



# THE NAVAJO NATION

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June 30, 1997

Robert D. Carlson, Project Manager  
Office of Nuclear Material Safety and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

40-868

**RE: Final Environmental Impact Statement to Construct and Operate the  
Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico**

Dear Mr Carlson:

The Navajo Nation Environmental Protection Agency's (NNEPA) technical reviewing staff submits the attached comments with this memo on the Final Environmental Impact Statement (FEIS) produced by the Nuclear Regulatory Commission. The comments are formatted by first including the subject heading directly from the FEIS and stating NNEPA's concern appropriately regarding that subject. NNEPA has also included a section for "General Comments" that are indirectly specific to the FEIS.

Your attention to NNEPA concerns If you have any questions regarding NNEPA comments, please contact me at (520) 871-7692.

Sincerely,

*Bennie Cohoe*

Bennie Cohoe, Executive Director  
Navajo Nation Environmental Protection Agency

NLOS

xc: Thomas Atcity, Navajo Nation Vice President  
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**NAVAJO NATION ENVIRONMENTAL PROTECTION AGENCY  
REVIEW COMMENTS TO:**

**FINAL ENVIRONMENTAL IMPACT STATEMENT to Constuct and Operate the  
Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico  
Produced by the U.S. NUCLEAR REGULATORY COMMISSION**

**SUBMITTED BY**

**NAVAJO NATION ENVIRONMENTAL PROTECTION AGENCY**

**JUNE 1997**

The following are NNEPA comments on the FEIS produced by the NRC regarding HRI's proposed in situ uranium mining project.

## 1.7 OTHER STATE AND FEDERAL AGENCIES

One agency prominently left out of this section is the Navajo Nation Environmental Protection Agency (NNEPA). NNEPA enforces all applicable environmental regulations for the Navajo Nation, such as the Navajo Nation Water Code. The Code contains the standards with which HRI would have to comply during restoration, and which could not be exceeded at any drinking water wells that could be impacted by the mining operations. NNEPA is also in the process of applying for SDWA primacy from U.S.EPA, which will give them primary enforcement authority to administer UIC and other programs. Last, the Navajo Nation has other regulations, such as those promulgated by the Water Resources Department for well closure and abandonment, with which HRI must comply when operating within Navajo Indian country.

## 2.1 ALTERNATIVE 1 (THE PROPOSED ACTION)

### 2.1.1.1 Well Field Procedures and Equipment

How many failed mechanical integrity tests will have to occur before a proposed well is considered not to be operational?

What is the frequency for pressure testing the well field piping system? Increased incidents of releases from the system should increase the frequency for pressure testing.

What kind of control system will be used on the pressure relief valves on the trunk pipelines to disperse radon, carbon dioxide, and/or oxygen?

Sections 2.1.1.1 and 2.1.3.2: On Navajo Nation land, or within Navajo Indian country, closure and abandonment must be conducted in compliance with relevant Navajo Nation regulations, as stated in Section 2.1.3.2, Well Fields.

### 2.1.1.4 Uranium Recovery Process

Need to clarify where radium recovery systems are installed? Is radium recovered on all eluant from the ion exchange column?

### 2.1.1.5 Waste Retention Ponds

Where would the retention ponds be located at each of the processing sites? It is unclear if HRI has already designated pond locations at the processing sites, and whether or not these locations would have the ponds below or above grade. Past documentation appeared to have the proposed pond locations depicted.

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#### 2.1.1.6 Instrumentation

There is not considerable information on instrumentation, but rather general procedures.

#### 2.1.2 Description of the Proposed Waste Management and Effluent Control System

For the disposal of 11e(2) by-product material, it is unclear if HRI has an agreement, or agreements, with a licensed facility, or facilities, to handle such disposal needs. If such agreements are already in place, when will these permits expire?

##### 2.1.2.1 Gaseous Effluents and Airborne Particulate

Need further clarification. The ion exchange vessels open at the tops of tanks when transferring resin in or out of the tanks. Radon would be released at these times. The second paragraph states that ion exchange vessels are closed systems, thus no vent? However, the third paragraph states Radon is released during resin transfer and ventilation is necessary.

Sections 2.1.2.1, 4.6.1.1 and 4.6.1.2: By keeping radon gas in solution, the amount of radon and daughter products in the groundwater will increase. This issue is not addressed by the discussion in these sections.

##### 2.1.2.4 Liquid Waste Disposal Options

Off-site land application of wastewater for the Church Rock lease may occur in Section 16, T16N, R13W. Section 16, as well as other adjacent sections, is used for grazing purposes by area Navajo families.

The FEIS states off-site land applications for the Crownpoint Unit 1 sites could occur on 256 ha (640 acres) in Section 12, T17N, R13W, north of the Crownpoint and Unit 1 sites. Has this land application been included in the initial environmental assessment and/or environmental impact statement as required for compliance to the National Environmental Policy Act (NEPA) of 1969? The FEIS states another disposal method utilized by the solution mining industry is surface discharge, requiring authorization by the U.S. EPA or other appropriate agencies. HRI will be subjected to permit requirements established by the Navajo Nation Environmental Protection Agency's National Pollutant Discharge Elimination Systems Program.

Sections 2.1.2.4 and 4.1.2.2: By the time HRI is ready to begin surface discharge activities, the Navajo Nation will probably have primacy from U.S.EPA for NPDES; HRI will have to get Navajo Nation permits for surface discharge or for land application within Navajo Indian country.

##### 2.1.3.1 Aquifer Restoration

The Navajo Nation strongly contests the intent of the NRC to use New Mexico drinking water

standards for groundwater restoration goals. Since, by law, groundwater is treated as part of the surface, not the mineral, estate, the relevant standards used by whoever has jurisdiction of the surface estate should be used. This would be the Navajo Nation standards for all lands in the three project units, since the lands are either tribal trust or within Navajo Indian country.

#### 2.1.3.2 Land Reclamation, etc.

The company must provide the best strategies to reclaim the Navajo Lands, regardless of the drought. Also they must include other reclamation management alternatives that could be utilized to accomplish the same success rate.

The FEIS states that the final decommissioning plan will be submitted to NRC for review and approval 12 months prior to license termination, and that reclamation would occur in interim steps during and after mining takes place.

Will environmental monitoring for surface radiation be conducted simultaneously with ongoing work activities at drilling sites? Equipment or buildings should not be released or sold to local Navajo families and/or surrounding Navajo communities due to the relaxed decontamination standards for nuclear facilities. Gamma survey and soil samples results will be compared with background values near the well fields. Recommend HRI establish one regional background value consisting of a series of survey points rather than concentrating on values derived at the sites and values associated with Naturally Occurring Radioactive Materials (NORM). Utilize radiological detection equipment capable of measuring and determining accurate natural background levels and anomalies associated with the sites. With reference to revegetation of disturbed areas, was a risk assessment conducted to determine potential contamination uptake in animals grazing in the vicinity and exposure to the general public?

HRI's proposed ISL activities will involve disturbing a significant amount of land surface area. HRI may be required to obtain a general permit for storm water discharges from construction sites. Although HRI indicates that its proposed processing plants will divert all surface water of concerns to retention ponds, it is unclear if all of HRI's leases will not be subject to storm water carrying potential contaminants off-site. If this is a strong possibility, HRI may also be required to obtain a general permit for storm water discharges associated with industrial activity. These permits would be obtained through NNEPA from the U.S. Army Corps of Engineers.

#### 2.1.3.3 Plant Decontamination and Decommissioning

Where would transuranic wastes be disposed of? The FEIS states wastes will be classified as contaminated or noncontaminated according to their radiological survey results. What threshold determines contaminated and noncontaminated wastes? Contaminated material accumulated may be disposed as of 11e(2) by-product material, what is 11e(2) by-product material? Has a location on-site been identified to bury decontaminated materials that have no resale value? What measures will be taken to address soil contamination?



NNEPA's Solid Waste Management Program should be consulted concerning the disposal of decontaminated material that has no resale value (i.e., building foundations). NNEPA is in the process of developing guidelines for the reuse and disposal of construction debris.

#### 2.1.4.2 The Unit 1 Site

HRI proposes to use an area within Section 16 for land application of treated wastewater during the aquifer restoration phases at the Unit 1 and Crownpoint leases. Are the detailed descriptions of the affected environment and environmental consequences for the Unit 1 and Crownpoint leases also applicable to Section 16?

Table 2.2: Equation 2a should read "... +4Na<sup>+</sup> + H<sub>2</sub>O"

#### 3.1.2 Air Quality

The NRC should utilize units equivalent to the CFR standards? (e.g. Table 3.4 and 3.5 units should be ug/m<sup>3</sup>, not fg/m<sup>3</sup>).

#### 3.3.1.2 Crownpoint (Hydrology)

Analysis of data from April 1992 pump test of a well in the Dakota Sandstone was reportedly complicated by the influence from the pumping of the public water supply wells in Crownpoint. Is this set of data valid for determining that the Dakota Sandstone aquifer is not interconnected with the Westwater Canyon aquifer?

Due to the lack of jurisdiction of the State of New Mexico, New Mexico drinking water standards are irrelevant. This section should state that water quality in the Crownpoint wells meets Navajo Nation primary and secondary drinking water standards.

Sections 3.3.1.2, 3.3.1.3, and 3.3.1.4, and Tables 3.12, 3.13, 3.14, 3.16, 3.17, 3.19, 3.20, and 3.21: The text in these sections states that water quality in the subject aquifer either meets or does not meet New Mexico drinking water quality standards. However, the tables correctly reference EPA and NNEPA drinking water standards. This discrepancy in the text should be corrected. Do the tables show Navajo Nation standards?

#### 3.3.1.4 Church Rock

To the best of NNEPA's knowledge, no modeling has been done by HRI or the NRC to show the influence of the mine workings on groundwater flow in the immediate area. Even if the workings are partially or fully collapsed, they would still form areas of increased transmissivity. Have we seen that the mine workings within the Westwater are isolated from other aquifers by constructed bulwarks within the main shaft? If not, it can contaminate upper aquifers as well.

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### 3.3.2.1 Regional (Surface Water)

What are the watershed sizes for the drainages that would be impacted by ISL activities at the Crownpoint lease? What is the peak runoff flow rate for the drainages that run near/through the Crownpoint lease?

## 3.4 TRANSPORTATION

The FEIS does not adequately address the transportation risks on Navajo dirt roads. There are no local emergency and police personnel mentioned to respond to a spill incident, therefore this increases the response time. There is limited Emergency Response training in the Church Rock and Crownpoint areas. The Crownpoint hospital is not equipped to handle radioactive emergencies, and the appropriate monitors and protective clothing are not available for that type of medical attention. HRI also needs to provide what the decontamination procedures for the contaminated person(s), vehicles, hospital emergency room, etc..

### 3.4.1 Regional Roads

In the transportation of chemicals and yellowcake to and from the lease sites, HRI should be deterred from utilizing unpaved roadways. These unimproved routes pose too much of a risk due to road conditions, unposted traffic limits, etc. NNEPA recommends that these unpaved segments of the Church and Picnic Roads be paved.

The length of unpaved road between Unit 1 and Navajo 9 is not specified.

### 3.4.2 Truck Accident Data

The accident rate per trip is meaningless without information on the estimated number of trips during the life of the operation.

## 3.6 LAND USE

### 3.6.2 Crownpoint

The statement of land ownership in this section is not accurate. The site is composed of mixed private surface owned by HRI and others, Federal, and Navajo Nation tribal trust and allotted land. Mineral ownership is mixed private, Federal, and allotted.

### 3.6.3 Unit 1

The information on numbers of residences and numbers of persons in the residences is four years old. Has an update been done?

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### 3.7 SOCIOECONOMICS

On page 3-56, the first sentence should read, "... "checkerboard" for its mixed private, tribal and government property rights."

#### 3.7.5 Taxes and Local Finance

The third paragraph states, "The county can also tax any Navajo Reservation lands that have been acquired as private property." This statement is unclear and subject to misinterpretation. Those private lands within the Navajo Reservation that have been acquired by entities other than the Navajo Nation as fee land are fully subject to all Navajo Nation taxes, not New Mexico or McKinley County taxes. Fee land acquired by the Navajo Nation is subject to New Mexico or McKinley County taxes only if not treated as tribal trust land. The paragraph should be clarified.

### 3.8 AESTHETICS

Were the local residents consulted about specific mountains, trees, and other esthetic elements within the project areas? In contradiction to this section, the next four sections all refer to regional or local important or high-quality vistas and landscapes associated with the project sites. This contradiction should be addressed.

### 3.10 ENVIRONMENTAL JUSTICE

Section 3.10.1 and Section 9: One could argue that the intent of environmental justice was violated by not insuring that the Navajo Nation Environmental Protection Agency, which has been participating in the DEIS and FEIS process to the fullest extent it has been allowed, received at least one copy of the FEIS.

#### 3.7.4.3 Police, Fire, and Emergency Protection

The FEIS did not adequately address spill prevention, only spill management.

The FEIS did not address a "One Plan" approach for spill contingency and emergency planning.

Sections 3.10.5 and 4.12.1: The Navajo Nation's sensitivity has been heightened during the preparation of this EIS, in that participation by the Navajo Nation was not encouraged by the BIA, nor by the NRC until late in the process. Recognition of the existing jurisdictional rights of the Navajo Nation has also been lacking in both the NRC and the BIA until late in the process.

#### 4.1.1.2 Processing Emissions

Sections 4.1.1.2 and 4.1.3: How will worker safety from excess radon exposure be insured?

Is there actual data available from other in-situ mining operations on the releases of radioactive



elements? The example of an amount of Radon released from processing plants to the atmosphere. Are the results similar to the MILDOS-AREA analysis results?

Consolidated Operations Plan (COP) Section 9.7 on the history of uranium particulate monitoring of URI's Kingsville Dome Project Site 1996 show that the maximum DAC values each month inside the dryer purchasing area exceed the concentration limits in 10 CFR 20 Appendix B, Table 1, Column 3. Has there been any type of modification of the dryer system that will minimize these values which exceed concentration limits?

Is there consideration for radon and other ambient air monitoring in the well fields for leaks from pipelines that are within the uncertainty margins of operating pressures?

HRI needs to implement an ambient air monitoring system on the downwind area from the Crownpoint processing plant to reassure the community's health and safety.

#### 4.1.3 Alternative 3 (The NRC Staff-recommended Action)

Need to clarify section on airborne effluent environmental monitoring on continuous air monitoring. What is meant by 'monitoring devices will be exchanged quarterly'? What is the sampling frequency for the analysis?

The COP lacks QA plans for air quality review/analysis of data.

## 4.2 GEOLOGY AND SOILS

### 4.2.1.1 Crownpoint

If soil electrical conductivity rises above 70 percent of the maximum level tolerated by planted crop, HRI proposes to move the irrigation area to another portion of Section 12. HRI has access to all of Section 12. Section 12 was reportedly used by Mobil in the early 1980's as a drilling mud farm. HRI should attempt to stay within the areas previously used by Mobil as opposed to moving land irrigation to any previously undisturbed areas.

HRI will have to address limiting conditions on TDS and sodium absorption for land application of wastewater. If soil impacts are found to be more significant than anticipated, this may place more burden on reinjection or surface discharge.

### 4.2.1.3 Church Rock

No mention is made in this section of the fact that Section 17, T. 16N, R. 16W, is Navajo Nation trust land. No lease agreement has been entered into for surface use of this site for such a purpose. How can they do any land application on Tribal Trust land? Can they do this under a UIC permit? Do they plan on operating in Section 17? It is understood that they had withdrawn

the section from their NRC and UIC applications.

#### 4.2.3 Alternative 3 (The NRC Staff-recommended Action)

A soils analysis using the universal soil loss equation was performed by NNEPA, indicating that any well drilling or well field establishment in the steep-sloped areas of the Crownpoint Unit would lead to extensive soil loss. This would certainly constitute an impact to soils, yet no mitigation or avoidance is prescribed by the NRC.

Sections 4.2.3 and A.14.3.5: NNEPA will be the primary Navajo Nation agency reviewing any mining reclamation plan submitted by HRI. This is appropriate since the project takes place entirely within Navajo Indian country.

#### 4.3.1 ALTERNATIVE 1 (THE PROPOSED ACTION)

##### *Premining Activities*

What is the specific period for post-restoration ground water quality monitoring? Will the surety bond still be in effect for this monitoring period? Has HRI considered problems that may occur with residual contamination sources found in fissures, joints, and mine workings?

##### *Retention Pond Leak Detection Monitoring*

HRI proposes to use chloride and specific conductance leak detection indicators for the retention ponds. How about using radium-226 as an indicator since water treatment would result in radium-contaminated sludge accumulating in ponds.

How would the operation/use of the ponds be affected by winter conditions when evaporation rates decrease, water levels rise, and ice covers develop?

##### *Post-Mining Activities/Groundwater Restoration*

What is the NRC process for HRI to "request a license amendment that would allow some change in restoration requirements on a parameter by parameter basis"? Is this similar to requests for Alternate Cleanup Levels (ACLs), as implemented at the United Nuclear Corporation Superfund site near Church Rock? Also, will the process take into account current or proposed uses of the affected aquifer.

Sections 4.3.1, 4.3.1.1 and Tables 4.6 and 4.7: In the groundwater restoration portion of these sections, there is constant reference to U.S.EPA and State of New Mexico primary and secondary groundwater standards, but Navajo Nation standards are only mentioned in Table 4.7. NNEPA must remind the NRC that the Navajo Nation has enacted primary and secondary drinking water standards, and these must be taken into account, since it is primarily Navajo Nation groundwater that will be impacted by the mining activities, and since both the Navajo Nation and U.S.EPA

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maintain that the Navajo Nation has jurisdiction for such matters over all project units.

Section 4.3.1: If primary or secondary goals cannot be attained for any of the groundwater parameters, then the Navajo Nation must be consulted during the process of establishing new restoration goals.

Section 4.3.1 and 4.3.3: The sampling, reporting and statistical analysis methodology for post-restoration water quality monitoring is not described. NNEPA suggests that production and monitoring wells in all production fields be sampled for all parameters on a biweekly basis, that reports be submitted to the NRC and other appropriate regulatory agencies at least every six months, showing all collected data and the trends over time for each parameter, and that monitoring not be discontinued until the parameters have either (1) leveled off at or below the primary or secondary standard for ten sampling events or more, or (2) leveled off above the secondary goal for ten sampling events or more, at which time discussions would begin to determine a new restoration goal for that parameter.

#### 4.3.1.1 Crownpoint

##### *Groundwater Impacts of ISL Mining*

HRI modeling showed that the influence of the drinking water wells in Crownpoint would not result in threats of horizontal excursions at the Crownpoint lease site. Has HRI or NRC accounted for potential increases in pump rates on the Crownpoint drinking water wells? This would be an overall long-term, permanent increase, not seasonal. Increased population and other proposed economic development ventures may require an overall increase in water use.

In the event a vertical excursion occurs, the FEIS frankly states that it would go undetected and flow toward some of the drinking water wells in Crownpoint. The corrective actions described on Pg. 4-21 are geared almost exclusively for horizontal excursions. NNEPA recommends that this be mitigated by NRC's requirement that HRI replace the five town wells.

##### *Groundwater Restoration*

The site-specific representative ground water demonstrations may also provide more to understanding the geochemical process of adsorption. In no way should higher post-restoration Radium concentrations of ground water at the Crownpoint lease adversely affect the lower Radium concentrations at the drinking water wells in Crownpoint.

Does dissolved organic matter exist in the soil matrix of the Westwater Canyon aquifer? If so, how will HRI address any discoloration of ground water that may be caused by dissolved organic matter? Will this require use of an additive?

What authority exists that will prompt NTUA and BIA to comply with requirements to relocate their drinking water wells in Crownpoint?

The Mine Unit Hydrologic Test Document to be submitted to the New Mexico Environment Department must also be submitted to the Navajo Nation Water Resources Department for evaluation. In addition, HRI would have to meet all relevant requirements of the U.S.EPA UIC permit prior to lixiviant injection.

Sections 4.3.1.1, 4.3.3 and 4.12.1: The NRC's position on the town of Crownpoint wells is not at all clear. In Section 4.3.1.1, HRI proposes to reimburse NTUA and BIA for increased costs due to water level drawdown impacts. This is born out in Section 4.3.3. However, the NRC also states in Section 4.3.3 that HRI must replace the town of Crownpoint wells and seal off the existing wells. NRC must clarify their position. In addition, it would seem appropriate for HRI to bear any increased operations and maintenance costs that NTUA and BIA would incur due to the replacement of the in-town wells with one well located outside Crownpoint, including the cost of merging the two systems.

#### 4.3.1.3 Church Rock

##### *Groundwater Impacts of Land Application*

The FEIS indicates that "land application should pose no threat to groundwater quality in the underlying aquifers." On Pg. 3-41, it is reported that "Shallow groundwater in the alluvium in the North Fork is tapped by several wells." In the event a significant release occurs at the Church Rock land application site, will any of these alluvial wells be threatened?

##### *Groundwater Monitoring*

Monitoring of the underlying aquifer: Drill holes and/or faults could provide conduits from the Westwater Canyon aquifer through the Recapture Shale to the underlying aquifer (Cow Springs Sandstone). There is no information provided to assure that these drill holes are properly constructed and abandoned. Data and discussion is needed on the water quality of the underlying aquifer. Monitor wells should be installed at selected locations to monitor the underlying aquifer for hydraulic connection and potential downward excursions from the Westwater Canyon mine zone.

##### *Groundwater Restoration*

"HRI concludes that if the mine workings are affected chemically by ISL mining, they should require less restoration effort than the native sandstone leached in other areas." This is too vague a statement. HRI knowingly will be entering mine workings that have the potential to have poor water quality. This should not be used for lenient restoration efforts. This is not considered natural background conditions.

Sections 4.3.1.3 and A.7.2.6: Premining tests for aquifer confinement should be conducted in the vicinity of the old mine workings, with observation wells in every aquifer above the Westwater Canyon. The mine workings extended into the Brushy Basin member as well as the Westwater;

and if the shaft was not adequately sealed at each mine level or aquifer, it could form a conduit for horizontal and vertical excursions.

#### 4.3.3 Alternative 3 (The NRC Staff-recommended Action)

NNEPA formally requests that it be involved in review of the effluent and environmental monitoring plan to be submitted by HRI.

The NRC should define what is meant by "three independent samples" to be collected to determine baseline groundwater quality. Over what time period should these be gathered? NNEPA suggests that the samples be taken at least two weeks apart; any sooner, and they would not be statistically independent. NNEPA also recommends that the baseline water quality database include all previous data gathered from wells at the site, in order to provide additional background data.

### 4.4 SURFACE WATER

#### 4.4.1 Alternative 1 (The Proposed Action)

##### 4.4.1.1 Crownpoint

"HRI has not provided detailed information regarding specific and unique details of the diversion channels of the project impoundment system." Any conclusions drawn from existing general information should not be considered as final until the detailed data is developed and reviewed. Similarly, as mentioned on Pg. 4-80, HRI did not submit a detailed plan for land application.

The FEIS did not adequately describe specifics of exactly what the company proposes to convert existing surface facilities into ISL processing plant. Does this include old concrete pads built using old design criteria? Does this include old vessels? Does this include old piping?

The FEIS did not address the issue of what impact multiple vessels breaching would have on the design of the foundation and walls, which is only designed to hold the contents of the largest vessel.

The FEIS did not address the potential for the sumps and drains to clog or overflow. What would be the alternative to handle spills inside the concrete pad. Are all the sumps and drains connected to the retention ponds? Will the retention ponds be permitted? What is the frequency of inspections of the ponds for integrity? Are there other alternatives for leak detections system besides mechanical, such as electronic monitoring?

Surface water sections in the EIS provided some data for washes associated with site flood potential for Church Rock and Unit 1 sites but not Crownpoint. Two unnamed washes are associated with the facility border the evaporation ponds. No watershed topography maps for the sites were included in the EIS. No flood flow estimates resulting in berm failure overflow



impacts to evaporation ponds or the rest of the Crownpoint facility were provided. A Crownpoint site reconnaissance conducted on May 15, 1997 by Tom Morris, NNEPA Water Quality Program staff, yielded the following comments:

What size event would it take to top the third pond berm at the southwest corner?  
Approximately 1.5-2 meters of berm is above the current highest observed bench in the south bordering wash (South Wash). Three to four meters of berm is above the highest observed bench in the west bordering wash (West Wash).

What size event would overflow the ponds causing discharge to adjacent surface waters?  
What levels and species of radionuclides and heavy metals would be expected with a discharge or breach?

No AS-BUILT's for flood control had been provided by HRI for EIS inclusion. Engineered plans are to be provided later. Gabions and rip-rap are highly questionable methods in these hydrologic systems. NNEPA Water Quality Program requests to be provided with flood control plans for each site in order to provide comments prior to review conclusions by NRC.

The middle evaporation pond (Crownpoint site) has no obvious drainage system to the third pond as does the first to the second. There are, however, two 24" diameter culverts that appear to originate near the top of the second pond and discharge into South Wash. Is this so? Where do these culverts originate? Splash pads are needed for the culverts regardless.

A large grate covered tank sits at the edge of South wash as the wash enters facility's perimeter. The tank was nearly full of a liquid that looked and smelled like septage. This liquid is seeping from the tank into South Wash. This must be remedied. A National Pollution Discharge Elimination System 402 Permit is needed to discharge, and the tank must be replaced regardless.

Two large, empty, half buried tanks are on either side of the septage tank. These tanks appeared to have been bermed at one time, but the berms have mostly eroded away. These tanks are adjacent to South Wash approximately five meters upgradient. Will these tanks see future use and what will the contents be?

The evaporation pond liners are deteriorating. Numerous holes in the liners were observed. The liners will need to be replaced or covered with another liner to prevent potential piping from destroying berm integrity allowing discharge to surface waters.

Runoff control berms observed on the facility's east side are in disrepair and incapable of controlling potential events. Berm constructions and maintenance need to be upgraded.

#### 4.4.1.3 Church Rock

NNEPA must make clear that, without a lease from the Navajo Nation and compliance with other Navajo Nation permit requirements, no surface discharge or other surface disturbance activities will be allowed in Section 17 of the Church Rock unit. The surface estate of this section is tribal trust land, which gives the Navajo Nation clear jurisdiction over all surface-disturbing activities. The NRC license may contain requirements for managing such activities, but they cannot take place without the proper lease and permits. In addition, the Navajo Nation must be consulted on all designs or plans submitted by HRI to the NRC that would involve surface disturbance in Section 17.

### 4.6 HEALTH PHYSICS AND RADIOLOGICAL IMPACTS

#### 4.6.1 Alternative 1 (The Proposed Action)

The FEIS states in Paragraph 2 no radioactive waste material would be released into surface waters, but in 2.1.2.4 *Liquid Waste Disposal Options*, the last paragraph states another disposal method utilized by the solution mining industry is surface discharge. Will there be radioactive waste discharge into surface waters? Paragraph 2 states some contaminated water leaked from retention ponds could affect the groundwater system, no significant contribution to dose by water pathways is anticipated. A build up of radioactive contaminated wastes will occur even if the leak is on a small scale. Paragraph 3 states drill cuttings containing uranium ore would be in the wet drilling mud, and would be contained in the mudpits. There must be no significant radiological impact to the area. HRI would be required to verify that well fields have been properly reclaimed and meet appropriate requirements before releasing the well field back to unrestricted use. The appropriate requirements for soil clean up criteria for natural uranium (not in equilibrium with its daughters) is 30 pCi/g and for radium is 5 pCi/g. Will surface radiation assessment be conducted prior to any drilling activities? What considerations are given for well field surface exposure rate determination?

Drill cuttings should be surveyed to determine radiation levels, and if necessary, should be disposed of off-site in Section 12 to eliminate potential future exposure risks to local residents.

##### 4.6.1.1 Crownpoint and Unit 1

#### *Air Releases*

Paragraph 2 states that off-gas (radon) would be captured, compressed, and injected into the lixiviant injection system for reintroduction into the ore zone. The reintroduction of compressed gas into the ore zone would build up high levels of concentrated radon and progeny. Have these impacts been assessed? What are impacts to groundwater from radon and progeny? Would there be cross-contamination of groundwater aquifers with radon? What are the impacts from long-lived radon daughters (progeny) to water, soil, and the public? The project would have controlled releases from three areas (source terms): (1) resin transfer/process circuit; (2) process

circuit pressure vents, and (3) land application release. The source term (3) would have the highest release of radon; would HRI be able to meet reclamation and decontamination requirements or would all contaminated material be buried on site? What measures will HRI take to limit exposure to the general public and animals grazing within the general vicinity? Based on data gathered from the Texas operation, are there additional parameters requiring monitoring?

#### *Meteorological Parameters*

Updated weather data should be obtained from the Church Rock and Crownpoint site, independently from information obtained from Gallup, New Mexico. This section should provide a description of the meteorological diffusion characteristics of the site and its surrounding area. The description should be based on data collected on site and/or at nearby meteorological stations. Sufficient data should be included to permit independent evaluations and assessments of atmospheric diffusion characteristics. This information should be fully documented and substantiated as being representative of expected long term conditions at and near the site. In addition, this section should provide a discussion of general climatology, existing levels of air pollution, the relationship of the meteorological data gathered on a regional basis to the local data, the impact of the local terrain and large lakes and other bodies of water.

#### *Individual Receptor Locations*

What components consists in the comprehensive environmental monitoring program? What mechanisms would be implemented when annual dose requirements be exceeded?

#### *Exposure Pathways*

Will HRI consider conducting an informal risk assessment to properly document and determine radiation dose to the public rather than depending on models that currently do not consider cultural impacts? Cultural variations in the parts of the animal that are consumed by Navajo individuals were also not well recognized in risk calculations. These calculations focused on liver and kidneys, and not on typical Navajo foods such as blood sausage, etc. There has not been a careful study of risks posed by the site-related contaminants for tribal specific land uses, such as from the smoking or medicinal use of ceremonial plants, or the ceremonial use of waters and sediments. Environmental exposure pathways of concern for airborne effluents from the project include inhalation, absorption, and ingestion of radioactive materials. Deposition of airborne effluents in soil from long-lived daughter products should be assessed thoroughly. What mechanism would HRI implement when off-site contamination and exposure occurs? Will HRI implement a detailed environmental monitoring program involving the local families? This monitoring would not be limited to placing samplers in and/or near the residence. How do those families feel about unwarranted radiation exposure?

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### *Estimated Doses at Modeled Receptors*

The FEIS states the dose assessment presented here considers dose to infants, which are slightly more sensitive than other age categories. What relates to unwarranted radiation exposure?

### *Liquid Waste Disposal*

The FEIS states land application could result in exposure to individuals, not only during operations but also in the far future, long after operations have ceased. What mechanism will HRI implement to address these issues? When will the Environmental Assessment for the land application be available for review? Does Table 4.22 reflect source term (3) (land application) radon values of 133,000 pCi/l? The calculated dose in Table 4.22, are they hourly, daily, monthly or annual doses?

What would radiological exposure rates be for workers encountering radium associated with the ponds and for personnel responding to transportation incidents?

### *Decontamination and Disposal*

What decontamination standard would apply to equipment, tools and materials with resale value? All decontaminated equipment, tools, and materials should not be sold to local individuals and families. As a license condition, why does NRC allow HRI to submit a decommissioning plan one year prior to beginning closure of production facilities? What implications would bankruptcy impact the decommissioning plan? Will NRC allow the Navajo Nation to review and comment on decommissioning plan?

#### 4.9.6 Alternative 3 (The NRC Staff-recommended Action)

The report of number of employees hired, salary levels, etc., should be formulated according to Navajo Nation Office of Navajo Labor Relations guidelines, and should be submitted to that office at the required frequency.

Sections 4.9.6 and 4.12.7(Socioeconomics): While the NRC's intent is good, their proposal for HRI to hire exclusively from the chapters containing the project units is contrary to Navajo Nation law. The Navajo Preference in Employment Act requires that preference be given to Navajo applicants, but does not allow "local" preference, that is, preference for applicants from certain geographic areas. Any questions about this matter should be addressed to the Navajo Nation Office of Navajo Labor Relations. However, it would be acceptable if the intent is merely to inform local residents of job opportunities in a timely manner, as stated in Section 4.12.7, but to advertise more widely than just the local chapters.



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## NNEPA GENERAL COMMENTS

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NNEPA would like to thank the NRC for the strides it has taken in recognizing the rights and jurisdiction of the Navajo Nation, and for its efforts to include the Navajo Nation in the development of the FEIS. NNEPA hopes that the NRC will continue its efforts to insure that the Navajo Nation and its governmental entities are allowed to fully participate in the regulatory aspects of the proposed project.

Regulatory Guides are issued to describe and make available to the public methods acceptable to the NRC staff for implementing specific parts of the Commission's regulations, to delineate techniques used by the staff in evaluating specific problems postulated accidents, or to provide guidance to applicants. The FEIS fails to mention and apply Reg. Guide 3.46 within the FEIS and in particular regard to *4.1.3 Alternative 3 (The NRC Staff-recommended Action)* and *Appendix B NRC Staff's Proposed License Conditions and Additional Recommendations*. Various possible pathways for radiation exposure to man should be identified and described in textual and flow-chart format. Discussion of exposure pathways involving radionuclide accumulation in specific components of the environment need to be addressed. Formats for supplying information necessary for NRC independent evaluation of offsite radiological impacts resulting from the operation of a proposed commercial-scale facility are outlined in Appendix A this document.

The FEIS states the evaluation is based on the requirements of the National Environmental Policy Act (NEPA) of 1969 as amended, NRC's "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions" that potential significant impacts from the proposed project can be mitigated, and that HRI should be issued a license with conditioned commitments made by HRI in its license application and related submittals (see Appendix B of the FEIS) and various NRC mitigation requirements and recommendations discussed in Section 4 and Appendix B of the FEIS. Furthermore, a NRC source and byproduct material license is required in order to process uranium solutions extracted from in situ uranium solution mining operations. General guidance for filling an application is provided in Section 40.31 of 10 CFR Part 40, "Domestic Licensing of Source Material." Regulatory Guide 3.46 provides guidance on the format and content of applications, including environmental reports, for licenses to authorize in situ uranium solution mining operations. This guide conforms to NRC regulations and reflects experience gained over the past several years in actual licensing cases. As apparent, the FEIS lacks the above mentioned information necessary for NRC to adequately conduct their independent review and is supported with numerous concerns and comments reflected in Appendix A, *NRC Staff's Responses to Written Comments on the DEIS*. Basic detailed guidance is essential to applicants for efficient preparation of applications, including environmental reports, for in situ uranium solution mining facility licenses and for their review by the NRC staff. Such detailed guidance is not presently delineated in NRC regulations. Based on experience gained in the issuance of such licenses, the NRC staff has identified information that should be contained in applications to reflect present needs and practices. Such information provided in regulatory guide will be helpful to both applicants and the NRC staff in reducing the cost and time involved in preparing and processing license applications. This review allows



NRC information to properly characterize radiological impacts currently denoted in the FEIS. NNEPA's concern reflects the amount of information submitted by HRI to the NRC and how it relates to the Regulatory Guide 3.46 (Task FP 818-4) table of contents (Appendix B of this document).

## ABOVEGROUND STORAGE TANKS

The FEIS did not completely describe the aboveground storage facilities specifications for each of the different types and sizes of vessel surge tanks, and piping (i.e. material compatibility, structural strength, etc.). Minimal information was provided on the Chemical Storage Tank system, therefore more information is requested regarding the specifications for the special tank system design and the applicable standards utilized for each area of the design. For instance, the tank itself, the piping, the recovery system, the secondary containment, overfill prevention, each set of vessels, and other surge tanks, etc.

The Aboveground Storage Tank(s) needs to meet or exceed National Fire Protection Association standards, i.e. distance requirements, etc. All AST information should also be shared with the Navajo Nation Fire Department's Fire Chief, Mr. Larry Tolth.

What other alternative sites is the company considering off of Navajo? Is there any anticipated expansion of the project if the market demand for uranium increases?

## AIR QUALITY

Need to clarify the Uranium disintegration series and which radioactive elements are significant? This information is essential in clarifying for the public what they may be exposed to, as well as, which radioactive elements may be detrimental to the environment, long and short term effects.

When suspending an operation for maintenance, which areas of operations of the whole project are shut down, and which are kept operating? What are the controls?

## CULTURAL AND PROCEDURAL CONCERNS

Permitting is being done by the BLM and the BIA with NRC oversight. These entities do not have the interest of the Navajo Nation at heart, but rather are concerned with the "national interest" of the United States. Throughout the report there are attempts to accommodate or placate Navajo interests; however, because of HRI's refusal to directly acknowledge the Navajo Nation and to address sovereignty up front, the point is lost.

The FEIS was inadequately distributed to potential Navajo commenters.

The Navajo Nation was not directly involved as it should have been. The FEIS should have directly and to the point described how the Navajo Nation and the Navajo population as a whole would directly benefit from this project. Instead the benefits are by-products of the actual intent

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of the project.

Although cultural surveys are "underway" the FEIS states that they are not complete.

Following NRC guidance for Environmental Justice does not mean that environmental justice has been served. For instance, public meetings and comment periods do not necessarily address the concerns of the traditional population, many of whom are hesitant to participate in that type of forum. However, Environmental Justice can only be addressed *in part* by maximization of the outreach. All assumptions should be eliminated as best as possible.

The FEIS states that with regards to cultural impacts, "it is difficult to determine the significance of such an impact, either in terms of cultural resources or environmental justice". That is a true statement and one which needs to be considered further.

## APPENDIX A

# **INFORMATION NEEDED BY NRC STAFF TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES**

1. Detailed site plot plan (overlaid on topographic map, with scale and true north arrow) clearly identifying all locations of:
  - a. Site property boundaries
  - b. Restricted area boundaries, if different from site property boundaries
  - c. All radiological effluent release points (or areas) such as:
    - 1) Production wells
    - 2) Yellowcake drying and packaging area emission stacks or vents
    - 3) Evaporation, settling, or any other solid/liquid disposal pond areas
    - 4) Any other release points of emission to the atmosphere
  - d. Lands owned, leased, or otherwise controlled by the applicant
  - e. Lands usable and available for grazing
  - f. Private residence or other structures used by the general public
  - g. Vegetable or other crops, identified by type and growing season
  - h. Milk animals (cows or goats)
2. Location of sources and receptors  
 All locations should be given in terms of distances from a central release point. Coordinates relative to this release point should be given as follows:
  - a. x kilometers east of the central release point
  - b. y kilometers north of the central release point
  - c. z meters elevation from the base of the central release point

Table 1 lists the types of sources and receptors and the format suggested for reporting the locations requested.

**Table 1**

Sources		East (km)	North (km)	Elevation (meter)
1.	Yellowcake dryer	0	0	-----
2.	Center of ore bodies (at ground surface level)	---	---	-----
3.	Solid/liquid disposal areas	---	---	-----
4.	Production wells	---	---	-----
5.	Other sources, if applicable	---	---	-----
<u>Receptors</u>				
1.	Nearest resident	---	---	-----
2.	Nearest resident in prevailing wind direction	---	---	-----
3.	Ranch	---	---	-----
4.	Farm	---	---	-----
5.	Orchard	---	---	-----
6.	Grazing location 1	---	---	-----
7.	Grazing location 2	---	---	-----
8.	Garden	---	---	-----
9.	Ranger bunk house	---	---	-----
10.	Mine camp	---	---	-----
11.	Town	---	---	-----
12.	Town 2	---	---	-----
13.	City 1	---	---	-----
14.	Other nearby residents, industrial (or recreational) facilities	---	---	-----
15.	Restricted area boundaries (N, S, E, W, NE, SE, NW)	---	---	-----

3. Time-sequenced bar graph describing various stages of the facility's operational and post operational life. This should include any alterations relating to the sources of emission such as source location, operation, restoration, termination. Changes in exposed areas in evaporation ponds should also be indicated.
4. The following parameter values should be provided (if there are changes in Part 3 above, multiple corresponding values for each stage should be reflected here):

<u>Parameter</u>	<u>Value</u>
Average ore quality, U3O8, in ore body	_____ %
Ore activity, U-238, U-234, Th-230, Ra-226 and Pb-210	_____ pCi/g
Operating days per year (plant factor)	_____ days
Dimensions of the ore body or bodies	
Acres per year to be mines	_____ acres
Average thickness of body (bodies)	_____ meters
Average production flow rate	_____ gpm
Formation porosity	_____ %
Process recovery	_____ %
Leaching efficiency	_____ %
Rock density	_____ g/cubic cm
Restoration flow rate	_____ gpm
Production cell parameters	
Residence time	_____ days
Type of cell pattern (5, 7 spot, or other)	_____
Radius	_____ m
Average cell flow rate	_____ gpm
Annual Rn-222 emission from production	_____ Ci/yr
Annual Rn-222 emission from restoration	_____ Ci/yr
(Note: If the Rn-222 is not measured, indicate the complete calculational methodology, providing all assumed parameter values and references.)	
Yellowcake drying and packaging data (if applicable)	
Processing rates for drying and packaging if different	_____ MT/hr
Estimated annual yellowcake production rate	_____ MT/hr
Expected yellowcake purity, U3O8 by weight	_____ %
Any measured airborne effluent concentration	_____ Ci U-238/yr
	_____ Ci Th-230/yr
	_____ Ci Ra-226/yr
	_____ Ci Pb-210/yr
Stack heights and airflow	
	Drying _____ m, cubic m/s
	Packaging _____ m, cubic m/s
	Other _____ m, cubic m/s
Anticipated release rates for dryer stack, the packaging area ventilation exhaust, and any yellowcake storage area ventilation exhausts	Dryer Stack _____ kg/hr
	Packaging Stack _____ kg/hr
	Other _____ kg/hr
Drying and packaging operations are carried out	_____ hr/d and d/yr
Description of all ventilation air filtration, equipment with design, expected, and minimum efficiencies (if applicable)	(Attach sheet)
Filtration equipment testing procedure and frequencies	(Attach sheet)
Solid/liquid disposal impoundment, e.g., evaporation ponds	(Attach sheet)
Complete physical, chemical, hydrological, and radiological description of disposal impoundment system.	
Total area of each impoundment area and surface area expected to be under water, saturated, moist, and dry (indicate surface moisture contents used as basis of estimates).	
Anticipated Rn-222 release rates for surface areas under water, saturated, moist, and dry, Ci/yr per meter square.	
If not included above, please provide the following:	
Total dissolved solids in liquid waste	_____ g/l
Activity of solid impoundment	_____ pCi U-238/g
	_____ pCi Th-230/g
	_____ pCi Ra-226/g
	_____ pCi Pb-210/g
Activity in liquids in impoundment's	_____ pCi U-238/l
	_____ pCi Th-230/l
	_____ pCi Ra-226/l
	_____ pCi Pb-210/l
Density of solids	_____ g/cubic meter



5. Meteorological Data

Annual joint relative frequency distributions of wind direction and wind speed by atmospheric stability class (see Table 2)

- Wind direction to be given in the 16 compass directions.
- Wind speed to be given in knots in the indicated classes (i.e., 0-3, 4-6, 7-10, 11-16, 17-21, over 21)
- Atmospheric stability to be given in the following manner:
  - A - Extremely unstable
  - B - Moderately unstable
  - C - Slightly unstable
  - D - Neutral
  - E - Moderately stable
  - F - Very stable

Further information is available in Regulatory Guide 1.23 (Safety Guide 23), "Onsite Meteorological Programs." For each atmospheric stability class, provide the data in the format in indicated in Table 2.

Table 2

Stability Class Wind Direction	Wind Speed Class (knots)					
	0-3	4-6	7-10	11-16	17-21	Over 21
N						
NNE						
NE						
ENE						
E						
ESE						
SE						
SSE						
S						
SSW						
SW						
WSW						
W						
WNW						
NW						
NNW						

- Regional Data (within 80 km) (Attached sheet)
  - Population distributions by direction (12) and radius (1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, and 80 km) for a recent year (no earlier than 1970) and for the last year of expected operations (see Table 3 for reporting table format).
  - Available county food production data, in kg/yr, for vegetables (by type and totals), meat (all types), and milk; if available, include any future predictions by local governmental or industrial or institutional organizations.

6. Miscellaneous

If not included above, please provide:

Fraction of year during which cattle graze locally \_\_\_\_\_ %  
 Fraction of cattle feed obtained by grazing \_\_\_\_\_ %  
 Fraction of stored cattle feed grown locally \_\_\_\_\_ %  
 Acreage required to graze 1 animal unit  
 (450 kg) for one month (AUM) \_\_\_\_\_ ha  
 Length of growing season \_\_\_\_\_ mo/yr  
 Fraction of locally produced vegetables  
 consumed locally \_\_\_\_\_ %  
 Fraction of locally produced meat  
 consumed locally \_\_\_\_\_ %  
 Fraction of locally produced milk  
 consumed locally \_\_\_\_\_ %

Table 3

[illegible]

## APPENDIX B

Chapter 1	Proposed Activities
Chapter 2	Site Characterization
2.1	Site location and layout
2.2	Uses of Adjacent land and waters
2.3	Population distribution
2.4	Regional historic, archeological, architectural, scenic, cultural, and natural landmarks
2.5	Meteorology
2.6	Geology and seismology
2.7	Hydrology
2.7.1	Ground water
2.7.2	Surface water
2.8	Ecology
2.9	Background radiological characteristics
2.10	Background nonradiological characteristics
2.11	Other environmental features
Chapter 3	Description of Proposed Facility
3.1	Solution mining process and equipment
3.2	Recovery plant equipment
3.3	Instrumentation
Chapter 4	Effluent Control Systems
4.1	Gases and airborne particulates
4.2	Liquids and solids
4.3	Contaminated equipment
Chapter 5	Operations
5.1	Corporate organization and administrative procedures
5.2	Management control programs
5.3	Management audit and inspection program
5.4	Qualifications
5.5	Training
5.6	Security
5.7	Radiation safety controls and monitoring
5.7.1	Effluent control techniques
5.7.2	External radiation exposure monitoring program
5.7.3	Airborne radiation monitoring program
5.7.4	Exposure calculations
5.7.5	Bioassay program
5.7.6	Airborne effluent and environmental monitoring programs
5.7.7	Ground water and surface water monitoring programs
5.7.8	Quality assurance
Chapter 6	Ground water quality restoration, surface reclamation, and plant decommissioning
Chapter 7	Environmental effects
7.1	Site preparation and construction
7.2	Effects of operation
7.3	Radiological effects
7.3.1	Exposure pathways
7.3.2	Exposure from water pathways
7.3.3	Exposure from air pathways
7.3.4	Exposure from external radiation
7.3.5	Total human exposures
7.3.6	Exposure to flora and fauna
7.4	Nonradiological effects
7.5	Effects of accidents
7.5.1	Accidents involving radioactivity
7.5.2	Transportation accidents
7.5.3	Other accidents
7.6	Economic and social effects of construction and operations
7.6.1	Benefits
7.6.2	Costs
7.6.3	Resources committed
Chapter 8	Alternatives to proposed action
Chapter 9	Benefit cost analysis
Chapter 10	Environmental approvals and consultation
Chapter 11	References
Appendix A	Information needed by NRC staff to perform radiological impact evaluation for commercial scale in situ uranium solution mining facilities
Value / Impact Statement	

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### ***Bibliography***

- Cooley et al, 1969. *Regional Hydrogeology of the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah*. U.S. Geological Survey Professional Paper 521-A. 61p.
- Crossey, L.J., 1989. *Clay mineral diagenesis in Westwater Canyon Sandstone Member of Morrison Formation, San Juan Basin, New Mexico* (abs): American Association of Petroleum Geologists, Rocky Mountain Section Meeting, Albuquerque, N.Mex., Oct. 1-4, 1989, p. 41.
- Dam, W.L., 1995. *Geochemistry of Ground Water in the Gallup, Dakota, and Morrison Aquifers, San Juan Basin, New Mexico*. U.S. Geological Survey Water Resources Investigations Report 94-4253, 76 p.
- Duffield, Glenn M., 1995. AQTESOLV: Aquifer Test Solver Version 2.01, Geraghty & Miller, Inc. Modeling Group, Reston VA, 128 p.
- Geraghty and Miller, Inc, 1978. *Ground-water Elements of In Situ Leach Mining of Uranium* August 1978. Prepared for Nuclear Regulatory Commission, Washington, D.C. Div. Of Fuel Cycle and Material Safety, 93 p.
- Harshbarger, J.W., C.A. Repenning, and J.N. Irwin, 1957. *Stratigraphy of the uppermost Triassic and Jurassic rocks of the Navajo Country*: U.S. Geological Survey Professional Paper 291, 74 p.
- Krusemann, G.P. and N.A. de Ridder, 1990. *Analysis and Evaluation of Pumping Test Data*, (second ed.), ILRI publication 47, Wageningen, The Netherlands. 377 p.
- Rautman, C.A., 1980. *Geology and mineral technology of the Grants uranium region 1979*. NMBM Memoir 38. 400 p.
- Robinson, P., C. Shuey, R. Morgan, 1995. *Uranium Mining in Navajo Ground Water: The Risks Outweigh the Benefits*. Southwest Research and Information Center. 26 p.
- Stone et al., 1983. *Hydrogeology and Water Resources of San Juan Basin, New Mexico*. NMBM Hydrologic Report 6. 70 p.
- Tweeton, D.R. and Peterson, K.A., 1981. *Selection of lixivants for in situ uranium leaching*. U.S. Dept. Of Interior, Bureau of Mines. Pg. 17-24.