted area, employees will be required to monitor themselves for radioactive contamination or take a shower and change their clothing in accordance with Regulatory Guide 8.30. The monitoring will consist of a visual examination to detect any visible yellowcake and an instrument survey to ensure that any suspected contamination is below the acceptable limits. If the contamination limit is exceeded, personnel must decontaminate their skin and/or clothing, repeat the survey, and notify the RSO. The RSO will investigate ~~of~~ the cause of the contamination and take corrective action, if appropriate. Employees will be trained during initial radiation safety training to self-monitor using a rate meter with an alpha scintillation detector. The results of the personnel surveys will be recorded on the access log at the survey station. The RSO will routinely observe employees leaving the restricted area to ensure that proper personnel contamination survey methods are employed. Restricted areas include the central plant and drum storage areas as shown on Figure 2.1-3. All wellfield areas will be controlled areas as defined in 10 CFR §20.1003. Wellfield areas are shown on Figures 2.1-2 and 3.1-2

Decontamination of surfaces will be guided by the ALARA principle to reduce surface contamination to levels as far below the limits as practical. Particular attention will be given to equipment and structures in which radiological materials could accumulate in inaccessible locations including piping, traps, junctions, and access points. Contamination of these materials will be determined by surveys at accessible locations. Items that cannot be adequately characterized or that are too large to be scanned will be considered contaminated in excess of the limits and will be managed as licensed material (i.e., stored in a controlled area until decontaminated or disposed of at a properly licensed facility.

Uncontaminated mMaterials, equipment, instruments, and other materialsetc. intended for unrestricted release from the Moore Ranch project will be surveyed for alpha contamination before removal from the restricted and controlled areas. The RSO, or a qualified member of the radiation safety staff, or properly trained employees will perform these surveys of all items removed from the restricted areas with the exception of small, hand-carried items described above. In specific instances, other employees may receive training to perform unrestricted release surveys. For instance, a plant operator may be trained to perform release surveys on resin shipments during evening and weekend hours. In these cases, these individuals will receive specific training for release surveys in accordance with NRC and Department of Transportation (DOT) requirements. This training will include specific procedural requirements contained in Standard Operating Procedures, instrument use and limitations, and documentation of release surveys. Training will be documented in the individual's training records and available for inspection by NRC.

The release limits will be set as specified in "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses For Byproduct or Source Materials", USNRC, May 1987. The release limits for alpha radiation are as follows:

- Removable alpha contamination of 1,000 dpm/100cm2
- Average total alpha contamination of 5,000 dpm/100 cm2 over an area no greater than one square meter
- Maximum total alpha contamination of 15,000 dpm/100 cm2 over an area no greater than 100 cm2.

Surveys will be performed with the following equipment:

1. Total surface activity will be measured with an appropriate alpha survey meter. A Ludlum Model 2241 scaler or a Ludlum Model 177 Ratemeter with a Model 43-65 or Model 43-5 alpha scintillation probe, or equivalent, will be used for the surveys.

2. Portable GM survey meter with a beta/gamma probe with an end window thickness of not more than 7 mg/cm2, a Ludlum Model 3 survey meter with a Ludlum 44-38 probe or equivalent.

5. Swipes for removable contamination surveys as required.

Survey equipment will be calibrated annually or at the manufacturer's recommended frequency, whichever is more frequent. Surface contamination instruments will be checked daily when in use. Alpha survey meters for personnel surveys will be response checked before each use.

As recommended in USNRC Regulatory Guide 8.30, EMC will conduct quarterly unannounced spot checks of personnel to verify the effectiveness of the surveys for personnel contamination. The purpose of the spot check surveys is to ensure that employees are adequately surveying and decontaminating themselves prior to exiting the restricted areas.

Contamination control during maintenance or other nonroutine activities will be controlled through the use of an RWP unless standard operating procedures have been developed. In preparing an RWP, the RSO will assess the potential hazard to workers from loose and fixed contamination. In general, any work on pumps, piping, tankage, containers, or associated equipment will be evaluated for an RWP by the RSO. This would include any nonroutine maintenance or repairs in the drying and packaging facilities; sandblasting, welding, or grinding on any contaminated metal surfaces; and chipping or drilling concrete in plant buildings where contamination may be present. The RWP will contain requirements for specific contamination control techniques suited to the maintenance task. In most instances, some method of decontamination prior to performing maintenance work will be required. Methods typically employed at ISR facilities have included pressure washing surfaces or performing decontamination with a mild solution of muriatic acid to reduce contamination levels to a minimum. In some cases, work that may involve generation of dust that may contain radioactive materials will be performed under wet conditions.

Radiological Open Issue No. 17
Detection of Ra-226 and other naturally occurring daughter products during personnel monitoring
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that any gross alpha contamination on the skin or clothing will be considered removable and will be subject to the limit of 1000 dpm/100 cm2. The removable contamination limit for Ra-226 is 20 dpm/100 cm2. The applicant does not provide sufficient information regarding its ability to account for and detect Ra-226 as defined in Enclosure 2 to Policy and Guidance Directive 83-23, as well as other possible contaminants that may be present as a result of the uranium recovery operations.

Answer: This issue was addressed by NRC at the November 17, 2009 licensing workshop held in Denver, Colorado. As an action item, NRC stated that they would review the appropriate release limits under the guidance currently contained in USNRC Regulatory Guide 8.30 and would clarify this issue with industry. Therefore, no response is provided at this time.

Proposed Revisions to License Application

See response July Open Issue 16

Radiological Open Issue No. 18
Contamination monitoring of hand carried items
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that hand carried items used in the well fields and controlled areas will also be monitored for surface contamination. The applicant needs to define the contamination control program in more detail and what action limits will be used to control contamination. For example, will hand-carried items be monitored at the central processing facility or will they be monitored in the field? If the applicant plans to check the hand-carried items in the field, what instruments will be used?

Answer:

In accordance with 10 CFR §20.1003, controlled areas can be established by the licensee for any purpose. At Moore Ranch, controlled areas will be established to minimize the opportunity for public access related to physical security, to prevent inadvertent contact with licensed material by the general public, and in the general interest of public and worker safety. An example of controlled areas at Moore Ranch would be wellfield areas. Quantities and/or concentrations of radioactive materials potentially in these areas would not be expected to exceed licensed quantities and therefore these areas will not need to be restricted for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials as required in 10 CFR §20.1003.

It is recognized that small hand tools and similar items may come in contact with solutions and/or materials in restricted areas (e.g., the Central Process Plant) and may become contaminated at low levels above background. These items may be needed for tasks in the controlled areas. For instance, clipboards and portable radios are routinely carried between the restricted and controlled areas. Survey of these items by personnel prior to entering controlled areas from the restricted area is appropriate in the interest of ALARA. As stated in section 5.7.6 of the Technical Report, personnel will be allowed to conduct contamination monitoring of small, hand-carried items as long as all surfaces can be reached with the instrument probe and the item does not originate in yellowcake areas. These surveys will be performed at the contamination control point(s) located for the restricted area boundary using the equipment specified in section 5.7.6 and will be properly documented. As further stated in the Technical Report, surveys of materials, equipment, instruments, etc. intended for release from the restricted and controlled areas to unrestricted areas will only be performed by the RSO, the radiation safety staff, or properly trained employees.

All employees will have received basic radiation safety training as radiation workers (see Technical Report section 5.5.1.3) and those working in wellfield and similar controlled areas will be specifically trained as radiation workers by the RSO in basic survey procedures. Action limits for release of all equipment and materials from the restricted area to controlled areas will be consistent, regardless of where on site the equipment may have originated. However, for personal items, it is standard practice to apply personnel contamination limits to them.

Proposed Revisions to License Application

See response July Open Issue 16

Radiological Open Issue No. 19
Beta surveys of operations involving direct handling of large quantities of aged yellowcake
July 27 2009 Teleconference

Open Issue discussion:

The applicant does not address how it plans to conduct beta surveys in the plant and what action levels will be taken to protect personnel working in potential beta and gamma radiation fields.

Answer:

Beta exposure rate surveys will be performed at the specific operations that involve direct handling of large quantities of aged yellowcake. This would include in plant areas associated with precipitation, dewatering (filter press) and drying/packaging. Surveys will be performed with a Ludlum 44-6 sidewall GM detector or equivalent. These surveys will be performed near the surface of the material (e.g., within 10 cm) so as to be representative of beta exposure rates to workers' hands and skin during the handling of the material. Surveys will be performed at initiation of operations and subsequent surveys and/or beta evaluations will be performed whenever procedural and/or equipment changes could affect the beta levels to which employees may be exposed. Any beta exposure rate evaluations for these operations that are performed in lieu of instrument surveys will use the information provided in Regulatory Guide 8.30 Figures 1 and 2.

Beta contamination surveys will similarly be performed in these same plant areas initially and whenever procedural and/or equipment change may increase risk of beta contamination. These surveys will be performed with a Ludlum 43-1-1 alpha – beta phoswich scintillation probe or equivalent. This probe has an active window area of 83 cm^2, rated efficiencies of 30% alpha (Pu^{239}) and 30% beta (Sr^{90} / Y^{90}) and typical backgrounds of 3 cpm alpha and < 300 cpm beta.

If it is determined that beta exposure rates to which workers could be exposed could result in shallow dose equivalents to the skin or the skin of extremities that are ≥ 10% of the limits from 10 CFR §20.1201 (a)(2), provisions for personnel beta monitoring (e.g., ring and/or wrist badges) will be provided.

Proposed Revisions to License Application

See Open Item 7

Radiological Open Issue No. 20
Qualifications of individuals performing contamination surveys for release from restricted and controlled areas
July 27 2009 Teleconference

Open Issue discussion:

The applicant states that the Radiation Safety Officer (RSO), the radiation safety staff, or properly trained employees perform surveys of all items removed from the restricted areas with the exception of small, hand-carried items described in open issue 19. The staff is looking for EMC to define the term "properly trained."

Answer:

During the teleconference discussing this Open Issue, NRC staff referenced NRC Inspection and Enforcement Circular 81-07, issued May 14, 1981, which provides guidance in response to events reported in Information Notice No. 80-22 at nuclear power reactor facilities regarding the release of radioactive contamination to unrestricted areas by trash disposal and sale of scrap metal. The circular establishes acceptable contamination limits for beta-gamma emitters at nuclear power reactor facilities and defines qualifications for personnel conducting contamination surveys per USNRC Regulatory Guide 1.8, *Qualification and Training of Personnel at Nuclear Power Plants*. However, I & E Circular 81-07 states: "Because of the limitations of the technical analysis supporting this guidance, this circular is applicable only to nuclear power reactor facilities".

All personnel conducting contamination surveys for release of equipment and materials to unrestricted areas, including resin trucks on off hours, will have been trained as radiation workers in accordance with guidance in USNRC Regulatory Guide 8.31, section 2.5, *Radiation Safety Training* and as described in the Moore Ranch Technical Report section 5.5.1.3. Radiation worker training includes instruction on the use of portable survey instrumentation for assessment of contamination on personnel and equipment.

In general, the RSO or radiation safety staff will perform all surveys required for unrestricted release of equipment and materials. However, this can prove problematic for resin shipments due to the continuous nature of the operation. The RSO and radiation safety staff are typically on site during regular working hours. Ion exchange (IX) resin must be transferred from the satellite IX columns or central plant elution columns to the transport vehicle at the time it is determined to be fully loaded (satellite plant) or elution is complete (central plant). To prevent the need to call the RSO or a member of the radiation safety staff out to the remote satellite or central plant location and/or store multiple trailers loaded with IX resin on site, it has been industry practice to train selected individuals (usually the plant operator) to perform release surveys on resin shipments containing loaded and barren IX resin for shipment between facilities during the evenings and weekend hours. In order to accomplish this, these individuals receive specific training for surveys of resin shipments in accordance with NRC and Department of Transportation (DOT) requirements. This training includes specific procedural requirements contained in Standard Operating Procedures, instrument use and limitations, and documentation of release surveys.

Training is documented in the individual's training records. The records of this training and release surveys have been inspected by NRC at current licensees and found to be acceptable.

Proposed Revisions to License Application

See response July Open Issue 16

Radiological Open Issue No. 21
No issue 21
July 27 2009 Teleconference

Open Issue discussion:

Deleted by NRC.

Answer:

Proposed Revisions to License Application

Radiological Open Issue No. 22
Clarification of QA organization
July 27 2009 Teleconference

Open Issue discussion:

The applicant needs to identify the person with the ultimate authority for the QA Program at the site.

Answer:

The Moore Ranch Mine Manager has the ultimate authority for all activities conducted at the Moore Ranch Facility. Responsibility for administration of the QA Program has been assigned to the Radiation Safety Officer.

The text in Addendum 5-A of the Technical Report has been modified to reflect this change.

Proposed Revisions to License Application

Addendum 5-A, *Wyoming ISR Operations Quality Assurance Plan*, of the license application will be revised in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method in the December 2009, revision of Addendum 5-A included with the July 27, 2009 Miscellaneous Open Issue 9 response.

Radiological Open Issue No. 23
Discussion of routine quality control checks
July 27 2009 Teleconference

Open Issue discussion:

The applicant has not provided enough information regarding the routine quality control checks for acceptable performances, such as background checks, reference checks, and the use of control charts to track trends.

Answer: EMC will revise the Technical Report to include the following information concerning routine quality control checks for instrumentation used for detecting radiation. EMC will utilize Regulatory Guide 8.30, Section 8 Calibration of Survey Instruments, guidance of ±20% as the criteria to determine acceptable performance for instrument response. This criterion will be added to the Standard Operating Procedures for site radiological surveys and included on instrument response check forms.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Section 5.7.2.1, Gamma Surveys:

5.7.2.1 Gamma Surveys

External gamma radiation surveys will be performed routinely at the Moore Ranch Uranium Project. The required frequency will be quarterly in designated Radiation Areas and semiannually in all other areas of the plant. Surveys will be performed at worker occupied stations and areas of potential gamma sources such as tanks and filters. EMC will establish and post as a Radiation Area any area, accessible to workers, in which levels could result in an individual receiving a dose in excess of 5 mrem in 1 hour. An investigation will be performed to determine the probable source and survey frequency for areas exceeding 5.0 mRem per hour is increased to monthly. Records will be maintained of each investigation and the corrective action taken. If the results of a gamma survey identified areas where gamma radiation is in excess of levels that delineate a "radiation area", access to the area will be restricted and the area will be posted as required in 10 CFR §20.1902 (a).

External gamma surveys will be performed with survey equipment that meets the following minimum specifications:

1. Range - Lowest range not to exceed 200 microRoentgens per hour (μR/hr) full-scale with the highest range to read at least 100 milliRoentgens per hour (mR per hour) full scale;

2. Battery operated and portable;

Examples of satisfactory instrumentation that meets these requirements are the Ludlum Model 3 survey meter with a Ludlum 44-38 probe or equivalent. The Model 3 is a general purpose survey meter with a meter scale of 0 to 2 mrem/hr and scale multiplier adjustments of X 0.1, X 1.0, X 10, and X 100. Accordingly, the effective range of this survey meter and probe is 0 – 200 mrem/hr. The model 44-38 has a sensitivity of 1,200 cpm per mrem/hr and backgrounds of 20 cpm (beta shield closed) and 25 cpm open. Accordingly, the MDL for this instrument is approximately 30 μR/hr at twice background. Gamma survey instruments will be calibrated at the manufacturer's suggested interval or at least annually and will be operated in accordance with the manufacturer's recommendations. Instrument checks will be performed ~~each day that an instrument is used~~as summarized in the following schedule:

- Physical check – Daily when in use
- Battery Check (if applicable) – Daily when in use
- Response source check (± 20%) – Daily when in use
- Calibration verification – Daily when in use
- Background measurement – Daily or before each use

Section 5.7.3.1, Airborne Uranium Particulate Monitoring:

5.7.3.1 Airborne Uranium Particulate Monitoring

Airborne particulate levels at solution mines that employ vacuum dryers are very low since there are no emissions. The primary potential source of airborne uranium is during yellowcake packaging. This operation will be confined to the dryer room. The room will be closed and posted as an airborne radioactivity area during packaging. The proposed airborne uranium sampling locations for the Moore Ranch Central Plant are shown on Figure 5.7-1. Samples will be obtained using area samplers on a monthly frequency.

Area samples will be taken in accordance with standard operating procedures. These procedures will implement the guidance contained in USNRC Regulatory Guide 8.25. Samples will be taken with a glass fiber filter and a regulated air sampler such as an Eberline RAS-1 or equivalent. Sample volume will be adequate to achieve the lower limits of detection (LLD) for uranium in air. Samplers will be calibrated at the manufacturer's suggested interval or semiannually with a digital mass flowmeter or other primary calibration standard.

Breathing zone sampling will be performed to determine individual exposure to airborne uranium during certain operations. Sampling will be performed with a lapel sampler or equivalent. The air filters will be counted and compared to the Derived Air Concentration (DAC) using the same method used for area sampling. Air samplers will be calibrated at the manufacturer's recommended frequency or at least every six months using a primary calibration standard. Air sampler calibration will be performed in accordance with standard operating procedures.

Measurement of airborne uranium will be performed by gross alpha counting of the air filters using an alpha scaler such as a Ludlum Model 2000 or equivalent. The DAC for moderately soluble (W classification) natural uranium of 3x10-10 μCi/ml from Appendix B to 10 CFR §§20.1001 - 20.2401 will initially be used at the Moore Ranch project until in vitro solubility studies can be performed on the uranium compounds present. This is approach because the available literature indicates that the wet process UO4 and dried UO3 products of modern ISRs in general will be ICRP 19 Class D (or ICRP 66 Class F) compounds. EMC will assume them to be Class W (or ICRP 66 Class M) for purposes of establishing the initial DAC upon plant startup. Should in vitro solubility studies indicate that Class D or a "mixed" DAC (i.e., a combination of the Class D and Class W DACs) is appropriate for the Moore Ranch material, the DAC will be adjusted accordingly using a standard sum of fractions rule. An action level of 25% of the DAC for natural uranium will be established at the Moore Ranch Plant. If an airborne uranium sample exceeds the action level, the RSO will investigate the cause and evaluate the need for corrective action.

Instruments utilized in determining gross alpha count for air filters will be function checked prior to use to ensure proper operations. Scaler type instruments are used to analyze the alpha contamination on air filters and loose surface contamination ("smear") samples. These instruments consist of a detector and a scaler and include the Ludlum Model 2000 Scaler or equivalent. These instruments require the following checks at the noted frequency:

- Physical check – Daily when in use
- Battery Check (if applicable) – Daily when in use
- High Voltage Check (if applicable) – Daily when in use
- Calibration verification check (± 20%) – Daily when in use
- Background measurement – Daily when in use
- Determination of efficiency/correction factor – Daily when in use
- Determination of instrument reliability factor – Initially after calibration, after repair or if instrument response is questionable
- Determination of lower limit of detection – Initially after calibration, after repair or if instrument response is questionable
- High voltage plateau – Initially after calibration, after repair or if instrument response is questionable.

Section 5.7.3.2, Radon Daughter Concentration Monitoring:

5.7.3.2 Radon Daughter Concentration Monitoring

Surveys for radon daughter concentrations will be conducted in the operating areas of the Moore Ranch Plant on a monthly basis. Sampling locations will be determined in accordance with the guidance contained in USNRC Regulatory Guide 8.25. Proposed radon daughter sampling locations for the Moore Ranch Plant are shown on Figure 5.7-1.

Samples will be collected with a low volume air pump (e.g., lapel sampler) and then analyzed with an alpha scaler using the Modified Kusnetz method described in ANSI-N13.8-1973. Routine radon daughter monitoring will be performed in accordance with standard operating procedures. Samplers will be calibrated at the manufacturer's suggested interval or semiannually with a digital mass flowmeter or other primary calibration standard. Air sampler calibration will be performed in accordance with standard operating procedures.

Instruments utilized in determining gross alpha count for radon daughter concentration samples will be function checked prior to use to ensure proper operations. Function checks will be the same as those discussed for airborne uranium particulate monitoring described in Section 5.7.3.1.

Section 5.7.6, Contamination Control Program:

EMC will perform surveys for surface contamination in operating and clean areas of the Moore Ranch Plant in accordance with the guidelines contained in USNRC Regulatory Guide 8.30. Surveys for total alpha contamination in clean areas will be conducted weekly. In designated clean areas, such as lunchrooms, offices, change rooms, and respirator cabinets, the target level of contamination is nothing detectable above background. If the total alpha survey indicates contamination that exceeds 250 dpm/100 cm^2 (i.e., 25% of the removable limit) a smear survey will be performed to assess the level of removable alpha activity. If smear test results indicate removable contamination greater than 250 dpm/100 cm^2, the area will be promptly cleaned and resurveyed.

All personnel leaving the restricted area will be required to perform and document alpha contamination monitoring. In addition, personnel who could come in contact with potentially contaminated solutions outside a restricted area such as in the wellfields will be required to monitor themselves prior to leaving the area. All personnel will receive training in the performance of surveys for skin and personal contamination. Although no detectable contamination above background is considered the ALARA objective, all contamination on skin and clothing is considered removable, so the limit of 1,000 dpm/100 cm^2 will be applied to personnel monitoring. Personnel will also be allowed to conduct contamination monitoring of small, hand-carried items for use in controlled areas (e.g., wellfields) as long as all surfaces can be reached with the instrument probe and the item does not originate in yellowcake areas. All other items and items intended for unrestricted release from the Moore Ranch project will be surveyed by the RSO, the radiation safety staff, or properly trained employees as described below.

Employees that enter a restricted area will be required to sign in on an access log and note their name and the time entered. Upon leaving the restricted area, employees will be required to monitor themselves for radioactive contamination or take a shower and change their clothing in accordance with Regulatory Guide 8.30. The monitoring will consist of a visual examination to detect any visible yellowcake and an instrument survey to ensure that any suspected contamination is below the acceptable limits. If the contamination limit is exceeded, personnel must decontaminate their skin and/or clothing, repeat the survey, and notify the RSO. The RSO will investigate the cause of the contamination and take corrective action, if appropriate. Employees will be trained during initial radiation safety training to self-monitor using a rate meter with an alpha scintillation detector. The results of the personnel surveys will be recorded on the access log at the survey station. The RSO will routinely observe employees leaving the restricted area to ensure that proper personnel contamination survey methods are employed. Restricted areas include the central plant and drum storage areas as shown on Figure 2.1-3. All wellfield areas will be controlled areas as defined in 10 CFR §20.1003. Wellfield areas are shown on Figures 2.1-2 and 3.1-2

Decontamination of surfaces will be guided by the ALARA principle to reduce surface contamination to levels as far below the limits as practical. Particular attention will be given to equipment and structures in which radiological materials could accumulate in inaccessible locations including piping, traps, junctions, and access points. Contamination of these materials will be determined by surveys at accessible locations. Items that cannot be adequately characterized or that are too large to be scanned will be considered contaminated in excess of the limits and will be managed as licensed material (i.e., stored in a controlled area until decontaminated or disposed of at a properly licensed facility.

Materials, equipment, instruments, etc. intended for unrestricted release from the Moore Ranch project will be surveyed for alpha contamination before removal from the restricted and controlled areas. The RSO or a qualified member of the radiation safety staff will perform these surveys. In specific instances, other employees may receive training to perform release surveys. For instance, a plant operator may be trained to perform release surveys on the resin transport vehicle and exterior of the exclusive use resin shipment containers during evening and weekend hours. In these cases, these individuals will receive specific training for release surveys in accordance with NRC and Department of Transportation (DOT) requirements. This training will include specific procedural requirements contained in Standard Operating Procedures, instrument use and limitations, and documentation of release surveys. Training will be documented in the individual's training records and available for inspection by NRC.

The release limits will be set as specified in "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses For Byproduct or Source Materials", USNRC, May 1987. The release limits for alpha radiation are as follows:

- Removable alpha contamination of 1,000 dpm/100cm2
- Average total alpha contamination of 5,000 dpm/100 cm2 over an area no greater than one square meter
- Maximum total alpha contamination of 15,000 dpm/100 cm2 over an area no greater than 100 cm2.

Surveys will be performed with the following equipment:

1. Total surface activity will be measured with an appropriate alpha survey meter. A Ludlum Model 2241 scaler or a Ludlum Model 177 Ratemeter with a Model 43-65 or Model 43-5 alpha scintillation probe, or equivalent, will be used for the surveys.

2. Portable GM survey meter with a beta/gamma probe with an end window thickness of not more than 7 mg/cm2, a Ludlum Model 3 survey meter with a Ludlum 44-38 probe or equivalent.

5. Swipes for removable contamination surveys as required.

Survey equipment will be calibrated annually or at the manufacturer's recommended frequency, whichever is more frequent. Surface contamination instruments will be checked daily when in use. Alpha survey meters for personnel surveys will be response checked before each use.

Surface contamination instruments are used to measure alpha and beta-gamma surface contamination levels and include the Ludlum Model 2241 Ratemeter/Scaler Survey Meter. These instruments require the following checks at the noted frequency:

- Response source check (± 20%) – Before each use
- Battery Check (if applicable) – Daily when in use
- High Voltage Check (if applicable) – Daily when in use
- Calibration verification check – Daily when in use
- Background measurement – Daily or before each use
- Determination of efficiency/correction factor – Daily when in use

- Determination of instrument reliability factor – Initially after calibration

Alpha survey meters are used to measure alpha surface contamination levels on skin and equipment and include a ratemeter such as the Ludlum Model 12 or equivalent. These instruments require the following checks at the noted frequency:

- Response source check (±20%) – Before each use
- Battery Check (if applicable) – Weekly
- High Voltage Check (if applicable) – Weekly
- Calibration verification check – Weekly
- Background measurement – Weekly
- Determination of efficiency/correction factor – Weekly
- Determination of instrument reliability factor – Initially after calibration

As recommended in USNRC Regulatory Guide 8.30, EMC will conduct quarterly unannounced spot checks of personnel to verify the effectiveness of the surveys for personnel contamination. The purpose of the spot check surveys is to ensure that employees are adequately surveying and decontaminating themselves prior to exiting the restricted areas.

Contamination control during maintenance or other nonroutine activities will be controlled through the use of an RWP unless standard operating procedures have been developed. In preparing an RWP, the RSO will assess the potential hazard to workers from loose and fixed contamination. In general, any work on pumps, piping, tankage, containers, or associated equipment will be evaluated for an RWP by the RSO. This would include any nonroutine maintenance or repairs in the drying and packaging facilities; sandblasting, welding, or grinding on any contaminated metal surfaces; and chipping or drilling concrete in plant buildings where contamination may be present. The RWP will contain requirements for specific contamination control techniques suited to the maintenance task. In most instances, some method of decontamination prior to performing maintenance work will be required. Methods typically employed at ISR facilities have included pressure washing surfaces or performing decontamination with a mild solution of muriatic acid to reduce contamination levels to a minimum. In some cases, work that may involve generation of dust that may contain radioactive materials will be performed under wet conditions.

Radiological Open Issue No. 24
Incorporation of data acquired through non-direct measurements into QA/QC program
July 27 2009 Teleconference

Open Issue discussion:

The applicant stated that data acquired through non-direct measurements may include data from historical databases, literature references, background information from historical facility files, climatic data, and regional geology or hydrology description. NRC staff cannot determine how data acquired through non-direct measurements will be incorporated into the QA/QC program including, for example, record keeping and verification and validation.

Answer:
Section 7.48 Data Acquisition Requirements through Non-Direct Measurements will be used for historical information purposes and EMC will not try to do QA/QC validation on this data.

EMC will remove reference to Section 7.48 from Addendum 5-A of the Technical Report.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER question.

Addendum 5-A, *Wyoming ISR Operations Quality Assurance Plan*, of the license application has been revised in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method in the December 2009, revision of Addendum 5-A included with the July 27, 2009 Miscellaneous Open Issue 9 response.

Radiological Open Issue No. 25
Discussion of corrective action program integrating QA components
July 27 2009 Teleconference

Open Issue discussion:

The applicant has not discussed a corrective action program at the site that integrates components of the Quality Assurance Program.

Answer:

Add a section to QA Plan as follows:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

7.7.1.1 Corrective Actions

Corrective actions are the process of identifying, recommending, approving and implementing measures to improve unacceptable procedures, and sampling practices that may affect data quality. All proposed and implemented corrective actions will be documented through the site SERP process. Items requiring immediate corrective actions will be implemented with the approval of the Radiation Safety Office and modifications documented through the SERP process.

If corrective actions are insufficient, the appropriate personnel may issue suspension of work until the problem can be resolved.

During any field sampling activity, the field personnel will be responsible for documenting and reporting all QA nonconformance's and suspected deficiencies associated with the sampling being conducted. All nonconformance's and or deficiencies will be documented in the field log book or sheets and reported to the RSO. If the problem is associated with field measurement sampling equipment, the field personnel will take the appropriate corrective actions. If the field corrective actions are not sufficient to correct the deficiency, personnel may suspend field activities until the problem can be resolved. Any time field activities have been suspended due to QA deficiencies the RSO shall be notified.

Field corrective actions could include:

- Repeating the measurement to check for errors
- Checking, recharging or replacing batteries in sampling equipment
- Re-calibration or function check of instrument or equipment to ensure proper operations

- Replacing meter or instruments not functions properly

Field corrective actions will be documented in the field sampling log book or field sampling sheets.

Miscellaneous Open Issue No. 1
Justification for using ACC met data to represent Moore Ranch meteorology
July 27 2009 Teleconference

Open Issue discussion:

The applicant provided topography photos and seasonal wind roses for the Glenrock Coal Company and Antelope Coal Company (ACC) sites. However, the applicant did not provide sufficient information regarding the representativeness of the meteorology of the ACC site to Moore Ranch.

Answer:

As per discussions in the November 23, conference call with the NRC, additional data from near by meteorological sites with in the Powder River Basin were compiled to support the use of the ACC site as a representative off-site meteorological data source in Section 2.5 of the Technical Report. A brief discussion describing the six coal mine meteorological stations used in the comparison is provided below. Figure 1 depicts the locations of the six meteorological stations and the location of the Moore Ranch Project. Wind roses for the six sites are presented in the attached Figure 2. Meteorological site summaries are provided for review in Appendix A. Based on the attached information the ACC site remains the most representative off-site data source that best represents meteorological conditions for the Moore Ranch site.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER Open Issue. Information provided in response to this open issue will be provided in Addendum 2.5-B (new) of the revised Technical Report.

Support for Antelope Coal Mine Meteorology as Representative Of Moore Ranch Property
December 8, 2009

The Nuclear Regulatory Commission has requested additional information to support the use of off-site monitoring data for the meteorology section of the Moore Ranch project Technical Report. Antelope Coal Company (ACC), approximately 25 miles east of the Moore Ranch permit area, was proposed as the off-site source of meteorological data. A case for the similarity in topography and vegetation between the two sites has already been made. At issue is the similarity of wind speed and direction between ACC and Moore Ranch.

In an effort to establish uniformly trending wind patterns in the Powder River Basin (PRB), IML Air Science has compiled meteorological summaries and wind roses for a total of 6 coal mine meteorological stations in the PRB (including ACC). Figure 1 below shows the 6 mines and the Moore Ranch permit area. Meteorological summaries for these mines appear in Appendix A. Long-term average wind speeds at all sites except Glenrock Coal Company (GCC) range from 9.4 to 11.2 mph. GCC averages 14.8 mph due to the higher altitude and the funneling effect of the nearby Laramie Range.

Figure 2 illustrates a north-to-south trend in wind directions. The wind roses in Figure 2 should be examined from left to right, then top to bottom. From the northern PRB to the southern PRB, prevailing wind directions gradually shift from a northwest-southeast, bimodal flow to a predominantly west-southwesterly flow. In the northern part of the PRB, represented by the Cordero Rojo meteorological station, the northwesterly and southeasterly winds dominate. Farther south, the Black Thunder and Jacobs Ranch meteorological stations show an emerging west-southwesterly component. Farther south still, the North Rochelle meteorological station exhibits a more pronounced west-southwesterly component. Proceeding southward to ACC, one observes an even more prominent west-southwesterly wind component. The Glenrock Coal meteorological station, at the southern extreme of the PRB, shows the west-southwesterly winds to be dominant.

ACC was chosen as being representative of the Moore Ranch meteorology for several reasons. First, among the coal mines in the PRB, ACC lies closest to the Moore Ranch project. Second, given the north-to-south trend in wind directions throughout the PRB, the similar latitudes of the ACC and Moore Ranch sites should account for this trend. Third, the topography at ACC is very similar to the topography at Moore Ranch.

FIGURE 1

Moore Ranch Met Stations

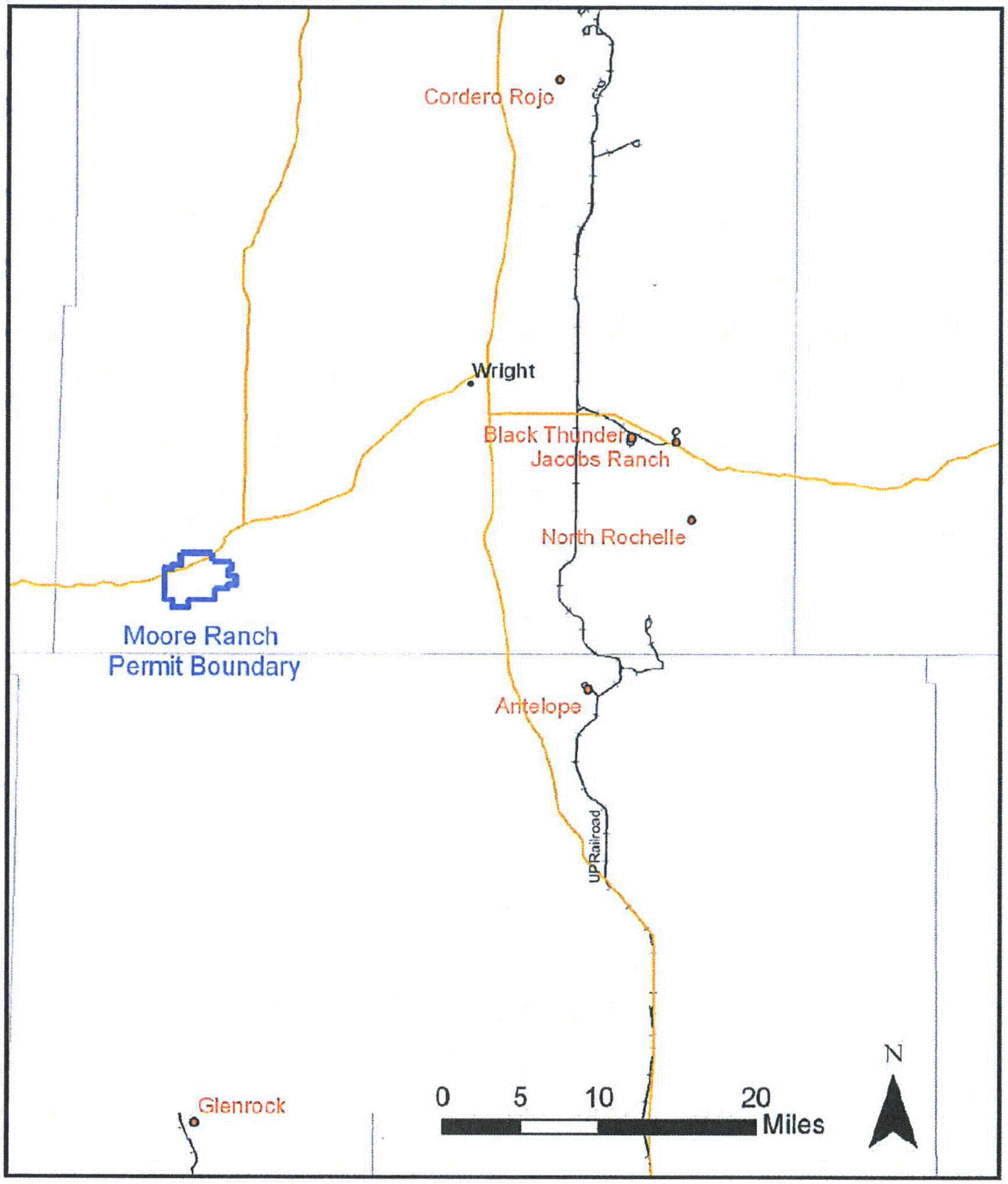
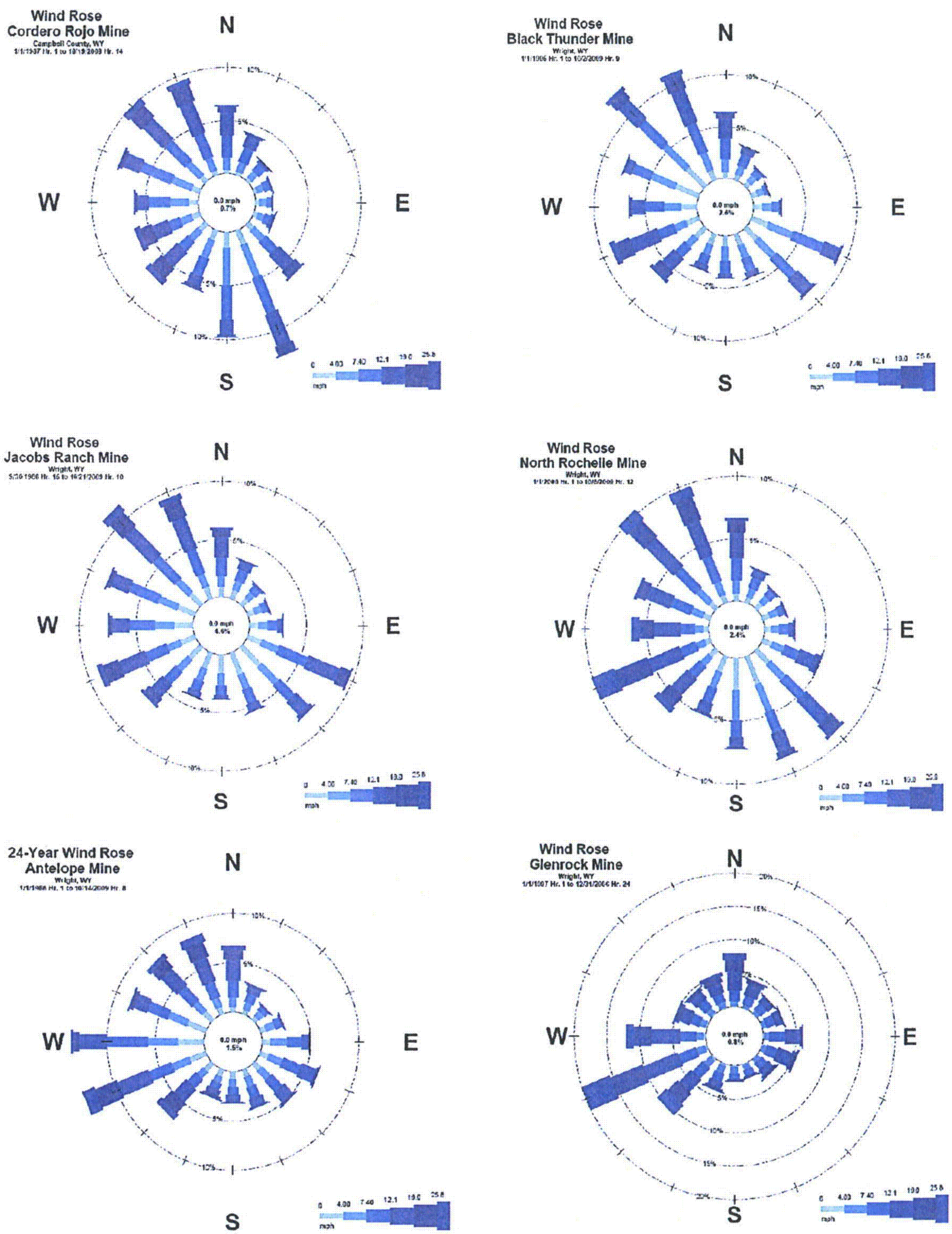


FIGURE 2


Wind Rose
Cordero Rojo Mine
Campbell County, WY
N
W
E
S
0 4.00 7.40 12.1 19.0 25.8
mph
Wind Rose
Black Thunder Mine
Wright, WY
N
W
E
S
0 4.00 7.40 12.1 19.0 25.8
mph
Wind Rose
Jacobs Ranch Mine
Wright, WY
N
W
E
S
0 4.00 7.40 12.1 19.0 25.8
mph
Wind Rose
North Rochelle Mine
Wright, WY
N
W
E
S
0 4.00 7.40 12.1 19.0 25.8
mph
24-Year Wind Rose
Antelope Mine
Wright, WY
N
W
E
S
0 4.00 7.40 12.1 19.0 25.8
mph
Wind Rose
Glenrock Mine
Wright, WY
N
W
E
S
0 4.00 7.40 12.1 19.0 25.8
mph

Appendix A – Meteorological Summaries

Cordero Rojo Complex

Meteorological Data Summary

1/1/1987 - 10/19/2009

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	10.9	49.3	0.0
Sigma-Theta (°)	12.7	103.4	0.0
Temperature (F)	43.3	104.4	-35.6
Precipitation (in)	248.13	2.66	

Predominant wind direction was from the SSE sector, accounting for 12.5% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	199872	192937	96.53%
Wind Direction	199872	191668	95.90%
Sigma-Theta	199872	181457	90.79%
Temperature	199872	184836	92.48%
Precipitation	199872	186676	93.40%

Black Thunder Mine

Meteorological Data Summary

1/1/1995 - 10/2/2009

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	9.4	50.2	0.0
Sigma-Theta (°)	16.5	100.0	0.0
Temperature (F)	46.7	102.6	-29.0
Relative Humidity (%)	56.3	100.0	2.0
Precipitation (in)	115.57	0.92	

Predominant wind direction was from the NW sector, accounting for 12.5% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	129336	123326	95.35%
Wind Direction	129336	122236	94.51%
Sigma-Theta	129336	122236	94.51%
Temperature	129336	124494	96.26%
Relative Humidity	129336	79947	61.81%
Precipitation	129336	94302	72.91%

Jacobs Ranch Mine

Meteorological Data Summary

1/1/1986 - 10/21/2009

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	9.9	51.8	0.0
Sigma-Theta (°)	15.8	102.8	0.0
Temperature (F)	45.8	102.5	-63.9
Relative Humidity (%)	19.7	141.1	0.0
Precipitation (in)	207.80	1.75	

Predominant wind direction was from the NW sector, accounting for 11.3% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	208680	185249	88.77%
Wind Direction	208680	185848	89.06%
Sigma-Theta	208680	183829	88.09%
Temperature	208680	185433	88.86%
Relative Humidity	208680	188382	90.27%
Precipitation	208680	179133	85.84%

North Rochelle Mine

Meteorological Data Summary

1/1/2000 - 10/6/2009

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	12.0	48.2	0.0
Sigma-Theta (°)	13.8	92.3	0.0
Temperature (F)	46.9	103.8	-26.8
Precipitation (in)	74.40	1.57	

Predominant wind direction was from the NW sector, accounting for 10.4% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	85608	84822	99.08%
Wind Direction	85608	85141	99.45%
Sigma-Theta	85608	85140	99.45%
Temperature	85608	81764	95.51%
Precipitation	85608	85105	99.41%

Antelope Mine

Meteorological Data Summary

1/1/1997 - 12/31/2006

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	11.2	50.6	0.0
Sigma-Theta (°)	16.3	82.0	0.4
Temperature (F)	47.5	102.1	-33.8
Precipitation (in)	102.34	1.48	
Bar. Pressure (in Hg)	25.3	25.9	20.0

Predominant wind direction was from the W sector,
accounting for 15.2% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	87648	81938	93.49%
Wind Direction	87648	81951	93.50%
Sigma-Theta	87648	81951	93.50%
Temperature	87648	83702	95.50%
Precipitation	87648	83705	95.50%
Bar. Pressure	87648	43174	49.26%

Glenrock Coal Company

Meteorological Data Summary

1/1/1997 - 12/31/2006

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	14.8	57.6	0.0
Sigma-Theta (°)	11.0	79.3	0.0
Temperature (F)	46.1	97.4	-25.0
Precipitation (in)	89.92	1.56	

Predominant wind direction was from the WSW sector, accounting for 20.0% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	87648	81406	92.88%
Wind Direction	87648	81406	92.88%
Sigma-Theta	87648	78171	89.19%
Temperature	87648	81376	92.84%
Precipitation	87648	82827	94.50%

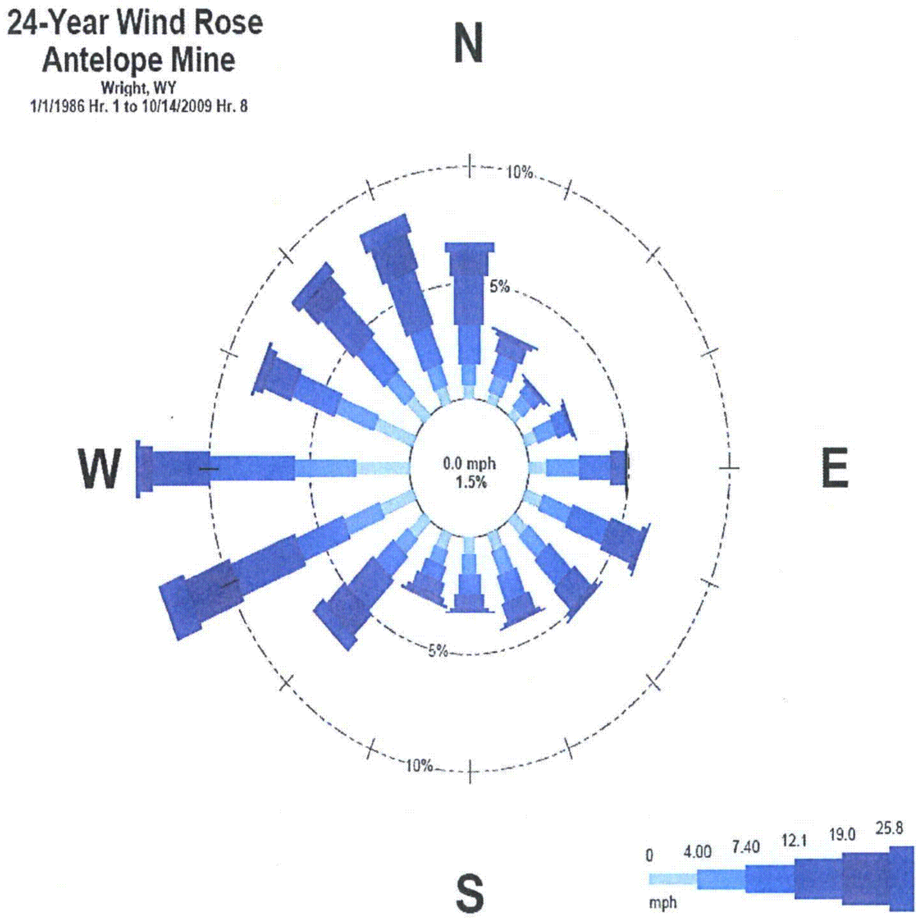
Miscellaneous Open Issue No. 2
Demonstration that ACC data represents long-term meteorological conditions
July 27 2009 Teleconference

Open Issue discussion:

The applicant did not compare the 10 years of data from ACC to the longer term data from ACC to demonstrate that the period of data used is representative of long-term meteorological conditions in the site vicinity.

Answer:

A 24-year wind rose and Meteorology Data Summary have been provided to NRC for the ACC site. The 24-year period represents data from when the site was installed through October of 2009.



24-Year Wind Rose
Antelope Mine
Wright, WY
1/1/1986 Hr. 1 to 10/14/2009 Hr. 8
N
W
E
S
10%
5%
0.0 mph
1.5%
0
4.00
7.40
12.1
19.0
25.8
mph

Antelope Mine

Meteorological Data Summary

1/1/1986 - 10/14/2009

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	11.0	51.7	0.0
Sigma-Theta (°)	14.8	99.0	0.0
Temperature (F)	46.1	102.1	-39.9
Precipitation (in)	238.73	1.48	
Bar. Pressure (in Hg)	25.3	25.9	20.0

Predominant wind direction was from the W sector,
accounting for 13.7% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	208512	183979	88.23%
Wind Direction	208512	184327	88.40%
Sigma-Theta	208512	182745	87.64%
Temperature	208512	195587	93.80%
Precipitation	208512	195093	93.56%
Bar. Pressure	208512	67550	32.40%

Proposed Revisions to License Application

The 24-year wind rose and Meteorology Data Summary table will be added to the revised Technical Report, Section 2.5.

Miscellaneous Open Issue No. 3
Wind speed and direction data not consistent in Technical Report
July 27 2009 Teleconference

Open Issue discussion:

In Table 2.5-9 of the Technical Report, the applicant reports wind direction recovery as 45.25% for ACC. This is not consistent with the wind direction recovery data in Table 2.5-6. The staff notes that the wind direction recovery data is not consistent.

Answer:

Table 2.5-9 has been revises to reflect corrected wind data recovery percentages.

Table 2.5-9 ACC Wind Summary
Antelope Mine

Wind Data Summary

1/1/1997 - 12/31/2006

Hourly Data

		Average	Max	Min
Wind Speed (mph)		11.18	50.60	-
Sigma Theta (°)		16.35	82.00	0.35
Wind Direction				
	N	13.33	47.32	0.30
	NNE	10.53	39.25	0.58
	NE	7.34	37.61	0.38
	ENE	6.07	27.41	0.60
	E	7.32	28.30	0.56
	ESE	9.92	33.86	0.50
	SE	9.76	35.52	0.50
	SSE	8.99	33.57	0.40
	S	8.88	32.30	0.69
	SSW	8.38	36.90	0.57
	SW	13.05	42.54	-
	WSW	15.81	50.60	0.09
	W	10.26	37.90	0.30
	WNW	8.39	37.40	0.30
	NW	11.50	45.10	0.30
	NNW	14.49	43.50	-

Predominant wind direction was from the W sector, accounting for 15.2% of the winds, the average wind direction was 276°.

Data Recovery

	Possible (hours)	Reported (hours)	Recovery
Wind Speed	87648	81938	93.49%
Sigma Theta	87648	81951	93.50%
Wind Direction	87648	81951	93.50%

Miscellaneous Open Issue No. 4
No annual wind rose provided
July 27 2009 Teleconference

Open Issue discussion:

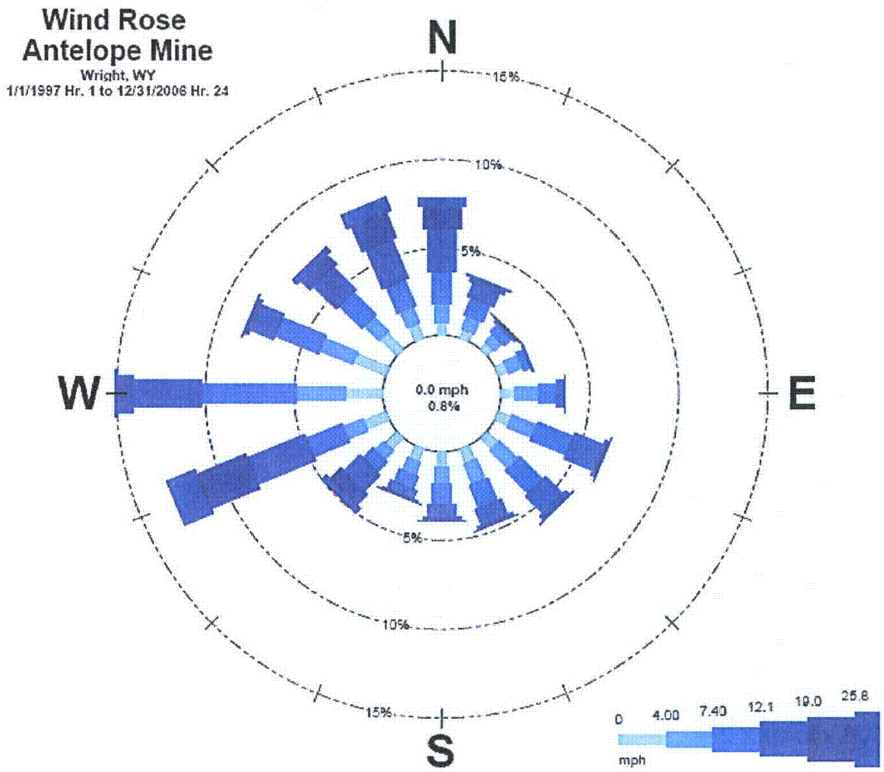
The applicant provides seasonal wind roses but did not provide an annual wind rose summary.

Answer:

The 10 year annual wind rose for the ACC station is provided below.

Proposed Revisions to License Application

The 10 year annual wind rose for the ACC station will be added to Section 2.5 of the revised Technical Report.


Wind Rose
Antelope Mine
Wright, WY
1/1/1997 Hr. 1 to 12/31/2006 Hr. 24
N
E
S
W
15%
10%
5%
0.0 mph
0.8%
0
4.00
7.40
12.1
19.0
25.8
mph

Miscellaneous Open Issue No. 5
Mixing height data representative of the Moore Ranch site
July 27 2009 Teleconference

Open Issue discussion:

The applicant discussed three sources of inversion and mixing height data in the Technical Report but did not propose a source of mixing height data that is representative of the Moore Ranch site.

Answer:

As discussed with the NRC in the November 23, 2009 conference call, the Wyoming WDEQ-AQD mixing heights will be utilized for all dispersion modeling. A commitment to this fact will be made in Section 2.5.3.3 of the revised Technical Report.

Proposed Revisions to License Application

The italicized language at the end of the second paragraph in Section 2.5.3.3 will be inserted in to the revised Technical Report.

2.5.3.3 Average Inversion and Mixing Layer Heights

The Air Quality Division of the Wyoming Department of Environmental Quality (WDEQ-AQD) has provided statewide mixing heights to be used in dispersion modeling with the Industrial Source Complex (ISC3) model. These are based on the methods of Holsworth (1972) as applied to Lander, located in central Wyoming. For modeling purposes, the annual average mixing heights are assigned according to stability class as follows:

Class A	3,450 meters
Class B	2,300 meters
Class C	2,300 meters
Class D	2,300 meters
Class E	10,000 meters
Class F	10,000 meters

Stability classes E and F are given an arbitrarily high number to indicate the absence of a distinct boundary in the upper atmosphere. Based on the exclusive use of these numbers for air quality modeling by mines in the Powder River Basin, all dispersion modeling will use the mixing heights provided by WDEQ-AQD.

Miscellaneous Open Issue No. 6
Calibration of meteorological data collection system
July 27 2009 Teleconference

Open Issue discussion:

Regulatory Guide 3.63 states that the system should be calibrated at least semiannually to ensure that the system accuracies in this guide are met. The applicant has not provided sufficient information demonstrating that the meteorological system at the ACC site was calibrated in accordance with Regulatory Guide 3.63.

Answer:

Information has been provided below to demonstrate that the ACC meteorological station used in Section 2.5 of the Moore Ranch Technical Report was calibrated in accordance with EPA guidance. A table is also provided comparing the EPA guidance criteria for system accuracies with NRC RG 3.63 and IML Air Science.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER Open Issue. Audit information for the ACC sites will be added to the revised Technical Report as a new Addendum 2.5-A

Measurement Variable	System Accuracy			Starting Threshold		
	EPA[1]	NRC[2]	IML[3]	EPA[1]	NRC[2]	IML[3]
Wind Speed	± (0.2 m/s + 5% of observed)	± 0.2 m/s for speeds < 2 m/s; 10% for speeds between 2 and 22 m/s	± 0.4 mph (0.2 m/s) or 1% of reading	0.5 m/s (1.0 mph)	0.5 m/s (1.0 mph)	0.9 mph
Wind Direction	± 5° Azimuth	± 5° Azimuth	± 3° Azimuth	0.5 m/s (1.0 mph)	0.5 m/s (1.0 mph)	1.0 mph
Ambient Temperature	± 0.5° C	(N/A)	± 0.5° C	(N/A)	(N/A)	(N/A)
Precipitation	0.3 mm (0.01 inch)	0.25 mm (0.01 inch)	± 0.5% at 0.5 inch/hour rate	(N/A)	(N/A)	(N/A)

1 - On-Site Meteorological Program Guidance For Regulatory Modeling Applications: EPA -450/4-87-013: February 2000; Environmental Protection Agency

2 - Onsite Meteorological Measurement Program For Uranium Recovery Facilities - Data Acquisition and Reporting; RG 3.63 - Task ES 401-4; March 1988

3 - IML Air Science; Standard Operating Procedure For Meteorological Station Audit - SOP AIR-12

Standard Operating Procedure
For
Meteorological Station Audit
SOP AIR-12

Procedural Section

1.0 Scope and Application

1.1 In 1970 the Clean Air Act (CAA) was signed into law. The CAA and its amendments provide the framework for all pertinent organizations to protect air quality. On July 18, 1997, in Federal Register: Vol. 62, No. 138, the United States Environmental Protection Agency (EPA) revised the particulate matter ambient air standards. Along with the establishment of the standard is the requirement for a national monitoring network utilizing a filter-based method adopted by EPA. The Antelope Mine is obligated to adopt the TSP and PM_{10} standards and establish a PM monitoring network.

1.2 This procedure applies to the following equipment: RM Young wind sensor, Met One 12" tipping bucket precipitation device, Fenwal 107 temperature monitor, Vaisala PTB 101B barometric pressure sensor, and Campbell Scientific CR-10X data logger, which are used in the Antelope Mine PM monitoring network.

1.3 The elements of this SOP are applicable for all sampling frequencies.

1.4 To ensure that the recorded meteorological data for wind speed, wind direction, temperature, barometric pressure, and precipitation match readings provided by known references, within acceptable limits.

2.0 Summary of Method

2.1 The Antelope Mine is responsible for the accuracy audit of their Meteorological station. The actual procedure is performed by Division field personnel or contracted.

2.2 The meteorological audit consists of checking current readings for all parameters against reference values.

3.0 Health and Safety Warnings

3.1 General safety precautions related to electrical hazards must be observed at all times when working with electronic equipment. Electrical receptacles and equipment must be properly grounded. Use caution when servicing or operating electrical equipment in wet conditions.

3.2 General precautions for working with heavy equipment and electro-mechanical equipment should be taken.

4.0 <u>Cautions</u>

4.1 Damage to the instrument may result if caution is not taken to properly install and maintain the device. Follow the manufacturer's instructions for maintenance of all equipment and for safe, secure installation.

5.0 <u>Personnel Qualifications</u>

5.1 Persons performing this SOP must be familiar with the operation of environmental measurement instrumentation.

5.2 Computer skills are necessary for programming the sampler and for troubleshooting.

5.3 Familiarity with electronic and mechanical test equipment is required.

6.0 <u>Equipment</u>

6.1 Quartz-referenced wind speed motor, with adapters

6.2 Starting torque measurement disc and weights

6.3 NIST traceable thermometer

6.4 Two insulated containers (one with ice water and the other with hot water)

6.5 Engineer's transit

6.6 Class B pipette

6.7 Field data sheet

6.8 Miscellaneous tools

7.0 <u>Meteorological Station Audit Procedure</u>

7.1 Record the date, station ID, auditor(s), description of sensors, and note

any visible anomalies in the field log book. Check that the data logger is displaying reasonable current readings.

7.2.1 Check the initial alignment of the wind direction sensor using the transit, being sure to adjust for the local declination of 12° East.

7.3 Locate the reference, aspirated thermometer near the met station's temperature sensor, allow each sensor to reach equilibrium and record both readings.

7.4 Record the "time system off line", just before lowering the tower. Remove the appropriate base mounting bolts, detach the guy wire perpendicular to the base hinge, and ***carefully*** lower the tower.

7.5 Remove the anemometer propeller. Attach the propeller torque disc to the shaft and record the starting torque in the counter-clockwise direction.

7.6 Attach the anemometer drive motor to the shaft and rotate at speeds corresponding to approximately 3 mph, 9 mph, 30 mph, and 90 mph, recording the motor speeds and wind speed readings from the data logger.

7.7 Assess the linearity of the wind direction sensor by physically holding the anemometer at 0°, 90°, 180°, and 270°, recording the corresponding readings from the data logger.

7.8 Immerse the reference thermometer and met station temperature sensor in an ice bath. After the sensors have attained equilibrium, record the measurements from both. Repeat the procedure for a warm water bath (approximately 80°F - 100°F).

7.9 After all measurements on the tower have been taken, inspect the sensors and all cables and mounting hardware. Repair or replace any damaged components if indicated.

7.10 Make sure all cables and mounting hardware are sound and secure. ***Carefully*** raise the tower, secure the base, and equalize the guy wire tensions.

7.11 Using the pipette, admit water slowly into the inlet of the precipitation gauge (*as found, i.e. do not clean)* until the bucket tips 10 times (0.1" precipitation equivalent). Record the amount of water required for the 10 tips, and the amount registered on the data logger. Repeat the procedure two more times. After the readings have been taken, clean the inlet, and perform any indicated adjustments and/or repairs can be performed and noted. Note

the condition of the gauge prior to, and after the audit. If the ambient temperature is cold enough, assess whether the heater is working.

7.12 Record any findings, repairs, replacements and any other anomalies in the field log book. Record the time the station was returned to normal operating condition.

References

1. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements; EPA/600/4-90/003; August 1989; U.S. Environmental Protection Agency

2. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April 1994; U.S. Environmental Protection Agency

3. On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

4. Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-450/4-87-007; May, 1987; U.S. Environmental Protection Agency

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a division of Inter-Mountain Laboratories, Inc. 555 Absaraka, Sheridan, WY 82801

Meteorological Station Audit/Calibration

Network:

Date: Auditors: DAS time off-line:

Notes; system as found:

Sensors

DAS:	Temp/Asp:
Wind Speed:	Wind Direction:
Bar. Pres.:	RH:
Precipitation:	

System Audit

Wind Speed

starting torque		gm-cm
reference	DAS	after adj.
0 rpm		
rpm mph		
rpm mph		
rpm mph		
rpm mph		

Wind Direction

starting torque

ccw: cw: gm-cm

initial alignment:

reference	DAS	after adj.
360		
060		
090		
120		
180		
240		
270		
300		

Barometric Pressure

ref.	
DAS	

Relative Humidity

ref. dry bulb	ref. RH
ref. wet bulb	DAS RH

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Temperature

Height: ______________

reference	DAS	after adj.
aspirated ambient °F °C		
°F °C		
°F °C		

Precipitation (Tipping Bucket)

mls/weight	tips	in. equiv.

Heater working?

Inspection

Precipitation (Weighing Bucket)

in. equiv.	Chart	Δ Chart
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

DAS Day: ______________
DAS Time: ______________
DAS Year: ______________
DAS Battery: ______________
SM Battery OK? ______________
Enclosure Humidity OK? ______________
WS Channel: ______________
WD Channel: ______________
Ta Channel: ______________
Precip. Channel: ______________
RH Channel: ______________
Pa Channel: ______________
Batt. Channel: ______________

Notes: ______________

End System Audit

DAS time on-line: ______________

Meteorological Station Audit Summary

Met Station: Belle Ayr Mine
Date: 19-Jul-06
Audit Performed By: S.Engel & K.Jahnke--IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young WM AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young WM AQ	transit, compass
Temperature (T):	Climatronics #2304, TS-10 motor aspirator	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One 12" tipping bucket	lab grade burette
Barometric Pressure (BP)	CSI CS 105	aneroid barometer
Data acquisition system (DAS):	CSI CR-10x	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.45	(1)
		3.44	3.44	0.00	0.62	(1)
		9.16	9.16	0.00	0.91	(1)
		34.35	34.35	0.00	2.17	(1)
		91.60	91.60	0.00	5.03	(1)
WS start torque (gm-cm)		OK	N/A	N/A	0.50	(3)
WD (degrees)		0.0	0.5	0.5	5.0	(1)
		90.0	90.1	0.1	5.0	(1)
		180.0	180.4	0.4	5.0	(1)
		270.0	270.6	0.6	5.0	(1)
Temperature (°F)	Ice water bath	30.5	30.1	0.44	0.9	(1)
	Warm water bath	66.8	66.3	0.48	0.9	(1)
	Hot water bath	102.9	102.7	0.20	0.9	(1)
Precipitation (0.04" equiv.)		73.1	74.0	0.9	7.4	(1)
		71.8	74.0	2.2	7.4	(1)
		72.4	74.0	1.6	7.4	(1)
Barometric Pressure ("Hg)		25.36	30.21	4.85	0.09	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed in EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1019 MST -- returned on-line at 1330 MST

New anemometer and temperature cables were installed.

METEOROLOGICAL STATION DETAILS

Antelope	10m tower	CR10X Logger		
Parameter	**Instrument**	**Range**	**Accuracy**	**Threshold**
Wind Speed	RM Young	0-112 mph	±0.4 mph or 1% of reading	0.9 mph
Wind Dir	RM Young	0-360°	±3°	1.0 mph
Temp	CS 107	-35°- 50°C	±0.5° C @ given Range	--
Precip	Met One 12" tip	Temp: -20° - 50°C	±0.5% @ 0.5 in/hr rate	--
Bar Press	Vaisalla	600 -1060 mb	±0.5 mb @ 20°C	--
Glenrock	10m tower	CR10 Logger		
Parameter	**Instrument**	**Range**	**Accuracy**	**Threshold**
Wind Speed	RM Young	0-112 mph	±0.4 mph or 1% of reading	0.9 mph
Wind Dir	RM Young	0-360°	±3°	1.0 mph
Temp	F107	-35°- 50°C	±0.5° C @ given Range	--
Precip	Met One 8" tip	Temp: -20° - 50°C	±0.5% @ 0.5 in/hr rate	--

Measurement Variable	System Accuracy			Starting Threshold		
	EPA[1]	NRC[2]	IML[3]	EPA[1]	NRC[2]	IML[3]
Wind Speed	± (0.2 m/s + 5% of observed)	± 0.2 m/s for speeds < 2 m/s; 10% for speeds between 2 and 22 m/s	± 0.4 mph (0.2 m/s) or 1% of reading	0.5 m/s (1.0 mph)	0.5 m/s (1.0 mph)	0.9 mph
Wind Direction	± 5° Azimuth	± 5° Azimuth	± 3° Azimuth	0.5 m/s (1.0 mph)	0.5 m/s (1.0 mph)	1.0 mph
Ambient Temperature	± 0.5° C	(N/A)	± 0.5° C	(N/A)	(N/A)	(N/A)
Precipitation	0.3 mm (0.01 inch)	0.25 mm (0.01 inch)	± 0.5% at 0.5 inch/hour rate	(N/A)	(N/A)	(N/A)

[1] - On-Site Meteorological Program Guidance For Regulatory Modeling Applications: EPA -450/4-87-013: February 2000; Environmental Protection Agency

[2] - Onsite Meteorological Measurement Program For Uranium Recovery Facilities - Data Acquision and Reporting; RG 3.63 - Task ES 401-4; March 1988

[3] - IML Air Science; Standard Operating Procedure For Meteorological Satation Audit - SOP AIR-12

HIGH PLAINS
URANIUM

1718 Capitol Ave.
Cheyenne, WY 82001

August 28, 2006

Mr. Paul Michalak
United States Nuclear Regulatory Commission
Division of Fuel Cycle Safety and Safeguards
Mail Stop: T8F42
Washington, DC 20555-001

RE: Proposed Meteorological Study Plan for the Allemand Ross Project

Dear Mr. Michalak,

During the introductory meeting between High Plains Uranium, Inc. (HPU) and Nuclear Regulatory Commission (NRC) staff members on August 22, 2006, HPU requested guidance on a proposed meteorological study plan for the Allemand Ross Project (ARP) area. The NRC staff requested that HPU provide more detailed information regarding the meteorological monitoring stations proposed for use with the plan. The request was made to ensure that the data collected from the proposed monitoring stations would meet the acceptance criteria as outlined in Section 2.5, Meteorology of NUREG-1569, "Standard Review Plan for In Situ Leach Uranium Extraction License Applications".

Specifically, NUREG-1569 states that the proposed monitoring stations should be set up according to Regulatory Guide 3.63, "Onsite Meteorological Measurement Program for Uranium Recovery Facilities – Data Acquisition and Reporting" (NRC 1988). Regulatory Guide 3.63 details the meteorological data required to perform a site evaluation. HPU has included correspondence dated August 25, 2006 from IML Air Science (author of the plan and operator of the stations) detailing site specific information for the two meteorological monitoring stations proposed for the study plan. Data collected over a three year period will be used from meteorological stations at the Antelope and Glenrock coal mines located within 80-kilometers of the proposed ARP facility in the Powder River Basin. The ARP facility will not include a tailings impoundment, therefore according to Section C of Regulatory Guide 3.63 the required parameters that need to be monitored are wind direction, wind speed, and atmospheric stability for a minimum consecutive 12-month period.

HPU believes that the proposed meteorological stations meet all requirements of Regulatory Guide 3.63, including monitored parameters, instrument locations, system accuracies and maintenance and data recovery. Therefore, these stations should be recognized as acceptable installations to provide appropriate baseline meteorological data for the license application.

If you have any questions, please contact me at (307) 459-4128.

Sincerely,

Leland Huffman

Leland Huffman
ISL General Manager

encl
cc: Pat Lorello
Dani Wright

IML Air Science
a division of Inter-Mountain Laboratories, Inc.
555 Absaraka, Sheridan, WY 82801

August 25, 2006

Leland Huffman
General Manager
High Plains Uranium
1718 Capitol Ave.
Cheyenne, WY 82001

Re: Meteorological Data Plan

Dear Leland:

In response to your request, we have assembled site information, instrument data, quality assurance procedures and regulatory references to support the validity of meteorological data collected and reported by IML Air Science. As I mentioned on the phone, the data from the Antelope Mine, Glenrock Mine, and all of our monitoring sites meet EPA criteria for quality assurance and for use in atmospheric dispersion modeling. This encompasses tower siting, instrument procurement and acceptance testing, instrument calibration and audits, data validation and data reporting.

We audit all of our met stations every other quarter, as stipulated in the QA guidance. A detailed form and SOP are attached to show the procedure, the parameters audited and the audit tolerances for each parameter. The most recent met audit, typical of all of our sites, was performed for the Belle Ayr Mine (attached). Since the Antelope and Glenrock mine sites have been proposed as surrogates for your project site, I've also attached a tabular description of each of those stations.

All of the meteorological data acquired by IML Air Science are stored in a relational database. Software validation supplemented by operator inspection, assures reasonable values and continuity in the hourly average data. Data are summarized in quarterly reports, which also include data recovery statistics and diagnosis of invalidated records. Reports are read by the client as well as the state regulatory authority. In some states (including Wyoming), the regulatory authority uploads these meteorological data to the national Air Quality System (AQS) database.

We believe the level of rigor associated with collecting and validating our meteorological data is comparable, if not superior to National Weather Service standards.

Please let me know if you need further information.

Sincerely,

Ronn Smith, P.E.

Standard Operating Procedure
For
Meteorological Station Audit
SOP AIR-12

Procedural Section

1.0 Scope and Application

1.1 In 1970 the Clean Air Act (CAA) was signed into law. The CAA and its amendments provide the framework for all pertinent organizations to protect air quality. On July 18, 1997, in Federal Register: Vol. 62, No. 138, the United States Environmental Protection Agency (EPA) revised the particulate matter ambient air standards. Along with the establishment of the standard is the requirement for a national monitoring network utilizing a filter-based method adopted by EPA. The Antelope Mine is obligated to adopt the TSP and PM_{10} standards and establish a PM monitoring network.

1.2 This procedure applies to the following equipment: RM Young wind sensor, Met One 12" tipping bucket precipitation device, Fenwal 107 temperature monitor, Vaisala PTB 101B barometric pressure sensor, and Campbell Scientific CR-10X data logger, which are used in the Antelope Mine PM monitoring network.

1.3 The elements of this SOP are applicable for all sampling frequencies.

1.4 To ensure that the recorded meteorological data for wind speed, wind direction, temperature, barometric pressure, and precipitation match readings provided by known references, within acceptable limits.

2.0 Summary of Method

2.1 The Antelope Mine is responsible for the accuracy audit of their Meteorological station. The actual procedure is performed by Division field personnel or contracted.

2.2 The meteorological audit consists of checking current readings for all parameters against reference values.

3.0 Health and Safety Warnings

3.1 General safety precautions related to electrical hazards must be observed at all times when working with electronic equipment. Electrical receptacles and equipment must be properly grounded. Use caution when servicing or operating electrical equipment in wet conditions.

3.2 General precautions for working with heavy equipment and electro-mechanical equipment should be taken.

4.0 Cautions

4.1 Damage to the instrument may result if caution is not taken to properly install and maintain the device. Follow the manufacturer's instructions for maintenance of all equipment and for safe, secure installation.

5.0 Personnel Qualifications

5.1 Persons performing this SOP must be familiar with the operation of environmental measurement instrumentation.

5.2 Computer skills are necessary for programming the sampler and for troubleshooting.

5.3 Familiarity with electronic and mechanical test equipment is required.

6.0 Equipment

6.1 Quartz-referenced wind speed motor, with adapters

6.2 Starting torque measurement disc and weights

6.3 NIST traceable thermometer

6.4 Two insulated containers (one with ice water and the other with hot water)

6.5 Engineer's transit

6.6 Class B pipette

6.7 Field data sheet

6.8 Miscellaneous tools

7.0 Meteorological Station Audit Procedure

7.1 Record the date, station ID, auditor(s), description of sensors, and note

any visible anomalies in the field log book. Check that the data logger is displaying reasonable current readings.

7.2.1 Check the initial alignment of the wind direction sensor using the transit, being sure to adjust for the local declination of 12° East.

7.3 Locate the reference, aspirated thermometer near the met station's temperature sensor, allow each sensor to reach equilibrium and record both readings.

7.4 Record the "time system off line", just before lowering the tower. Remove the appropriate base mounting bolts, detach the guy wire perpendicular to the base hinge, and ***carefully*** lower the tower.

7.5 Remove the anemometer propeller. Attach the propeller torque disc to the shaft and record the starting torque in the counter-clockwise direction.

7.6 Attach the anemometer drive motor to the shaft and rotate at speeds corresponding to approximately 3 mph, 9 mph, 30 mph, and 90 mph, recording the motor speeds and wind speed readings from the data logger.

7.7 Assess the linearity of the wind direction sensor by physically holding the anemometer at 0°, 90°, 180°, and 270°, recording the corresponding readings from the data logger.

7.8 Immerse the reference thermometer and met station temperature sensor in an ice bath. After the sensors have attained equilibrium, record the measurements from both. Repeat the procedure for a warm water bath (approximately 80°F - 100°F).

7.9 After all measurements on the tower have been taken, inspect the sensors and all cables and mounting hardware. Repair or replace any damaged components if indicated.

7.10 Make sure all cables and mounting hardware are sound and secure. ***Carefully*** raise the tower, secure the base, and equalize the guy wire tensions.

7.11 Using the pipette, admit water slowly into the inlet of the precipitation gauge (*as found, i.e. do not clean)* until the bucket tips 10 times (0.1" precipitation equivalent). Record the amount of water required for the 10 tips, and the amount registered on the data logger. Repeat the procedure two more times. After the readings have been taken, clean the inlet, and perform any indicated adjustments and/or repairs can be performed and noted. Note

the condition of the gauge prior to, and after the audit. If the ambient temperature is cold enough, assess whether the heater is working.

7.12 Record any findings, repairs, replacements and any other anomalies in the field log book. Record the time the station was returned to normal operating condition.

References

1. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements; EPA/600/4-90/003; August 1989; U.S. Environmental Protection Agency

2. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April 1994; U.S. Environmental Protection Agency

3. On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

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iml Air Science

a division of Inter-Mountain Laboratories, Inc. 555 Absaraka, Sheridan, WY 82801

Meteorological Station Audit/Calibration

Network:

Date: Auditors: DAS time off-line:

Notes; system as found:

Sensors

DAS:	Temp/Asp:
Wind Speed:	Wind Direction:
Bar. Pres.:	RH:
Precipitation:	

System Audit

Wind Speed

starting torque		gm-cm
reference	DAS	after adj.
0 rpm		
rpm mph		
rpm mph		
rpm mph		
rpm mph		

Wind Direction

starting torque		
ccw:	cw:	gm-cm
initial alignment:		
reference	DAS	after adj.
360		
060		
090		
120		
180		
240		
270		
300		

Barometric Pressure

ref.	
DAS	

Relative Humidity

ref. dry bulb	ref. RH
ref. wet bulb	DAS RH

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555 Absaraka, Sheridan, WY 82801

Temperature

Height: ______

reference	DAS	after adj.
aspirated ambient °F °C		
°F °C		
°F °C		

Precipitation (Tipping Bucket)

mls/weight	tips	in. equiv.

Heater working? ______

Inspection ______

Precipitation (Weighing Bucket)

in. equiv.	Chart	Δ Chart
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

DAS Day: ______
DAS Time: ______
DAS Year: ______
DAS Battery: ______
SM Battery OK? ______
Enclosure Humidity OK? ______
WS Channel: ______
WD Channel: ______
Ta Channel: ______
Precip. Channel: ______
RH Channel: ______
Pa Channel: ______
Batt. Channel: ______

Notes: ______

End System Audit

DAS time on-line: ______

Meteorological Station Audit Summary

Met Station: Belle Ayr Mine
Date: 19-Jul-06
Audit Performed By: S.Engel & K.Jahnke--IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young WM AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young WM AQ	transit, compass
Temperature (T):	Climatronics #2304, TS-10 motor aspirator	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One 12" tipping bucket	lab grade burette
Barometric Pressure (BP)	CSI CS 105	aneroid barometer
Data acquisition system (DAS):	CSI CR-10x	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.45	(1)
		3.44	3.44	0.00	0.62	(1)
		9.16	9.16	0.00	0.91	(1)
		34.35	34.35	0.00	2.17	(1)
		91.60	91.60	0.00	5.03	(1)
WS start torque (gm-cm)		OK	N/A	N/A	0.50	(3)
WD (degrees)		0.0	0.5	0.5	5.0	(1)
		90.0	90.1	0.1	5.0	(1)
		180.0	180.4	0.4	5.0	(1)
		270.0	270.6	0.6	5.0	(1)
Temperature (°F)	Ice water bath	30.5	30.1	0.44	0.9	(1)
	Warm water bath	66.8	66.3	0.48	0.9	(1)
	Hot water bath	102.9	102.7	0.20	0.9	(1)
Precipitation (0.04" equiv.)		73.1	74.0	0.9	7.4	(1)
		71.8	74.0	2.2	7.4	(1)
		72.4	74.0	1.6	7.4	(1)
Barometric Pressure ("Hg)		25.36	30.21	4.85	0.09	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
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Air Pollution Measurement Systems, Vol. IV, 1989
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Notes, Recommendations

System taken off-line at 1019 MST -- returned on-line at 1330 MST

New anemometer and temperature cables were installed.

METEOROLOGICAL STATION DETAILS

Antelope	10m tower	CR10X Logger		
Parameter	**Instrument**	**Range**	**Accuracy**	**Threshold**
Wind Speed	RM Young	0-112 mph	±0.4 mph or 1% of reading	0.9 mph
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Temp	CS 107	-35°- 50°C	±0.5°C @ given Range	--
Precip	Met One 12" tip	Temp: -20°- 50°C	±0.5% @ 0.5 in/hr rate	--
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Glenrock	10m tower	CR10 Logger		
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IML Air Science
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555 Absaraka, Sheridan, WY 82801

August 25, 2006

Leland Huffman
General Manager
High Plains Uranium
1718 Capitol Ave.
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Sincerely,

Ronn Smith, P.E.

Standard Operating Procedure
For
Meteorological Station Audit
SOP AIR-12

Procedural Section

1.0 Scope and Application

1.1 In 1970 the Clean Air Act (CAA) was signed into law. The CAA and its amendments provide the framework for all pertinent organizations to protect air quality. On July 18, 1997, in Federal Register: Vol. 62, No. 138, the United States Environmental Protection Agency (EPA) revised the particulate matter ambient air standards. Along with the establishment of the standard is the requirement for a national monitoring network utilizing a filter-based method adopted by EPA. The Antelope Mine is obligated to adopt the TSP and PM_{10} standards and establish a PM monitoring network.

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1.3 The elements of this SOP are applicable for all sampling frequencies.

1.4 To ensure that the recorded meteorological data for wind speed, wind direction, temperature, barometric pressure, and precipitation match readings provided by known references, within acceptable limits.

2.0 Summary of Method

2.1 The Antelope Mine is responsible for the accuracy audit of their Meteorological station. The actual procedure is performed by Division field personnel or contracted.

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6.2 Starting torque measurement disc and weights

6.3 NIST traceable thermometer

6.4 Two insulated containers (one with ice water and the other with hot water)

6.5 Engineer's transit

6.6 Class B pipette

6.7 Field data sheet

6.8 Miscellaneous tools

7.0 Meteorological Station Audit Procedure

7.1 Record the date, station ID, auditor(s), description of sensors, and note

any visible anomalies in the field log book. Check that the data logger is displaying reasonable current readings.

7.2.1 Check the initial alignment of the wind direction sensor using the transit, being sure to adjust for the local declination of 12° East.

7.3 Locate the reference, aspirated thermometer near the met station's temperature sensor, allow each sensor to reach equilibrium and record both readings.

7.4 Record the "time system off line", just before lowering the tower. Remove the appropriate base mounting bolts, detach the guy wire perpendicular to the base hinge, and ***carefully*** lower the tower.

7.5 Remove the anemometer propeller. Attach the propeller torque disc to the shaft and record the starting torque in the counter-clockwise direction.

7.6 Attach the anemometer drive motor to the shaft and rotate at speeds corresponding to approximately 3 mph, 9 mph, 30 mph, and 90 mph, recording the motor speeds and wind speed readings from the data logger.

7.7 Assess the linearity of the wind direction sensor by physically holding the anemometer at 0°, 90°, 180°, and 270°, recording the corresponding readings from the data logger.

7.8 Immerse the reference thermometer and met station temperature sensor in an ice bath. After the sensors have attained equilibrium, record the measurements from both. Repeat the procedure for a warm water bath (approximately 80°F - 100°F).

7.9 After all measurements on the tower have been taken, inspect the sensors and all cables and mounting hardware. Repair or replace any damaged components if indicated.

7.10 Make sure all cables and mounting hardware are sound and secure. ***Carefully*** raise the tower, secure the base, and equalize the guy wire tensions.

7.11 Using the pipette, admit water slowly into the inlet of the precipitation gauge (*as found, i.e. do not clean)* until the bucket tips 10 times (0.1" precipitation equivalent). Record the amount of water required for the 10 tips, and the amount registered on the data logger. Repeat the procedure two more times. After the readings have been taken, clean the inlet, and perform any indicated adjustments and/or repairs can be performed and noted. Note

the condition of the gauge prior to, and after the audit. If the ambient temperature is cold enough, assess whether the heater is working.

7.12 Record any findings, repairs, replacements and any other anomalies in the field log book. Record the time the station was returned to normal operating condition.

References

1. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements; EPA/600/4-90/003; August 1989; U.S. Environmental Protection Agency

2. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April 1994; U.S. Environmental Protection Agency

3. On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

4. Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-450/4-87-007; May, 1987; U.S. Environmental Protection Agency

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Meteorological Station Audit/Calibration

Network:

Date: Auditors: DAS time off-line:

Notes; system as found:

Sensors

DAS:	Temp/Asp:
Wind Speed:	Wind Direction:
Bar. Pres.:	RH:
Precipitation:	

System Audit

Wind Speed

starting torque		gm-cm
reference	DAS	after adj.
0 rpm		
rpm mph		
rpm mph		
rpm mph		
rpm mph		

Wind Direction

starting torque		
ccw:	cw:	gm-cm
initial alignment:		
reference	DAS	after adj.
360		
060		
090		
120		
180		
240		
270		
300		

Barometric Pressure

ref.
DAS

Relative Humidity

ref. dry bulb	ref. RH
ref. wet bulb	DAS RH

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Temperature

Height: ____________

reference	DAS	after adj.
aspirated ambient °F °C		
°F °C		
°F °C		

Precipitation (Tipping Bucket)

mls/weight	tips	in. equiv.

Heater working?

Inspection

Precipitation (Weighing Bucket)

in. equiv.	Chart	Δ Chart
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

DAS Day: ____________

DAS Time: ____________

DAS Year: ____________

DAS Battery: ____________

SM Battery OK? ____________

Enclosure Humidity OK? ____________

WS Channel: ____________

WD Channel: ____________

Ta Channel: ____________

Precip. Channel: ____________

RH Channel: ____________

Pa Channel: ____________

Batt. Channel: ____________

Notes: ____________

End System Audit

DAS time on-line: ____________

Meteorological Station Audit Summary

Met Station: Belle Ayr Mine
Date: 19-Jul-06
Audit Performed By: S.Engel & K.Jahnke--IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young WM AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young WM AQ	transit, compass
Temperature (T):	Climatronics #2304, TS-10 motor aspirator	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One 12" tipping bucket	lab grade burette
Barometric Pressure (BP)	CSI CS 105	aneroid barometer
Data acquisition system (DAS):	CSI CR-10x	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.45	(1)
		3.44	3.44	0.00	0.62	(1)
		9.16	9.16	0.00	0.91	(1)
		34.35	34.35	0.00	2.17	(1)
		91.60	91.60	0.00	5.03	(1)
WS start torque (gm-cm)		OK	N/A	N/A	0.50	(3)
WD (degrees)		0.0	0.5	0.5	5.0	(1)
		90.0	90.1	0.1	5.0	(1)
		180.0	180.4	0.4	5.0	(1)
		270.0	270.6	0.6	5.0	(1)
Temperature (°F)	Ice water bath	30.5	30.1	0.44	0.9	(1)
	Warm water bath	66.8	66.3	0.48	0.9	(1)
	Hot water bath	102.9	102.7	0.20	0.9	(1)
Precipitation (0.04" equiv.)		73.1	74.0	0.9	7.4	(1)
		71.8	74.0	2.2	7.4	(1)
		72.4	74.0	1.6	7.4	(1)
Barometric Pressure ("Hg)		25.36	30.21	4.85	0.09	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1019 MST -- returned on-line at 1330 MST

New anemometer and temperature cables were installed.

METEOROLOGICAL STATION DETAILS

Antelope	10m tower	CR10X Logger		
Parameter	**Instrument**	**Range**	**Accuracy**	**Threshold**
Wind Speed	RM Young	0-112 mph	±0.4 mph or 1% of reading	0.9 mph
Wind Dir	RM Young	0-360°	±3°	1.0 mph
Temp	CS 107	-35°- 50° C	±0.5° C @ given Range	--
Precip	Met One 12" tip	Temp: -20° - 50° C	±0.5% @ 0.5 in/hr rate	--
Bar Press	Vaisalla	600 -1060 mb	±0.5 mb @ 20°C	--
Glenrock	10m tower	CR10 Logger		
Parameter	**Instrument**	**Range**	**Accuracy**	**Threshold**
Wind Speed	RM Young	0-112 mph	±0.4 mph or 1% of reading	0.9 mph
Wind Dir	RM Young	0-360°	±3°	1.0 mph
Temp	F107	-35°- 50° C	±0.5° C @ given Range	--
Precip	Met One 8" tip	Temp: -20° - 50° C	±0.5% @ 0.5 in/hr rate	--

Miscellaneous Open Issue No. 7
Adequacy of monitoring well ring
July 27 2009 Teleconference

Open Issue discussion:

Uranium One used groundwater modeling of the ore zone "70 sand" unconfined aquifer to show hydraulic communication between the wellfield and the monitoring ring wells located 500 feet away and 500 feet apart. This communication will be verified by field pumping tests. NRC staff notes that although hydraulic communication with the well ring may be established, this does not confirm that the well spacing is sufficient to detect an excursion. Given the small radial extent of the cone of depression developed in extraction wells in the unconfined aquifer (potentially less than 100 ft at extraction rate limits), it is possible that an excursion could pass undetected between the monitoring wells located 500 feet apart. Uranium One is requested to provide evidence that this spacing is sufficient to detect an excursion in the "70 sand" unconfined aquifer.

Answer:

A numerical groundwater flow model was previously submitted to the NRC to address issues related to hydraulic stresses on the production zone aquifer during typical production and restoration operations (Numerical Modeling of Groundwater Conditions Related to Insitu Recovery at the Moore Ranch Uranium Project, Wyoming, Petrotek, 2008). That same numerical model was used to simulate an excursion recovery simulation and to demonstrate that a 500-foot monitor well ring spacing was adequate for detection of an excursion. The simulations is described in revised Addendum 5.7.A

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

See Addendum 5.7.A

Miscellaneous Open Issue No. 8
Qualifications of non-RSO personnel to conduct inspections
July 27 2009 Teleconference

Open Issue discussion:

Applicant states that the RSO, Radiation Safety Technician, or a qualified designee will conduct a daily walkthrough inspection of the plant. The applicant does not define how it will determine the qualified designee.

Answer:

The response to this Open Issue is similar to the response to Radiological Open Issue No. 20 from the July 27, 2009 teleconference. In general, the RSO or radiation safety staff will perform all of the daily walkthrough inspections of the plant. However, this can prove problematic on weekends because the RSO and radiation safety staff are typically on site during regular working hours. To address weekend inspection, it has been industry practice to train selected individuals (usually the plant operator) to perform the weekend daily walkthrough inspections. In order to accomplish this, in addition to their training as radiation workers in accordance with guidance in Regulatory Guide 8.31, section 2.5, Radiation Safety Training, these individuals receive specific training for inspections for radiological safety. This training includes specific procedural requirements contained in Standard Operating Procedures and related documentation of inspections. A checklist will be prepared by the RSO which will provide a "tool" for the designated worker's use to maintain consistency and continuity of this function. Training is documented in the individual's training records. The records of this training and the results of daily walkthrough inspections have been inspected by NRC at current licensees and found to be acceptable.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

5.3.1.1 Daily Inspections

The RSO, RST or a qualified designee will conduct a daily walkthrough inspection of the plant. Generally, the RSO or RST will always perform the daily walkthrough inspection when they are on shift. A qualified designee (e.g., the plant operator) may be trained to perform the daily walkthrough inspections on the weekends. Qualified designees will receive specific training for conducting daily inspections from the RSO. This training will include specific procedural requirements contained in Standard Operating Procedures and related documentation of inspections. Any significant radiological hazards noted during these inspections will be reported immediately to the RSO. Training will be documented in the individual's training records and available for inspection by NRC. The inspection will entail a visual examination of compliance or other problems, which will reviewed with the Manager, Wyoming Operations.

Miscellaneous Open Issue No. 9
Qualification of QA personnel
July 27 2009 Teleconference

Open Issue discussion:

Uranium One stated the Senior Environmental Specialist (SES) will manage the majority of QA/QC activities and report directly to this manager. The QA plan did not indicate if the SES would be located on the specific site. The SES was not listed as a key site person in the corporate and site management structure at Moore Ranch. As the SES is identified in this plan as the person responsible for almost all QA activities in the field and laboratory, his or her placement in the organization is requested. The applicant stated that QA staff will perform independent assessments of environmental monitoring activities and will be qualified as lead assessors. The applicant did not describe how this qualification would be attained.

Answer:

The duties of the Senior Environmental Specialist (SES) in oversight of the QA/QC activities have been assigned to the Radiation Safety Officer (RSO). The RSO will report directly to the Mine Manager and will coordinate responsibilities with the Manager of Environmental and Regulatory Affairs, Wyoming.

Independent assessments of environmental monitoring activities will be performed by personnel qualified through work experience, education background or combination of experience and education. These QA audits may be conducted by site supervisory personnel experienced with the QA process, the RSO, the Director of Environmental and Regulatory Affairs or an outside auditing service.

Addendum 5-A of the Technical Report will be revised to reflect this change and submitted as a revision to the Technical Report to the USNRC.

Proposed Revisions to License Application

Addendum 5-A, *Wyoming ISR Operations Quality Assurance Plan*, of the license application will be revised in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

ADDENDUM 5-A

WYOMING ISR OPERATIONS QUALITY ASSURANCE PLAN

Wyoming In Situ Recovery Projects
Quality Assurance Plan

Prepared by
Uranium One Americas
Casper, Wyoming

Policy and Signature Page

Uranium One Americas is committed to establishing, maintaining, and implementing an effective Quality Assurance program that achieves quality in all activities through planning, performing, assessing, and continually improving the process.

The achievement of quality is an interdisciplinary function led by management and is the responsibility of all personnel. Work is accomplished through the resources of people, equipment, and procedures. Managers are responsible for ensuring that people have the information, resources, and support necessary to complete the work in a safe, efficient, and quality manner. All work performed by Uranium One Americas at Wyoming In Situ Recovery (ISR) sites must comply with the requirements of this Quality Assurance Project Plan.

Prepared By: ____________________ Date: ____________

Approved By: ____________________ Date: ____________

Table of Contents

1 INTRODUCTION

This Quality Assurance Plan is applicable to the environmental monitoring program implemented by Uranium One Americas at Wyoming ISR sites. The plan provides the quality requirements for field collection of samples and the subsequent analysis of those samples at a laboratory.

2 QUALITY PLAN REVIEW, REVISION AND DISTRIBUTION

This Quality Assurance Plan will be reviewed by affected project managers in accordance with the company policy for controlled documents. Revisions will be made at the direction of the Manager of Environmental and Regulatory Affairs, Wyoming to reflect changes in work scope, organizational interfaces or new regulatory requirements. This plan will be reviewed annually to ensure the content is valid and applicable to monitoring activities. Revisions to this plan will require approvals at the same level as the original document. At a minimum, copies of this QA Plan shall be available to all affected employees and support organizations.

3 REGULATORY REQUIREMENTS

This Quality Assurance Plan is designed to incorporate quality assurance/quality control requirements and guidance the following regulatory references:

– USNRC Regulatory Guide 4.14, *Radiological Effluent and Environmental Monitoring at Uranium Mills*, Revision 1, April 1980.

– USNRC Regulatory Guide 4.15, *Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Steams and the Environment*, Revision 1, February 1979.

4 ORGANIZATION

Administration of the environmental monitoring programs in Wyoming is assigned to the Manager of Environmental and Regulatory Affairs, Wyoming. The Manager may delegate the day-to-day implementation of the environmental monitoring program to other EMC employees or to outside contractors, but he may not delegate the ultimate responsibility. Such assignment shall be in writing.

Key positions within the Uranium One Americas management system include:

Senior Vice President, ISR Operations – The Senior Vice President, ISR Operations has responsibility for overall management of Wyoming operations for Uranium One Americas. The Senior Vice President, ISR Operations reports to the Executive Vice President, Uranium One Americas.

Director of Environmental and Regulatory Affairs - The Director of Environmental and Regulatory Affairs has responsibility for preparation and oversight of environmental monitoring programs for Uranium One Americas. The Director of Environmental and Regulatory Affairs reports to the Executive Vice President, Uranium One Americas.

Mine Manager - The Mine Manager is responsible for all uranium production activity at the project site. All site operations, maintenance, construction, environmental health and safety, and support groups report directly to the Mine Manager. In addition to production activities, the Mine Manager is also responsible for implementing any industrial and radiation safety and environmental protection programs associated with operations.

Manager of Environmental and Regulatory Affairs, Wyoming – The Manager of Environmental and Regulatory Affairs, Wyoming has responsibility for the overall management of the environmental monitoring programs for Uranium One Americas. The Manager of Environmental and Regulatory Affairs, Wyoming reports to the Senior Vice President, ISR Operations.

~~Senior Environmental Specialist – The Senior Environmental Specialist has responsibility for the day-to-day supervision of the environmental monitoring programs for Uranium One Americas. The Senior Environmental Specialist reports to the Manager of Environmental and Regulatory Affairs, Wyoming.~~

Radiation Safety Officer – The Radiation Safety Officer has responsibility for the overall management of the radiation safety program and the environmental monitoring programs for Uranium One Americas including implementation of QA Program requirements related to radiation safety and environmental programs. The Radiation Safety Officer reports to the Mine Manager and will coordinate with the Manager of Environmental and Regulatory Affairs, Wyoming.

5 QUALITY OBJECTIVES

Environmental data for the Wyoming ISR sites, derived through long-term monitoring and data interpretation, will be of sufficient quantitative and qualitative value to determine whether performance criteria are being met. The type and quality of data provided to the appropriate regulatory agencies will be used to document the performance of the uranium recovery operation and later attainment of reclamation and restoration goals.

Monitoring strategy for sampling and analytical QA objectives for data include:

– Data will be of sufficient quality to withstand scientific and legal scrutiny.
– Data will be acquired in accordance with procedures appropriate for their intended use.
– Data will be of known accuracy and precision.
– Data will be complete, representative, and comparable.

5.1 Field Quality Objectives

The field and analytical methods chosen for use in completing the work are industry standards and are consistent with accepted standards for conducting environmental investigations.

5.2 Laboratory Quality Objectives

The quality of data generated by the analytical laboratory is dependent on method precision, accuracy, and sensitivity and the basic nature of the analysis and type of equipment used to perform an analysis. Precision is a measure of the reproducibility of an analytical measurement, and accuracy is the difference between a measured value and a true or known value. These considerations are dependent upon the sample matrix and performance criteria, and method sensitivity may not be achieved in all sample matrices.

5.2.1 Precision

Precision is the agreement between a set of replicate measurements without assumption about or knowledge of the true value. Precision is assessed on the basis of repetitive measurements. Replicate field measurements of ground water are not needed because they are sequentially recorded during well purging. Evaluations will be performed to judge the precision of both field and laboratory measurement processes.

Duplicate sample analyses are used to monitor the overall precision that can be expected for a particular environmental medium within an analytical sample batch. Requirements for the collection frequency of QA samples will be specified in the site-specific environmental planning document sample events.

In the laboratory, precision is a measure of reproducibility and may be determined by repeated analysis of laboratory control samples (LCSs) or reference standards or by duplicate analysis. The laboratory will demonstrate precision through analysis of replicate standards and performance samples prior to analysis of investigative samples as required by the particular analytical method.

5.2.2 Bias

Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction. The analytical laboratory will analyze reference materials to verify that the analytical results are not biased. Calibration and operational checks of field instruments will verify that no bias is present in field measurements.

5.2.3 Accuracy

Accuracy is the nearness of a measurement or the mean of a set of measurements, to the true value and is usually expressed as the difference between the two values or the difference as a percentage of true value.

It is not possible to directly assess accuracy of field measurements and water levels because true values for these measurements are not known. To ensure accuracy of the field data, instruments and equipment used in surveying, sampling, or obtaining the measurements will be maintained and calibrated. Accuracy of surface water and ground water field measurements is addressed indirectly through instrument checks and calibrations, which will be documented in field logbooks or on field data sheets, as appropriate.

Accuracy will be assessed for analytical data by examining the results obtained from laboratory Quality Control (QC) samples. The primary means of determining the accuracy of an analytical method is to compare the results of repeated measurements of laboratory control samples and reference material with published known values. The secondary method of accessing accuracy is to analyze matrix spike samples. Accuracy requirements of routine analytical services are specified in the analytical methods. Accuracy for each analysis will be stated as a percent recovery in laboratory analytical reports.

5.2.4 Representativeness

Representativeness is generally ensured through the use of standard sampling protocols. Representativeness will be accomplished:

- Through extensive sampling that includes implementation of field QA/QC procedures.
- By careful and informed selection of sampling sites, sampling depths, and analytical parameters

- Through the proper collection and handling of samples to avoid interferences and to minimize constituent loss
- By monitoring field activities to ensure procedure compliance and adherence to sampling protocols
- By meeting sample care and custody requirements

5.2.5 Comparability

Comparability is the confidence with which one data set can be compared to another. Comparability is ensured by employing approved sampling plans, standardized field procedures, and experienced personnel using properly maintained and calibrated instruments. In the laboratory, sample handling and preparation procedures, analytical procedures, holding times, and QA protocols will be adhered to. All data in a particular data set will be obtained by the same methods and will use consistent units for reportable data. Prescribed QC procedures will be used to provide results of known quality. Data will be grouped and evaluated according to similar sampling methods, sampling media, and laboratory analytical methods.

5.2.6 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the analyte of interest. An evaluation of sensitivity is included in the analytical methods that are used to analyze samples.

6 PERSONNEL AND TRAINING

6.1 Personnel Requirements

6.1.1 Training

Personnel will be qualified to perform their assigned job through meeting basic job description requirements, education standards, experience, and ongoing performance reviews. Training will be provided when needed to maintain proficiency; to adapt to new technologies, equipment, or instruments; and to perform new assigned responsibilities.

The ~~Senior Environmental Specialist~~RSO is responsible for determining site-required training and communicating the requirements to appropriate managers. Managers are responsible for determining training needs of their staff. Personnel assigned to environmental monitoring activities are responsible for ensuring that their required training are documented and are maintained in a current status for their assignments. At a minimum, individual training requirements will be reviewed annually and updated as needed.

The ~~Senior Environmental Specialist~~RSO is responsible for ensuring that personnel assigned to environmental monitoring tasks are sufficiently familiar with the implementing documents (e.g., plans, procedures, and drawings) and the requirements established for environmental monitoring, sample collection, analysis, documenting and reporting activities, and demonstrating proficiency.

The ~~Senior Environmental Specialist~~RSO will ensure that personnel assigned to field sampling activities can demonstrate proficiency when performing the work or that they are properly supervised by a person who is proficient.

6.1.2 Certifications

QA staff that performs independent assessments of environmental monitoring activities or management systems will be qualified as lead assessors.

Laboratories used for analysis of samples collected for characterization, compliance, or other purposes will be required to pass an audit or be certified by the National Environmental Laboratory Accreditation Conference (NELAC).

7 DATA GENERATION AND ACQUISITION

This section addresses aspects of the measurement system design and implementation to ensure that appropriate methods for sampling, analysis, data handling, and QC are employed and will be thoroughly documented.

7.1 Sampling Process Design

The data obtained through monitoring site conditions will be of sufficient quantity and quality to achieve environmental monitoring objectives.

Monitoring procedures for the Wyoming ISR sites have been established. These monitoring programs are designed to ensure that monitoring data would satisfy applicable regulations and would ensure that there were no unacceptable risks to human health or the environment. The site-specific environmental monitoring plan defines the sample locations and sampling frequency and determines the types of analyses that will be conducted on the samples collected from these locations. The plans are reviewed every 5 years.~~, and changes to sampling strategies may be proposed on the basis of analytical results, site conditions, or regulatory requirements.~~ Any updates to the monitoring plan that would eliminate or modify monitoring parameters, locations, or frequencies specified in the License Application will be made by license amendment. The RSO can initiate changes to environmental monitoring plans that do not require a license amendment. These changes will be managed as required by the Performance Based License Condition.

7.2 Sampling Methods

Field measurements and sample collection will follow procedures attached to nationally recognized consensus standards such as EPA methods, American Society for Testing and Materials standards, or instrument manufacturer recommended procedures. Deviation from approved procedures requires approval by the ~~Senior Environmental Specialist~~RSO before the start of work.

7.2.1 Sample Collection Procedures

Sampling procedures used at Wyoming ISR sites will be managed as controlled documents and will be amended according to the requirements of this plan.

Procedures must be followed for documenting field activities and delivering the samples to the laboratory. Procedures will identify the methods employed to obtain representative field measurements and samples of specified media. The procedures will identify the equipment, instruments, and sampling tools that are needed and, where appropriate, performance criteria (e.g., special handling, operational checks, field calibrations) to ensure the quality of the field data.

The ~~Senior Environmental Specialist~~RSO is responsible for ensuring that inspections, operations and maintenance activities, field measurements, and specified samples are properly documented, occur at the prescribed frequency and locations, and are obtained in compliance with procedures and requirements specified in the project documents. Daily QC checks and data reviews will ensure that requirements have been met. If field conditions prevent inspections, required field measurements, and/or specified sample collection, the conditions will be fully documented in the field book as a field variance.

7.2.2 Field Measurements and Sampling Methods

Field measurements and sampling schedules are summarized in the environmental monitoring procedures. The data obtained through these activities will be used to monitor compliance with performance requirements. Field procedures used in well inspections, field measurements, sample collection methods, field data, equipment and supplies applicable to the field activities, sample preservation requirements, and QC sample requirements are described in the environmental monitoring procedures.

7.3 Preparation and Decontamination Requirements for Sampling Equipment

7.3.1 Requirements for Sample Containers, Preservation, and Holding Times

Nondedicated equipment used in obtaining samples will be visually inspected and cleaned before use at each sample location. Measures will be taken (e.g., storage in trays, plastic bags, or boxes) to protect clean or decontaminated equipment while it is not being used. Sample containers will be inspected for integrity and cleanliness before being used. Suspect containers will be discarded in a manner that will preclude their inadvertent use, or they will be tagged and segregated for return to the supplier.

7.3.2 Container Requirements

Sample containers will be will be provided by the analytical laboratory or purchased. ~~new or pre-cleaned.~~ Containers will be of an adequate size to contain the required sample volume and of an approved material (e.g., amber/clear glass or HDPE) that does not promote sample degradation. As appropriate, supplier provided certificates of cleanliness will be retained with the project documentation.

Water samples collected for analysis will be filled to near 90 percent of capacity to allow for expansion.

7.3.3 Preservation and Holding Times

Efforts to preserve the integrity of the samples through prescribed chemical additives and/or temperature-controlled storage will be maintained as appropriate from the time the containers are received, throughout the sample collection and shipping process, and will continue until all analyses are performed. Procedures that will be employed to collect and preserve the integrity of the samples are described in the procedures. Holding times begin at the time the sample is collected, not when the sample is received by the laboratory.

7.3.4 Decontamination Procedures and Materials

Where practical, dedicated pumps will be installed in monitor wells and disposable materials will be used to minimize the decontamination requirements. The final rinse following equipment decontamination will be collected as an equipment blank QC sample.

7.4 Sample Handling and Custody Requirements

Sample handling, custody, and shipping procedures are addressed in the environmental monitoring procedures. A minimum number of individuals should be involved in sample collection and handling to ensure integrity of the sample and compliance with custody procedures. To maintain evidence of authenticity, the samples collected must be properly identified and easily discernable from like samples. To maintain the integrity of the sample, proper preservation, storage, and shipping methods will be used.

Unused sampling equipment, sample containers, and coolers that have been shipped or transported to a sampling location will be kept in a clean, temperature-controlled, and secure location to minimize damage, tampering, degradation, and possible cross-contamination.

7.4.1 Identification, Handling, Packaging, and Storage

7.4.1.1 Sample Identification

Environmental samples and associated QC samples will be assigned a unique identification number. In addition to the unique number, QC samples will be assigned a fictitious location identifier that is consistent with the sample location identification scheme.

Samples will be identified by a label or tag attached to the sample container that specifies, as appropriate, the project, sample location, unique identification number, preservatives added, date and time collected, and the sampler's name. Sample labels, tags, and/or container markings should be completed with indelible (waterproof) ink. Clear tape may be placed over each sample label for added protection, if needed.

7.4.1.2 Sample Handling and Storage

During field collection, sample containers may be stored in boxes, trays, or coolers, as dictated by protection and preservation needs. Samples that require refrigeration will be stored in coolers with sufficient ice to maintain the required temperature controls during field collection, packaging, and shipping. Samples that are not transported to the laboratory the day of collection must be stored in containers that will prevent damage or degradation of the sample. In addition, samples must be stored in locked containers or buildings when they are out of the direct control of the responsible custodian. Samples stored overnight or at locations where access is not solely controlled by the custodian will have custody seals placed on the outside of the container (cooler or box) as a measure of security.

7.4.1.3 Sample Custody

To ensure the integrity of the sample, the field custodian is responsible for the care, packaging, and custody of the samples until they are transferred to the laboratory.

Chain of Custody forms will be used to list all samples and transfers of sample possession to provide documentation that the samples were in constant custody between collection and analysis. The filled-in Chain of Sample Custody form, a copy of which is retained by the originator, will accompany samples that are sent or transported to the analytical laboratory.

7.4.1.4 Sample Packaging and Shipping

All samples will be handled, packaged, and transported or shipped in accordance with applicable U.S. Department of Transportation requirements. Sample storage containers (e.g., boxes or coolers) and sample containers will be securely packaged to protect the contents from damage, spilling, leaking, or breaking. Void space in shipping containers should be filled with an inert material or additional ice, if appropriate, to further protect and secure the contents.

Custody seals are not required for containers or samples that are transported directly to the analytical laboratory for analysis or interim storage. Custody seals are required for shipping containers (e.g., coolers or boxes) that are sent by common carrier. Clear tape should be placed over the seals as protection against tearing during shipment.

Mailed sample packages will be registered with return receipt requested. If packages are sent by common carrier, receipts are retained as part of the chain of custody documentation. Other commercial carrier documents shall be maintained with the chain of custody records.

7.4.2 Laboratory Requirements

7.4.2.1 Laboratory Sample Receipt

The subcontract analytical laboratory personnel are responsible for the care and custody of samples from the time they are received until the time the sample is analyzed and archive portions are discarded. On arrival at the laboratory, laboratory personnel must examine the container and document the receiving condition, including the integrity of custody seals, when applicable. When opening the shipping container, laboratory personnel will examine the contents and record the condition of the individual sample containers (e.g., bottles broken or leaking), the temperature (when applicable), method of shipment, carrier name(s), and other information relevant to sample receipt and log-in. Laboratory personnel verify that the information on the sample containers matches the information on the Chain of Sample Custody form.

7.4.2.2 Discrepancies Identified During Sample Receipt

If discrepancies are identified during the sample receiving process, laboratory personnel will attempt to resolve the problem by checking all available information (e.g., other markings on sample containers and type of sample), recording appropriate notes on the Chain of Sample Custody form, and contacting the ~~Senior Environmental Specialist~~RSO to resolve any questions.

If the laboratory judges the sample integrity to be questionable (e.g., samples arrive damaged or leaking, or the temperature range is exceeded), the ~~Senior Environmental Specialist~~RSO will be contacted and will bring in appropriate technical staff to make a decision regarding rejecting or flagging the data and/or re-sampling the location. Damaged samples will be rescheduled for collection and analysis, if necessary.

Discrepancies noted during sample receiving at a subcontracted laboratory or testing facility will be resolved in accordance with the procurement documents. In general, the ~~Senior Environmental Specialist~~RSO will be contacted to facilitate resolution of a problem.

7.4.2.3 Sample Disposition

When sample analyses and necessary QA/QC checks have been completed in the laboratory, the residual sample material and wastes generated as a result of the analytical process will be treated, shipped, and disposed of in accordance with all applicable federal, state, and local transportation and waste management requirements. When samples are stored, they will be protected to prevent damage or degradation. At a minimum, samples shall not be removed from the laboratory sooner than 60 days after the delivery of laboratory data reports.

7.4.3 Analytical Methods

Laboratories involved in the analysis of samples will have a written QA/QC program that provides rules and guidelines to ensure reliability and validity of the work conducted at the laboratory.

The analytical procedures to be used by subcontracted laboratory services will be specified in the procurement documents. These procedures typically consist of EPA methods. The use of these methods will ensure that required method detection limits and project reporting limits are achieved for each of the requested analytes.

Required analytical methods will be documented in appropriate site-specific documents.

7.4.3.1 Subcontracted Laboratory Requirements

The subcontracted laboratory will have a documented QA program in place, the implementation of which may be independently verified through proposal reviews, prior history, and/or pre-award survey. As appropriate, subcontracted laboratories will use EPA or EPA-approved methods or other methods specified and approved within the provisions of the procurement documents. Subcontracted laboratories are required to pass an audit or be certified by NELAC. Internal method requirements for analysis of spikes, duplicates, or replicates will be followed and may be used as performance indicators for these services.

Data turnaround times, sample disposition, and other requirements of the analytical laboratory are identified in procurement documents. The laboratory must obtain authorization from the ~~Senior Environmental Specialist~~RSO for changes to the procurement documents.

Work submitted to the laboratory may not be subcontracted by the laboratory without the prior consent of Uranium One Americas.

7.4.4 Quality Assurance/Quality Control

7.4.4.1 Field QA/QC

A variety of instruments, equipment, sampling tools, and supplies will be used to collect samples and to monitor site conditions. Proper inspection, calibration, maintenance, and use of the instruments and equipment are required to ensure field data quality. In addition, field QA will be implemented through the use of approved procedures, proper cleaning and decontamination, protective storage of equipment and supplies, and timely data reviews during field activities. The QC objective of these data collection activities is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the intended use of the data.

QC samples will consist of field duplicates, equipment rinsate blanks, and trip blanks, as appropriate, for the matrix and analytes involved. An additional volume of ground water for selected analyses will be collected for matrix spike/matrix spike duplicate (MS/MSD) use, as requested by the laboratory. Field QC samples will be used to quantitatively and qualitatively evaluate the analytical performance of the laboratory and to assess external and internal effects on the accuracy and comparability of the reported results. Field QC samples will be uniquely identified.

Where applicable, field measurement data will be compared to previous measurements obtained at the same location. Large variations (greater than 30 percent) in field measurement data at a location will be examined to evaluate whether general trends are developing. Variations in data that cannot be explained will be assigned a lower level of confidence through assignment of qualifiers or will be flagged for additional sampling or evaluation.

7.4.4.2 Laboratory QA/QC

Laboratory QC checks are internal system checks and control samples introduced by the laboratory into the sample analysis stream. These checks are used to validate data and calculate the accuracy and precision of the data. The objectives of the laboratory QA/QC program should be to:

- Ensure that procedures and any revisions are documented
- Ensure that analytical procedures are conducted according to sound scientific principals and have been validated
- Monitor the performance of the laboratory by a systematic inspection program and provide for corrective measures, as necessary.
- Collaborate with other laboratories in establishing quality levels, as appropriate
- Ensure that data are properly recorded and archived

Internal QA procedures for analytical services will be implemented by the laboratory in accordance with the laboratory's standard operating procedures. Data sheets, which also report the blank and spiked sample checks that have been performed, will be provided and will indicate when a QC check was performed. Analytical data that do not meet acceptance criteria will be qualified and flagged in accordance with standard operating procedures.

Laboratory quality control procedures are defined within the particular analytical method or are defined in procurement documents.

7.4.5 Instrument/Equipment Testing, Inspection, Calibration, and Maintenance

A variety of equipment, instruments, and sampling tools will be used to collect data and samples for the Wyoming ISR sites. Proper maintenance, calibration, and use of equipment and instruments are imperative to ensure the quality of all the data that are collected.

Field and laboratory equipment, instruments, tools, gauges, and other items used in performing work tasks that require preventive maintenance will be serviced in accordance with manufacturers' recommendations and instructions. When applicable, technical procedures will identify the manufacturers' instructions and recommended frequency for servicing the equipment. Preventive maintenance for calibrated measuring and test equipment will be performed either by field or laboratory personnel who are knowledgeable of the equipment, or by manufacturer's authorized service center as part of routine calibration tasks. Records of equipment calibration, repair, or replacement of controlled instruments will be filed and maintained in accordance with the applicable records management requirements.

Instruments that are not calibrated to the manufacturers' specifications will display a warning tag to alert the sampler and analyst that the instrument has only limited calibration.

7.4.5.1 Field Equipment and Instruments

Field equipment, instruments, and associated supplies used to obtain field measurements and collect samples are specified in sampling procedures.

Field personnel will conduct visual inspections and operational checks of field equipment and instruments before they are shipped or carried to the field and before using the equipment or instruments in field data collection activities. Whenever any equipment, instrument, or tool is found to be defective or fails to meet project requirements, it will not be used, and as appropriate, it will be tagged defective and segregated to prevent inadvertent use. Backup equipment, instruments, and tools should be available on site or within 1-day shipment to avoid delays in the field schedule.

The ~~Senior Environmental Specialist~~RSO is responsible for the overall maintenance, operation, calibration, and repairs made to field equipment, instruments, and tools. He is also responsible for ensuring that the field book has adequate documentation that describes any maintenance, repairs, and calibrations performed in the field.

Equipment and instruments used to obtain data will be maintained and calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturers' specifications. Calibration of equipment and instruments will be performed at approved intervals, as specified by the manufacturer, or more frequently as conditions dictate. Calibration standards used as reference standards will be traceable to the National Institute of Standards and Technology or other recognized standards when available. Instruments found to be out of tolerance will be tagged defective and segregated to prevent inadvertent use.

In some instances, calibration periods will be based on usage rather than periodic calibration. Equipment will be calibrated or checked as a part of its operational use. Records of field calibration will be documented on forms provided for technical procedures or recorded in the field logbook. Calibration checks will be performed in accordance with procedures.

Procedures recommended by the manufacturer will be used for equipment preventive maintenance. Backup equipment, supplies, and critical spare parts (e.g., tape, bottles, filters, pH paper, tubing, probes, electrodes, and batteries) will be kept on site to minimize downtime. The ~~Senior Environmental Specialist~~RSO is responsible for ensuring that routine maintenance is performed and that tools and spare parts used to conduct routine maintenance are available.

7.4.5.2 Laboratory Equipment and Instruments

As part of the QA/QC program for the analytical laboratory, routine preventive maintenance is conducted to minimize the occurrence of instrument failure and other system malfunctions. The laboratory will maintain a schedule for servicing critical items and will perform routine maintenance, scheduled maintenance and repair, or coordinate with a vendor to arrange for maintenance and repair service, as required. All laboratory instruments will be maintained in accordance with the manufacturers' specifications and the requirements of the specific method employed. Equipment will be tested during routine calibration, and deficiencies will be corrected as specified in procedures.

The concentration of standards and frequency of initial and continuing calibration of analytical instruments will be as specified in the laboratory procedures. Calibration data will be provided with the analytical data package. Calibration records pertaining to subcontracted laboratory services will be filed and maintained by the laboratory in accordance with internal procedures.

7.4.6 Instrument/Equipment Calibration and Frequency

Calibration of analytical laboratory equipment will be based on approved written procedures. The concentration of standards and frequency of initial and continuing calibration of analytical instruments will be as specified in the laboratory SOPs. The analytical laboratory will maintain calibration records. Calibration data will be provided with the analytical data package, as specified in the procurement documents.

7.4.7 Inspection/Acceptance of Supplies and Consumables

7.4.7.1 Sample Containers

Sample containers for water, soil, sediment, and other media will be provided by the subcontracted laboratory and will be new or pre-cleaned. As appropriate, supplier-provided certificates of cleanliness will be retained with field documentation.

Containers will be visually inspected for integrity and cleanliness before being used. Suspect containers will not be used and will be discarded in a controlled manner to prevent inadvertent future use. If sufficient quantities of containers are suspect, the laboratory will immediately be notified of the condition and requested to provide a sufficient quantity of replacement containers. Suspect containers will be collected, segregated, and tagged for return to the analytical laboratory. The ~~Senior Environmental Specialist~~RSO will describe the situation in the field book as a field variance.

7.4.7.2 Supplies and Consumables

The ~~Senior Environmental Specialist~~RSO is responsible for ensuring that supplies, materials, and consumable items used during field activities are properly inspected for integrity, cleanliness, and compliance with specified tolerances and that they are appropriate to the activity. Items with a specified shelf life or expiration date will be labeled. Expired materials will not be used and will be properly disposed of or returned to the laboratory for disposal, as appropriate. Supplies, materials, and equipment will be inventoried at the conclusion of the sampling event in preparation for the next scheduled event.

~~7.4.8 Data Acquisition Requirements through Non-Direct Measurements~~

~~Data acquired through non-direct measurements may include data from historical databases, literature references, background information from historical facility files, climatic data, and regional geology or hydrology descriptions. Generally, these data are ancillary to the project.~~

~~Data from historical databases or historical facility files should be evaluated within the context in which they are presented and a determination made as to how accurate the data of interest may be. The exact nature of the evaluation likely will have to be made on a case-by-case basis. Information obtained from literature references should be from peer-reviewed journals or books whenever possible. Information such as climatic data and regional geology or hydrology descriptions should be obtained from documents produced by state or federal agencies whenever possible.~~

~~7.4.9~~7.4.8 Data Management

Project data are generated mainly from routine sampling of monitor wells, routine operations system sampling, and occasional soil sampling events. The ~~Senior Environmental Specialist~~RSO is responsible for managing project data in compliance with Uranium One Americas requirements.

Field data books are assembled for most sampling events. These books contain information such as sample location identification (ID), date, QA sample ID, well purge method, sampling method, and field measurements. These are completed at the time of sample collection.

Data from samples submitted to an analytical laboratory are received as both hard copy and as electronic data. The hard copy analytical reports are archived in the project records along with the original field data forms and other relevant hard copy forms or documents containing project data. The hard copy forms are categorized in the project records according to the project filing procedures. Electronic data are also archived in the project records according to the project filing procedures.

7.5 Data Validation and Usability

Technical data, including field data and results of laboratory analyses, will be routinely verified and validated to ensure that the data are of sufficient quality and quantity to meet the project's intended data needs. Results of data validation efforts will be documented and summarized in the site-specific validation reports. The ~~Senior Environmental Specialist~~RSO is responsible for initiating the review, verification, validation, and screening associated with field and/or laboratory data.

7.5.1 Field Measurement Data

The objective of field data verification is to ensure that data are collected in a consistent manner and in accordance with procedures and schedules established in the Wyoming

ISR environmental planning documents. Field data validation procedures include a review of raw data and supporting documentation generated from field investigations. The data are reviewed for completeness, transcription errors, compliance with procedures, and accuracy of calculations.

The person doing the validation (in consultation with the ~~Senior Environmental Specialist~~RSO, if required) may correct problems that are found or noted in field documentation. Corrections to data forms will be made by lining through the incorrect entry, correcting the information, then initialing and dating the corrected information. The person validating the document, with the consent of the ~~Senior Environmental Specialist~~RSO, may also determine that incorrect data should not be entered into a database or that the data should have an additional qualifier.

7.5.2 Laboratory Data

The laboratory performing the analyses will document the analytical data in accordance with standard procedures inherent in the analytical methods and as approved by the ~~Senior Environmental Specialist~~RSO, if required.

Once the data package is received from the analytical laboratory, laboratory records and data package requirements will be checked to assess the completeness of the data package, and the data will be validated by personnel qualified and experienced in laboratory data validation.

The QC data provided by the laboratory (method blanks, matrix spikes, etc.) will be evaluated to see if they are within the acceptance range. If they are not, the data set affected by the QC samples will be evaluated to determine if corrective action is necessary.

7.5.2.1 Quality Control Samples

QC samples consisting of trip blanks, equipment rinsate blanks, field duplicate samples (replicated or co-located samples), laboratory spikes, laboratory blanks, laboratory duplicates, and laboratory control samples (including thermoluminescent dosimeters) are evaluated in the data validation process.

7.5.3 Qualification of Data and Corrective Actions

Qualification criteria are defined in the Uranium One Americas procedures. In addition to the process of qualifying the data, other corrective actions may be used. These may include reanalysis of the data by the laboratory or re-sampling of the affected locations.

Other corrective actions to prevent contamination of future samples may also be proposed.

7.5.4 Determination of Anomalous Data

The final aspect of data validation involves the screening of both field and laboratory analytical data for potentially anomalous data points.

7.5.4.1 Data Screening

The initial step in determining potentially anomalous data points consists of screening all data from a sampling event for values that fall outside a designated historical data range. The historical data range used for comparison will be from previous sampling events.

7.5.4.2 Technical Review

The next step involves a review of the screened data by a qualified individual experienced in data review. Each data point will be evaluated to determine if the data point is acceptable or if follow-up action is required. This evaluation will consider factors such as number of historical data points, analyte concentration, magnitude of the deviation from the historical data range, number of historical non-detects, variability of the historical data, location of the sample point relative to other potential interfering activities, and correlation with other analytes.

7.5.4.3 Follow-up Actions

Follow-up actions can include one or more of the following:

- Requesting a laboratory check of calculations and dilutions
- Sample reanalysis
- Re-sampling
- Comparison to results from the next sampling event
- Data qualification

Based on the results of the follow-up action, the ~~Senior Environmental Specialist~~RSO will make a final determination of validity of the data point. The data point will be considered acceptable or it will be qualified, and a record of the action will be made. A summary of any anomalous data will be included in the site-specific data validation report.

7.5.4.4 Data Qualification

After the ~~Senior Environmental Specialist~~RSO has determined that a data point is anomalous, the data point will be qualified with an "R" flag (unusable) in the database. Qualification of data will be noted with a brief justification for the qualification.

7.6 Documentation and Records

The requirements for documentation and records management apply to the preparation, review, approval, issue, use, and revision of documents or forms that prescribe processes, specify requirements, or establish design. Records must be specified, prepared, reviewed, approved, and maintained as directed by Uranium One Americas policy.

Field and laboratory data will be sufficiently documented to provide a scientifically defensible record of the activities and analyses performed. Records of field variance reports, internal reviews, field and laboratory records of tests and analyses, field logs, Chain of Custody forms, and project reports will be used in interpreting and assessing the usability of the data. Standardized forms and computer files, codes, programs, and printouts will be designed to eliminate errors made during data entry and reduction. Calculation steps are described in the technical and analytical procedures and software lists. Routine data-transfer and data-entry verification checks are performed.

Laboratories must demonstrate continued proficiency through participation in performance evaluation programs required by the USNRC and WDEQ.

7.6.1 Records Management Plan

A site-specific records management plan shall be prepared to identify the records to be generated, file locations, and retention schedule for the Wyoming ISR site. The records management plan establishes the requirements for preparing, preserving, and storing records. Project personnel will work with the ~~Senior Environmental Specialist~~RSO, or his designee, to ensure that environmental monitoring records are correctly identified and maintained in accordance with the plan. Modifications to the plan shall be submitted to the ~~Senior Environmental Specialist~~RSO and are subject to his review and approval. At a minimum the site record management plan will include the following requirements:

Records not utilized to determine occupational dose that require a 3 year retention period as specified in 10 CFR §20.2103:

- Area beta-gamma measurements and associated instrument calibrations not utilized to determine employee dose;
- Equipment release records and associated instrument calibrations

- Instrument daily function check records;
- Alpha contamination surveys eating areas; and
- Personnel contamination surveys frisking stations

Instructions for the proper maintenance, control, and retention of records will be developed and will be consistent with the requirements of 10 CFR 20 Subpart L and 10 CFR §40.61 (d) and (e). The following specific records will be permanently maintained and retained until license termination:

- Records of disposal of byproduct material on site through deep disposal wells as required in 10 CFR §20.2002 and transfers or disposal off site of source or byproduct material;
- Records of surveys, calibrations, personnel monitoring, and bioassays as required in 10 CFR §20.2103;
- Records containing information pertinent to decommissioning and reclamation such as descriptions of spills, excursions, contamination events etc. including the dates, locations, areas, or facilities affected, assessments of hazards, corrective and cleanup actions taken, and potential locations of inaccessible contamination;
- Records of information related to site and aquifer characterization and background radiation levels;
- As-build drawings and photographs of structures, equipment, restricted areas, well fields, areas where radioactive materials are stored, and any modifications showing the locations of these structures and systems; and
- Records of the radiation protection program including program revisions, standard operating procedures, radiation work permits, training and qualification records, SERP proceedings and audits.

The RSO will be responsible for ensuring that the required records are maintained and controlled. Hard copies of all records will be maintained on site in a controlled environment to protect them from damage deterioration and will be available for inspection by regulatory agencies. Electronic copies may be maintained in addition to hard copies with backup protection. Duplicates of all records will be maintained in the Casper office or other offsite location(s).

7.6.2 Document Control and Changes

Uranium One Americas policy and procedures will be followed to ensure that the preparation, issuance, and revisions to project documents and forms will be controlled so that current and correct information is available at the work location. These project documents (e.g., plans, procedures, drawings, and forms) and subsequent revisions will be reviewed for adequacy and approved before being issued for use. Written records and photo documentation will be handled in a manner that ensures association to the activity, the samples, and their locations. The ~~Senior Environmental Specialist~~RSO can authorize minor changes to project documents without requiring a formal review process.

At a minimum, personnel responsible for environmental monitoring activities at the Wyoming ISR site will have access to the applicable documents and will be knowledgeable of the contents before the associated work assignment.

Nonroutine sampling and field investigations will be documented in the file. The ~~Senior Environmental Specialist~~RSO will be briefed on and will approve all nonroutine field investigations before the work begins.

7.6.3 Corrections to Documents

When practical, correction of errors should be made by the individual who made the entry. The method used to make a correction is to draw a line through the error, enter the correct information, then initial and date the entry. The erroneous material must not be obscured.

When a document requires replacement due to illegibility or inaccuracies, the document will be voided, and a replacement document will be prepared. A notation will be made on the voided document that a replacement document was completed. The voided document will be retained with the field documentation.

7.6.4 Project Documents

Project documents are written materials that provide a background or history of the work, establish the basis for the work, give guidance to the work, and provide a summary of the work. They may be documents such as technical reports, technical and administrative plans, inspection or test documents, and design or as-built drawings. Documents prepared for the Wyoming ISR site that establishes instructions or procedures will be developed in accordance with the applicable requirements. Documents that are subject to revision will be managed and issued as controlled documents. These include, but are not limited to, the following documents:

- Quality Assurance Plans and Procedures
- Site-Specific Environmental Monitoring and Sampling Plans

7.6.5 Procedure Requirements

Uranium One Americas personnel will comply with the requirements of all approved written procedures or other instructions. Any deviation from approved field procedures must be authorized by the ~~Senior Environmental Specialist~~RSO. Field changes to project plans or deviation from procedures will be documented in the field book as a field variance and communicated to the ~~Senior Environmental Specialist~~RSO as soon as possible.

The ~~Senior Environmental Specialist~~RSO will be notified of any changes to subcontract laboratory procedures. He will be informed of and review changes to laboratory procedures. Impacts will be identified to the ~~Senior Environmental Specialist~~RSO. As appropriate, procedure changes that affect laboratory data will be identified and documented during the data review, verification, and validation activities. As appropriate, the ~~Senior Environmental Specialist~~RSO will inform Uranium One Americas management of technical or other substantive changes to laboratory procedures that may affect reporting limits or analytical sensitivity.

7.6.6 Field Documentation

Field documentation requirements are specified in the sampling procedures. All entries in field documents will be made with indelible (waterproof) ink and will be legible, reproducible, accurate, complete, and traceable to the sample measurements and/or site location. These documents will be retained as project records. Field documents are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the field sampling activities. Field logbooks and forms (e.g., sample collection data sheets, field measurement data forms, Chain of Custody forms, and shipping forms) will be stored in a manner that protects them from loss or damage.

The ~~Senior Environmental Specialist~~RSO will adequately document and identify field measurements and each sample collected. Field records will be completed at the time the observation or measurement is made and when the sample is collected. Project documents and written procedures will be available at the work site. The ~~Senior Environmental Specialist~~RSO will ensure that specified requirements are followed so that an accurate record of sample collection and transfer activities is maintained.

As appropriate, sample disposition will be specified to the subcontract laboratory in the appropriate procurement documents.

7.6.6.1 Field Books and Forms

Any person conducting field sampling will maintain a field book to provide a daily record of field activities associated with monitoring and sampling events and to document relevant operations and measurements. If initials are used in place of signatures, a signature/initials log will be maintained to identify personnel who are authorized to record, review, and authenticate field data.

Field books for project activities will be prepared, managed, and maintained in accordance with project records requirements. Project field books will be prepared and issued by the ~~Senior Environmental Specialist~~RSO. Field book information may include documentation associated with routine or ad hoc field measurements and sampling, chain of custody, soil boring and well installation, sampling equipment, calibration records and standards, and general field notes, including repairs made to equipment and instruments.

7.6.6.2 Field Variance and Nonconformance Documentation

Changes from specified field protocols established in planning documents or standard operating procedures must be authorized by the ~~Senior Environmental Specialist~~RSO and fully documented by the person doing the sampling. Field variances will be reported in a timely manner to evaluate the impact the variance has on the data or system operations. Field variance reporting applies to deviations from (1) prescribed field sampling and measurement requirements; (2) specified shipping, handling, or storage requirements; and (3) decontamination procedures.

A variance must be documented whenever an activity is performed or sample is obtained where:

- The activity performed or sample collection technique does not fall within the methods or protocols specified.
- The monitoring or measurement instrument that was used was out of calibration or had failed an operational check.
- Insufficient documentation results in the inability to trace the activity, measurement, or sample to the prescribed or selected location
- There is a loss of or damage to records that cannot be duplicated.

The variance should be fully described, and corrective action, if applicable, should be taken immediately. Comments describing the variance will be used during data evaluation to assess the use of associated results and validity of the data. Field variances should be noted in the field data sheet, on a general log sheet, or in the activity logbook. As appropriate, field variances will be summarized in the report at the conclusion of the activity.

7.6.6.3 Chain of Sample Custody

The custody of individual samples will be documented by recording each sample's identification, number of containers, and matrix on a standardized Chain of Custody form. This form will be used to list all transfers of sample possession.

7.6.7 Laboratory Documentation

The format and content of laboratory reports depend on contract requirements, regulatory reporting formats, and whether explanatory text is required. At a minimum, the laboratory data report will include the following items:

- Analytical method used
- Date and time of analysis
- The Chain of Custody form
- Sample receiving documentation
- QC data results and report
- Sample data results by analysis, including method detection limits, reporting limits, and dilution factors
- Summary of results (e.g., case narrative)
- Certification by the laboratory that the analytical data meet applicable data quality requirements

Analytical data that do not meet specified criteria will be qualified and flagged to allow data evaluation before use. Any nonconformances or difficulties encountered during analyses will be documented with each data package.

7.6.8 Reports Received from Subcontractors

7.6.8.1 Laboratory or Other Data Reports

Reporting requirements and formats will be defined in procurement documents issued for subcontracted services. The ~~Senior Environmental Specialist~~RSO will be consulted regarding difficulties or nonconformance associated with subcontracted analytical services and will resolve disputes that could affect data quality.

7.6.8.2 Plans and Technical Reports

The criteria for technical reports received from subcontracted services may include a deliverable schedule for draft and final documents, required reviews, format, software type and version requirements, and contents of the document, including any supporting documents, data, and references.

7.7 Quality Improvement, Assessment, and Oversight

All personnel must continually seek to improve the quality of their work. This section addresses the activities for assessing the effectiveness of the implementation of the project and associated QA/QC requirements.

7.7.1 Quality Improvement

Management encourages innovation and continuous improvement in the work environment by fostering a "no fault" attitude to encourage the identification of problems and to create an atmosphere of openness to suggestions for improvement. All personnel are encouraged to identify and suggest improvements.

Personnel have the freedom and authority to stop work until effective corrective action has been taken. Work that is performed by subcontractors will be subject to oversight. The work may be suspended immediately for imminent threats to health, safety, environmental release, or significant adverse quality issues. Re-start of such work stoppages will be at the direction of the Senior Vice President, ISR Operations.

7.7.2 Assessment and Response Actions

Assessments of project activities will be planned and scheduled with the appropriate levels of management. The Director of Environmental and Regulatory Affairs is responsible for scheduling and administering the internal assessment plan. When the assessment is conducted, results will be evaluated to measure the effectiveness of the implemented quality system. Assessment activities may include management assessments and independent assessments.

Assessment activities will be documented. Reports resulting from management assessments will be issued to the responsible manager and distributed internally to project management. Assessment activities involving subcontracted services will be coordinated with the appropriate levels of project management and will be documented.

The ~~Senior Environmental Specialist~~RSO will promptly define corrective actions and correct deficiencies identified through assessments. Corrective actions will be independently verified by staff not organizationally reporting to the ~~Senior Environmental Specialist~~RSO. Verification will be documented and retained in the assessment file.

7.7.2.1 Management Assessments

Included in the management assessments are human resource issues, operations issues, resource allocation, financial performance, financial controls, and quality control. The Senior Vice President, ISR Operations is responsible for ensuring that project staff supports these activities as delegated, that they observe firsthand the work in progress, communicate with those performing the work, identify potential or current problems, and identify good practices.

The Senior Vice President, ISR Operations shall determine the scope, schedule, and responsibilities for site-specific management assessment. All levels of management are responsible for responding to assessment findings and completing agreed-upon corrective actions.

7.7.2.2 Independent Assessments

Independent assessments (e.g., audits and surveillances) will be planned, performed, and documented in accordance with written instructions, procedures, or checklists.

Personnel who lead independent assessments (audits or surveillances) must be qualified, have reporting independence, and have access to the areas of inquiry. The Senior Vice President, ISR Operations or designee will track, report on the status, and verify closure of independent assessments and external assessment findings.

The Senior Vice President, ISR Operations is responsible for responding to assessment findings and ensuring that agreed-upon corrective actions are completed in a timely manner.

7.7.3 Reviews

Reviews are an integral component to the success of project activities. Reviews are conducted during planning and throughout the project to ensure that project objectives will be met. Reviews conducted at the project level may consist of:

- Management reviews—to ensure the adequacy of planning and availability of resources
- Administrative and technical reviews—typically include reviews of project documents to ensure that project objectives are clearly described and sufficiently planned, scheduled, and managed in accordance with project management strategies.

- Procurement Reviews—typically Uranium One Americas policies and procedures that apply to purchasing goods and services. Subcontracted analytical laboratories are required to have a documented QA program. Laboratory capability may be evaluated through review of the QA program description or through pre-award survey or vendor audit activities. The results of the survey are documented and provided to the laboratory.
- Readiness Reviews—Readiness reviews are routinely conducted to ensure that appropriate planning has taken place to allow the work to proceed safely and effectively and to ensure that as many contingencies and prerequisites as possible have been reviewed and addressed for the work. The Senior Vice President, ISR Operations is responsible for determining the level of rigor and formality of project readiness reviews based on complexity, frequency, and risk of work. Readiness reviews are routinely planned and conducted before the start of major project activities, before the start of new or infrequent tasks, and prior to scheduled sampling events.
- Independent Peer Reviews—May be conducted to solicit input for the planned technical approach and data quality objectives of the project or task.
- Data Review—to ensure that the data collected and used for each activity of the project are of sufficient quality. The ~~Senior Environmental Specialist~~RSO will conduct data reviews as a quality measure to ensure the adequacy and completeness of field activities. In addition, data review, verification, and validation will be conducted after a sampling event. Analytical data will be reviewed and summarized in the laboratory report. The results will include an explanation of any laboratory problems and their possible effects on data quality.

7.7.4 Reports to Management

Management assessments, internal assessments, and external appraisal report findings are documented. The QA organization maintains the schedule and file for these reports that are typically issued to the responsible manager.

Quality improvement actions (e.g., planning, lessons learned, nonconformance reporting, tracking and follow-up, and reviews) will be documented and reported to management.

Miscellaneous Open Issue No. 10
Procedure for updating monitoring plan
July 27 2009 Teleconference

Open Issue discussion:

The applicant stated that monitoring procedures have been established for the sampling and process design at WY ISR sites. It stated that the site specific environmental monitoring plan defined in the application describes the sample location and sampling frequency and types of analysis. The applicant stated that the environmental monitoring plan would be reviewed every five years and updated as necessary. NRC staff concurs that non-radiological environmental monitoring to be conducted at Moore Ranch has been sufficiently described in the application. However, the applicant did not state that updates to the monitoring plan will be made by license amendment or through the SERP Process. (QA Plan pg 8).

Answer:

Any updates to the monitoring plan that would eliminate or modify monitoring parameters, locations, or frequencies specified in the License Application will be made by license amendment. The RSO can initiate changes to environmental monitoring plans that do not require a license amendment. These changes will be managed as described in Section 5.2 of the Technical Report.

Proposed Revisions to License Application

Addendum 5-A, *Wyoming ISR Operations Quality Assurance Plan,* of the license application has been revised in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method in the December 2009, revision of Addendum 5-A included with the July 27, 2009 Miscellaneous Open Issue 9 response.

Miscellaneous Open Issue No. 11
Discussion of standard procedures for sampling
July 27 2009 Teleconference

Open Issue discussion:

The applicant stated that sampling methods will follow procedures based on nationally recognized consensus standards such as EPA methods, American Society for Testing and Materials Standards, or instrument manufacturer recommended procedures. The Senior Environmental Specialist (SES) will be responsible for ensuring that field measurements and samples are properly documented, occur at the prescribed frequency and location, and are obtained in compliance with procedures and requirements specified. The applicant reported that any deviation from these procedures would have to be approved by the SES before the start of work. The applicant did not state how standard procedures would be selected, maintained on site, provided to the employees, or revised. (QA Plan pg 9).

Answer: The Radiation Safety Officer has been assigned the responsibilities for ensuring that the QA Plan is followed. Standard Operating Procedures are developed by the Environmental or Radiation staff for activities involving sampling specified by the license. Standard Operating Procedures are reviewed and approved by the Radiation Safety Officer prior to implementation. All standard procedures will be available electronically or a hard copy is available at the site environmental or radiation offices.

Standard procedures are selected and or revised as specified in Section 5.2.1 of the Technical Report and Section 7.2 of the QA Plan.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

No proposed changes to text

Miscellaneous Open Issue No. 12
Lack of discussion of decontamination of sample containers and equipment
July 27 2009 Teleconference

Open Issue discussion:

The applicant described the preparation and decontamination requirements for the sampling equipment. This included a brief discussion of requirements for sample containers, preservation, and holding times. No description of in-house cleaning of sampling equipment, sample containers, or other instruments was provided. Please discuss the above procedures to prevent cross-contamination of samples (QA Plan pg 10).

Answer:

The in-house laboratory QA/QC is described in Addendum 5-A, Sections 7.4.4.2 Laboratory QA/QC and 7.4.5 Instrument/Equipment Testing Inspection, Calibration and Maintenance which address the cross-contamination concerns. Although not currently developed a detailed in-house Laboratory Quality Assurance Plan will incorporate equipment, instrument and container cleaning protocols.

Field QA/QC requirements for equipment, instruments and containers are addressed in Addendum 5-A, Section 7.4.4.1 Field QA/QC and Section 7.4.5.1 Field Equipment and Instruments which address the cross-contamination concerns.

Section 7.3.2 Container of Requirements, of Addendum 5-A will be modified to clarify concerns of cross contamination.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Addendum 5-A, *Wyoming ISR Operations Quality Assurance Plan*, of the license application has been revised in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method in the December 2009, revision of Addendum 5-A included with the July 27, 2009 Miscellaneous Open Issue 9 response.

Miscellaneous Open Issue No. 13
Site specific records management plan
July 27 2009 Teleconference

Open Issue discussion:

The applicant stated that documentation and records will be specified, prepared, reviewed, approved, and maintained under a site-specific records management plan. Procedures for document control and changes, corrections to documents, document updates and revisions, field documentation, laboratory documentation and reports received from subcontractors were presented. The SES will be responsible for ensuring that all documentation and records are appropriately identified and maintained. Modifications to the site-specific records plan must be submitted and approved by the SES. The applicant did not provide the site-specific records management plan to enable NRC to evaluate where or how long records will be maintained. (QA Plan pg 22)

Answer:

The Wyoming ISR Operations Quality Assurance Plan was developed to cover all Uranium One ISR operations in Wyoming and I necessarily general in nature. A site-specific records management plan will be necessary for each operation based on specific regulatory and license/permit requirements for that site. Addendum 5-A will be revised to reflect the minimum regulatory requirements for all records management plans and will include the following information.

Records not utilized to determine occupational dose that require a 3 year retention period as specified in 10 CFR §20.2103:

- Area beta-gamma measurements and associated instrument calibrations not utilized to determine employee dose;
- Equipment release records and associated instrument calibrations
- Instrument daily function check records;
- Alpha contamination surveys eating areas; and
- Personnel contamination surveys frisking stations

Instructions for the proper maintenance, control, and retention of records will be developed and will be consistent with the requirements of 10 CFR 20 Subpart L and 10 CFR §40.61 (d) and (e). The following specific records will be permanently maintained and retained until license termination:

- Records of disposal of byproduct material on site through deep disposal wells as required in 10 CFR §20.2002 and transfers or disposal off site of source or byproduct material;
- Records of surveys, calibrations, personnel monitoring, and bioassays as required in 10 CFR §20.2103;

- Records containing information pertinent to decommissioning and reclamation such as descriptions of spills, excursions, contamination events etc. including the dates, locations, areas, or facilities affected, assessments of hazards, corrective and cleanup actions taken, and potential locations of inaccessible contamination;
- Records of information related to site and aquifer characterization and background radiation levels;
- As-build drawings and photographs of structures, equipment, restricted areas, well fields, areas where radioactive materials are stored, and any modifications showing the locations of these structures and systems; and
- Records of the radiation protection program including program revisions, standard operating procedures, radiation work permits, training and qualification records, SERP proceedings and audits.

The RSO will be responsible for ensuring that the required records are maintained and controlled. Hard copies of all records will be maintained on site in a controlled environment to protect them from damage deterioration and will be available for NRC inspection. Electronic copies may be maintained in addition to hard copies with backup protection. Duplicates of all records will be maintained in the Casper office or other offsite location(s).

Recordkeeping and retention has been incorporated into Addendum 5-A of the Technical Report in Section 7.6.1.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

5.2.3 Record Keeping and Retention

Records not utilized to determine Occupations dose that require a 3 years retention period as specified in 10 CFR §20.2103:

- Area beta-gamma measurements and associated instrument calibrations not utilized to determine employee dose;
- Equipment release records and associated instrument calibrations
- Instrument daily function check records;
- Alpha contamination surveys eating areas; and
- Personnel contamination surveys frisking stations

In addition, Addendum 5-A, *Wyoming ISR Operations Quality Assurance Plan*, of the license application has been revised in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method in the December

2009, revision of Addendum 5-A included with the July 27, 2009 Miscellaneous Open Issue 9 response.

Miscellaneous Open Issue No. 14
Discussion of functions of onsite and subcontract labs and their QA programs
July 27 2009 Teleconference

Open Issue discussion:

The applicant provided procedures for receipt of samples at the subcontract analytical laboratory. It stated that upon receipt, the lab will be responsible for the care, custody, archiving, and disposal of samples. It stated that any laboratory that analyzes samples will have a written QA/QC program that ensures reliability and validity of all analyses. It stated that subcontracted laboratories will be required to pass appropriate audits or be certified. In the plan, the applicant did not distinguish between the on-site laboratory or subcontractor laboratory. NRC staff, therefore, could not assess if these terms were synonymous. Please describe the function of the on-site laboratory and subcontract laboratory and state if the QA/QC and accreditation at the onsite laboratory would be the same as the subcontract laboratory. (QA Plan pgs 8 and 14).

Answer:
The primary function of the on-site laboratory is for process control and product grade determinations and is currently not intended to be a Radioanalytical Laboratory. Accreditation of the onsite laboratory will not be required.

Analysis of Environmental samples for wellfield excursion indicators will be performed for chloride, conductivity and total alkalinity at the on-site laboratory. QA/QC practices will follow the applicable guidance specified in Section 6.2 of Regulatory Guide 4.15. Specific laboratory standard operating procedures and quality assurance plan will be developed prior to operation for the onsite laboratory.

The on-site analytical laboratory will utilize standard EPA methodologies, standard methodologies or equivalent for analytical methods.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

<u>No changes proposed</u>

Miscellaneous Open Issue No. 15
Discussion of corrective action program integrating QA components
July 27 2009 Teleconference

Open Issue discussion:

The applicant has not discussed or demonstrated a corrective action program at the site that integrates components of the Quality Assurance program. The staff cannot determine if the applicant will adequately identify deficiencies and take corrective action.

Answer:

See Response to Open Item 25 in July 27, 2009

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 1
Proposed in-plant locations of airborne particulate and radon daughter monitoring
August 18, 2009 Teleconference

Open Issue discussion:

The applicant stated that the proposed locations of airborne particulate and radon daughter samples are depicted in Figure 5.7-1 of the Technical Report. The applicant provided a page with a title but no map or figures showing the proposed locations of airborne particulate and radon daughter sampling. The staff, therefore, cannot determine if the applicant has properly located the airborne particulate and radon daughter sampling stations in the facility in accordance with Regulatory Guide 8.25.

Answer:

See response to May 11,2009 Non-Hydrology Open Issue 5

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this SER question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 2
Frequency of air sampling in airborne radioactivity areas
August 18, 2009 Teleconference

Open Issue discussion:

No discussion of weekly sampling requirement for airborne areas per RG 8.30.

Answer:

The application will be revised to incorporate weekly sampling for airborne radioactivity areas.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

5.7.3 IN-PLANT AIRBORNE RADIATION MONITORING PROGRAM

5.7.3.1 Airborne Uranium Particulate Monitoring

Airborne particulate levels at solution mines that employ vacuum dryers are very low since there are no emissions. The primary potential source of airborne uranium is during yellowcake packaging. This operation will be confined to the dryer room. The room will be closed and posted as an airborne radioactivity area during packaging. The proposed airborne uranium sampling locations for the Moore Ranch Central Plant are shown on Figure 5.7-1. Samples will be obtained using area samplers on a monthly frequency. For airborne radioactivity areas as defined in 10 CFR 20.1003, samples will be obtained using area samplers on a weekly frequency if workers occupy the area.

AIRBORNE URANIUM PARTICULATE MONITORING PROGRAM

Radiological Open Issue No. 3
Action level for uranium or other radionuclides based on gross alpha counting of air filters
August 18, 2009 Teleconference

Open Issue discussion:

The applicant indicated that the measurement of airborne uranium will be performed by gross alpha counting of the air filters for uranium air particulates. The applicant has not provided justification that the air filters will contain only uranium or explained how it will evaluate a mixture of radionuclides including uranium. The staff notes that Ra-226 and Th-230 may also be present in the air, and thus, a mixture of radionuclides may be present on the air filters. Gross alpha counting of the air filters will not be able to differentiate specific radionuclides. Consequently, the applicant may not be able to accurately determine if the action level for uranium or other radionuclides, such as Ra-226 and Th-230, has been reached by relying on gross alpha counting of the air filters.

Answer:

In response to this open issue, it is important and fundamental to recognize the radiological environment of a modern ISR as related to the potential radionuclides of concern that could become airborne. Studies performed in the late 1970s and early 1980s of radionuclide mobilization from several ISRs (see references provided below) and subsequent measurements at operating ISRs indicate a relatively small portion of the uranium daughter products in the ore body are actually mobilized by the lixiviant. The vast majority of secular equilibrium radionuclides remain in the host formation. This is one of the recognized public health and safety benefits of ISR mining when compared with conventional milling. In these studies, thorium-230 appeared to equilibrate and very little was actually removed by the process. The majority of the mobilized radium-226 (80—90 percent), which was estimated to be approximately 5 to 15 percent of the calculated equilibrium radium in the host formation, followed the calcium chemistry in the process and resulted in radium carbonates/sulfates in the calcite byproduct waste streams. Little, if any, lead-210 was mobilized as the lead carbonate complexes formed in situ are virtually insoluble in the lixiviant processes studied.

In addition to the fact that very little of these uranium daughter products are mobilized in situ, the ion exchange (IX) resin used in ISR facilities is specific for removal of uranium. Thorium compounds are not removed by the IX resin and are therefore not present in the process downstream of the IX columns (e.g., elution, precipitation, and drying circuits). Accordingly, the "nuclide mix" that can potentially become airborne in the precipitation, drying and packaging areas of a modern ISR is expected to be almost exclusively U nat. Ingrowth of the first few short lived daughter products (Thorium 234, Protactinium 234) takes 4+ months to reach equilibrium and therefore is not expected to be associated with relatively fresh product.

Additionally, it should be noted that in accordance with 10 CFR §20.1204(g), nuclides can be ignored in a mixture in air if the total activity in the mixture is used to determine compliance with §20.1201 and §20.1502(b) and any nuclides ignored are < 10% of the mixture and the sum of all nuclides ignored are < 30% of the mixture. For modern ISRs, these conditions are expected to me met.

In order to confirm that natural uranium is the primary radionuclide of concern in airborne particulate samples at Moore Ranch, EMC will prepare composite samples from each of the air particulate monitoring locations noted in Figure 5.7-1 of the Technical Report. These sample locations will adequately characterize various points in the process (e.g., lixiviant, precipitation, and drying/packaging areas). These samples will be submitted to a contract laboratory for radioisotopic analysis. Samples will be analyzed for natural uranium, Th-230, and Ra-226. EMC will compare the results of these samples with mixture requirements in 10 CFR §20.1204(g) to ensure that the appropriate DAC from 10 CFR 20 Appendix B Table 1 is used. If a "mixture" exists that does not meet the exclusion rule @ 10 CFR §20.1204(g), a "sum of fractions" method will be used to determine the appropriate DAC.

References

(1) Brown, S. 1982, *Radiological Aspects of Uranium Solution Mining*, In: Uranium, 1, 1982, p. 37-52, Elsevier Scientific Publishing Co.

(2) Brown, S, 2007, *Radiological Aspects of In Situ Uranium Recovery.* American Society of Mechanical Engineers, Proceedings of 11th International Conference on Environmental Management, Bruges, Belgium, September; ASME Press, New York, NY, ISBN 0-7918-3818-8

Radiological Open Issue No. 5
Selection of action level for soluble natural uranium
August 18, 2009 Teleconference

Open Issue discussion:

This is similar to the issue that was discussed during the July 27 conference call. The applicant set an action level of 25 percent of the DAC for soluble natural uranium. The applicant stated that the DAC for soluble (inhalation class "D") natural uranium is 5 E-10 µCi/ml. The applicant further stated that gross alpha counting will be conducted for air particulate sampling. The applicant has not demonstrated that the activity on air samples is attributed solely to uranium and that the inhalation class of the uranium is inhalation class "D." The applicant has not demonstrated the most conservative DAC that will be used for establishing action levels.

Answer:

This open issue was addressed in the response to Radiological Open Issue #12 from the July 27, 2009 teleconference and in the response to Radiological Open Issue #3 from the August 18 teleconference above.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method. *Note that the license application text in this response contains revisions proposed for Radiological Open Issues 12 and 14 from the July 27, 2009 teleconference.*

5.7.3.1 Airborne Uranium Particulate Monitoring

Airborne particulate levels at solution mines that employ vacuum dryers are very low since there are no emissions. The primary potential source of airborne uranium is during yellowcake packaging. This operation will be confined to the dryer room. The room will be closed and posted as an airborne radioactivity area during packaging. The proposed airborne uranium sampling locations for the Moore Ranch Central Plant are shown on Figure 5.7-1. Samples will be obtained using area samplers on a monthly frequency. (weekly if >10% DAC)

Area samples will be taken in accordance with standard operating procedures. These procedures will implement the guidance contained in USNRC Regulatory Guide 8.25. Samples will be taken with a glass fiber filter and a regulated air sampler such as an Eberline RAS-1 or equivalent. Sample volume will be adequate to achieve the lower limits of detection (LLD) for uranium in air (e.g., ≤10% of the DAC). Samplers will be calibrated at the manufacturer's suggested interval or semiannually with a digital mass flowmeter or other primary calibration standard.

Breathing zone sampling will be performed to determine individual exposure to airborne uranium during certain operations. Sampling will be performed with a lapel sampler or equivalent. The air filters will be counted and compared to the Derived Air Concentration (DAC) using the same method used for area sampling. Air samplers will be calibrated at the manufacturer's recommended frequency or at least every six months using a primary calibration standard. Air sampler calibration will be performed in accordance with standard operating procedures.

Studies performed in the late 1970s and early 1980s of radionuclide mobilization from several ISRs and subsequent measurements at operating ISRs indicate a relatively small portion of the uranium daughter products in the ore body are actually mobilized by the lixiviant (Brown, S. 1982; Brown, S. 2007). The vast majority of secular equilibrium radionuclides remain in the host formation. In the studies, thorium-230 appeared to equilibrate and very little was actually removed by the process. The majority of the mobilized radium-226 (80—90 percent), which was estimated to be approximately 5 to 15 percent of the calculated equilibrium radium in the host formation, followed the calcium chemistry in the process and resulted in radium carbonates/sulfates in the calcite byproduct waste streams. Little, if any, lead-210 was mobilized as the lead carbonate complexes formed in situ are virtually insoluble in the lixiviant processes studied. EMC believes that these studies are indicative of the radionuclide mixture that should be expected at Moore Ranch.

In addition to the fact that very little of these uranium daughter products are mobilized in situ, the ion exchange (IX) resin planned for Moore Ranch is specific for removal of uranium. Thorium compounds are not removed by the IX resin and are therefore not present in the process downstream of the IX columns (e.g., elution, precipitation, and drying circuits). Accordingly, the "nuclide mix" that can potentially become airborne in the precipitation, drying and packaging areas at Moore Ranch is expected to be almost exclusively U-nat. Ingrowth of the first few short lived daughter products (Thorium 234, Protactinium 234) takes about 4 months to reach equilibrium and therefore is not expected to be associated with relatively fresh product.

In order to confirm these expectations concerning the radionuclides that may be potentially present in air particulate samples obtained at the Moore Ranch project, the initial air particulate samples obtained following plant startup will be composited according to the sampler location as shown on Figure 5.7-1. These sample locations will adequately characterize various points in the process (e.g., lixiviant, precipitation, and drying/packaging areas). These samples will be submitted to a contract laboratory for radioisotopic analysis. Samples will be analyzed for natural uranium, Th-230, and Ra-226. EMC will compare the results of these samples with mixture requirements in 10 CFR §20.1204(g) to ensure that the appropriate DAC from 10 CFR 20 Appendix B Table 1. During the time period between initial plant startup and receipt of the analytical results for these air particulate samples, EMC will apply the DAC for Th-230 to initial gross alpha counting results. The DAC for natural uranium and Ra-226 is the same (i.e., 3 x 10^{-10} µCi/ml for solubility Class W). The DAC for Th-230 is 3 x10^{-12} µCi/ml (solubility Class W). 10 CFR §20.1204(f) requires that if the identity of each radionuclide in the mixture are known but the concentrations of one or more radionuclides is not known, the most restrictive DAC must be used. If necessary, the "sum of fractions" approach will be applied to establish the DAC for a mixture.

Assuming that the results of the initial radioisotopic analysis confirm that U-nat is the primary radionuclide of concern in the air particulate samples and that any other uranium daughters can be disregarded as provided in 10 CFR §20.1204(g), measurement of airborne uranium will be performed by gross alpha counting of the air filters using an alpha scaler such as a Ludlum Model 2000 or equivalent.

The DAC for moderately soluble (W classification) natural uranium of 3×10^{-10} µCi/ml from 10 CFR 20 Appendix B will initially be used at the Moore Ranch project until in vitro solubility studies can be performed on the uranium compounds present. This is a conservative approach because the available literature indicates that the wet process UO4 and dried UO3 products of modern ISRs in general will be ICRP 19 Class D (or ICRP 66 Class F) compounds. It is also of note that ICRP 54, Individual Monitoring for Intakes of Radionuclides by Workers, which assigns Class W to UO3 indicates " ...there is evidence from animal studies that industrial uranium trioxide may behave more like a class D material ". Nonetheless, EMC will assume them to be Class W (or ICRP 66 Class M) for purposes of establishing the initial DAC upon plant startup. Should in vitro solubility studies indicate that Class D or a "mixed" DAC (i.e., a ratio of the Class D and Class W DACs) is appropriate for the Moore Ranch material, the DAC will be adjusted accordingly. An action level of 25% of the DAC for natural uranium will be established at the Moore Ranch Plant. If an airborne uranium sample exceeds the action level, the RSO will investigate the cause. Exposure to >10% DAC requires assignment of DAC-hrs of exposure using time studies or other means of assign

The results of airborne uranium particulate monitoring will be used to determine the committed effective dose equivalent (CEDE) or internal exposure as described in detail in Section 5.7.4.1.

Additional References for Section 5:

Brown, S. 1982, Radiological Aspects of Uranium Solution Mining, In: Uranium, 1, 1982, p. 37-52, Elsevier Scientific Publishing Co.

Brown, S, 2007, Radiological Aspects of In Situ Uranium Recovery. American Society of Mechanical Engineers, Proceedings of 11th International Conference on Environmental Management, Bruges, Belgium, September; ASME Press, New York, NY, ISBN 0-7918-3818-8

Radiological Open Issue No. 4
Instrument detection levels within 10 percent of DAC value for uranium and radon in air
August 18, 2009 Teleconference

Open Issue discussion:

The applicant stated that the sample volume will be adequate to achieve the lower limits of detection (LLD) for uranium in air. However, the applicant did not define the lower limit of detection for uranium. The applicant has stated that the predominant radionuclide in the air will be Rn-222, and that radon samples will be analyzed on an alpha scaler using the modified Kusnetz method. The applicant did not discuss the lower limit of detection (LLD) for the alpha scaler used to measure radon samples. Regulatory Guide 8.30 recommends that the quantity of the air sampled and the method of analysis should be 10 percent of 10 CFR 20 Appendix B limit. The staff cannot determine if the instrument can detect within 10 percent of the DAC value for uranium and radon.

Answer:

Lower limits of detection (LLDs) will be established to ensure the ability to detect < 10% of applicable DAC. For Unat in air, initially assuming solubility class W (M), this will be < 3 E-11 µCi/ml. For radon progeny, this will be < 0.03 WL. The following equipment will be used to obtain air samples.

- High volume air sampler (15 to 30 cfm) such as a Hi-Q or Staplex or equivalent;
- Hi-Q Low Volume samplers (0 to 100 lpm) or equivalent; and
- Breathing zone (lapel) sampler (0 to 5 lpm) such as a GilAir5 or equivalent.

For uranium in air, the volume of air sampled and air filter counting times will be established to ensure achievement of this LLD and calculated as follows:

$$\mu\text{Ci/ml Uranium} = \frac{(cpm_S - cpm_B)(4.5E\text{-}7\ \mu\text{Ci/dpm})}{(E)(V)}$$

Where:

	cpm_S	=	Sample count rate
	cpm_B	=	Background count rate
	E	=	Instrument efficiency (cpm/dpm)
	V	=	Sample volume (ml)

Radon Progeny in Air will be determined via the modified Kusnetz method as follows:

$$\text{Working Level (WL)} = \frac{\text{Sample cpm - background cpm}}{(\text{Eff})\ (\text{Vol})\ (\text{TF})}$$

Where:

cpm	=	Counts per minute (Sample – background)
Eff	=	Instrument counting efficiency
Vol	=	Total air volume pumped through filter (flow rate in liters x sample time in minutes)
TF	=	Time factor ("Kusnetz" factor from table @ 40 -90 minutes after sampling)

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

The following paragraph will be added at the end of Section 5.7.3.1:

Lower limits of detection (LLDs) will be established to ensure the ability to detect < 10% of applicable DAC. For Unat in air, initially assuming solubility class W (M), this will be < 3 E-11 µCi/ml. The following equipment will be used to obtain air samples.

- High volume air sampler (15 to 30 cfm) such as a Hi-Q or Staplex or equivalent;
- Hi-Q Low Volume samplers (0 to 100 lpm) or equivalent; and
- Breathing zone (lapel) sampler (0 to 5 lpm) such as a GilAir5 or equivalent.

For uranium in air, the volume of air sampled and air filter counting times will be established to ensure achievement of this LLD and calculated as follows:

$$\mu Ci/ml\ Uranium = \frac{(cpm_S - cpm_B)(4.5E\text{-}7\ \mu Ci/dpm)}{(E)(V)}$$

Where:

cpm_S	=	Sample count rate
cpm_B	=	Background count rate
E	=	Instrument efficiency (cpm/dpm)
V	=	Sample volume (ml)

The following paragraph will be added at the end of Section 5.7.3.2:

Lower limits of detection (LLDs) will be established to ensure the ability to detect < 10% of applicable DAC. For radon progeny, this will be < 0.03 WL. The following equipment will be used to obtain air samples.

- Breathing zone (lapel) sampler (0 to 5 lpm) such as a GilAir5 or equivalent.

Radon Progeny in Air will be determined via the modified Kusnetz method as follows:

$$\text{Working Level (WL)} = \frac{\text{Sample cpm - background cpm}}{\text{(Eff) (Vol) (TF)}}$$

Where:

cpm	=	Counts per minute (Sample – background)
Eff	=	Instrument counting efficiency
Vol	=	Total air volume pumped through filter (flow rate in liters x sample time in minutes)
TF	=	Time factor ("Kusnetz" factor from table @ 40 -90 minutes after sampling)

Radiological Open Issue No. 5
Selection of action level for soluble natural uranium
August 18, 2009 Teleconference

Open Issue discussion:

This is similar to the issue that was discussed during the July 27 conference call. The applicant set an action level of 25 percent of the DAC for soluble natural uranium. The applicant stated that the DAC for soluble (inhalation class "D") natural uranium is 5 E-10 μCi/ml. The applicant further stated that gross alpha counting will be conducted for air particulate sampling. The applicant has not demonstrated that the activity on air samples is attributed solely to uranium and that the inhalation class of the uranium is inhalation class "D." The applicant has not demonstrated the most conservative DAC that will be used for establishing action levels.

Answer:

This open issue was addressed in the response to Radiological Open Issue #12 from the July 27, 2009 teleconference and in the response to Radiological Open Issue #3 from the August 18 teleconference above.

Proposed Revisions to License Application

See response for August Open Item 3 and July Open Issue 12

Radiological Open Issue No. 6
Identification of employees who will receive more than 10% of the allowable occupational dose limit
August 18, 2009 Teleconference

Open Issue discussion:

The applicant stated that routine employee external exposures will be determined and recorded for those employees likely to receive more than 10 percent of the allowable occupational dose limit. 10 CFR 20.1502(a)(1) states that each licensee shall monitor occupational exposure to radiation sources under the control of the licensee and shall supply and require the use of individual monitoring devices by adults likely to receive in one year from sources external to the body, a dose in excess of 10 percent of the limits in 10 CFR 20.1201(a). The applicant has not defined those employees by work classification that will receive more than 10 percent of the allowable occupational dose limit.

Answer:

EMC plans to initially monitor all workers for external and internal dose upon startup of the Moore Ranch facility. As data is gathered, EMC will review worker doses and may discontinue monitoring for worker classifications that are not expected to receive more that 10 percent of the allowable occupational dose limit.

Radiological Open Issue No. 7
Review of external radiation monitoring program to ensure that unmonitored workers do not exceed 10% of the dose limits
August 18, 2009 Teleconference

Open Issue discussion:

The applicant stated that occupational exposure to external gamma and beta radiation will be measured using personnel dosimeters such as Thermoluminescent Dosimeters (TLDs) or Optically Stimulated Luminescence (OSL) dosimeters. The occupational exposure to external radiation will be used to determine the Total Effective Dose Equivalent (TEDE) for employees whose work locations or functions may exceed 10 percent of the occupational exposure limits. The applicant stated that the Radiation Safety Officer (RSO) will use historical and current monitoring and survey data to ensure that external radiation exposures are less than 10 percent of the occupational dose limit for all unmonitored workers. The results of the external radiation monitoring program will be recorded and reviewed annually by the RSO to ensure that unmonitored employees have not exceeded 10 percent of the dose limits. The staff notes that unmonitored employees may receive in excess of 10 percent of the dose limits prior to the annual review.

Answer:

The annual review discussed in Section 5.7.4.3 is related to the annual ALARA evaluation. This section should state that the RSO will review external exposure results as they are received from the dosimetry vendor to ensure that unmonitored employees do not exceed 10 percent of the dose limits.

Radiological Open Issue No. 9
Occupational exposure record and determination of actual scheduled time
August 18, 2009 Teleconference

Open Issue discussion:

The applicant stated that intakes will be totaled and entered onto each employee's Occupational Exposure Record. Reporting and recordkeeping will be consistent with Regulatory Guide 8.7. The applicant stated that each classification of workers will be assumed to have spent their entire work shift in the survey area(s). The applicant stated that occupancy time determinations will be based on the actual scheduled time in the restricted area for each occupational group. The staff cannot determine what is meant by the term "actual scheduled time," and the staff cannot determine how the applicant will address the occupancy time if the actual time is greater than the scheduled time.

Answer:

EMC will generally assume 100 percent occupancy time for each worker for determination of internal exposures. The RSO will obtain the actual hours worked during the monitoring period for each worker and will use this time to determine the individuals internal exposure, assuming that 100 percent of the time was spent in the restricted area. Alternatively, the RSO may perform a time study as discussed in the application if there is reason to believe that the 100 percent occupancy assumption is resulting in inaccurate internal exposures.

Radiological Open Issue No. 11a
20.2205 reporting required for doses under 20.2203 and 20.2204 to employee/public.
August 18, 2009 Teleconference

Open Issue discussion:

According to 10 CFR 20.2205, "When a licensee is required by §§20.2203 or 20.2204 to report to the Commission any exposure of an identified occupationally exposed individual, or unidentified member of the public, to radiation or radioactive material, the licensee shall also provide the individual a report on his or her exposure data included in the report to Commission. This report must be transmitted no later than the transmittal to the Commission." The applicant has not demonstrated that such a report will be transmitted to the individual or the Commission, or explain why such a report will not be transmitted to the individual and/or the Commission.

Answer:

Reporting as required in 10 CFR §20.2205 will be added to the application.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to these Open Issues. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

5.7.4 EXPOSURE DETERMINATION AND RECORDS

Employee exposure to radiation will be monitored and recorded in accordance with 10 CFR §20. 1502~~1001~~ to §20. 1201~~2401~~ and Regulatory Guides 8.30 and 8.34. Routine employee ~~external~~ exposures will be~~are~~ determined and recorded for those employees likely to receive more than 10% of the allowable occupational dose limit (i.e., 0.5 rem). During initial operation of the Moore Ranch facility, all workers will be monitored for external and internal exposure. Once an adequate exposure history is established, EMC may discontinue monitoring for worker classifications that have been shown to have no likelihood of exceeding 10 percent of the allowable occupational dose limit. External exposures will be determined using personnel dosimetry as discussed in Section 5.7.2.3. ~~Routine employee i~~Internal exposures will be determined and recorded ~~for those employees likely to receive more than 10% of the Annual Limit of Intake (ALI)~~ for internal exposure from radon daughters or uranium.

Following is a discussion of the exposure determination methods and documentation of results.

5.7.4.1 Natural Uranium Internal Exposure

Exposure calculations for airborne natural uranium will be performed using the intake method from USNRC Regulatory Guide 8.30, Section 2. The intake is calculated using the following equation:

$$I_u = b\sum_{i=1}^{n}\frac{X_i \times t_i}{PF}$$

where:

I_u = uranium intake, µg or µCi

t_i = time that the worker is exposed to concentrations X_i (hr)

X_i = average concentration of uranium in breathing zone, µg/m^3, µCi/m^3

b = breathing rate, 1.2 m^3/hr

PF = the respirator protection factor, if applicable

n = the number of exposure periods during the week or quarter

The intake for uranium will be calculated and recorded. The intakes will be totaled and entered onto each employee's Occupational Exposure Record.

Intake of soluble uranium will be limited to 10 mg per week per 10 CFR 20.1201(e). Accordingly, at an assumed specific activity of 0.67 μCi/gram for natural uranium (10 CFR 20, Appendix B, footnote 3), the weekly soluble intake limit is 6.7 E-3 μCi. Initially, solubility Class W will be used to establish the appropriate ALI of 0.8 μCi and DAC of 3 E-10 μCi/ml for U natural (10 CFR 20, App B, Table 1). Assuming a 40 hour work week and average breathing rate of 20 liters/min, the average concentration at the soluble weekly intake limit is approximately equal to 50% of the DAC. Compliance to this requirement will be documented by recording of worker airborne exposure in DAC–hrs, whenever long lived particulate concentrations in air are determined to be ≥ 10 % DAC and an action level of 25% DAC will be established requiring RSO investigation and potential corrective actions. Assignments of positive airborne exposures will be reviewed weekly. Accordingly, any exposures to soluble uranium > 5 % of the 10 mg/week limit will in fact be recorded (as DAC –hrs) and controlling exposure to 25% of DAC ensures both that the 10 mg / week limit is not exceeded and ALARA.

The data required to calculate internal exposure to airborne natural uranium will be determined as follows:

Time of Exposure Determination

~~The results of periodic time studies for each classification of worker or 100% occupancy time will be used to determine routine worker exposures.~~ In general, 100% occupancy time will be used to determine exposures. Using this method to determine time of exposure, each ~~classification of~~ worker is assumed to have spent their entire work shift in the survey area(s). ~~Note that the length of work shifts may vary by worker classification. Plant operators will generally be working on a shift schedule to provide full time coverage and this may result in some variation from the standard 40-hour week schedule. Maintenance, wellfield, and part-time workers may not spend a full shift in the restricted area(s).~~ The occupancy time determinations for each worker will be based on the actual ~~scheduled~~ time ~~in the restricted area for each occupational group~~worked during the monitoring period. This approach generally results in a conservative (i.e., higher than actual) estimate of internal exposure to airborne natural uranium because it does not account for time the ~~employee~~ worker may have spent outside the work area, such as during breaks and meals.

Alternatively, the RSO may perform a time study to determine the average time of exposure for each classification of worker. Under this approach, the RSO will have a representative population of each classification of worker track their time spent in different areas of the facility. The time study will be performed for an extended period (usually one month) and will provide the RSO with a percentage of time spent in each area for each classification of worker. If time studies are employed to determine time of exposure, they will be updated annually to account for any changes. Exposures during non-routine work (i.e., work requiring an RWP) will be based upon actual time.

Airborne Uranium Activity Determination

Airborne uranium activity will be determined from surveys performed as described in Section 5.7.3.1.

> Exposures to airborne uranium will initially be compared to the DAC for the "W" solubility class for natural uranium from Appendix B of 10 CFR §§20.1001 - 20.2401 (i.e., 3×10^{-10} µCi/ml). As noted in Section 5.7.3.1, EMC may perform in vitro solubility studies on the uranium compounds present at Moore Ranch after facility startup to determine the solubility class of the material *present.*

5.7.4.2 Radon Daughter Internal Exposure

Exposure calculations for airborne radon daughters will be performed using the intake method from USNRC Regulatory Guide 8.30, Section 2. The radon daughter intake will be calculated using the following equation:

$$I_r = \frac{1}{170} \sum_{i=1}^{n} \frac{W_i \times t_i}{PF}$$

where:

I_r = radon daughter intake, working-level months

t_i = time that the worker is exposed to concentrations W_i (hr)

W_i = average number of working levels in the air near the worker's breathing zone during the time (t_i)

170 = number of hours in a working month

PF = the respirator protection factor, if applicable

n = the number of exposure periods during the year

The data required to calculate exposure to radon daughters will be determined as follows:

Time of Exposure Determination

In general, 100% occupancy time will be used to determine exposures. Using this method to determine time of exposure, each worker is assumed to have spent their entire work shift in the survey area(s). The occupancy time determinations for each worker will be based on the actual time worked during the monitoring period. This approach generally results in a conservative (i.e., higher than actual) estimate of internal exposure to radon daughters because it does not account for time the worker may have spent outside the work area, such as during breaks and meals.

~~The results of periodic time studies for each classification of worker or 100% occupancy time will be used to determine routine worker exposure times. In general, 100% occupancy time will be used to determine exposures. Using this method, each classification of worker is assumed to have spent their entire work shift in the survey area(s). Note that the length of work shifts may vary by worker classification. Plant~~

~~operators will generally be working on a shift schedule to provide full time coverage and this may result in some variation from the standard 40-hour week schedule. Maintenance, wellfield, and part-time workers may not spend a full shift in the restricted area(s). The occupancy time determinations will be based on the actual scheduled time in the restricted area for each occupational group.~~

~~This approach generally results in a conservative (i.e., higher than actual) estimate of internal exposure to airborne natural uranium because it does not account for time the employee may have spent outside the work area, such as during breaks and meals.~~ Alternatively, the RSO may perform a time study to determine the average time of exposure for each classification of worker. Under this approach, the RSO will have a representative population of each classification of worker track their time spent in different areas of the facility. The time study will be performed for an extended period (usually one month) and will provide the RSO with a percentage of time spent in each area for each classification of worker. If time studies are employed to determine time of exposure, they will be updated annually to account for any changes. Exposures during non-routine work (i.e., work requiring an RWP) will be based upon actual time.

Radon Daughter Concentration Determination

Radon-222 daughter concentrations will be determined from surveys performed as described in Section 5.7.3.2. The working-level months for radon daughter exposure will be calculated and recorded. The working-level months will be totaled and entered onto each employee's Occupational Exposure Record.

Exposures to radon daughters will be compared to the DAC for radon daughters from Appendix B of 10 CFR §§20.1001 - 20.2401 (i.e., 0.33 WL).

5.7.4.3 External Exposure

Occupational exposure to external gamma and beta radiation will be measured using personnel dosimeters such as Thermoluminescent Dosimeters (TLD) or Optically Stimulated Luminescence (OSL) dosimeters as discussed in Section 5.7.2.3. Consistent with 10 CFR §20.1502 and Regulatory Guide 8.34, occupational exposure to external radiation will be used to determine the TEDE for employees whose work locations or functions may be expected to exceed 10% of the occupational exposure limits. During initial operation of the Moore Ranch facility, all workers will be monitored for external exposure. Once an adequate exposure history is established, EMC may discontinue monitoring for worker classifications that have been shown to have no likelihood of exceeding 10 percent of the allowable occupational dose limit. The RSO will use historical and current monitoring and survey data to ensure that external radiation exposures are less than 10% of the occupational dose limit for all unmonitored workers. The results of the external radiation monitoring program will be recorded and reviewed ~~annually~~ when the results are received by the RSO to ensure that unmonitored employees have not exceeded 10% of the dose limit.

5.7.4.4 Prenatal and Fetal Exposure

10 CFR §20.1208 requires that licensees ensure that the dose to an embryo/fetus during the entire pregnancy from occupational exposure of a declared pregnant woman does not exceed 0.5 Rem (500 mRem). Licensees are also required to make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman that would satisfy the 0.5 Rem limit. The dose to the embryo/fetus is calculated as the sum of (1) the deep-dose equivalent to the declared pregnant woman and (2) the dose to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

The dose equivalent to the embryo/fetus is determined by the monitoring of the declared pregnant woman. 10 CFR §20.1502(a)(2) requires monitoring the exposure of a declared pregnant woman when the external dose to the embryo/fetus is likely to exceed a dose from external sources in excess of 10% of the embryo/fetus dose limit (i.e., 0.05 Rem/yr). 10 CFR 20.1502(b)(2) also requires that the licensee monitor the occupational intakes of radioactive material for the declared pregnant woman if her intake is likely to exceed a committed effective dose equivalent in excess of 0.05 Rem/yr. Based on this 0.05 Rem threshold, the dose to the embryo/fetus must be determined if the intake is likely to exceed 1% of ALI during the entire period of gestation.

Prior to declaration of pregnancy, the woman may not have been subject to monitoring based on the conditions specified in 10 CFR §20.1502. In this case, EMC will estimate the exposure during the period monitoring was not provided, using any combination of surveys or other available data (e.g., air monitoring, area monitoring, and bioassay). Exposure calculations will be performed as recommended in USNRC Regulatory Guide 8.36:

- External Dose to the Embryo/Fetus

The deep-dose equivalent to the declared pregnant woman during the gestation period will be taken as the external dose for the embryo/fetus. The determination of external dose will consider all occupational exposures of the declared pregnant woman since the estimated date of conception and will be based on the methods discussed in Section 5.7.2.

- Internal Dose to the Embryo/Fetus

The internal dose to the embryo/fetus will consider the exposure to the embryo/fetus from radionuclides in the declared pregnant woman and in the embryo/fetus. The dose to the embryo/fetus will include the contribution from any radionuclides in the declared pregnant woman (body burden) from occupational intakes occurring prior to conception. The intake for the declared pregnant woman will be determined as discussed in Sections 5.7.3.1 and 5.7.3.2.

5.7.4.5 Exposure Recording and Reporting

For employees that are monitored for internal and/or external exposure, recording and reporting of monitoring results is required in 10 CFR §20.2106(a) and §20.2206(b), respectively. Records of exposure monitoring results will be maintained for each monitored individual on an NRC Form 5 or equivalent.

In addition, 10 CFR §20.2104 requires a determination of the individual's current year dose at other facilities. EMC will obtain prior dose histories for all employees. EMC will obtain an NRC Form 4 signed by the individual to be monitored, or a written statement that includes the names of all facilities that monitored the individual for occupational exposure to radiation during the current year and an estimate of the dose received. EMC will attempt to verify the information provided by the individual. EMC will also attempt to obtain records of the individual's lifetime cumulative occupational radiation dose. This lifetime dose may be based on a written estimate or an up-to-date NRC Form 4 signed by the individual.

In accordance with 10 CFR §19.13(b), monitored employees will be advised in writing on an annual basis of their calculated TEDE. Additionally, any employee may request a written report of their exposure history at any time. These reports will be provided within 30 days of the request and will provide the information outlined in 10 CFR §19.13.

In accordance with 10 CFR §20.2205, if EMC is required to report to the NRC any exposure of an identified occupationally exposed individual or an identified member of the public to radiation or radioactive material under 10 CFR §20.2203 (Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the constraints or limits) or 10 CFR §20.2204 (Reports of planned special exposures), EMC will also provided the employee(s) or identified member(s) of the public with a report of his or her exposure no later than the time that the report is submitted to the NRC.

Radiological Open Issue No. 7
Review of external radiation monitoring program to ensure that unmonitored workers do not exceed 10% of the dose limits
August 18, 2009 Teleconference

Open Issue discussion:
The applicant stated that occupational exposure to external gamma and beta radiation will be measured using personnel dosimeters such as Thermoluminescent Dosimeters (TLDs) or Optically Stimulated Luminescence (OSL) dosimeters. The occupational exposure to external radiation will be used to determine the Total Effective Dose Equivalent (TEDE) for employees whose work locations or functions may exceed 10 percent of the occupational exposure limits. The applicant stated that the Radiation Safety Officer (RSO) will use historical and current monitoring and survey data to ensure that external radiation exposures are less than 10 percent of the occupational dose limit for all unmonitored workers. The results of the external radiation monitoring program will be recorded and reviewed annually by the RSO to ensure that unmonitored employees have not exceeded 10 percent of the dose limits. The staff notes that unmonitored employees may receive in excess of 10 percent of the dose limits prior to the annual review.

Answer:
The annual review discussed in Section 5.7.4.3 is related to the annual ALARA evaluation. This section should state that the RSO will review external exposure results as they are received from the dosimetry vendor to ensure that unmonitored employees do not exceed 10 percent of the dose limits.

Proposed Revisions to License Application
The following changes are proposed to the license application in response to these Open Issues. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

See response to August Open Issue 6

Radiological Open Issue No. 8
Monitoring and recordkeeping related to soluble uranium intake by an individual, which is limited to 10 milligrams in a week
August 18, 2009 Teleconference

Open Issue discussion:

The staff notes that 10 CFR 20.1201(e) states that in addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity. The applicant has not described how it will monitor and keep records of this requirement.

Answer:

This Open Issue was addressed in the response to Open Issue Radiological No. 14 from the July 27, 2009 teleconference. No additional response is needed.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

See the proposed changes to Section 5.7.4.1 of the Technical Report discussed in the response to Open Issue No. 14 from the July 27, 2009 teleconference.

Radiological Open Issue No. 9
Occupational exposure record and determination of actual scheduled time
August 18, 2009 Teleconference

Open Issue discussion:
The applicant stated that intakes will be totaled and entered onto each employee's Occupational Exposure Record. Reporting and recordkeeping will be consistent with Regulatory Guide 8.7. The applicant stated that each classification of workers will be assumed to have spent their entire work shift in the survey area(s). The applicant stated that occupancy time determinations will be based on the actual scheduled time in the restricted area for each occupational group. The staff cannot determine what is meant by the term "actual scheduled time," and the staff cannot determine how the applicant will address the occupancy time if the actual time is greater than the scheduled time.

Answer:
EMC will generally assume 100 percent occupancy time for each worker for determination of internal exposures. The RSO will obtain the actual hours worked during the monitoring period for each worker and will use this time to determine the individuals internal exposure, assuming that 100 percent of the time was spent in the restricted area. Alternatively, the RSO may perform a time study as discussed in the application if there is reason to believe that the 100 percent occupancy assumption is resulting in inaccurate internal exposures.

Proposed Revisions to License Application
The following changes are proposed to the license application in response to these Open Issues. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

See response to August Open Issue 6

Radiological Open Issue No. 10
Identification of all radionuclides and concentrations that may exist in air and determination of the dose from this mixture
August 18, 2009 Teleconference

Open Issue discussion:

The applicant did not appear to address the possibility of other radionuclides that may be present in air concentrations. According to 10 CFR 20.1204(f), if the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not know, the DAC for the mixture must be the most restrictive DAC of any radionuclide in the mixture. The applicant must identify all radionuclides and concentrations that may exist in air and determine the dose from this mixture. The staff notes that this is similar to the DAC issue discussed during the July 27, 2009 phone call; however, the applicant should note that selection and justification of the appropriate DAC needs to be consistent throughout the application.

Answer:

Please see the responses to Open Issue No.12 from the July 27, 2009 teleconference and the responses to Open Issue No. 3 and 5 from the August 18, 2009 teleconference.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Please see the proposed changes to the Technical Report in the responses noted above.

Radiological Open Issue No. 11
Providing information related to prenatal/fetal dose to pregnant women
August 18, 2009 Teleconference

Open Issue discussion:

The applicant did not discuss how they will provide information to pregnant women, and other personnel, to help make decisions regarding radiation exposure during pregnancy.

Answer:

Section 5.5 of the application stated that training would be provided in part in accordance with the guidance contained in USNRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure" (Revision 3, June 1999). In order to clarify this Open Issue, the application will be revised to include a specific discussion of the training provided related to prenatal/fetal dose to pregnant women.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

5.5.1 Radiation Safety Training Program Content

5.5.1.1 Visitors

Visitors to the Moore Ranch Uranium Project facilities who have not received training will be escorted by on site personnel properly trained and knowledgeable about the hazards of the facility. At a minimum, visitors will be instructed specifically on what they should do to avoid possible hazards in the area of the facilities that they are visiting.

5.5.1.2 Contractors

Any contractors having work assignments at the Moore Ranch Uranium Project will be given appropriate radiation safety training. Contract workers who will be performing work on heavily contaminated equipment will receive the same training normally required of Moore Ranch workers as discussed in Section 5.5.1.3.

5.5.1.3 Radiation Worker Training

All EMC employees (and some contractors as noted in Section 5.5.1.2) will receive training as radiation workers. The program will incorporate the following topics recommended in USNRC Regulatory Guide 8.31:

Fundamentals of health protection

- Using respirators when appropriate.
- Eating, drinking and smoking only in designated areas.
- Using proper methods for decontamination.

Facility-provided protection

- Cleanliness of working space.
- Safety designed features for process equipment.
- Ventilation systems and effluent controls.
- Standard operating procedures.
- Security and access control to designated areas.

Health protection measurements

- Measurements of airborne radioactive material.
- Bioassay to detect uranium (urinalysis and in vivo counting).
- Surveys to detect contamination of personnel and equipment.
- Personnel dosimetry.

Radiation protection regulations

- Regulatory authority of NRC, OSHA and state.
- Employee rights in 10 CFR Part 19.
- Radiation protection requirements in 10 CFR Part 20.

Emergency procedures

All new workers, including supervisors, will be given instruction on the health and safety aspects of the specific jobs they will perform. This instruction is done in the form of individualized on-the-job training. Retraining is performed annually and documented.

5.5.1.4 Instruction Concerning Prenatal Exposure

Female workers who require training under 10 CFR §19.12 will be provided with training that meets the guidance contained in USNRC Regulatory Guide 8.13. In addition, they will receive a copy of USNRC Regulatory Guide 8.13. Supervisors that oversee female workers will also receive training on USNRC Regulatory Guide 8.13.

Radiological Open Issue No. 11a
20.2205 reporting required for doses under 20.2203 and 20.2204 to employee/public.
August 18, 2009 Teleconference

Open Issue discussion:
According to 10 CFR 20.2205, "When a licensee is required by §§20.2203 or 20.2204 to report to the Commission any exposure of an identified occupationally exposed individual, or unidentified member of the public, to radiation or radioactive material, the licensee shall also provide the individual a report on his or her exposure data included in the report to Commission. This report must be transmitted no later than the transmittal to the Commission." The applicant has not demonstrated that such a report will be transmitted to the individual or the Commission, or explain why such a report will not be transmitted to the individual and/or the Commission.

Answer:
Reporting as required in 10 CFR §20.2205 will be added to the application.

Proposed Revisions to License Application
The following changes are proposed to the license application in response to these Open Issues. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

See response to August Open Issue 6

Radiological Open Issue No. 12
Effluent monitoring program for airborne particulates and gaseous effluents
August 18, 2009 Teleconference

Open Issue discussion:

The applicant stated that the yellowcake drying facilities will be comprised of vacuum dryers, and by design, the vacuum dryers will not discharge any uranium when operating. The applicant, however, did not provide any data or information to substantiate the statement that the vacuum dryers will not discharge any uranium when operating. The applicant has not identified the release point of the discharge of air from the vacuum dryer and packaging system, so the NRC staff can not evaluate the effluent monitoring program for airborne particulates and gaseous effluents.

Answer:

This Open Issue is related to Open Issues 6a and 6b from the July 27, 2009 teleconference. Please see the responses to those Open Issues.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Please see the responses to Open Issues 6a and 6b from the July 27, 2009 teleconference.

Radiological Open Issue No. 13
Location of boundary air particulate samplers and impacts on proposed operational air particulate and direct radiation sampling locations
August 18, 2009 Teleconference

Open Issue discussion:

Per RG 4.14 Table 2, operational monitoring locations need to be in different sectors. No discussion of wind data; no annual wind rose; discussion similar to TR Sec 2.9 would suffice.

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 14
Location of radon monitoring stations in relation to air particulate stations
August 18, 2009 Teleconference

Open Issue discussion:

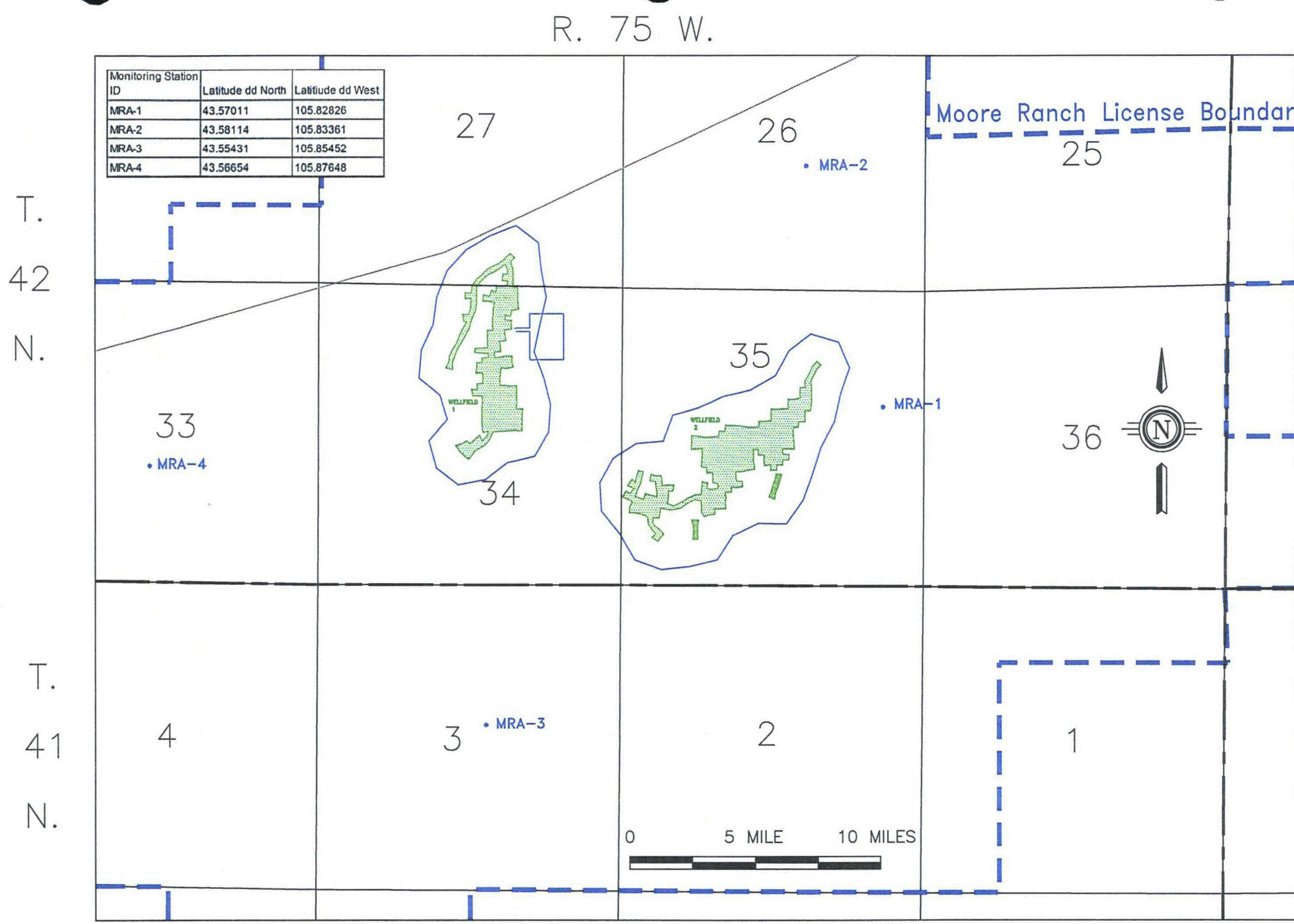
The wrong figure was submitted with the response showing the pre-operational sampler locations. Provide correct figure to match text.

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Monitoring Station ID	Latitude dd North	Latitiude dd West
MRA-1	43.57011	105.82826
MRA-2	43.58114	105.83361
MRA-3	43.55431	105.85452
MRA-4	43.56654	105.87648



LEGEND
• Air Particulate, Radon & Gamma Locations
MRA-4 is Control/Background Station

Figure 5.7-2 Proposed Moore Ranch Uranium Project Operational Environmental Monitoring Locations

Radiological Open Issue No. 15
Sediment sampling during operations
August 18, 2009 Teleconference

Open Issue discussion:

Regulatory Guide 4.14, Table 2, suggests that sediment sampling be conducted as an annual grab sample in one or two of the surface water sampling locations from each water body. The sediment samples should be analyzed for natural uranium, Th-230, Ra-226, and Pb-210. The applicant has not discussed sediment sampling during operations.

Answer:

This Open Issue was due to an oversight during preparation of the License Application. EMC intends to perform operational sediment sampling in accordance with the recommendations contained in Regulatory Guide 4.1.4.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

The following text will be added to Section 5.7.5 of the Technical Report immediately following the section that discusses operational surface soil monitoring:

Sediment

Operational sediment sampling will be conducted on an annual basis. Locations will include each of the surface water sampling locations discussed in Section 5.7.8.3. Samples will be analyzed for U-nat, Th-230, Ra-226, and Pb-210.

Radiological Open Issue No. 16
Operational sampling for food, fish, and vegetation sampling
August 18, 2009 Teleconference

Open Issue discussion:

The applicant has not provided sufficient justification for not conducting food or fish sampling in the application. The staff notes that the applicant has not provided any calculations to support the position that the vegetation pathway is not a potentially significant exposure pathway and an individual would not exceed 5 percent of the applicable radiation protection standards. The MILDOS analysis does not include a food/vegetation dose pathway analysis for the east sector at a distance of 1.5 km. The staff cannot verify that the assumptions used in the MILDOS analysis are representative of the anticipated conditions at the facility.

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 16
Operational sampling for food, fish, and vegetation sampling
August 18, 2009 Teleconference

Open Issue discussion:

Need to provide supporting justification for no operational vegetation sampling based on footnote o to RG 4.14. Table 7.3-6 in MILDOS lists location of highest Rn daughter surface soil deposition rates but not doses. (NOTE: max MILDOS TEDE + 0.8 mrem/yr; footnote o = 5 mrem/yr.)

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 17
Gamma levels and cleanup criteria
August 18, 2009 Teleconference

Open Issue discussion:

The applicant plans to use hand-held and GPS-based gamma surveys to guide soil remediation efforts. The applicant will monitor excavations with hand-held detection systems to guide the removal of contaminated material to the point where the applicant can determine that there is a high probability that an area meets the cleanup criteria. The applicant has not defined what gamma level will correspond to the cleanup criteria. Although the applicant identified a correlation between gamma readings and Ra-226 concentrations in soil in Section 2.9.2.2.3 of the Technical Report, the applicant has not demonstrated how the gamma level will correlate to the uranium or other radionuclides that may be present.

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 17
Gamma levels and cleanup criteria
August 18, 2009 Teleconference

Open Issue discussion:

Need to expand discussion of excavation control to include information on correlation discussed in 2.9.

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 18
Definition of potentially contaminated areas
August 18, 2009 Teleconference

Open Issue discussion:

The applicant states that cleanup of surface soils will be restricted to a few areas where there are known spills and, potentially, small spills near wellheads. The applicant will conduct final GPS-based gamma surveys in potentially contaminated areas; however, the applicant does not define potentially contaminated areas.

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 19
Gamma action limits and relation to preoperational gamma survey and preoperational environmental monitoring
August 18, 2009 Teleconference

Open Issue discussion:

The applicant states that pre-reclamation surveys will be conducted, as described in Section 6.2.1 of the Technical Report, in areas where known contamination has occurred or the potential for unknown soil contamination exists. The applicant plans to divide areas into 100 m2 grid blocks. Soil samples will be obtained from these grid blocks with gamma count rates exceeding the gamma action limit. The applicant does not define the gamma action limits or explain the relationship between the gamma count rates obtained during the surface soil cleanup verification and the preoperational gamma survey and preoperational environmental monitoring conducted prior to construction. The applicant has not provided assurance that the survey method for verification of soil cleanup is designed to provide 95 percent assurance that the soil units meet the cleanup guidelines.

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 20
Application of radium benchmark dose on remaining structures
August 18, 2009 Teleconference

Open Issue discussion:

According to 10 CFR 40 Appendix A, Criterion 6(6), it states, "Byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures, must not result in a total effective dose equivalent (TEDE) exceeding the dose from cleanup of radium contaminated soil to the above standard (benchmark dose), and must be at levels which are as low as is reasonably achievable." In Section 6.3 of the Technical Report, the applicant states that based on the results of the preliminary radiological surveys, gross decontamination techniques will be employed to remove loose contamination before decommissioning activities proceed. The applicant also discusses in Section 6.3 of the Technical Report the release limits for alpha contamination. However, the applicant does not discuss how byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures will not result in a total effective dose equivalent (TEDE) exceeding the dose from cleanup of the radium contaminated soil to the above standard (benchmark dose) and will be at levels which are as low as is reasonably achievable (ALARA).

Answer:

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

Radiological Open Issue No. 21
Alternate disposal of byproduct material
August 18, 2009 Teleconference

Open Issue discussion:

In addition to requiring a permit from Wyoming, to dispose of liquid wastes in deep wells, EMC must also show compliance with NRC regulations for the alternate disposal of byproduct material. The appropriate requirements are found in 10 CFR 20.2002. EMC has not provided sufficient information demonstrating that it will meet those requirements. Specifically, EMC has not discussed compliance with 20.2002(d) which requires analysis and procedures to ensure that doses are maintained ALARA and within the dose limits of 10 CFR Part 20.

Answer:

EMC addressed this issue in the response to a Request for Additional Information (RAI) submitted by the NRC Environmental Review Branch on the Moore Ranch Environmental Report (ER). Specifically, RAI Question 4.13 #1, Potential Exposures from Deep Disposal, asked for the following information:

It is proposed that liquid wastes for the most part will be disposed by deep well injection. Provide an evaluation of potential radiological impact for such disposal, addressing proposed total radioactivity, and potential radiological dose to members of the public for any feasible exposure pathways.

EMC provided a response to this SER under cover of a letter addressed to Mr. Doug Mandeville, NRC Project Manager, submitted August 27, 2009. EMC notes that this RAI response was submitted after the teleconference held to discuss this Open Issue with the Uranium Recovery Branch. The RAI response is duplicated here to assist the NRC Uranium Recovery Branch in their review of this Open Issue.

RAI Question 4.13 #1 – Potential Exposures from Deep Disposal

A primary benefit of the disposal of liquid waste using deep disposal wells is that the waste is permanently isolated from the human environment. Regulatory requirements for the construction, operation, maintenance, and testing of these well from the EPA Underground Injection Control program ensure that there are no releases of injected waste. The response to this question reviews the stringent controls in place to protect human health through the use of deep disposal wells.

In order to estimate the potential radiological impacts and total radioactivity from disposal of liquid waste at the Moore Ranch project the flow and radiological characteristics of the waste stream must be estimated. Uranium One provided the anticipated waste stream water quality in a response to the RAI issued by NRC for the

Moore Ranch Technical Report. That data is contained in Table 4-1 submitted in the revised Technical Report submitted to NRC in September 2008.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this Open Issue. These changes mirror those proposed in the RAI response for Section 4.13.2.5 of the Environmental Report. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

New Section 4.2.2.3:

4.2.2.3 Potential Exposure from Liquid Waste Disposal Method

As required in 10 CFR §20.2002(d), the following information is provided to demonstrate the analyses and procedures proposed by EMC will ensure that occupational and public exposure from disposal of liquid waste containing byproduct material is maintained ALARA and within the dose limits in 10 CFR Part 20.

4.2.2.3.1 Total Radioactivity Related to Liquid Waste Disposal

As previously noted, the average consumptive use during the operational and restoration phases of the Moore Ranch project is 105 gpm. This average flow will occur over a period of 12.5 years, resulting in a total groundwater use during the operational and restoration phases of 6.899E+8 gallons (2.61E+9 liters). Using the maximum anticipated radionuclide content for uranium and radium-226 from Table 4-1, the expected total radioactivity associated with uranium and radium-226 that will be disposed over the course of the Moore Ranch project is 26.5 and 7.83 Curies, respectively.

4.2.2.3.2 Feasible Exposure Pathways from Deep Well Injection

Deep well injection technology and the EPA and state Underground Injection Control ("UIC") Programs established by the Safe Drinking Water Act ("SDWA") (42 U.S.C. §§ 1420, et. seq.) to regulate this technology are major tools for protecting human health and the environment by preventing the endangerment of drinking water sources. A UIC permit cannot even be issued unless potential underground sources of drinking water (USDWs) are protected. The foundational assumptions of the Class I UIC program are that: (1) injected fluids will be permanently removed from the accessible environment, (2) the fate and transport of waste is well defined and understood, and (3) underground sources of drinking water will be protected. By definition, there cannot effectively be an exposure pathway for injectate to move from the injection zone and reach the public if a permit is to be granted.

The approved Wyoming UIC program must demonstrate that deep well injection facilities are maintained and operated in accordance with federal and state regulations and the UIC permits (see 40 C.F.R. §144.1(b)(1) and 40 CFR §147.2550). Consistent monitoring and enforcement assure that the wells will continue to be protective of human health and the environment. Permits allow for the injection and containment of substances within deep geological formations located thousands of feet below the Earth's surface where the injected fluids will remain isolated and contained for thousands of years, which is an effective way to protect human health and the environment, as well as underground and surface sources of drinking water.

EPA has repeatedly noted that "[w]hen wells are properly sited, constructed, and operated, underground injection is an effective and environmentally safe method to dispose of wastes" (EPA, 2001). EPA has found deep well injection to be "safer than virtually all other waste disposal practices" (EPA 1993). Implementation of EPA's current technical requirements for Class I wells, which are located at 40 C.F.R. 146, include extensive construction, monitoring, operating and reporting requirements. When wells comply with these regulations, the EPA has consistently found that "underground injection is an effective and environmentally safe alternative to surface disposal" (EPA 1999). Furthermore, the EPA has noted for Class I industrial deep wells that "there are no documented problems with the effectiveness of the UIC regulations." (55 Fed. Reg. 22,529, 22,658; June 1, 1990).

There are two potential pathways through which injected fluids can migrate to an underground source of drinking water (USDW) and present a potential exposure to the public: (1) failure of the well or (2) improperly plugged or completed wells or other pathways near the well (EPA 2001).

Contamination due to well failure may be caused by leaks in the well tubing and casing or when injected fluid is forced upward between the well's outer casing and the well bore should the well lose mechanical integrity. Internal mechanical integrity is the absence of significant leakage in the injection tubing, casing, or packer. An internal mechanical integrity failure can result from corrosion or mechanical failure of the tubular and casing materials. External mechanical integrity is the absence of significant flow along the outside of the casing. Failure of the well's external mechanical integrity occurs when fluid moves up the outside of the well due to a casing failure or improper installation of the cement. To reduce the potential threat of well failures, operators must demonstrate that there is no significant leak or fluid movement through channels adjacent to the well bore before the well is issued a permit and allowed to operate. In addition, operators must conduct appropriate mechanical integrity tests (MITs) every 5 years (for nonhazardous wells) thereafter to ensure the wells have internal and external mechanical integrity and are fit for operation. It is important to note that failure of an MIT, or even a loss of mechanical integrity, does not necessarily mean that wastewater will escape the injection zone. Class I wells have redundant safety systems to guard against loss of waste confinement.

The multi-layer construction of a Class I deep well, which is required in Wyoming, provides redundant safety features that guarantee injected wastes do not migrate from the well bore into protected aquifers due to well failure. These wells must be constructed with multiple layers of concentric tubing (made of steel or other materials designed to be compatible with the injected fluids) and cement which provides redundant layers of protection to the injection structure. This construction amounts to a pipe within a pipe within a pipe (three tubes, two layers of cement, and a fluid barrier) (EPA, 1994). Thus, "Class I wells have redundant safety systems and several protective layers to reduce the likelihood of failure. In the unlikely event that a well should fail, the geology of the injection and confining zones serves as a final check on movement of wastewaters to USDWs" (EPA 2001).

The Area of Review (AoR) is the zone of endangering influence around the well, or the radius at which pressure due to injection potentially could cause the migration of the injectate and/or formation fluid into a USDW if a conduit for flow (such as an improperly plugged well) existed. Improperly plugged or completed wells that penetrate the confining zone near the injection well could provide a pathway for fluids to travel from the injection zone to USDWs. These potential pathways are most common in areas of oil and gas exploration. To protect against migration through this pathway, wells that penetrate the zone affected by injection pressure must be properly constructed or plugged. Before injecting, operators must identify all wells within the AoR that penetrate the injection or confining zone, and repair all wells that are improperly completed or plugged before a permit is issued. Fluids could potentially be forced upward from the injection zone through transmissive faults or fractures in the confining beds which, like abandoned wells, can act as pathways for waste migration to USDWs. Faults or fractures may have formed naturally prior to injection or may be created by the waste dissolving the rocks of the confining zone. Artificial fractures may also be created by injecting wastewater at excessive pressures. To reduce this risk, injection wells are sited such that they inject below a confining bed that is free of known transmissive faults or fractures. In addition, during well operation, operators must monitor injection pressures to ensure that fractures are not propagated in the injection zone or initiated in the confining zone. It is noted that some states, including Wyoming, allow creation of artificial fractures during completion of a Class I injection well. However, such fractures must be contained within the injection zone, and the maximum operational injection pressure must be below fracture propagation pressure (e.g., the fracture cannot be extended during operations).

The 2001 EPA Risk Report discusses a study that quantitatively estimated the risk of waste containment loss as a result of various sets of events associated with Class I hazardous wells. Through a series of "event trees," the study estimated the probability that an initiating event will occur and be undiscovered, followed by subsequent events that could ultimately result in a release of injected fluids to a USDW. The study assumed that, given the redundant safety systems in a typical Class I well, loss of containment requires a string of improbable events to occur in sequence. For example, a leak develops in the packer, followed by a drop in annulus pressure that is undetected due to a simultaneous malfunction of the pressure monitoring system, followed by a leak in the long string casing between the surface casing and the upper confining layer, resulting in a loss of waste isolation (EPA 2001).

The study concluded that Class I hazardous injection wells which meet EPA's minimum design and operating requirements pose risks that are well below acceptable levels.

According to the study, the probability of containment loss resulting from each of the scenarios examined ranges from one-in-one-million to one-in-ten-quadrillion. The risks for each are ranked as follows (from most probable to least probable): cement microannulus leak, inadvertent extraction from the injection zone, major injection tube failure, major packer failure, breach of the confining zone(s), leak in the packer, and leak in the injection tubing.

EPA attributed this low risk to the use of engineered systems and geologic knowledge to provide multiple barriers to the release of wastewater to USDWs. Although the risk analysis was primarily concerned with Class I hazardous wells, many of the well design and construction requirements also apply to Class I nonhazardous wells and can be extrapolated to the wells planned for the Moore Ranch project.

A third potential pathway would involve drilling through the injection zone. In the unlikely event that a well were drilled through the injection zone, potential exposure is limited by many factors, which are discussed below.

The first factor that would limit potential exposure is that the radius of fluid displacement is limited. For example, for a 10-year operation of the proposed Moore Ranch deep disposal wells the radius of fluid displacement (based on piston-like displacement) is calculated to be 327 feet from each injection well. For the purposes of this discussion it is assumed that this pathway would only exist after the operational life of the Moore Ranch project since EMC would certainly detect drilling activity within the limited radius of fluid displacement during active operations at the site.

In addition, standard drilling practices used in the Power River Basin dictate drilling with mud which provides a hydraulic head in the well greater than the head in the formation drilled. As such, there would be no mechanism for flow from the injection zone into a well that was being drilled with mud. Rather, fluid is continually lost from the well into the formation while drilling proceeds.

Further, concentrations of radionuclides will decrease due to natural dispersion as fluid is displaced from the injection wells. An analogy for the concentration reduction due to dispersion was evaluated for COGEMA (2004; Wellfield Restoration Report, Irigaray Mine). For that project, a MODFLOW/MT3D model was used to assess transport of metals and radionuclides. Model simulations indicated that, on average, the concentration metals and radionuclides were reduced by a factor of seven over a transport distance of 400 feet due solely to dispersion (no retardation or precipitation was assumed).

The mobility of specific radioactive constituents of concern (uranium and radium-226) also is limited by natural retardation. The magnitude of retardation has been researched by Carlos, 2001; Johnson, 1994; U.S. DOE, 1996; and U.S. NRC, 1990. For the same project (COGEMA, 2004), sorption was implemented in some of the solute transport simulations. Sorption refers to the mass transfer between the constituent dissolved in groundwater and the constituent sorbed on the porous medium. Equilibrium conditions are generally assumed to exist between the aqueous phase and the solid phase concentrations and the sorption reactions are fast enough relative to groundwater velocity to be treated as instantaneous. A linear sorption isotherm assumes that the sorbed concentration (Cs) is directly proportional to the dissolved concentration (C):

$$Cs = K_d C$$

where: K_d is the distribution coefficient (L/kg).

The equilibrium controlled linear sorption isotherm is incorporated into the MT3DMS code through the use of a retardation factor, defined as:

$$R = 1 + p_b K_d / \phi$$

where: p_b= bulk density
ϕ= effective porosity

Representative retardation (K_d) values in published literature include:

Constituent	**Range of K_d Values (L/Kg)**	**Source**
Uranium	0.4 – 10	Carlos, 2001 Johnson, 1994 U.S. DOE, 1996 U.S. NRC, 1990
Radium-226	5 – 6,700 10	Moody, 1982 U.S. NRC, 1980

MODFLOW simulations using MT3D for transport were run to assess transport of radionuclides at Irigaray. Conservative K_d values on the lower end of the range identified in the literature search were used. Model simulations showed that the concentration of uranium at a distance of 400 feet was only 10% of the initial concentration when a K_d of 0.5 L/Kg was used. At 1,000 years of simulation time, the Ra-226 concentration at a distance of 400 feet was 5 pCi/L (the MCL for Ra-226) using a K_d of 5 L/Kg. This represents an order of magnitude decrease from the initial concentration of 50 pCi/L.

In summary:

- Based on piston-like flow, the radius of fluid displacement for the operational lifetime is small (approximately 327 feet)

- Because of the head induced by drilling mud, it is extremely unlikely that there would be flow from the injection zone into a well that was being drilled with mud. The amount of drilling cuttings generated, and the potential radioactive dose from those cuttings, is expected to be minimal.

- Dispersion alone likely will reduce concentrations of radionuclides by an approximate factor of seven over a 400-foot displacement distance

- Sorption/retardation will further reduce concentrations at 400 feet from the well by approximately one order of magnitude.

Based on the analogies from the COGEMA study, it is reasonable to assume that, if a well was drilled through the injection zone at a distance of 400 feet from the injection well, the concentration of radionuclides would be one to two orders of magnitude less than the original concentration injected into the Class I well. In addition, the use of drilling mud will prevent injected wastes from leaving the injection zone. Hence, potential exposure from a well drilled through the injection zone, even for a well located only 400 feet from the injection well, is minimal.

Additional References for Technical Report Section 4:

COGEMA Mining, Inc., 2004: Wellfield Restoration Report, Irigaray Mine; prepared by Petrotek Engineering Corporation.

Carlos, F., Colon, J., Brady, P., Siegel, M., and E. Lindgren, 2001. Historical Case Analysis of Uranium Plume Attenuation. Soil and Sediment Contamination 10(1): 71-115.

Johnson, R. 1994. Nonlinear Adsorption of Uranyl: Analytical Modeling of Liner Migration. Groundwater, Vol. 32; 293-304. U.S. DOE Contract DE-AC05-84OR21400.

Moody, J.B., 1982. Radionuclide migration/retardation: research and development technology status report. Battelle Mem. Inst. Report ONWI-321, Columbus, OH.

U.S. Department of Energy, 1996. Selected Radionuclides Important to Low Level Radioactive Waste Management. DOW/LLW-238 Section 15.

U.S. Environmental Protection Agency, "1991 Toxics Release Inventory: Public Data Release, EPA 745-R-93-003" (May 1993) ("1991 TRI PDR Report") at 305.

U.S. Environmental Protection Agency. "USEPA's Program to Regulate the Placement of Waste Water and Other Fluids Underground" (December 1999).

U.S. Environmental Protection Agency, "Class I Injection Wells and Your Drinking Water", July 1994

U.S. Environmental Protection Agency, "Class I Underground Injection Control Program: Study of the Risks Associated with Class I Underground Injection Wells" (March 2001).

U.S. Nuclear Regulatory Commission, 1980; Final Generic Environmental Impact Statement on Uranium Milling, September 1980. NUREG-0706, Volume II Appendix A-3.

U.S. Nuclear Regulatory Commission, 1990. Mobilization and Transport of Uranium at Uranium Mill Tailings Disposal Sites. NUREG/CR-5169; Prepared by R. Erickson, C. Hostetler and M. Kemmner; Pacific Northwest Laboratory.