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January 28, 2009

Mr. Keith I. McConnell, Deputy Director
Decommissioning and Uranium Recovery Licensing Directorate
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
U.S. Nuclear Regulatory Commission
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Rockville, MD 20852-2738

Mr. Mark D. Purcell
Remedial Project Manager
Superfund Division
U.S. Environmental Protection Agency, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Re: Executive Summary
2008 Groundwater Corrective Action Annual Review Report
Materials License No. SUA-1475
United Nuclear Corporation's Church Rock Tailings Site, Gallup, New Mexico

Dear Messrs. McConnell and Purcell:

On behalf of United Nuclear Corporation (UNC), Chester Engineers has prepared this annual performance review of the groundwater corrective action at UNC's Church Rock Mill and Tailings Site near Gallup, New Mexico, pursuant to License Condition 30C. This report is for the 2008 operating year and represents the period from October 2007 through October 2008. This cover letter serves as an Executive Summary of the report. Please note that the groundwater services group, formerly with N.A. Water Systems, was recently purchased by Chester Engineers, Inc. The same core group of individuals has prepared the Church Rock Annual Review Reports for 2003 (then as USFilter) and for 2004 through 2007 (then as N.A. Water Systems).

This report focuses on both active remediation and the groundwater performance of the natural geochemical systems without active remediation. As indicated in the U.S. Environmental Protection Agency's (EPA's) *First Five-Year Review Report* (EPA, 1998) and by the approvals to decommission or temporarily shut off the former pumping systems, the agencies recognized that those corrective action pumping systems had reached the limit of their effectiveness. EPA

(1988b) recommended that Technical Impracticability (TI) Waivers, Alternate Concentration Limits (ACLs), and Monitored Natural Attenuation (MNA) be used to complete the corrective action program. Those Record of Decision (ROD) recommendations continue to be timely.

Active Remediation in Zone 3

During 2006 UNC completed an extended pilot investigation to evaluate the suitability of hydrofracturing to enhance the extraction potential within the impacted area of Zone 3 (MACTEC, 2006). The hydrofracture study demonstrated that the new pumping configuration had achieved significant capture of the northward-advancing impacted water, while causing a notable improvement in the water quality within the northern tracking wells. Pumping in this part of Zone 3 continued during 2008. A new extraction well (RW A) was installed and started pumping on September 24, 2007. Hydrofractured extraction-well pumping (plus converted pumping Well PB 2) has removed almost 8 million gallons from 2005 through 2008. The pumped water is conveyed to an evaporation pond overlying part of the South Cell.

Groundwater quality in Zone 3 started to sharply degrade between May and December 2007 in several of the northern tracking wells (N.A. Water Systems, 2008b). Groundwater quality here has been oscillating between degrading and improving trends over the last six years. Individual well water-quality trends of improvement and degradation have become collectively asynchronous since May 2007. One of those wells (NBL 1) has recently shown sharply improved groundwater quality, but two others have shown poorer quality. Based on UNC's hydrogeologic analysis and recommendations for the design of a new pumping system to intercept and recover impacted water (N.A. Water Systems, 2008c), five new extraction wells were installed during September 2008. These wells and the nearby groundwater quality are discussed further in Section 3 of the enclosed report.

This annual evaluation of the Site corrective action reaches the following conclusions and recommendations.

Conclusions

- *There are no exceedances of hazardous constituents outside the UNC property within seepage-impacted groundwater – this is the case for all three hydrostratigraphic units.*
- *UNC is in full compliance with the NRC groundwater protection standards in the Southwest Alluvium.*
- *If NRC approves UNC's Zone 1 ACL application for nickel in Well 604 and total trihalomethanes (TTHMs) in Well 614 (N.A. Water Systems, 2008h), then UNC will be in full compliance with the NRC groundwater protection standards in Zone 1.*

- Hydraulic containment is not a necessary feature of the corrective action program in the Southwest Alluvium because of the geochemical attenuation that occurs naturally.
- Evaluation and prediction of constituent concentrations in the Southwest Alluvium is predicated on understanding the geochemical evolution of both the background water quality and later changes associated with passage of the seepage-impact front. Hazardous constituents derived from seepage impact continue to be attenuated.
- Sulfate, total dissolved solids (TDS), and manganese are non-hazardous constituents that exceed standards outside the Site boundary in both seepage-impacted and background (post-mining/pre-tailings) wells. Ahead of the current seepage-impact front in the Southwest Alluvium, downgradient background well SBL 1 has shown the highest sulfate and TDS concentrations and exceedances of manganese, cobalt, and nickel. Similarly, background waters in the other two hydrostratigraphic units also have shown exceedances of Site standards. For example, in Zone 3, Well NBL 1 has shown background exceedances of arsenic, cobalt, molybdenum, nickel, and combined radium. In Zone 1, Well EPA 4 has shown background exceedances of sulfate, manganese, combined radium, and lead-210.
- Concentrations of uranium in the Southwest Alluvium are an indicator that natural attenuation is at least as effective a remedy as pumping. With the single exception of Well GW 3, uranium concentrations and concentration-time trends have either stabilized (e.g., Wells GW 1 and GW 2) or shown decreasing trends (e.g., Well 802) since the pumps were turned off in January 2001. Well GW 3 has shown an increase in concentrations since shutoff which interpolates to a linear rate of increase of +0.008 mg/L of uranium per year. Over this same time period, bicarbonate in GW 3 has not been increasing. Alternatively, review of this uranium time-series indicates the possibility that the trend stabilized starting in October 2005, after which there have been modest fluctuations to present. In any case, uranium concentrations in many Southwest Alluvium wells have shown that variously gradual to steep uptrends and downtrends are typical, whether they occur during pumping or in the absence of pumping.
- The range of uranium concentrations in the background water has been empirically shown to be the same as the range within impacted water (GE, 2006). Uranium and bicarbonate concentrations are usually covariant in the Southwest Alluvium groundwater, i.e., when the concentration of the bicarbonate parameter changes uranium changes with it (provided that there is uranium available for dissolution or desorption in the sediments). This observation has held for both the 11 years of active pumping and the 7 years of post-pumping monitoring, and it is theoretically expected based on principles of aqueous chemistry. This means that uranium concentrations in the Southwest Alluvium are not directly related to the migration of uranium in tailings fluids. In fact, tailings solutions are far more depleted in uranium than are background solutions. This is an important consideration for the Site-Wide Supplemental

Feasibility Study (SWSFS, in preparation by UNC for EPA) because it means the following: (1) uranium in tailings-impacted water is not degrading the offsite water quality, and (2) there is no further improvement in alluvial water quality that can be made with respect to uranium concentrations.

- At downgradient Well 624 the increase in bicarbonate to a chart plateau starting in May 2000 is attributed to the migration of the bicarbonate "front" associated with tailings seepage impact. However, this well shows no covariance between the bicarbonate and uranium concentrations. At least two interpretations are possible: (1) at this well location there is little to no adsorbed or precipitated uranium (i.e., solid phase) within the alluvial sediments; and (2) aqueous uranium that originated from upgradient tailings seepage impact has been strongly attenuated during transport and it has not reached this location.
- *Both the Southwest Alluvium and Zone 1 natural systems are at least as effective as the former active remediation systems in attenuating the seepage-impacted water.* Acidic seepage is being neutralized, resulting in attenuation of metals and radionuclides. Natural geochemical conditions related to gypsum equilibrium and bicarbonate availability will control sulfate and manganese concentrations in both hydrostratigraphic units, regardless of whether or not the extraction wells are operated.
- Based on UNC's approved hydrogeologic analysis and workplan (N.A. Water Systems, 2008c), UNC installed five new extraction wells north of Well NBL 1 during September 2008. Pumping of these wells is expected to begin within approximately the next month. This remedy enhancement in Zone 3 is meant to intercept and extract impacted groundwater.
- The degree and extent of seepage impact in Zone 1 is diminishing. Outside the UNC property boundary in Zone 1, the post-pumping groundwater quality continues to improve overall (Tables 16 and 17). The exceedances of sulfate and TDS in Wells EPA 5 and EPA 7 reflect geochemical equilibrium of the groundwater with gypsum; these constituents are non-hazardous.
- In Zone 1, the continuing improvement in offsite water quality, combined with the stability of onsite concentrations, leads to the conclusion that the Zone 1 groundwater corrective action program has achieved success. However, closure requires meeting the Site standards, which will require that ACLs be established for POC Wells 604 (aluminum, manganese, and nickel) and 614 (TTHMs and chloride). UNC recently submitted an ACL application to NRC requesting revised groundwater protection standards for nickel in Well 604 and TTHMs in Well 614 (NRC's License does not have standards for aluminum, manganese, or chloride).

Recommendations

Southwest Alluvium

Predicted performance of the Southwest Alluvium natural attenuation system is summarized on Table 6. The continuing assessment of natural attenuation in this annual report is the basis for the following recommendations for the Southwest Alluvium corrective action system:

1. Decommission the offline pumping wells. Attenuation via natural geochemical processes has been shown to be at least as effective as pumping. Implement a No Further Action remedial alternative.
2. Change performance monitoring from quarterly to an annual basis because the seepage-impacted water quality is largely stable, the offsite impacted water quality is not hazardous, and a yearly frequency is sufficient for tracking the migration of the seepage-impact front (estimated to be moving southwestward toward Well SBL 1 at an average rate of 32 ft per year).
3. EPA should consider adopting the revised NRC standards for chloroform (revised to a TTHMs Site-wide standard of 80 ug/L) and combined radium (revised to 5.2 pCi/L standard for the Southwest Alluvium). EPA should also consider (a) revising their current ROD uranium standard of 5 mg/L and adopting the NRC site-wide standard of 0.3 mg/L (based on the review of dissolved uranium occurrences in the Southwest Alluvium presented by UNC (GE, 2006)), and (b) adopting the NRC (1996) standard for nitrate (throughout all three Site hydrostratigraphic units). Sulfate, TDS and manganese should be waived as constituents of concern based on NRC's (1996) background water quality analysis report and multiple reports by UNC (all of which are summarized in the SWSFS Part I; N.A. Water Systems, 2007b).
4. The Southwest Alluvium is in full compliance with the NRC groundwater protection standards. EPA's reluctance to issue a TI Waiver for sulfate and TDS is confusing because there are no known groundwater analyses anywhere in the Southwest Alluvium, seepage-impacted or not, that meet the New Mexico Standards for sulfate and TDS. Background water quality has shown modest exceedances of manganese, cobalt, and nickel; it is appropriate that the EPA consider revising the ROD to recognize the historic background water quality for these constituents in the Southwest Alluvium. UNC has recently conducted a statistical analysis of Site background water (N.A. Water Systems, 2008f) as part of developing the SWSFS, and we now have background concentrations for all constituents (data permitting) in all three hydrostratigraphic zones.
5. It has been long established that there is no method to achieve the standards for sulfate, TDS and manganese -- short of dewatering the alluvium. The last drop of water left in the alluvium would exceed the standards for these parameters. *UNC once again respectfully*

requests that EPA approve a TI Waiver for sulfate and TDS to the extrapolated, downgradient impact zone in the year 2204 shown in Figure 59. The ongoing development of a SWSFS will formally evaluate and prioritize the most appropriate remedial course of action.

Zone 3

1. Continue Zone 3 remediation using the natural system to improve the seepage impacts, in conjunction with the current pumping system that intercepts and removes seepage-impacted water.

2. UNC completed five new extraction wells in September 2008, located to the north of Well NBL 1. These wells should start pumping as soon as possible (likely to occur within approximately the next month). These wells will be monitored for hydraulic capture and water quality. After evaluating the performance of these new pumping wells, UNC may install more extraction wells if they are helpful at retarding the northward migration of seepage-impacted groundwater.

3. Declining yields from the current extraction-well array indicate that hydraulic control is temporary. This has always been the case for pumping in Zone 3. Zone 3 saturated thicknesses are quite low, and any future pumping to reduce the pressure head will obtain only limited short-term results. UNC recommends that consideration be given to other regulatory tools to manage the inherent physical limitations to the Zone 3 bedrock-groundwater system. As with Zone 1 and the Southwest Alluvium, the tools might include: ACLs, TI Waivers, monitored natural attenuation, and institutional controls (ICs).

4. EPA should consider revision of the ROD background concentrations for the following metals in Zone 3: arsenic, molybdenum, nickel, cobalt and manganese. Uranium should also be addressed unless EPA adopts the NRC standard for uranium.

5. Sulfate, TDS and manganese should be waived as constituents of concern based on NRC's (1996) background water quality analysis report.

Zone 1

Predicted performance of the Zone 1 natural attenuation system is summarized on Table 17. Implement the following recommendations toward closure of the Zone 1 corrective action system:

1. EPA should consider adopting the current NRC Site-wide groundwater protection standard of 80 ug/L for TTHMs. This value is the current MCL.

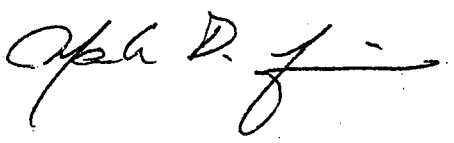
2. EPA should consider adopting the current NRC standard of 9.4 pCi/L for combined radium in Zone 1. This value is based on background water quality statistical analysis that was done for NRC in 2006 (N.A. Water Systems, 2006a), as part of an approved License amendment.

3. The Zone 1 seepage-impacted area has attained as-low-as-reasonably-achievable (ALARA) goals. Toward completing the corrective action program for Zone 1 UNC has recently submitted to NRC an ACL application for nickel in POC Well 604 and TTHMs in POC Well 614.

4. As first put forth by the NRC (1996), and further developed in several geochemistry (Earth Tech, 2000c) and annual reports (Earth Tech, 2000e; N.A. Water Systems, 2004, 2005b), there is no method to achieve the standards for sulfate and TDS, and Zone 1 has already been dewatered to the extent that is feasible (all pumping wells were decommissioned in 1999 because their yields were less than the decommissioning limit). *It is not appropriate to tie remediation progress to sulfate or TDS concentrations. Even the last drop of water left in Sections 1 and 2 of Zone 1 would exceed the standards for these parameters. Remedial alternatives to be presented in the pending SWSFS should be closely coordinated with the necessary TI Waiver(s), ACL applications, and other potentially appropriate changes in Site remediation standards, or, ICs (EPA, 2008b).*

Please contact Mr. Roy Blickwedel (General Electric Corporation) at (610) 992-7935 if you have any questions or need additional information.

Sincerely,



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Enclosures (2 hard and pdf copies for each addressee)

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