October 24, 1994

Terry V. Wetz, Project Manager
Energy Fuels Nuclear, Inc.
One Tabor Center, Suite 2500
1200 Seventeenth Street
Denver, CO 80202

SUBJECT: SAFETY EVALUATION REVIEW COMMENTS AND INFORMATION REQUEST ON ENERGY FUELS NUCLEAR, INC. LICENSE APPLICATION FOR AN IN-SITU LEACH FACILITY AT RENO CREEK, WYOMING

Dear Mr. Wetz:

The purpose of this letter is to transmit the enclosed subject document. These comments address the hydrology portion of the staff's Safety Evaluation Review of Energy Fuels Nuclear, Inc. license application for an in-situ leach facility at Reno Creek, WY.

In order to support the staff's review schedule, please provide your response to the enclosed comments within 60 days of this letter. If you are unable to meet this date please provide your schedule for responding within 10 days of receipt of this letter.

If you have any questions on this subject, please contact the Nuclear Regulatory Commission's Project Manager, Robert D. Carlson, at (301) 415-8165.

Sincerely,

/s/

Daniel M. Gillen, Section Leader
Uranium Recovery Projects Section
High-Level Waste and Uranium Recovery
Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

cc: G. Mooney, State of WY (DEQ/LDQ)
B. Schramm, ORNL

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U.S. NUCLEAR REGULATORY COMMISSION
SAFETY EVALUATION REVIEW COMMENTS AND INFORMATION REQUEST ON ENERGY FUELS NUCLEAR, INC. LICENSE APPLICATION FOR AN IN-SITU LEACH FACILITY AT RENO CREEK, WYOMING

The following comments and information requests represent the hydrology portion of NRC's Safety Evaluation Review (SER) of Energy Fuels Nuclear, Inc. (EFN's) license application for an in-situ leach facility at Reno Creek, Wyoming. The numbering sequence in this enclosure is a continuation of the previous SER comments sent to EFN on August 15, 1994. A list of pertinent references is provided at the end of this enclosure.

In addressing these comments, EFN is requested to provide the referenced information in the form of a separate comment response document, adhering to the numbering scheme presented in this enclosure for easy reference. Upon resolution of all open issues, EFN is requested to provide page changes reflecting these revisions that can readily be inserted into the license application.

HYDROLOGY

21. **ISSUE:** Unconfined Aquifer Conditions

The application does not describe anticipated ground water characterization, monitoring, and restoration differences between mining of unconfined versus confined mining units.

DISCUSSION:

On Page 1-2 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that the ore host sandstone is hydrologically confined in the western portion of the permit area and generally hydrologically unconfined east and south of Highway 387. To date, most in-situ leach uranium mines have been located in confined aquifers. Location of an in-situ leach mine in an unconfined aquifer will probably require different approaches to ground water characterization, monitoring, and restoration. For example, confined aquifers have small storage coefficients relative to unconfined aquifers. This means that water level draw-downs from pumping in an unconfined aquifer will be much less than draw downs in the same aquifer when it is confined. This could mean that the technique of using pump tests to demonstrate that monitor wells are connected to the mine unit may not be effective in an unconfined situation. This is because water level draw-downs caused by pumping wells in the mine unit may not be sufficient to reach them. Additionally, an unconfined aquifer may present a unique problem to restoration. If an unconfined aquifer is mined, it is not unreasonable to expect that unsaturated portions of the aquifer would become saturated, especially near injection wells. This means that lixiviant chemical residues could be left above the water table at the conclusion of mining, to later contaminant the aquifer after it has been restored.

ACTION NEEDED:

Provide a discussion of anticipated ground water characterization, monitoring, and restoration differences between mining unconfined versus confined mining units.

22. **ISSUE: Unconfined Aquifer Conditions Caused By Over-Pumping**

The application does not describe how the confined/water-table boundary will be effected by over-pumping.

DISCUSSION:

On Page 1-2 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that the ore host sandstone is hydrologically confined in the western portion of the permit area and generally hydrologically unconfined east and south of Highway 387. Over-pumping to produce a production bleed will remove water from the aquifer. This in turn should cause some areas of the ore aquifer to change from confined to unconfined conditions.

ACTION NEEDED:

Given the concerns expressed in "ISSUE #21 - Unconfined Aquifer Conditions," describe to what extent the confined/water-table boundary is estimated to change, and what effect will that change have on ground water characterization, monitoring, and restoration.

23. **ISSUE: Flow Into Ore Sand From Upper Aquifer**

The concept that leaching fluids will be contained if hydraulic heads in the Upper Aquifer are higher than in the Ore Sand appears to be incorrect.

DISCUSSION:

On Page 10-86 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that "Hydraulic heads in the Upper Aquifer are higher than in the Ore Sand in the permit area. Any flow or leakage would therefore be downward into the Ore Sand, thus containing leaching fluids". This statement cannot be correct, because injection well pressures will greatly exceed the hydraulic heads of all aquifers above the Ore Sand. From the Ore Sand such pressures could cause an upward flow into overlying aquifers through confining units, poorly completed wells, or badly sealed boreholes.

ACTION NEEDED:

Correct this portion of the report, or provide adequate explanation and justification of the proposed concept.

24. **ISSUE: Simulated Water Level Draw-Downs**

It is not possible to interpret the simulated water level draw-downs that were modeled to demonstrate the effect of over-pumping on water levels in the ore zone aquifer.

DISCUSSION:

On Page 10-89 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that Tables 10.5-1 and 10.5-2 contain input and output parameters for 29 simulated pumping wells designed to model water level draw-downs caused by over pumping (bleed rate) from Mining Unit 1. However, the output is in its raw state, described by the "I" and "J" rows and columns of the finite difference code. It is therefore impossible to interpret the distance that water level draw-downs traveled from the modeled well field.

ACTION NEEDED:

Provide a contour plot of water level draw-downs, including lateral scales, the location of the Mining Unit 1 well field, the permit area boundary, and the 29 simulated pumping wells.

25. **ISSUE: Solution Movement Into Upper Aquifer**

The conclusion that head conditions developed in the Ore Sand will not be large enough for flow to migrate from the Ore Sand into the Upper Aquifer appears to be incorrect.

DISCUSSION:

Section 10.5.5 on Page 10-92 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License" contains a description of simulated water level changes between an injection and recovery well. From this simulation it was concluded that "Water level changes in the Ore Sand aquifer adjacent to injection wells will only be a few feet above the static condition due to the overall draw-down in the vicinity. Therefore, the head conditions developed in the Ore Sand will not be large enough for flow to migrate from the Ore Sand into the Upper Aquifer. The only potential for solution movement into the Upper Aquifer will be through a cracked casing where the head inside the injection well is larger than the head in the Upper Aquifer."

To illustrate the modeling results that lead to this conclusion, a profile of simulated water levels between an injection and recovery well in an area of maximum water level rise is shown in Figure 10.5-4. From this figure, the injection well experienced a 16.5 feet rise in water level.

However, water levels at injection wells will, at a minimum, be at the land surface. Furthermore, because water will be injected under pressure, actual water levels should be higher than the land surface. From geologic cross-sections provided in this report, it is evident that the distance from the land surface to the top of the Ore Sand is often 200 feet. Therefore, near injection wells, water pressures will exceed the hydraulic heads of all overlying aquifers and water may not only move upward through cracked casing, but may also move upward through bad confining units, poorly completed wells, or through badly sealed boreholes.

ACTION NEEDED:

Correct this portion of the report or adequately explain these discrepancies.

26. **ISSUE: Upper Aquifer Monitoring For Mining Unit 1**

For Mining Unit 1, vertical excursion monitor wells are only planned to be installed in the Upper Ore Sand.

DISCUSSION:

In Section 16.1.1.1 on Page 16-1 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that all mining in Mining Unit 1 is planned to occur in the Lower Ore Sand and that vertical excursion monitoring will be proposed for the Upper Ore Sand. The problem with this approach is that no vertical excursion monitoring wells are proposed for the Upper Aquifer above the Upper Ore Sand. Admittedly, geologic cross-sections through Mining Unit 1 show the confining unit to be thicker between the Lower Ore Sand and the Upper Ore Sand than between the Upper Ore Sand and the Upper Aquifer. However, vertical excursions could still reach the Upper Aquifer through casing breaks, bad well completions, or poorly sealed boreholes. Unless monitoring wells are placed in the Upper Aquifer, these excursions would go undetected.

ACTION NEEDED:

Place vertical excursion monitor wells in the Upper Ore Sand and the Upper Aquifer, and adequately describe the planned locations for these monitor wells in the Mining Unit 1.

27. **ISSUE: Designation of the Mine Unit**

Redefining the mining zone for each mine unit may cause unnecessary confusion.

DISCUSSION:

In Section 16.1.1.1 on Page 16-1 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that "The designation of the mining zone, the next overlying aquifer, and the overlying aquitard is specific to each Mine Unit." This proposal appears to be based on the geologic information that indicates that the Upper and Lower Ore Sands in some areas of the mine site are one aquifer and in other areas they are separated by a confining unit. It also appears to be based on the observation that the Upper Aquifer is not continuous over the whole site. Future confusion may arise over which sands are mining zones and which sands are aquifers to be protected. If sands are identified as aquifers to be protected, then they must be monitored. If an excursion occurs in them, corrective action must be taken during mining. Likewise, if sands are defined as mining zones they must still be monitored for excursions. However, for those mining zones within the mining unit (i.e., within the monitor wells of the mining unit), corrective action can be delayed until restoration of the mining unit.

For example, in Section 16.1.1.1 on Page 16-1 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that all mining in Mining Unit 1 is planned to occur in the Lower Ore Sand and that vertical excursion monitoring will be proposed for the Upper Ore Sand. Alternatively, mining could still be confined to the Lower Ore Sand if the mining zone for Mining Unit 1 is defined as both the Upper and Lower Ore Sands. Furthermore, monitor wells would still be placed in the Upper Ore Sand and the Upper Aquifer to monitor for vertical excursions (see ISSUE #26 - Upper Aquifer Monitoring For Mining Unit 1). However, should a vertical excursion occur within Mining Unit 1 in the Upper Ore Sand, corrective action could be delayed until restoration of the well field begins.

Defining both the Upper and Lower Ore Sands as the mining zone would have the advantage of clearly defining what aquifers are to be protected and which ones can be disturbed by mining. In the future, this could prevent much confusion in those areas of the mine where the confining unit between the Upper and Lower Ore Sands is alternatively present or absent.

ACTION NEEDED:

Consider redefining both the Upper and Lower Ore Sands as one mining zone for the entire site.

28. **ISSUE: Single Point Resistivity Survey**

A single point resistivity survey cannot verify that cement occupies the annulus between the casing and the hole wall.

DISCUSSION:

On Page 15-15 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that single point resistivity surveys will be conducted to verify the casing is intact and has not been damaged by tools run into and out of the hole, and that cement occupies the annulus between the casing and the hole wall. The staff believes that single point resistivity surveys can be used to help verify where the casing breaks exist, but they cannot be used to verify that cement occupies the annulus between the casing and the hole wall.

ACTION NEEDED:

Correct this portion of the report, or explain how single point resistivity surveys can be used to verify that cement occupies the annulus between the casing and the hole wall.

29. **ISSUE: Location of Pump Tests**

A map is needed that locates, relative to the permit area boundary, all wells which were tested to determine hydrologic parameters.

DISCUSSION:

Pump test data and analyses are presented in "Reno Creek ISL Project, Attachment 10D, MP-9 Step-Drawdown Test and Multi-Well Aquifer Test," dated June 30, 1994 and in Attachments 10A RME Pump Tests and 10B EFNI Pump Tests of "Reno Creek ISL Project Campbell County, Wyoming, Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Materials License," dated November, 1993. Of these three attachments, only Attachment 10D contains a well location map. To determine where hydrologic parameters have been obtained from pump, injection, and recovery tests, a map is needed that shows the location, relative to the permit area boundary, of all wells which were a part of the tests to determine hydrologic parameters.

ACTION NEEDED:

Provide a map that locates, relative to the permit area boundary, all wells which were a part of ground water tests to determine hydrologic parameters.

30. **ISSUE: Reference Unavailable**

The reference "Hydro-Engineering, 1989, Guideline for Spacing Ore Sand Monitoring Wells Adjacent to an In-Situ Well Field" is not available to public access.

DISCUSSION:

On page 10-87 in Section 10.5.1 of "Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Material License," it states that "The placement of monitoring wells in the Ore Sand aquifer needs to be within the zone where the ground water flow is controlled by the operation of the mining unit." In describing how monitor wells are planned to be located, a report and figures in that report are referenced. This report is "Hydro- Engineering, 1989, Guideline for Spacing Ore Sand Monitoring Wells Adjacent to an In-Situ Well Field," and is not available to public access.

ACTION NEEDED:

Provide a copy of "Hydro-Engineering, 1989, Guideline for Spacing Ore Sand Monitoring Wells Adjacent to an In-Situ Well Field."

31. **ISSUE: LOCATION OF TEST PIT LOGS**

Appendix B.1 does not have a map showing the location of test pit logs or their location relative to elevation and planned engineering structures.

DISCUSSION:

Appendix B.1 of "Energy Fuels Nuclear, Inc. Reno Creek ISL Project Information and Design Criteria to Accompany An Application to Construct WasteWater Facilities," dated December 1993, contains test pit logs at the future collection pond, the reservoir, and dam construction sites. Section 6.3 "Water Storage Reservoir" references Drawing No. 35701-05 as showing test pit locations. However, the staff has been unable to locate this drawing within the license application.

ACTION NEEDED:

Provide a map showing the location of test pit logs and their location relative to elevation and planned engineering structures.

32. **ISSUE: Ground Water Piping (Flow) Under Planned Reservoir Dam**

The potential for ground water seepage under the planned reservoir dam should be investigated when addressing the concerns of U.S. Nuclear Regulatory Commission Regulatory Guide 3.11 "Design, Construction, and Inspection of Embankment Retention Systems For Uranium Mills."

DISCUSSION:

Appendix B.1 of "Energy Fuels Nuclear, Inc. Reno Creek ISL Project Information and Design Criteria to Accompany An Application to Construct WasteWater Facilities," dated December 1993, contains a description of geologic materials in test pit WTP-6. In this test pit more than eight feet of sand was described. The location for this test pit is described as "Dam Site - Right Abutment At Dam Axis on Ridge Line". If this material occurs under the future dam location, the dam might be compromised by ground water flow beneath the dam.

ACTION NEEDED:

Investigate the potential for ground water flow under the planned reservoir dam when addressing the concerns of U.S. Nuclear Regulatory Commission Regulatory Guide 3.11 "Design, Construction, and Inspection of Embankment Retention Systems For Uranium Mills."

33. **ISSUE: Reservoir Water Chemistry and Compatibility With Dam and Reservoir Geologic Materials**

The compatibility of geologic materials in the reservoir and the dam with the projected water chemistry of the planned reservoir should be investigated to help evaluate the potential for water to leak into the rock beneath the reservoir and to help address dam stability concerns.

DISCUSSION:

Appendix B.1 of "Energy Fuels Nuclear, Inc. Reno Creek ISL Project Information and Design Criteria to Accompany An Application to Construct WasteWater Facilities," dated December 1993, contains test pit logs in and around the future reservoir which show clay material greater than eight feet thick. It is expected that the soils, siltstones, and shales in the Reno Creek area contain clays which swell when wet (such as montmorillonite or bentonite). However, while it would be reasonable to expect such clays to swell (and therefore to become less permeable) when they are wet, this is not the case for all water chemistries. It is possible that for some water chemistries the clay particles may shrink and become less permeable. If clay particles were to shrink under the reservoir, the reservoir could become more permeable and leak more water into the ground. Furthermore, should the geologic materials used to construct the dam shrink, the dam could be compromised. Since the water chemistry of the planned reservoir is going to be very different from normal rain, surface, and ground water chemistries, the geologic materials of the dam and reservoir should be tested to determine if this could be a potential problem.

ACTION NEEDED:

Evaluate, and if necessary, test the compatibility of geologic materials in the reservoir and the dam with the projected water chemistry of the planned reservoir. This evaluation should consider the potential for water to leak into the rock beneath the reservoir and the relevancy of this concern to dam stability concerns at the site.

34. **ISSUE: Description of Deep Fluid Migration and Storage Model**

A better description is needed of the one-dimensional simulation of vadose-zone fluid transport which was performed to evaluate the likely fate of fluid percolating from the soil into the underlying bedrock.

DISCUSSION:

In Section 8.3 Deep Fluid Migration and Storage, of Attachment D of "Reno Creek ISL Project Campbell County, Wyoming Supporting Information To WasteWater Land Application Facility Permit Application, Revision 1.0," dated September 1994, a one dimensional model is described of vadose-zone fluid transport to evaluate the likely fate of fluid percolating from the soil into the underlying bedrock. From this modeling it was concluded that "... it is not believed that recharge to ground water by leakage through the vadose zone will have a measurable effect on ground water quality, and that any recharge will take in excess of 30 years to reach the ground water."

While the document describes in Attachment G the computer code LEACHM, which was used to construct this model, the text only provides the following description of the model, "... the subsurface was defined as a single 8.8 meter sandstone layer just below the midpoint of a mudstone profile, with an initially low moisture content (-10 bars)." Furthermore, "... a more conservative simulation, without the sandstone layer and with an initial moisture content of -5 bars indicated ..."

The above description leaves many questions about how the simulation was constructed. For example, information is not provided on the type of geologic materials or other parameter inputs such as infiltration rates that were used in the simulations, and why they are felt to be relevant to the problem being modeled. In addition, without a drawing (in this case a one dimensional geologic column) it is difficult to visualize what type of geology was modeled and how removal of a sandstone layer is more conservative.

ACTION NEEDED:

Provide a better description of the one-dimensional simulation of vadose-zone fluid transport which was done to evaluate the likely rate of fluid percolating from the surface into the underlying bedrock. Include drawings (one dimensional columns) that show the simulated geologic materials and their arrangement in the simulation.

35. **ISSUE: Hydrologic Simulations**

Complete descriptions are missing of how parameters were obtained for each of the hydrologic simulations, including discussions of data uncertainties and how those uncertainties were included in the simulations.

DISCUSSION:

The document "Reno Creek ISL Project, Campbell County, Wyoming, Supportive Information for Wyoming Department of environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory commission Source Materials License," dated November 1993, contains two attachments that reanalyze pump test data. Attachment 10A contains an analysis of pump test data that was collected by Rocky Mountain Energy Company and Attachment 10B contains an analysis of EFN's pump test data. Many of the tests described in these attachments appear to be of marginal quality. In a letter from Glenn Mooney to Terry V. Wetz, dated September 23, 1994, the Wyoming Department of Environmental Quality has made numerous comments that mirror the opinion of the NRC staff on the interpretation of this pump test data.

The use of marginal quality pump test data can result in substantial uncertainty associated with the hydrologic parameters derived from them. The NRC staff recognizes that projects which must use geologic and hydrologic data usually have to make use of information that have different levels of uncertainty or confidence associated with them. Particularly when studying a new site, it is a good idea to use previously collected data to supplement characterization data. Such data can be used to help fill site characterization data gaps or to confirm site characterization data.

However, when site characterization data is of varying quality, higher uncertainty data should not be given as much importance in site characterization as data with lower uncertainties. There are numerous ways this can be accomplished. For example, when deriving average hydrologic parameters, those parameters derived from low quality data should not be given the same weight in the averaging process as parameters derived from high quality data. Alternatively, conservative values (values that would make the site look worse) could be used to build additional confidence in projections or safety in site design. Another approach might be to select data in relation to the scale of a problem. For example, if pump test data is being used to characterize a large scale site where small scale tests (short pumping times) and large scale tests (long pumping times) have been conducted in the same area, the hydrologic parameters derived from the large tests may be selected over parameters derived from small scale tests.

In the source material license application, there appears to be three modeling studies where hydrologic parameters are used in modeling simulations to reach conclusions about the site:

1. Simulations to determine the zone of control described in Section 10.5, pages 10-87 to 10-123 of "Reno Creek ISL Project, Campbell County, Wyoming, Supportive Information for Wyoming Department of Environmental Quality Amendment to Mine Permit #479 and U.S. Nuclear Regulatory Commission Source Materials License," dated November 1993.

2. Simulations of ground water seepage through the bottom of the irrigation reservoir described in Section 3.0 Environmental Impacts, pages 9-10 of "Reno Creek ISL Project, Information and Design Criteria to Accompany an Application to Construct WasteWater Facilities," dated December 1993.

3. A one dimensional model of vadose-zone fluid transport to evaluate the likely fate of fluid percolating from the soil into the underlying bedrock described in Section 8.3 Deep Fluid Migration and Storage, of Attachment D of "Reno Creek ISL Project Campbell County, Wyoming Supporting Information To WasteWater Land Application Facility Permit Application, Revision 1.0," dated September 1994.

However, for these simulations, descriptions of how input parameters were obtained from site data are incomplete. For example, in the descriptions of simulations (#1) to determine the zone of control on page 10-89, it states that "Average aquifer properties (transmissivity and storage coefficient) for the Reno pump tests in this area were used. Properties that are thought best representative of the area along the line of draw-downs used for the reversal determination should be used. The simulation is for an area within the permit area where aquifer transmissivities are in the intermediate range. A transmissivity of 1600 gal/day/ft and a storage coefficient of 0.00013 are thought to best represent the Ore Sand aquifer in this area. The storage coefficient was obtained from observation well RI-34 (RME test-Figure 10A-18), and is a typical value for the Powder River Basin." This description does not answer the following questions:

a. How were the average properties determined (i.e., which tests were used, where were the tests located with respect the area being modeled, how was the average calculated, etc.)?

b. Why do these properties best represent the area along the line of draw-downs?

c. How was it determined that the area simulated is in an area where the aquifer transmissivities are in the intermediate range?

d. Why does a transmissivity of 1600 gal/day/ft and a storage coefficient of 0.00013 best represent the Ore Sand aquifer in this area?

e. Why is the storage coefficient a typical value for the Powder River Basin?

f. What are the boundary conditions of the model, how were they obtained, and why are they appropriate for what is being simulated?

g. Given that this report was written in November 1993, and a large scale pump test was conducted in Mining Unit 1 in June of 1994, how does this new pump test affect parameters that should be input into this simulation?

In the descriptions of simulations (#2) of ground water seepage through the bottom of the irrigation reservoir on pages 9 & 10 it states that "A rough estimate of the seepage rates was made by assuming saturated flow and using Darcy's equation. A vertical permeability of 1×10^{-8} cm/sec is thought to be representative of the type of material in the bottom of the irrigation reservoir. Permeability is based on knowledge of this type of material in the area. An average area of ten acres and a conservative gradient of 1 ft/ft was used for this calculation. These parameters indicate that an average seepage rate of 6.4 gpm will discharge from the irrigation reservoir to the ground water. This is based on a vertical permeability of 1×10^{-7} cm/sec for the mudstone material, a unit gradient of 1 ft/ft, and an effective porosity of 0.05." This description does not answer the following questions:

h. Why is a vertical permeability of 1×10^{-8} cm/sec thought to be representative of the type of material in the bottom of the irrigation reservoir? Where did the knowledge of this type of material come from (references, expert opinion, who's expert opinion, on site data)?

i. Why was an area of 10 acres chosen?

j. Why is a gradient of 1 ft/ft conservative?

k. What was the effective porosity of the material in the bottom of the irrigation reservoir?

l. Why was a vertical permeability of 1×10^{-7} cm/sec for the mudstone material, a unit gradient of 1 ft/ft, and an effective porosity of 0.05 chosen?

m. What was the thickness of the material in the bottom of the reservoir and the mudstone unit, and why were these thicknesses chosen?

n. What are the mathematics of this simulation? It is left to the reader to assume that what is being calculated is Darcy or Seepage velocity, which does not represent first arrival times when velocities that consider effects such as dispersion are considered.

o. Why do the material properties of this simulation differ from the material properties of the simulations of vadose-zone fluid transport to evaluate the likely fate of fluid percolating from the soil into the underlying bedrock (#3)? In this simulation a vertical permeability of

1×10^{-6} cm/sec is thought to be representative of the type of material in the bottom of the irrigation reservoir and a vertical permeability of 1×10^{-7} cm/sec was used for the mudstone material. However, in simulations of vadose-zone fluid transport a saturated hydraulic conductivity 2.03×10^{-2} cm/sec for the root and 8.3×10^{-5} cm/sec for the mudstones were used.

In descriptions of the simulations (#3) of vadose-zone fluid transport to evaluate the likely fate of fluid percolating from the soil into the underlying bedrock on page 48, it states "... in a conservative, but realistic simulation, the subsurface was defined as a single 8.8 meter sandstone layer just below the midpoint of a mudstone profile, with an initially low moisture content (-10 bars) profile. The result was that there was essentially no drainage over a 50 year period. A more conservative simulation, without the sandstone layer and with an initial moisture content of -5 bars indicated a recharge rate of 1.8 gpm after 30 years, spread over the entire irrigated area." Additionally, in Appendix C it states that "Subsurface conditions are primarily silt and mudstones, with stringers of sandstone. The chemical properties of a fine grained soil were used for input to simulate clay and mudstones and were carried to the 44-meter depth. The saturated hydraulic conductivity for the root zone was estimated as 732 mm/day (1.2 inch/hr), or the average for Thedalund soil. Based on lithologic and geophysical logs for boreholes in the irrigation area, the hydraulic conductivity of the shales and mudstones underlaying the irrigation area was estimated to 3 mm/day (0.118 inch/day)." This description does not answer the following questions:

p. How are these simulations conservative predictions of the effects of the proposed irrigation system?

q. In a one dimensional model, how can a sandstone layer be located below the midpoint of a mudstone profile?

r. From what soil were the chemical properties derived? Furthermore, because soil and rock chemistries are also dependent on the type of minerals present, how is this fine grained soil a reasonable representation of the shales and mudstones underlaying the irrigation area?

s. What was the basis for the estimated saturated hydraulic conductivity of 732 mm/day (1.2 inch/hr) for the root zone?

t. How was the saturated conductivity estimate of 3 mm/day (0.118 inch/day) of the shales and mudstones underlaying the irrigation area derived from lithologic and geophysical logs of boreholes in the irrigation area?

ACTION NEEDED:

Provide a description of how parameters were obtained for each of the simulations identified in the "DISCUSSION" section above, including a discussion of data uncertainties and how those uncertainties were included in the simulations.

REFERENCES

1. Hydro-Engineering, 1989, "Guideline for Spacing Ore Sand Monitoring Wells Adjacent to an In-Situ Well Field."

2. Mooney, Glenn, 1994, Letter to Terry V. Wetz, Energy Fuels Nuclear, dated September 23, regarding "Reno Creek Project Amendment Application, TFN 2 2/309."

3. U.S. Nuclear Regulatory Commission, 1977, "Design, Construction, and Inspection of Embankment Retention Systems For Uranium Mills," Regulatory Guide 3.11.

16 April 1997

From: H.E. Lefevre, NMSS HEL
To: Susan Fridley, RMB
Subject: Energy Fuels Nuclear, Inc. - Reno Creek ISL Project License Application, Docket No. 40-9024

Please docket the following document:

Letter of October 24, 1994, from Daniel M. Gillen, NRC to Terry V. Wetz, Energy Fuels Nuclear, Inc.

SUBJECT: Safety Evaluation Review Comments and Information Request on Energy Fuels Nuclear, Inc. License Application for an In-situ Leach Facility at Reno Creek, Wyoming

Thanks

Susan: My NUDOCS search did not turn up this document. Perhaps it is there but I didn't pick up on it. If the 40-9024 docket isn't closed please see that this document is included in the PDR files. If the docket is closed you may wish to enter it under EFN's successor, International Uranium (USA) Corporation (Docket No. 40-9048).