June 4, 2013

Mr. Roy Blickwedel
Remedial Project Manager
General Electric Company
640 Freedom Business Center
King of Prussia, PA 19406

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION ON THE LICENSE AMENDMENT REQUEST TO REVISE GROUNDWATER PROTECTION STANDARDS SUPPLEMENTED BY A GROUNDWATER FLOW MODEL FOR THE UNITED NUCLEAR CORPORATION - CHURCH ROCK MILL SITE, SOURCE MATERIAL LICENSE SUA-1475

Dear Mr. Blickwedel:

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its technical review of United Nuclear Corporation's (UNC) license amendment request dated April 17, 2012, to revise ground water protection standards in Condition 30.B of Source Material License SUA-1475 [Agencywide Document Access and Management System (ADAMs) Accession Number ML12150A146]. UNC's original license amendment request was supplemented on November 16, 2012, by a three (3) dimensional groundwater flow model for the UNC Church Rock Mill site and adjacent downgradient areas [ADAMs Accession Numbers ML12305A320; ML12305A324; ML12334A292].

UNC proposes to apply updated background concentrations to all three hydrostratigraphic units (i.e., Zone 1, Southwest Alluvium and Zone 3) at the site. Please note that the NRC review of the groundwater flow model was narrowly focused on information pertinent to your request to revise background concentrations in Zone 3.

Based on the review of UNC's entire license amendment request, the NRC staff has identified technical deficiencies that require the submittal of additional information. The request for additional information (RAI) is provided in Enclosures 1 and 2 of this letter. The NRC requests that the licensee provide written responses to the RAIs by July 22, 2013.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of the NRC's ADAMS. ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

If you have comments or questions regarding this letter, please contact the project manager, Yolande Norman at 301-415-7741 or via email at Yolande.norman@nrc.gov.

Sincerely,

/RA/

Lydia W. Chang, Branch Chief
Special Projects Branch
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 40-8907
License No.: SUA-1475

Enclosures 1 and 2:
Requests for Additional Information

cc: UNC Church Rock Distribution List

If you have comments or questions regarding this letter, please contact the project manager, Yolande Norman at 301-415-7741 or via email at Yolande.norman@nrc.gov.

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cc: UNC Church Rock Distribution List

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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"

General Comments

1) **Comment:** In Section 2, Identification of Samples Representative of Background Water Quality, Page 2; the establishment of monitoring wells having samples representative of background water quality in the 2008 N.A. Water Systems report [Agencywide Document Access and Management System (ADAMs) Accession Number ML083530220] was not formally reviewed or approved by the U.S. Nuclear Regulatory Commission (NRC). The NRC staff believes that this section, as drafted, incorrectly implies that the 2008 N.A. Water Systems report was submitted and approved by the NRC staff.

   Technical Basis: The current amendment request has chosen to utilize the same monitoring well network in the Southwest Alluvium and Zone 1 that was previously assessed during NRC review of Amendment No. 37 for the Technical Analysis Report revised in 2006 [ML006073004]. However, a key difference in the current submittal is that the time interval from the background wells includes two additional years of data than that was not previously assessed and includes data from Zone 3 background wells. Therefore, the monitoring wells associated with the current licensing request were reevaluated to determine if they are representative of background conditions for the newly proposed time interval.

   Path Forward: United Nuclear Corporation (UNC) should revise this section to clearly state that the 2008 N.A. Water Systems report was reviewed and approved only by the U.S. Environmental Protection Agency (EPA). The NRC will be reviewing the selected background wells to ensure they are representative of background water quality.

2) **Comment:** The Technical Analysis Report – April 2012 does not discuss the algorithmic method (if only dependent on higher order statistics and the value of k samples) used or the mathematical method used to determine the Upper Predictable Limit (UPL) 95 for the nonparametric background statistic.

   Technical Basis: The report is deficient in documenting how the ProUCL software calculates the nonparametric UPL 95.

   Path Forward: Provide a detailed explanation of how the nonparametric UPL 95 is determined.

3) **Comment:** Remedial action of Zone 3 is reported in numerous documents to have begun in 1983 at the Northeast Pump-Back wells. However, a December 7, 1981, quarterly report

[ADAMs No. ML101050277] from UNC to the New Mexico Natural Resources Department indicates that ten 400 series seepage extraction pumps in Section 36 and three 300 Series pumps around the tailings area were being utilized prior to 1981. While the document does not identify each of the 13 wells, early cross-sections and monitoring well maps indicate that many of the 400 and 300 series wells were screened within Zone 3.

Technical Basis: Information on seepage extraction prior to commencement of remedial action activities would provide accurate information necessary for the NRC staff to determine those influences that may have affected the transport of seepage from the tailings cells and burrow pits.

Path Forward: Provide further detailed information about the wells used for seepage extraction prior to commencement of remedial actions for each of the hydrostratigraphic units.

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 1 and 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.

U.S. Nuclear Regulatory Commission
Request for Additional Information on the Supplemental Report Entitled
"Groundwater Flow Model of the Church Rock Site and Local Area Church Rock, New Mexico, October 2012"

General Comments

1) **Comment:** The Zone 1 Sandstone and Southwest Alluvium aquifer were not the focus of the groundwater model in the report; instead, effort and attention was applied to the Zone 3 Sandstone portion of the flow model. [From page 1, "As the potential for such applications is anticipated to be greatest for the Zone 3 hydrostratigraphic unit, that unit is the focus of interest of the Flow Model."] Consequently, the groundwater model in its current state should not be used to support decision-making for issues related to Zone 1 Sandstone and the Southwest Alluvium aquifer. This qualification should be clearly stated in the introductory section.

2) **Comment:** Electronic copies of the input files the from the groundwater flow model need to be provided.

   Technical Basis: In order to better understand the model output, NRC staff would like to examine the model input files. In all likelihood, staff will try to duplicate the simulation results so as to recognize significant assumptions and obtain a thorough knowledge of the input data reflecting significant processes and features of the numerical model.

   Path Forward: Provide electronic copies of the input files from groundwater flow model.

3) **Comment:** Technical bases for major assumptions relied upon to construct a site conceptual model and to interpret results from the groundwater flow model were not adequately described and the validity of these assumptions were not adequately demonstrated. Various aspects of the model were qualitatively described with terms such as "reasonable to conclude," "likely reason," "expected," "judged," "estimated," and "implied," that are usually associated with some types of assumption. For example, additional information is needed to support the following assumptions:

   3a) The slow rates of migration found in the Morrison Formation are applicable to the Gallup Sandstone.

   3b) There are conflicting statements regarding the Pipeline Canyon lineament. Raymondi and Conrad (1983) state that lineament-related fractures facilitate infiltration of mine discharge water. McLin and Tien (1982), however, note that when observing the fractures in an outcrop near the Pipeline Canyon lineament, "the fractures are typically filled with secondary mineralization (gypsum or limonite) and they concluded that their influence on groundwater migration is secondary to the geometry of surface-water sources." Without providing further argument or evidence, the modelers assume that the geologic units near the 'lineament' have a greater hydraulic conductivity in their conceptual model.

   The aforementioned is a major assumption and appears to be a major influence on direction of water movement (see particle tracking shown in Figures 20 and 21).

3c) Although Wells 0141, 0142, and 0143 are approximately a mile away from NECR Mine Shaft 1, it is assumed by the authors that the two sites should have the same water table elevation: "The earliest water-level measurements from these wells, made in November 1980, indicate piezometric elevations ranging from 6749 to 6755 (ft amsl), or about 60 feet higher than the measured elevation of the pre-mining water table (6692 ft amsl in NECR shaft 1). The likely reason for this is that, by 1980, piezometric heads in the portion of Zone 1 occupied by pre-mining groundwater had been elevated by contact with background groundwater introduced after March 1968. However, evidence from the sampling history of these wells indicates that contact between these two classes of groundwater (background and natural) had little if any apparent effect on the quality of the sampled groundwater, either before or subsequent to July 1989 (the date of initial routine sampling)."

Is there any evidence that the piezometric heads at Wells 0141, 0142, and 0143 had ever been lower? If so detail such evidence.

If a technical basis can be documented showing that a "portion of Zone 1 occupied by pre-mining groundwater had been elevated by contact with background groundwater introduced after March 1968," a conceptual model should be presented demonstrating how contact between these two classes of groundwater (background and natural) could have had such apparent diminutive effect on the quality of the sampled groundwater: "However, evidence from the sampling history of these wells indicates that contact between these two classes of groundwater (background and natural) had little if any apparent effect on the quality of the sampled groundwater, either before or subsequent to July 1989."

Technical Basis: Identification of the major assumptions relied upon to construct site conceptual models and interpret results, determine if a model will closely represent the physical system (i.e., flow and transport phenomena in the aquifer system), and provide accurate, useful information for decision makings. Technical bases or justifications of major assumptions need to be well developed and clearly documented.

Path Forward: Provide the technical bases or justifications for the assumptions discussed in 3a) through 3c) (e.g., extent of the Pipeline Canyon lineament and associated hydraulic properties). If these are not major assumptions and do not significantly affect the outcome of the simulation results, technical bases or justifications are less urgent and documented demonstrations (e.g., sensitivity analyses) would be sufficient. [Also see Comment 7]

4) **Comment:** The groundwater model calibration efforts were not adequately documented and discussed.

Technical Basis: Reviewing and evaluating the quality of the model calibration is not possible without the accompanying documentation. The usefulness and applicability of the model output remains uncertain without assessing how the model is calibrated and the outcomes of the calibration.

Path Forward: Provide documentation of the model calibration efforts and results. This documentation should address the identification of calibration targets and acceptable residuals and the rationale behind the choice of which model inputs were varied and which were not varied during the course of calibration.

5) **Comment:** A water balance for the entire model domain is not presented (e.g., table showing the water volume rates entering, and exiting the model domain). The volume should be further subdivided into the main components of a water balance including surface recharge (precipitation minus runoff minus evapotranspiration), influent and effluent stream flow, lateral boundary recharge, lateral boundary drainage, water storage change, and deep percolation.

   Technical Basis: The constructed model involves a number of inputs in and outputs from the aquifer system, including recharge from the Pipeline Arroyo (mine water discharge and periodic runoff events), some tributaries due to surface runoffs, and tailings ponds, and discharge from groundwater extraction wells. Examination of water balance is imperative to understand the conceptual model of the groundwater flow. A water budget for the groundwater flow model is used to understand how a groundwater flow system functions. This water balance information and the water budgets from various time periods provide insight into the flow model and the flow system.

   Path Forward: Provide a water balance for the entire model domain. For example, a table could be constructed showing the water volume rates entering, and exiting, the model domain each year. This should then be further divided into the main components of a water balance including surface recharge, influent and effluent stream flow, lateral boundary recharge, lateral boundary drainage, water storage change, and deep percolation.

6) **Comment:** A sensitivity analysis should be provided to identify the input parameters that have the most impact on the degree of model calibration and on the conclusions of the modeling prediction.

   Technical Basis: Given that site-specific data (e.g., recharge rates) is very limited, a detailed model sensitivity analysis needs to be performed for better evaluating the model. The purpose of a sensitivity analysis is to identify the input parameters that are the major contributors to the results. The identification of these major parameters is important in providing users with an understanding of the level of confidence in model results and identifying data deficiencies contributing to a reliable decision making process.

   Path Forward: Provide a section on the sensitivity analysis identifying significant processes and features that impact model performance. The documentation should state which model inputs were varied, which computed outputs are examined and, in addition, provide figures and tables of the results.

7) **Comment:** The report should discuss which parts of the model have the greatest uncertainty and what consequence that may have on the results. Any discussion should identify how much uncertainty is associated with the major assumptions, the most significant parameters, and key components of the model.

Technical Basis: There will always be some uncertainty associated with conceptual model and input parameters that influence the performance of a numerical model, and also with the appropriateness of the simulation software to truly represent the real-world processes and events. Understanding of the extent of model uncertainty, and the type of uncertainty associated with model results is essential in order to make well-informed decisions.

Path Forward: Provide the documentation discussing the uncertainty associated with the conceptual model(s), the most significant parameters, and the major assumptions.

8) **Comment:** Model validation in Section 5 is not adequately documented in the Groundwater Flow Model Report – October 2012. It is not clear what data set or measurements were used in the hydraulic head comparison with the model-predicted heads. Based on the discussion about the relationship between hydraulic head residuals and time (Figure 24A in Section 5.3), it appears that the hydraulic head data collected from 1979 to 2011 are used in the model validation analysis. It then raises the question as to what data set or subset was used for the model calibration.

Technical Basis: N/A

Path Forward: Provide clarification on hydraulic head data sets used in the model validation and calibration analysis.

Specific Comments

1) In Section 1.2.2 (page 4): Due to the assumed importance of the Pipeline Canyon lineament and the Pinedale monocline, more detailed descriptions from a geological and hydrogeological perspective are needed. The yellow lines in Figures 4 and 10 indicate the location of the Pinedale monocline, but nothing is seen in the cross-section of Figure 11B. If the term "Pinedale monocline" is exclusively referring to Gallup Sandstone's regional dip, this should clearly be stated.

2) In Section 2.2 (page 9, paragraph 1): It states, "…the extents were limited to the north down-gradient of the pre-mining water table at a sufficient distance to allow for migration ...." Please modify this section to explain how this distance was estimated to be sufficient to allow for migration of the pre-mining groundwater.

3) In Section 2.3.1 (page 10, paragraph 3): Drain cells allow for discharge of groundwater out of the model domain; however, Section 2.3.1 states, "MODFLOW river cells operate similarly to drain cells, with the important difference that they also allow for discharge of groundwater out of the model domain." The report seems to indicate that there are no differences between MODFLOW's river cells and drain cells. Are any river cells in the current model allowing for discharge of groundwater out of the model domain?

4) In Section 2.3.2 (page 12, paragraph 6): It states, "…the model-predicted rates of drainage out of the area of water-level measurements that surpassed those implied by the measurements." The referred measurements should be documented in the model report, or referenced.

5) In Section 3.2 (page 18): Provide information on how the boundaries between the active cells representing the Dilco Coal and neighboring inactive cells were determined. See Figure 15B.

6) In Section 6 (page 31): The terms “sufficient accuracy” and “functionality goals” should be defined or discussed in more detail.

7) In Section 7 (pages 32 -35): All references should be readily available for review. Staff suggests that the licensee incorporate all references on a computer disc to facilitate ease of review. Outlined below are documents which were referenced, but not readily available for review.

- McLin, S.G., and P.L. Tien, 1982, Hydrogeologic characterization of seepage from uranium mill tailings impoundment in New Mexico, in Proceedings of the Second Ann. Symp. on aquifer restoration and groundwater monitoring, Columbus OH, Nat. Water Well Assoc., pp. 343-358. May.

- Raymondi, R.R., and R.C. Conrad, 1983, Hydrogeology of Pipeline Canyon, Groundwater, V.21, N.2, pp. 188-198.

- Science Applications, Inc., November 1981, Status Report – Geology of the United Nuclear Corporation’s N.E. Church Rock Tailings Area, United Nuclear Corporation, Mining and Milling Division, Albuquerque, New Mexico.

- Stone, William J., 1981, Hydrogeology of the Gallup Sandstone, San Juan Basin, Northwest New Mexico, Groundwater, v.19, n. 1, pp. 4-11.

8) Table 5: Justification for values used in the model should be documented in a transparent and traceable manner. Technical bases supporting the parameter values used should be provided.

9) Figure 9: This figure is not legible.

10) Figure 10: The “Upper Gallup Sandstone” is being identified in this figure; however, it is not clear if the arrow is pointing to the orange or the yellow unit. Both the orange and the yellow units should be labeled.

11) Figure 11A: “Elevation of pre-mining water table shown in Zone 1 is interpreted by analogy, but is also consistent with sampling data from Zone 1 monitoring wells.” Provide, or reference, sample data from the Zone 1 monitoring wells. The pre-mining water table indicates the ineffectiveness of Zone 2 as an aquitard. Can this be explained?

12) Figure 11A: Can the cross-section be extended beyond endpoint A so as to intersect the Pipeline Canyon lineament?

13) Figure A-2: Provide the technical basis for coupling the drain cells with the measurements of Well 0627. Provide the technical basis for coupling the drain cell elevations at an elevation 10 ft below that of the Well 0627 measurements.