Norman, Yolande

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Sent: Wednesday, July 03, 2013 12:21 PM
To: Norman, Yolande
Cc: Blickwedel, Roy (GE, Corporate); Warren, Robert; Ewart, James
Subject: enclosure 1 comment 4
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R. Warren – Chester Engineers 7/2/13
Response to Enclosure 1 Comment 4 From:
U.S. Nuclear Regulatory Commission
Request for Additional Information on the Report Entitled "Technical Analysis Report in Support of License Amendment Request for Revised Groundwater Protection Standards Based on Updated Background Concentrations, Source Materials License SUA-1475, Groundwater Corrective Action Program, United Nuclear Corporation Church Rock Mill and Tailings Site, New Mexico April 2012"

4) Comment: Molybdenum concentrations have been observed in far downgradient Zone 3 wells at concentrations greater than expected for being impacted by mining alone. The origin of the high molybdenum concentrations is unclear due to the lack of groundwater data available prior to 1989.

Technical Basis: It would be unlikely that the concentrations were a result of mining effluents discharged to the Southwest Alluvium or seepage from the drying pads at the Quivira facilities which contained a minimum amount of water. The Upper Gallup Sandstone is known to be fractured in the vicinity of the site. The NRC staff is concerned that fracture controlled flow could account for the unusually high concentrations observed at distant downgradient wells including the tendency of the plume to migrate toward the north-northeast instead of in the down dip direction to the northwest. Molybdenum concentrations obtained from a limited number of sampling events for the North Pond and Burrow Pits 1and 2 ranged from 0.001 mg/l to 18.7 mg/l.

Path Forward: Provide further explanation of the high concentrations of molybdenum found downgradient in Zone 3 and historic sampling results from the tailings ponds and burrow pits during operations.

1. Tailings liquid Mo concentrations
    a. We've been unable to locate the NRC-referenced data showing the elevated molybdenum concentrations for the North Ponds and Borrow Pits 1 and 2 (i.e., at concentrations up to 18.7 mg/l); however, data we reviewed show tailings liquid to have relatively low molybdenum concentrations.
        i. Table 3 of the Record of Decision (ROD, USEPA 1988) (see scan attached) indicates that the tailings liquid molybdenum concentrations in three samples by UNC had a range of <0.05 mg/l to 0.15 mg/l and a 1987 sample by NRC had a concentration of 0.24 mg/l.
    b. Significant variability in Mo concentrations in tailings liquids (i.e., NRC-reported range).
2. Can NRC cite examples of Zone 3 downgradient wells for which elevated Mo results may indicate seepage impacts resulting from fracture-controlled flow?
    a. Tailings seepage impacts are more commonly, reliably indicated by other parameters (e.g., pH, HCO3-)
    b. If tailings seepage had high Mo concentrations, the seepage impact "signature" wouldn't be limited to elevated Mo concentrations. Would see indications in other parameters as well.
3. Should Mo be considered to be an indicator of tailings seepage impact?
    a. Few Mo detects in SWA and Zone 1 background and impacted well data.
    b. Wide, overlapping range of molybdenum concentrations observed in Zone 3 background and impacted wells (2008 background and impacted groundwater statistical studies), but significantly higher concentrations in background data set.

Summary Statistics for Molybdenum (mg/L) in Background Groundwater (NAWS, 2008a)

Zone	Total Data	Percent Nondetect	Minimum Detected	Maximum Detected	Mean of Detected	Median of Detected	UCL95 of Mean
Z3	184	14.13%	0.02	75	11.88	3.76	17.43
Z1	234	97.9%	0.03	0.27	0.12	0.13	0.132
SWA	391	99.5%	0.03	0.03	N/A	N/A	N/A

Summary Statistics for Molybdenum (mg/L) in Impacted Groundwater (NAWS, 2008b)

Zone	Total Data	Percent Nondetect	Minimum Detected	Maximum Detected	Mean of Detected	Median of Detected	UCL95 of Mean
Z3	70	54.3%	0.1	5	1.084	0.3	0.739
Z1	16	100.0%	N/A	N/A	N/A	N/A	N/A
SWA	96	100.0%	N/A	N/A	N/A	N/A	N/A

c. Mo geochemistry is complex
   i. Hem (1985) indicates that the dominant Mo species change at pH values of 2 and 5 and that above pH 5 the molybdate ion (MoO_4^{-2}) is dominant.
   ii. Hem (1985) further indicates that many metallic elements have molybdates of low solubility and that ferrous molybdate specifically limits Mo solubility in relatively iron rich waters below pH 5. This suggests a sensitivity to pH, but also effects from the availability of other dissolved metals.

Table 3
PROBABLE TAILINGS LIQUID CHEMISTRY

Parameter	Units	UNC[1] Summary	Well No. 633[2] 2/26/86	NRC Sample April 1987
pH	S.U.	1 - 3	1.71	3.34
TDS	mg/L	38,462 - 61,932	46,793	58,860
Aluminum	mg/L	1,167 - 2,906	2,880	2,100
Manganese	mg/L	100	100	210
Ammonia	mg/L	1,450 - 5,500	438	5,860
Nitrate	mg/L	75.5 - 282	1.84	<50
Th-230	pCi/L	1,064 - 277,733	-	13
Conductivity	umhos/cm	-	17,718	-
Calcium	mg/L	-	240	460
Magnesium	mg/L	-	287	1,100
Sodium	mg/L	-	526	890
Potassium	mg/L	-	4	-
Bicarbonate	mg/L	-	0	<1
Chloride	mg/L	-	253	580
Sulfate	mg/L	24,813 - 43,581	28,209	41,000
Arsenic	mg/L	0.024 - 0.208	0.65	<0.60
Selenium	mg/L	0.001 - 0.161	0.29	<1.2
Iron	mg/L	-	4,350	2,700
Lead	mg/L	-	0.6	3.34
Cadmium	mg/L	-	0.013	0.24
Zinc	mg/L	-	10	20
Molybdenum	mg/L	<0.05 - 0.15	-	<0.24
Ra-226	pCi/L	13	-	24 [3]
Ra-228	pCi/L	2.6	-	

(1) Range for 3 samples collected and analyzed by UNC.
(2) One-time sampling event. Analytical data is also presented in Appendix G.
(3) Total Radon (226 + 228)