APP-019

NMA
THE AMERICAN RESOURCE

November 30, 2007

United States Nuclear Regulatory Commission
Attn: Mr. Larry Camper, Director
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental
Management Programs
One Two White Flint North
11545 Rockville Pike
Rockville, MD 20852

Dear Mr. Camper:

In February 2007, the Nuclear Regulatory Commission (NRC) announced that it was considering the preparation of a generic environmental impact statement in anticipation of receiving up to fourteen potential license applications for new *in situ* uranium recovery (ISR) facilities (hereinafter "ISR GEIS"). After receiving a full briefing from NRC Staff on the proposed ISR GEIS, the Commission issued a Staff Requirements Memorandum (SRM) in which NRC Staff was directed to initiate the process of preparing an ISR GEIS. Pursuant to this Commission directive, on July 24, 2007, NRC issued a Notice of Intent (NOI) to prepare an ISR GEIS and began the ISR GEIS development process by initiating a standard National Environmental Policy Act of 1969 (NEPA) scoping process, including an opportunity for interested stakeholders to submit comments on the issues to be addressed in the ISR GEIS. *See generally* 72 Fed. Reg. 40344 (July 24, 2007). In addition, two (2) public scoping meetings to be held in Casper, Wyoming on August 7, 2007 and Albuquerque, New Mexico on August 9, 2007 were announced. *See id.* After concluding these two public scoping meetings, NRC received requests for an extension of the scoping comment period. In response, NRC issued a revised NOI in which the public comment period was extended to October 31, 2007 and a third public scoping meeting was scheduled for Grants, New Mexico on September 27, 2007. This scoping comment period was then extended a further thirty days to November 30, 2007. *See* 72 Fed. Reg. 61912 (November 1, 2007).

In response to NRC's request for public scoping comments, the National Mining Association (NMA), on behalf of the members of its Uranium Environmental Subcommittee (UES), hereby submits these scoping comments and attachments in an effort to provide NRC with the benefit of NMA UES members' over thirty years of ISR uranium recovery experience and data. NMA's UES members consist of current conventional and/or ISR uranium recovery licensees, as well as potential future conventional and/or ISR uranium recovery license applicants.

NMA's scoping comments will consist of the following components: (1) general comments regarding the scope of the proposed ISR GEIS; (2) specific comments addressing specific issues associated with ISR uranium recovery projects and scoping comments offered by interested stakeholders; and (3) an attachment consisting of a generic environmental report (GER) prepared by members of the uranium recovery industry. Given that NRC intends to prepare a GEIS in accordance with its 10 CFR Part 51 NEPA regulations and given that licensees/license applicants have the primary responsibility for the possession and management of AEA materials in a manner that adequately protects public health and safety and the environment, the attached GER has been prepared to comport with the licensee's/license applicant's responsibility to submit detailed technical and environmental evaluations in support of proposed NRC licensing actions. This GER reflects NRC guidance in NUREG-1748 entitled *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* and NUREG-1569 entitled *Standard Review Plan for In Situ Leach Uranium Extraction License Applications* in order to provide NRC with the most relevant format for utilizing the data and analyses generated by industry in these scoping comments and the attached GER.

I. <u>GENERAL COMMENTS</u>

NMA's general comments focus on a broad overview of the statutory and regulatory programs associated with the preparation of an ISR GEIS and licensing of ISR uranium recovery projects. It is NMA's experience that these issues are frequently mischaracterized or misunderstood by interested stakeholders and, therefore, it is of primary importance that all such stakeholders understand these issues so that the low-risk nature of ISR uranium recovery can be gauged properly.

A. <u>PREPARATION AND USE OF THE ISR GEIS</u>

1. The specific intent in preparing these scoping comments and the attached GER is to facilitate the creation of a generic resource to be used in evaluating newly proposed ISR uranium recovery projects, including satellite wellfields to be added onto existing ISR projects or so-called remote ion-exchange (IX) facilities. As the operators of research and development (R&D) and full-scale commercial production operations over a thirty plus year period, the ISR uranium recovery industry possesses relevant technical and environmental database, as well as associated extensive site and regional-specific analyses of the geological, hydrological, geochemical, and other relevant conditions at sites where uranium resources amenable to the ISR uranium recovery technique are found. This array of data and analyses is spread throughout a variety of NRC and Agreement State licenses and license amendment applications and their accompanying technical and environmental reports and required considerable effort to compile and consolidate, to the extent reasonably achievable, within the allotted timeframe. As a result, NMA believes that NRC should make the attached GER available with these scoping comments, so the technical and environmental data and analyses provided promote a better understanding that ISR uranium recovery is an essentially *benign* form of AEA-regulated activity—indeed, the lowest risk activity in the nuclear fuel cycle by a significant margin.

2. In some instances, interested stakeholders participating in the scoping process have argued that the ISR GEIS is intended to obviate the need for site-specific assessments of proposed ISR uranium recovery projects. NMA states unequivocally that the preparation of an ISR GEIS cannot and will not obviate the need for site-specific technical and environmental analyses for each proposed ISR uranium recovery process facility. The point of a generic or programmatic assessment is, however, to promote the efficient use of time and resources by focusing detailed attention on the site-specific circumstances and issues that differ significantly from the ISR GEIS' evaluations and conclusions regarding such issues. Indeed, a site-specific NRC Staff review which determines that the issues being assessed fall within the ISR GEIS' assessment and conclusions effectively is a form of site-specific assessment.

Indeed, NRC's regulations and guidance prohibit the issuance of ISR uranium recovery licenses for new projects without some form of site-specific technical and environmental assessment to address any issues not assessed adequately in the ISR GEIS. The categorical exclusions in NRC's 10 CFR Part 51 regulations do not apply to ISR uranium recovery projects. Thus, regardless of the existence of an ISR GEIS, NRC will perform a systematic analysis of the technical issues and potential environmental impacts presented by each proposed ISR uranium recovery project, but the level of site-specific review required likely will be different for each project.

Specifically, NRC has a detailed systematic process for determining the level of environmental review required for ISR uranium recovery projects. (*See* Figure 1 in NUREG-1748.) Initially, NRC is required to define the proposed licensing action and determine, if a categorical exclusion is not appropriate, whether an EIS is required. By preparing the ISR GEIS, NRC will satisfy the regulatory requirements of Part 51.20(b)(8) for EISs. However, NRC has made clear, and NMA does not disagree, that ISR uranium recovery projects do have site-specific aspects that will require assessment above and beyond the ISR GEIS. Accordingly, if NRC begins its systematic evaluation by concluding that, under Figure 1 and in light of an ISR GEIS, a site-specific EIS is not required, NRC will then proceed with the preparation of an environmental assessment (EA) for a proposed ISR project. After it completes the site-specific EA, NRC is required to determine whether the EA will yield a finding of no significant impact (FONSI) or whether additional assessment is required. In the event that a FONSI is warranted, NRC will complete its review and render a decision on the proposed licensing action. In the event that additional assessment is required, NRC will perform a site-specific EIS for the proposed licensing action. Thus, even given the existence of the ISR GEIS, NRC will still conduct site-specific analyses for proposed licensing actions, just in more or less detail, depending upon the site-specific issues that may be present. Therefore, assertions that the ISR GEIS is intended to obviate the need for site-specific assessments are incorrect.

3. Both Council on Environmental Quality (CEQ) regulations and past NRC practice contemplate and promote tiering of environmental analyses as with NRC's proposed use of the ISR GEIS to allow for the "tiering" of site-specific EAs for proposed ISR uranium recovery projects. CEQ's regulations directly address the process of "tiering." As defined in 40 CFR § 1508.28, "tiering" "refers to the coverage of general matters in broader environmental impact statements . . . with subsequent narrower statements or environmental analyses . . . incorporating

by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared. NRC NEPA regulations specifically take into consideration the CEQ regulations. (See 10 CFR § 51.10(a) the NRC regulations "*reflect the Commission's announced policy to take account of the regulations of the Council on Environmental Quality published November 29, 1978 (43 FR 55978–56007) voluntarily, subject to certain conditions*.")

In addition, NUREG-1748, Section 1.6.2.specifically recognizes the "tiering" concept as "a procedure by which more specific or more narrowly focused environmental documents can be prepared *without duplicating relevant parts of previously prepared, more general, or broader documents. The new, more specific environmental document concentrates on the issues and impacts of the project which are not specifically covered in the broader document*." NUREG-1748 at 1-10.

The use of "tiering" is also consistent with past NRC practice. For example, in 1980, NRC created NUREG-0706 entitled *Generic Environmental Impact Statement on Uranium Milling* (1980 GEIS) in which the common elements of conventional uranium recovery facilities were assessed in a generic, programmatic fashion. For over twenty-seven years, NUREG-0706 has served as a generic platform from which NRC has based its evaluations of license and license amendment applications for conventional uranium recovery facilities. For such facilities, NRC determined that the potential site-specific impacts could not be addressed adequately in a site-specific EA and, therefore, required site-specific EISs. However, NRC continues to use the findings of NUREG-0706 as a platform from which site-specific EISs can be "tiered." Thus, NRC will be able to use the ISR GEIS as a platform from which site-specific EAs or truncated EISs can be "tiered," depending on the site-specific aspects of a given proposed ISR uranium recovery project.

4. NMA recommends that NRC consider adopting a uniform "checklist" approach to determine the extent site-specific analyses are necessary when "tiering" off the ISR GEIS. NRC and other sister federal agencies have employed this approach in the past, and NMA believes that such an approach is particularly warranted for use with the ISR GEIS, given the benign nature of ISR recovery. For example, in preparing a GEIS for a rulemaking involving the License Termination Rule, "a *checklist* was developed to assist in the determination of whether the GEIS in support of the License Termination Rule (NRC, 1997) is applicable to proposed decommissioning actions." *Id.* (emphasis added).

Similarly, the Bureau of Land Management (BLM) has developed a systematic approach to determining whether the programmatic analyses offered in a document like an ISR GEIS are adequate for "tiering" site-specific EAs for given projects. The Utah BLM Guidebook has formalized an Interdisciplinary Team Record Checklist for a variety of purposes, one of which is determining which resources require detailed analysis in an EA or EIS. NMA believes that NRC could greatly benefit by tailoring the BLM approach to fit the requirements of the ISR GEIS and the process of "tiering" off site-specific environmental analyses. Using this Checklist as a guide, NMA has formulated a similar approach for assessing the scope and extent of site-specific analyses "tiered" from the ISR GEIS which is presented in the attached GER. Among other benefits of this approach, it promotes better coordination among cooperating agencies. It is

likely that many proposed ISR uranium recovery projects will require coordination with other federal, State, and/or Tribal agencies, including BLM. By tailoring its approach for the ISR GEIS, NRC will further streamline the review process by allowing other cooperating federal agencies who use similar approaches to shorten their review process while continuing to comply with their regulatory requirements. Thus, by using this type of approach, NRC will streamline its review process and will assist other cooperating agencies in doing the same.

B. THE ISR URANIUM RECOVERY PROCESS

1. The nature of the ISR uranium recovery process and the geologic and hydrologic conditions under which uranium deposits amenable to this process are found both are critical factors in understanding the low-risk nature of ISR uranium recovery. Even though ISR uranium recovery technology is not new, the process itself is frequently misunderstood or mischaracterized. Therefore, NMA provides this overview of the ISR process and its associated process safeguards to promote a better understanding of the ISR process and related potential impacts.

ISR uranium recovery leaves the underground ore body in place and continuously re-circulates native groundwater from the aquifer in which the ore body resides (fortified with oxygen and carbon dioxide, which is not a “toxic chemical cocktail”) through the ore body. ISR uranium recovery was first tried on an experimental basis in the early 1960s with the first commercial facility commencing operations in 1974. Uranium deposits amenable to ISR uranium recovery occur in permeable sand or sandstones that are confined above and below by impermeable strata. These formations may either be flat or “roll-front” in cross-section, C-shaped deposits within a permeable sedimentary layer. These uranium-bearing formations were formed by the lateral movement of groundwater bearing minute amounts of oxidized uranium in solution through the aquifer with precipitation of the uranium occurring when the oxygen content decreases along extensive oxidation-reduction interfaces. *Uranium roll front deposition currently is ongoing on a regional basis every day*. Regional roll fronts require broad areas of upgradient oxidation to keep uranium mobile until the oxidized water moves downgradient far enough to encounter a zone of abundant reductant. It is at this regional *redox interface* where the oxygenated water is reduced and uranium is deposited in what is known as a *redistributed* ore body that ISR uranium recovery operations are conducted.

Uranium mineralization leaves a distinct radiochemical footprint in rock and water. The basis for geophysical logging is the presence of radioactive materials which allow the discovery and delineation of ore. Where the uranium ore zone is saturated by groundwater, the footprint extends itself into water. Given natural erosion processes, uranium and uranium progeny accumulated in the rock will manifest themselves in surrounding media. For a uranium ore body to be amenable to ISR uranium recovery using the typical recovery chemistry noted above, the ore zone must be saturated with relatively fresh water and the rock must have enough transmissivity for water to flow from injection to extraction wells. In other words, for ISR uranium recovery to work, the ore must be situated in an aquifer. *There are no ISR uranium recovery operations in ore bodies that are not in aquifers.*

Techniques for ISR uranium recovery have evolved to the point where it is a controlled, safe, and, indeed, an occupationally and environmentally *benign* method of uranium recovery that does not result in any significant, potential adverse impacts to workers, the surface (lands) or the subsurface (groundwater), including *underground* sources of drinking water (USDWs). After an ore body that is amenable to ISR uranium recovery is identified, the licensee develops wellfield designs that progressively remove uranium from the identified ore body. Wellfield design is based on grids with alternating extraction and injection wells and a ring of monitoring wells above and below and outside of but surrounding the entire recovery area to detect any potential *excursions* of solubilized uranium and other minerals from the uranium recovery production zone.

As noted above, during active operations, native groundwater from the recovery zone in the aquifer is pumped to the surface for fortification with oxygen and carbon dioxide. This fortified water (i.e., lixiviant), which is similar to soda water, is then returned to the recovery zone through a series of *injection* wells in varying patterns in the wellfields. Water withdrawn from *extraction wells* in these patterns exceeds the water injected into the patterns creating a "cone of depression" that assures a *net inflow* of water into the recovery zone of the aquifer so that adjacent, non-exempt USDWs will not be impacted by excursions of recovery solutions. It also brings fresh water into the recovery zone to inhibit the build-up of contaminants, such as sodium chloride, that could reduce the efficiency of the operation.

Since water from the ore body, already containing naturally occurring uranium and its progeny, is continuously refortified with oxygen and re-circulated through the sandstone to enhance uranium values removed in the ion-exchange (IX) columns, injection is "locked" to extraction (i.e., without extracting at least as much water as is injected, the surface plant will run dry and re-circulation will stop). Injection cannot proceed without an equal or greater amount of extraction; therefore, over-injection across the area cannot take place. Wellfield *balance* is critical to optimum uranium recovery operations and post-operation recovery efforts. Wellfield *balance* involves monitoring, to the extent necessary, and adjusting pumping pressure in every well and across every wellfield on a daily basis or even hour-to-hour basis. To help keep the continuously operating system *in balance*, the extra water that is extracted is removed from the circuit as a process "bleed." The process "bleed," which contains elevated levels of radium, can be, and in the past frequently was, treated in settlement ponds or by filtration to remove the radium using a barium-radium sulphate precipitation method. Otherwise, the process "bleed" water is then discharged to holding ponds or tanks and from there it must be disposed of using land application, deep well injection, solar evaporation or some combination of these methods.

During active uranium recovery operations and groundwater restoration activities, ISR operators are required to install a comprehensive system of monitoring wells around, above, and below the aquifer zone where uranium recovery will occur to assure that, if excursions occur, they can be identified readily and addressed immediately. The design, installation, and operation of monitoring wells are performed in a progressive, iterative manner to assure that they remain viable and, thus, provide the ISR operator with adequate, up-to-date information to identify any excursions. The wells are cased to ensure that recovery solutions only flow through and from the ore zone and do not migrate to adjacent, overlying or underlying, non-exempt USDWs. Prior to

use, all monitoring wells are pump-tested to verify that they are operational and technically sufficient for active operations. Pump tests also are used to verify continuing confinement provided by less permeable overlying and underlying strata (i.e., aquitards), which forced the regional groundwater flow through the more porous sands which contain the redistributed uranium ore body amenable to the ISR process. Indeed, without the confining strata, these redistributed uranium ore bodies probably would not exist. The confining strata assist ISR operators' control of recovery solutions by limiting their movement to radial or lateral flow paths.

After uranium recovery ceases, the groundwater in the recovery zone is restored *consistent with baseline* or other water quality standards that are approved by NRC prior to the commencement of active production operations. Upon completion of groundwater restoration, wells are sealed or capped below the soil surface using approved plugging methods. Surface process facilities are decontaminated, if necessary, and removed, and any necessary reclamation and re-vegetation of surface soils is completed. *As a result, after site closure is completed and approved, there is no visual evidence of an ISR uranium recovery site, and the decommissioned site will be available for unrestricted (i.e., any future) use*.

In over three decades of ISR operations, there have been *no significant, adverse impacts to adjacent, non-exempt USDWs* outside the recovery zone and into the related area of review (AOR) [1] from ISR uranium recovery operations in the United States. Wellfield balancing, including the process "bleed," monitoring, and pump tests at ISR uranium recovery sites have been highly successful in assuring that recovery solutions are contained within the ore (recovery) zone. Before monitoring ceases, restoration is completed to minimize or eliminate the potential risk of post-operation excursions that could result in the migration of contaminants from the exempted recovery zone portion of the aquifer to adjacent, non-exempt portions of the aquifer. Restoration assist in restoring the pre-operational reductant conditions in the recovery zone(s) which the introduction of solubilizing "soda-water-like" recovery solutions reversed during active recovery operations.

2. The inescapable reality of massive regional redox capacity over the long-term combined with the presence of adequate safeguards under NRC's AEA and EPA's UIC program make it highly unlikely that excursions to adjacent, non-exempt USDWs will occur after operations cease. Indeed, NRC has imposed groundwater restoration requirements on *all* ISR operators to minimize, if not eliminate, the potential for excursions to adjacent, non-exempt USDWs after such restoration is complete.

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[1] The "area of review" is essentially a "buffer zone" prescribed by EPA's underground injection control (UIC) program to provide additional protection for USDWs during ISR uranium recovery. 40 CFR § 146.6 requires that all ISR uranium recovery licensees must establish a fixed radius of not less than ¼ mile for the area surrounding the recovery zone. The regulation also states:

> "In determining the fixed radius, the following factors shall be taken into consideration: Chemistry of injected and formation fluids; hydrogeology; population and ground-water use and dependence; and historical practices in the area."

40 CFR § 146.6(b)(2).

Pursuant to relevant NRC license conditions, ISR operators are required to engage in active groundwater restoration for each portion of the defined ore body where wellfields have been installed and where uranium recovery has occurred. Indeed, in NUREG-1508, NRC specifically states:

> "Following uranium recovery in each mine [recovery] unit, HRI would be required by NRC license to restore groundwater quality….Detailed restoration, reclamation, and decommissioning plans, related cost estimates, and an appropriate surety would be required by the NRC before HRI [or any other licensee] could begin uranium recovery operations."

The process of determining a licensable approach to restoration begins well before the issuance of an NRC license when an applicant/licensee proposes a technical plan for groundwater restoration, including an estimate of the number of "pore volumes" necessary to complete restoration, which is adequately protective of public health and safety. "Pore volume" is an industry and NRC term which is used to describe the quantity of free water in the pores of a given volume of rock. "Pore volume" provides a unit of reference that an ISR operator can use to describe the amount of circulation that is needed to deplete an ore body or to describe the amount of water that must be circulated through a quantity of depleted ore to achieve restoration. Using this pore volume *estimate*, licensees can calculate adequate financial assurance cost estimates based on the amount of water that likely will need to be used to complete adequate restoration.

However, the number of pore volumes required for groundwater restoration, like many aspects of the ISR process, is calculated based on the best available data and analyses when an applicant submits a license application. After a licensee ceases active operations in a given wellfield, active groundwater restoration commences. During the restoration process, a licensee may determine that additional or fewer "pore volumes" are required to restore water quality consistent with baseline. If this is the case, pursuant to 10 CFR Part 40, Appendix A, Criterion 9, the licensee is required to notify NRC Staff of the proposed change in estimated "pore volumes" in order to re-calculate its financial assurance cost estimate based on the increase or decrease in "pore volumes."[2] Simply put, groundwater restoration requirements, as reflected in mandatory financial assurance commitments, provide additional evidence that ISR operations are iterative and "phased" in nature and that adequate NRC safeguards exist to ensure that site water quality is restored in a manner that minimizes, if not eliminates, the potential for excursions to adjacent, non-exempt USDWs after restoration is approved by NRC.

NRC's restoration approach was further refined by the Commission in the HRI administrative litigation by requiring that an ISR operator submit a groundwater restoration action plan (RAP)[3] providing NRC Staff with line-item cost estimates for site reclamation,

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[2] More broadly, a licensee is required to update its financial assurance cost estimates annually pursuant to Criterion 9, regardless of whether additional or fewer "pore volumes" are required.

[3] The imposition of the RAP requirement was a creation of the HRI administrative litigation which is discussed in the Preamble to the attached GER.

including restoration and disposition of resulting wastes *prior to the issuance of an NRC uranium recovery license.* While the actual financial assurance mechanism is not required to be available until the licensee is prepared to commence active uranium recovery operations, the RAP detailing its proposed line-item cost estimates (including costs for groundwater restoration) must be approved by NRC Staff prior to the issuance of an NRC uranium recovery license. As a result, no ISR license applicant may receive a license to conduct active ISR operations without NRC's Staff's express approval of its proposed RAP.

In addition, EPA's UIC program provides a final regulatory safeguard which ensures that, in the highly unlikely event that a post-restoration excursion to an adjacent, non-exempt aquifer occurs, post-restoration water quality will be maintained. 40 CFR § 146.7 provides the EPA Administrator with the authority to require that an ISR operator re-commence active groundwater restoration/remediation if a post-restoration excursion occurs. However, while this regulatory safeguard exists, to the best of NMA's knowledge, neither EPA nor a State with UIC "primacy" has ever exercised this authority with any ISR operator nor has the need ever been presented. Thus, in summary, adequate safeguards exist during active ISR operations, during groundwater restoration, and after restoration to ensure that adjacent, non-exempt USDWs will not experience any significant, adverse impacts as a result of ISR operations.

C. STATUTORY AND REGULATORY PROGRAMS FOR ISR URANIUM RECOVERY

1. Similar to the ISR process, the major statutory and regulatory programs applicable to ISR operations are frequently misunderstood or mischaracterized. As a result, NMA provides a brief overview of these programs, so that all parties to this scoping process understand that, despite the low-risk nature of ISR uranium recovery operations, a robust regulatory program is in place to assure adequate protection of public health and safety and the environment.

a. Pursuant to the AEA, as amended by UMTRCA, NRC is the federal agency empowered with the responsibility for regulating ISR uranium recovery operations. NRC maintains active regulatory oversight over the conduct of ISR operations by using license conditions and 10 CFR Part 40, Appendix A Criteria, as relevant and appropriate, 10 CFR Parts 20 & 51, and related guidance.

Appendix A Criteria are broad, performance-oriented *Criteria* that govern uranium recovery activities and waste disposal. At a time when emerging environmental regulations were frequently considered to be extremely prescriptive, Appendix A can be classified as somewhat "ahead of its time" because NRC sought to develop performance-oriented *Criteria* rather than prescriptive regulations so that uranium recovery licensees could address site-specific circumstances effectively.[4] In total, Appendix A contains thirteen criteria designed to allow licensees to properly locate, operate, and decontaminate and decommission their sites.

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[4] For example, NRC Staff developed these Appendix A Criteria "mindful of the fact that the problem of mill tailings management is highly site-specific. The precise details of a program can be worked out only when the unique conditions of a site are known." Indeed, the word "requirements" in the

As noted, NRC's performance-oriented criteria in Appendix A and applicable guidance are specifically designed to allow licensees to take into account site-specific conditions. The Introduction to Appendix A states:

> "In many cases, *flexibility* is provided in the criteria to allow achieving an optimum tailings disposal program on a site-specific basis…Licensees or applicants may propose *alternatives* to the specific requirements in this appendix. The *alternative* proposals may take into account local or regional conditions, including geology, topography, hydrology, and meteorology."[5]

Since Appendix A was promulgated with the intention of maintaining *flexible* performance-oriented criteria and Section 84(c) of the AEA, as amended by UMTRCA, specifically authorizes it, NRC will evaluate site-specific *alternatives* proposed by a licensee in conjunction with a licensee's operations or decommissioning proposals. As stated in the Introduction to Appendix A:

> "the Commission may find that the proposed *alternatives* meet the Commission's requirements if the *alternatives* will achieve a level of stabilization and containment of the sites concerned, and a level of protection for public health, safety, and the environment from radiological and non-radiological hazards associated with the sites, which is equivalent, to the extent practicable, or more stringent than the level which would be achieved by the requirements of this appendix and the standards promulgated by the Environmental Protection Agency in 40 CFR Part 192, subparts D and E."[6]

However, given that Appendix A Criteria were designed primarily for application to conventional mills and not ISR facilities, NRC has determined that Appendix A Criteria will be applied to ISR projects "as relevant and appropriate." As a result, NRC has applied these Criteria to ISR licensees through the use of specific license conditions.

As stated above, pursuant to an NRC/Agreement State license conditions, ISR licensees will be required to *restore* mining zone groundwater (exempted aquifer groundwater) consistent with *baseline* or *secondary* standards (e.g., maximum contaminant levels (MCLs)[7] prescribed for

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Introduction to "Appendix A" was replaced with the word "criteria", NUREG 0706, Volume II A-81, 82.

[5] See 10 CFR Part 40, App. A (emphasis added)

[6] To be successful, licensee proposed *alternatives* to NRC or EPA regulatory *requirements* likely will require substantial justification, thorough review by NRC Staff, a public hearing, and, ultimately, a decision by the Commission. (emphasis added).

[7] It is important to note that an MCL, by definition, establishes *the highest permissible concentration level of a particular contaminant in public water supplies*. Thus, levels of contaminants in water supplies exceeding an MCL are illustrative of a water source that could be harmful to human health if consumed.

given constituents pursuant to the Safe Drinking Water Act (SDWA) or relevant State standards.[8] However, if neither restoration goal referenced above is "*reasonably achievable*," a licensee is permitted to request a constituent-specific, risk-based limit upon a showing that there will be no significant, adverse impacts on public health and safety. This flexibility is reasonable and appropriate to assure protection of public health and safety, since the goal of restoration is not to create a USDW where one did not previously exist, but rather to minimize or eliminate the potential for post-restoration impacts on adjacent, non-exempt USDWs. Moreover, this flexibility is appropriate, because, at some point, the potentially significant water consumption and financial resource impacts of continued restoration pumping after the "asymptotic curve" is reached in an attempt to further reduce the level of some constituents, (which may not even be hazardous to human health [e.g., chlorides and sulfates] or which already satisfy State class-of-use limits), to baseline or secondary limits in a portion of an aquifer that can never be a USDW cannot be justified *reasonably*.

b. To assure safe and effective underground injection throughout the United States, the United States Congress also enacted the Safe Drinking Water Act of 1974 (SDWA),[9] which, in part, authorized establishment of the Underground Injection Control (UIC) program so that injection wells would not endanger current and future USDWs. The SDWA empowered EPA with the primary authority to regulate underground injection to protect current and future sources of drinking water. EPA also was authorized to provide States with the opportunity to assume primary authority over UIC programs in accordance with final regulations promulgated by EPA in 1980, which set minimum standards for State programs to meet to be delegated primary enforcement responsibility (primacy) for such programs.[10]

Between 1981 and 1996, EPA granted primacy to 34 States for all injection wells (except those on Tribal lands). EPA implements the UIC program directly in 10 States and shares responsibility in six (6) other States. For example, the States of Wyoming and New Mexico have primacy for the UIC program, but EPA directly implements UIC programs for all Native American lands. Unless authorized by rule or by permit, any underground injection is unlawful and is in violation of the SDWA and UIC regulations.

Underground injection is broadly defined as *the process of placing fluids underground in porous formations of rocks through wells or other similar conveyance systems*. Before NRC-licensed ISR uranium recovery operations can commence at any project site, an ISR licensee must have obtained two UIC authorizations: (1) an aquifer exemption for the aquifer or portion of the aquifer wherein ISR uranium recovery operations will occur and (2) a Class III UIC permit.[11]

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[8] *See e.g.*, United States Nuclear Regulatory Commission, Hydro Resources, Inc. Materials License, SUA-1508, License Condition 10.21.
[9] *See* 42 U.S.C. § 300j-9(i) *et seq.*
[10] *See* 42 U.S.C. § 300h(1).
[11] *See e.g.*, United States Nuclear Regulatory Commission, Hydro Resources, Inc., SUA-1508, License Condition 9.14. ISR operators also may require a Class I UIC permit for deep-well

EPA's UIC program was created to protect current or future USDWs. A USDW is defined as an aquifer, or portion thereof, which serves as a source of drinking water for human consumption, or contains a sufficient quantity of water to supply a public water system, and contains fewer than 10,000 mg/liter of total dissolved solids (TDS). The broad definition of a USDW was mandated by Congress in Section 1421(d)(2)[12] of the SDWA to ensure that future USDWs will be protected, even where those aquifers currently are not being utilized as a drinking water source or could not be so used without some form of water treatment.

Within this regulatory framework, however, some aquifers or portions of aquifers, which can satisfy the broad regulatory definition of a USDW, may not reasonably be expected to serve as a current or future source of drinking water. As a result, the UIC program regulations allow EPA to *exempt* portions of an aquifer from delineation as a USDW and allow for injection into such aquifers or portions thereof. EPA regulations at 40 CFR § 146.4 state:

> "An aquifer or a portion thereof which meets the criteria for an 'underground source of drinking water' in § 146.3 may be determined under 40 CFR § 144.7 [sic] to be an *'exempted aquifer"* if it meets the following criteria:
>
> *a. It does not currently serve as a source of drinking water; and*
>
> b. *It cannot now and will not in the future serve as a source of drinking water*…or
>
> c. The total dissolved solids content of the ground water are more than 3,000 and less than 10,000 mg/L and it is not reasonably expected to supply a public water system."[13]

According to EPA, aquifers meeting one or more of these criteria are generally associated with *in situ* mineral and enhanced oil recovery. If an operator or licensee/permittee wishes to inject into a USDW for the purpose of recovering minerals (e.g., uranium), a demonstration must be made that the proposed aquifer meets at least one of the exemption criteria.[14] To the best of NMA's knowledge, there is no provision in the SDWA authorizing revocation of an approved aquifer exemption granted pursuant to 40 CFR § 146.4, EPA has not promulgated implementing regulations establishing criteria for revocation of an aquifer exemption, nor has EPA ever actually revoked such an exemption. Aquifer exemptions are a *mandatory* prerequisite for any ISR project.

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disposal of liquid 11e.(2) byproduct material during active operations and groundwater restoration.

[12] *See* 42 U.S.C. § 300h(b)(1).

[13] *See* 40 CFR § 146.4 (emphasis added).

[14] In other words, a proposed ISR uranium recovery operation can only be conducted in an aquifer or portion thereof that cannot now or in the future serve as a source of drinking water due to the presence of significantly elevated concentrations of *naturally occurring radionuclides and/or other hazardous constituents*. Thus, it is incorrect and misleading for members of the public or organizations to assert that the conduct of ISR uranium recovery operations results in a degradation of "pristine" or otherwise potable sources of water.

Therefore, logically, EPA does not prescribe specific groundwater *restoration* standards for exempted aquifers, because such exempted aquifers will never be used as drinking water sources at any point before, during or after ISR operations are complete. However, as described in 40 CFR § 146.7, EPA can require corrective action/remediation of any contamination of *adjacent, non-exempt* aquifers in accordance with the purpose of the SDWA and the UIC program to protect USDWs.[15]

UIC regulations also establish specific performance criteria for classes of wells to assure that drinking water sources, actual and potential, are not rendered unfit for such use by underground injection of the fluids common to that particular category of wells.

To obtain a permit for a new Class I deep-well injection to dispose of 11e.(2) byproduct material and other wastes or Class III uranium recovery wells, the owner/operator or licensee must file an application with the UIC Director for the relevant jurisdiction containing specific information listed in 40 CFR Part 146 or in applicable State requirements. Once a UIC permit application has been reviewed, the applicant will be notified of the items needed to complete the application, if any. After a complete application is received, an initial decision to grant or deny the permit is issued. UIC regulations also provide opportunities for public participation and comment.

A UIC permit for each site also is a *mandatory* prerequisite for the operation of an ISR project. For individual ISR uranium recovery projects, a UIC permit is required for Class III wells for uranium recovery and, if the licensee/permitee seeks to use Class I deep injection wells for disposal of liquid wastes. As stated above, such permits necessarily assume the existence of an aquifer exemption for that portion of the aquifer to be used for underground injection—*water that cannot now or in the future be used as a USDW.*

D. NRC LICENSING OF ISR URANIUM RECOVERY PROJECTS

1. In the course of preparing the ISR GEIS, NMA recommends that NRC include a thorough discussion of the "process-oriented" and "phased" nature of ISR uranium recovery projects. Some interested stakeholders have identified site-specific issues such as the establishment and development of groundwater quality parameters claiming that such issues must be addressed and completed by license applicants prior to the issuance of a license. NRC should explain in clear terms how and why ISR projects are licensed in an iterative, "phased" manner.

To provide ISR license applicants with guidance regarding the iterative, "phased" approach to ISR site development, NUREG-1569 discusses the first two phases of ISR uranium recovery licensing: (1) site characterization and (2) operations. The *Site Characterization* phase involves a *general* NRC Staff review of a license applicant's pre-operational data collection, site assessments, and proposed standard operating procedures SOPs). *See e.g.,* NUREG-1569 at 2-1, 2-5, & 2-17. However, NUREG-1569 specifically notes that "[r]eviewers should keep in mind

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[15] *See* 40 CFR § 146.7.

that the development and initial licensing of an *in situ* leach facility is *not based on comprehensive information….reviewers should not expect that information needed to fully describe each aspect of all the operations will be available in the initial application*." NUREG-1569 at 2-1 & 2-2 (emphasis added). The *Site Characterization* phase of ISR uranium recovery projects is designed to provide *general information* demonstrating the location of an ore body and the techniques or procedures to be used when recovering uranium and when monitoring health and safety or other relevant parameters such as water quality. This phase is not, however, designed to provide detailed site-specific, including subsurface, information and, as such, NRC license conditions, an EIS or other licensee commitments generally require extensive future actions as the project proceeds forward.

On the other hand, the *Operations* phase of ISR uranium recovery projects as described in Chapter 5 of NUREG-1569 requires detailed site-specific, (including subsurface), activities, such as the design of wellfields, drilling of injection, extraction, and monitoring wells, and assessment of whether such wells, piping or other equipment is properly installed and operative. Another example of phasing is a license condition that requires cessation of any site activities and the conduct of a cultural resources inventory if previously undetected historic or cultural properties are discovered during the development and construction of wellfields. Thus, "phasing" is an essential and integral component of *all aspects* of ISL uranium recovery projects.

Further, NRC regulations at 10 CFR § 40.32(e) specifically state that development of an ISR site cannot occur until NRC Staff:

> "has concluded, after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives, that the action called for is the issuance of the proposed license, with any appropriate conditions to protect environmental values. *Commencement of construction prior to this conclusion is grounds for denial of a license to possess and use source and byproduct material in the plant or facility*. As used in this paragraph, the term "commencement of construction" means any clearing of land, excavation, or other substantial action that would adversely affect the environment of a site. The term does not mean site exploration, roads necessary for site exploration, borings to determine foundation conditions, or other preconstruction monitoring or testing to establish background information related to the suitability of the site or the protection of environmental values."

NUREG-1569 at 2-10 (emphasis added).

The sequential development of ISR uranium recovery wellfields is another example of the iterative, "phased" nature of ISR uranium recovery projects. The development of these wellfields is "phased" as the accumulation of a complete sampling database cannot take place until a project operator installs baseline, production, and monitor wells. Engineers and geologists must revisit the previous day's analysis before the next well is drilled as new information becomes available everyday. Prior to placing monitor wells, additional exploration and delineation has to be conducted to assure the wells are properly placed. As wellfields are developed in an iterative fashion, all wells, including monitor wells, are tested to assure that they

are functional prior to being sampled. Sampling establishes water quality within and outside the ore zone (i.e., at the monitor wells) enabling the licensee to determine readily if an excursion has occurred. The results in one wellfield may cause the site engineer or geologist to change design in the next. This process is both progressive and iterative, as each wellfield is developed and tested with the mineral being progressively depleted from different parts of the ore body.

2. Prior to the Commission's determination that restoration fluids from ISR operations constitute 11e.(2) byproduct material and, by implication, that the subsurface activities during ISR operations effectively constitute "milling underground" or "processing" thereby making the provisions of 10 CFR § 51.20(b)(8) applicable to ISR operations, NRC typically analyzed the potential impacts from proposed ISR projects using a site-specific EA rather than an site-specific EIS.

At the beginning of its experience with the ISR process, NRC performed site-specific EISs for proposed ISR projects. However, sometime around the mid-1980s, NRC determined that proposed ISR projects, absent any site-specific issue (e.g., land ownership status), merely required site-specific EAs due to their low level of risk. To the best of NMA's knowledge, in the last 15-20 years, the only site-specific EIS performed by NRC for a proposed ISR project is HRI's Crownpoint Uranium Project (CUP). However, in the case of the CUP, one of the four proposed project sites (Unit One) was located on Bureau of Indian Affairs (BIA)-administered lands and, pursuant to BIA procedures, a site-specific EIS would be required for that particular project site. However, NRC informed HRI that all of the project sites could be merged into one site-specific EIS rather than performing EAs for certain project sites and an EIS for the Unit One site. As a result, HRI agreed to have one site-specific EIS for the entire CUP. Therefore, the only site-specific EIS performed for a proposed ISR project in the past 15-20 years was performed due to the land ownership status of a project site and not due to its potential impacts.

3. NMA is aware that NRC and other relevant regulatory entities (i.e., EPA) have been engaged in ongoing discussions regarding a proposed rulemaking for ISR uranium recovery operations. As stated in the Preamble to the attached GER, NRC Staff has determined that the existing regulatory regime for uranium recovery facilities does not properly address some aspects of ISR projects. The original 10 CFR Part 40, Appendix A Criteria and the environmental assessments conducted in the 1980 GEIS were specifically tailored towards conventional uranium recovery facilities, as ISR uranium recovery processes were not deemed to be a significant contributor to domestic uranium production. However, as ISR uranium recovery processes developed into the dominant form of domestic uranium production, NRC has determined that its regulatory program must address with more specificity the potential health and safety issues of such processes.

In response to the need for harmonized regulations for uranium recovery processes, the Commission recently issued a Staff Requirements Memorandum (SRM) approving the commencement of a rulemaking to promulgate new regulations specifically to address avoidance of duplicative regulatory oversight of ISR facilities, particularly with respect to approving final

groundwater restoration.[16] The Commission directed NRC Staff to continue to pursue MOUs with the States of Wyoming and Nebraska and to exercise enforcement discretion to permit current licensees to meet appropriate state groundwater requirements, through license amendments allowing States to determine that groundwater restoration efforts were satisfactory.[17]

The primary issue of interest for NMA in this rulemaking is revisions to Appendix A to provide ISR uranium recovery licensees with the *legal right* to obtain a constituent-specific alternate concentration limit (ACL) to complete groundwater restoration at a given facility. Currently, ISR uranium recovery licensees are permitted to apply for constituent-specific variances (i.e., the functional equivalent of an ACL on given site-specific parameters), but such licensees do not have a *legal right* to apply for an ACL under 10 CFR Part 40, Appendix A. To the best of NMA's knowledge, this proposal has been agreed-upon by NRC and EPA. Further, NMA believes that, pursuant to this proposal, ISR uranium recovery licensees would be permitted to use "class of use" as one justifying factor when applying for an ACL. Therefore, NMA requests that NRC address this issue, to the extent practicable, in the ISR GEIS.

4. It is NMA's understanding that NRC intends to prepare the ISR GEIS, in part, to clarify the statements and policies articulated in NUREG-1569, so that license applicants and licensees will be able to prepare high-quality license and license amendment applications that will satisfy NRC's acceptance review criteria and that will meet NRC Staff's goal of issuing only one set of requests for additional information (RAIs). However, many aspects of NUREG-1569 reference previously prepared Regulatory Guides and other guidance for the preparation of plans for establishment of site-specific background parameters such as soil and water quality sampling. Regulatory Guides such as 4.14 were originally prepared to address conventional uranium recovery facilities and only have specific application to ISR uranium recovery facilities as relevant and appropriate. As a result, license applicants are required to formulate their own site-specific sampling plans and other SOPs, rather than having express NRC guidance upon which to rely. Therefore, NMA requests that NRC include guidance for its licensees and license applicants with respect to the specific application of its Regulatory Guides to ISR uranium recovery operations.

E. <u>POTENTIAL IMPACTS OF ISR URANIUM RECOVERY</u>

1. One of the issues most frequently raised by interested stakeholders is the potential impacts to public health and safety from ISR uranium recovery, as compared with those from previous conventional uranium mining/milling. It appears that such stakeholders may believe that the potential impacts from conventional uranium mining/milling are essentially similar to those from ISR uranium recovery. Thus, NMA will provide a brief discussion of why this assumption is patently incorrect and why the potential risks associated with ISR operations are, by orders of magnitude, lower than those from conventional uranium mining/milling. Indeed, it is also worth repeating that conventional uranium *mining* is not now and never has been

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[16] *See* SRM-COMJSM-06-0001 (March 24, 2006).
[17] *Id.*

regulated under the AEA by NRC, and there is no evidence of significant adverse public health or environmental impacts from conventional *milling,* which has been and is regulated by NRC.

As described in the attached GER, the extremely low-risk nature of ISR operations can be seen in the differences in potential radiation dose impacts on workers and the public from conventional uranium mining/milling versus ISR uranium recovery and natural background radiation in the areas where ISR projects likely will take place.

As a general matter, ionizing radiation is ubiquitous throughout the United States and, according to the National Council on Radiation Protection and Measurement (NCRP), the average background radiation dose to a member of the public in the United States is approximately 300 mrem/year. Dose from naturally occurring sources, which is the largest potential source of public radiation dose within the ambit of NRC's definition of "background radiation," is highly variable (i.e., it can vary by as much as a factor of ten across the country). Dose from "background radiation" results from cosmic radiation sources such as cosmic rays from the sun and supernova explosions and from anthropogenic (human) activities, such as global fallout and surface nuclear weapons testing, internal dose from ingested or inhaled radionuclides, terrestrial gamma doses, and the largest percentage of dose, which is from radon and its decay products. Indeed, the largest everyday anthropogenic activity causing releases of radon into the atmosphere is farming. As a result, it can be said with confidence that members of the public are exposed to radiation dose all of the time and that, depending on a person's geographic location, it can vary greatly.

Given these parameters, a proper understanding of the potential sources of radiation dose from uranium recovery operations and the corresponding potential risk is necessary. Initially, it is well-accepted that the planet contains a multitude of naturally occurring radiation sources that "bathe" every living thing on this planet in radiation. These sources are augmented further by the creation of anthropogenic sources of radiation outside the control of a licensee, such as global fallout and Chernobyl, which prompted NRC to alter its definition of "background radiation" to include such sources.[18] Further, as noted above, potential dose from naturally occurring radiation sources is highly variable, according to former NRC Commissioner Dr. Gail de Planque.[19] Thus, it is likely that locations containing elevated levels of naturally occurring radionuclides, such as recoverable uranium, will exhibit elevated levels of naturally occurring radiation. Indeed, NRC has indicated that, in the United States, background radiation total effective dose equivalents (TEDE) range from 100 mrem/year-1,000 mrem/year with higher levels in the higher altitudes in the mineralized areas of the western part of the country.

Added to this, a variety of data and analyses are available that provide evidence that potential radiation dose risks associated with both conventional and ISR uranium recovery are well below regulatory limits. While current data and analyses from United States-based conventional uranium mining operations are not available, many such data and analyses are

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[18] *See* 10 CFR § 20.1003.
[19] Dr. Gail de Planque, *In Search of….Background,* NRC Workshop on Site Characterization for Decommissioning (November 19, 1994).

available from Canadian-based operations. These data show the average total dose (TEDE) dose for underground miners for the period 1997 to 2005 is about 3.3 mSv, equivalent to 330 mrem, which is approximately equal to the average dose received from natural background radiation in the United States and is approximately, 1/17th of the annual worker dose limit in the United States of 5,000 mrem/year. Mill workers in Canada received an average dose of 186 mrem, and surface mining personnel received an average dose of 47 mrem. In 1975, 7 of 17 uranium mills in the US reported an average whole body dose to mill workers of 380 mrem/year. [NRC GEIS 1980] This value although somewhat higher than the current value reported for Canadian mills, is well within regulatory limits and, again, is comparable to the dose received from natural background. Thus, the dose to workers at uranium mining/milling facilities and members of the public living nearby are well-within the lower level of the range of average natural background exposures and far below NRC's annual exposure limit for workers or members of the public.

With respect to ISR operations, the potential impacts from radiation dose are, by orders of magnitude, lower than those posed by conventional mining/milling. Many of the dose pathways relevant to conventional mining/milling, such as ore removal, hauling, ore storage, mill tailings, and wind-blown particulate are not present, and therefore do not pose any risk, at ISR facilities, since no ore or waste rock is brought to the surface and there are no tailings associated with ISR activities. Thus, it is anticipated that the potential doses to actual members of the public who live near ISR facilities will be significantly lower, on the order of 1 mrem/year which equates to NCRP's negligible individual risk level (NIRL).[20] Thus, it is highly unlikely that an ISR worker, much less a member of the public, will receive a dose in excess of 10 CFR § 20.1301 regulatory limits.

F. <u>TRANSPORTATION</u>

1. NMA notes that potential transportation impacts associated with the transport of yellowcake, yellowcake slurry, and uranium-laden resins from uranium recovery or other operations already have been assessed exhaustively, and NRC need not "re-invent the wheel" when assessing such potential impacts.

In July of 1980, NRC issued NUREG-0535 entitled *Review and Assessment of Package Requirements (Yellowcake) and Emergency Response to Transportation Accidents-Final Report* in which it was determined that:

> "The concept underlying the regulation of the safe transportation of these LSA materials is that the concentration of radioactivity is low enough to obviate the requirement for rigorous packaging standards. The low concentration of radioactivity conceptually renders the material "inherently safe," considering radiological effects of the material, because it is highly unlikely, under any circumstances arising in the transportation of these materials, including accidents in which the material is released to the environment, that a person could take in enough material to produce a significant radiological effect.

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[20] NCRP's NIRL is "a level of average annual excess risk of fatal health effects attributable to irradiation, below which further effort to reduce radiation exposure to the individual is unwarranted."

> Consequently, only minimal packaging standards are necessary; operational controls may be used to supplement these standards to achieve safety in transportation."

NUREG-0535 also concludes that, "[t]he risk of damage to public health and safety from the transportation of LSA materials is very small although the number of LSA packages shipped each year is large."

Moreover, the preamble to 10 C.F.R. Part 51 explicitly states that the transportation of radioactive materials does not pose any *significant radiological* threat to public health and safety. DOT found in an EA on the transport of radioactive materials that "the risks of highway transport are so low that the regulations authorizing such transport will have no *significant* environmental impact." The Commission, in NUREG-0170, considered the environmental impacts of the transportation of *all* types of radioactive materials. This NUREG set forth the Commission's conclusion that:

> "the environmental impacts, radiological *as well as non-radiological*, of both the normal transportation of radioactive materials and of the risk and consequent environmental impacts attendant on accidents involving radioactive material shipments were sufficiently small that shipments by *all* modes of transport should be allowed to continue and no immediate changes to NRC regulations were needed."[21]

Further, NRC in its 1980 GEIS has assessed the transport of dried and packaged yellowcake from conventional uranium mills and has reviewed the proposed transportation of yellowcake and uranium-loaded IX resins from central processing facilities in a variety of license applications for new conventional or ISR uranium recovery facilities and license amendment applications for new satellite wellfields from existing licensees.[22] These analyses have demonstrated that the transport of such materials does not pose a significant threat to public health and safety or the environment.

G. <u>OTHER COMMENTS</u>

13. As a general proposition, ISR uranium recovery processes involve the use of ion-exchange (IX) technology, including synthetic IX resins, to remove uranium from site groundwater and concentrate such uranium for further processing to produce yellowcake. In addition, these synthetic IX resins are also used in a variety of other operations where uranium is removed from drinking water or in other water treatment operations. These synthetic IX resins are similar technologically, if not identical, and remove uranium from groundwater in a similar

[21] 49 Fed. Reg. 9352, 9374 (March 12, 1984).

[22] It is also worth noting that NRC's recent issuance of a source material license for R.M.D. Operations, LLC also assessed the transport of loaded IX resins from multiple community water systems (CWSs) to licensed uranium recovery facilities (conventional or ISR) for processing. Given that RMD's IX resins are substantially similar, if not identical to, ISR IX resins, this analysis should also be factored into NRC's assessment of transportation issues in the ISR GEIS.

fashion. Thus, on a site-by-site basis, there is little, if any, difference between uranium-laden IX resins from one ISR project site or from a drinking water or other water treatment site.

Thus, while ISR uranium recovery licensees are viewed as the predominant users of synthetic IX resins for uranium recovery operations, both ISR and conventional uranium recovery licensees have, and have had, the capacity to process uranium-laden IX resins. With NRC's or an Agreement State's authorization, conventional uranium recovery facilities are allowed to utilize IX stripping and elution facilities at their licensed site(s). Indeed, the 1980 GEIS for conventional uranium milling specifically identified IX resins as a potential source of uranium recovery, whether from on-site processing or off-site water treatment:

> "the resulting impure dilute leach solutions have to undergo *concentration* and *purification* as a prerequisite to the production of a final, high-grade, uranium product. A number of major techniques are used to affect this stage of the milling process. They are: *ion-exchange…solvent extraction*…."[23]

Further, while conventional uranium recovery facilities may create uranium-laden IX resins as a part of their processing operation, NRC also has identified IX resins from various water treatment operations as a potential source of uranium recovery material:

> "The Nuclear Regulatory Commission (NRC) and Agreement States have received, and in some cases approved, requests to allow a uranium mill to process feed material that was not natural (native, raw) uranium ore and dispose of the resulting waste in the facility's tailings impoundment. In those cases, the feed material was generally either processing wastes from other extraction procedures or *the residues from mine-water treatment.* These requests were handled on a case-by-case basis, and approvals were based on the interpretation that the proposed feed material was *refined or processed ore.*"[24]

Given the statements noted above and the fact that both ISR and conventional uranium recovery facilities utilize similar technology to strip uranium-laden IX resins, NRC already has demonstrated that such IX resins are acceptable for processing at ISR and conventional uranium recovery facilities if such facilities have IX stripping and elution facilities that are licensed by NRC or an Agreement State. Since the receipt and processing of such IX resins has been acknowledged and assessed by NRC in the past, NMA believes that NRC should make clear in the ISR GEIS that both ISR and conventional uranium recovery facilities can accept uranium-laden resins from ISR operators and/or other water treatment operators without the need for a license amendment.

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[23] 1980 GEIS at B-9.
[24] 57 Fed. Reg. 20525, 20532 (May 13, 1992).

H. CONCLUSION

1. In addition to these general and specific comments, NMA hereby submits the attached GER to provide NRC with a generic reference document based on over thirty years ISR uranium recovery experience, data, and analyses. The GER is formatted pursuant to NRC's 10 CFR Part 51 and NUREG-1748 guidance for EISs to provide NRC Staff with as full an overview of the ISR uranium recovery industry as possible in the allotted timeframe and an analysis of the potential impacts of all aspects of licensed ISR operations. NMA believes that the data and analyses provided in the GER will provide NRC Staff with considerable assistance in compiling and assessing the potential impacts of ISR operations in the ISR GEIS.

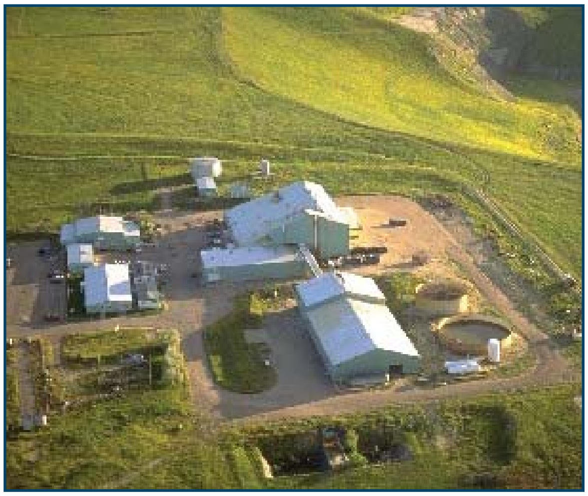
Further, NMA believes that its scoping comments and attachments will provide NRC, Agreement States, and interested stakeholders with a comprehensive overview of the low-risk, *benign* nature of ISR uranium recovery and the potential technical and environmental issues associated with proposed ISR projects. NMA welcomes questions on these scoping comments and its attachments and hopes to engage in an active dialogue regarding the future development of the ISR GEIS and the licensing of new ISR projects. Thank you for your time and consideration in this matter.

Respectfully Submitted,

Katie Sweeney
Associate General Counsel

Generic Environmental Report in Support of the Nuclear Regulatory Commission's Generic Environmental Impact Statement for In Situ Uranium Recovery Facilities

November 30, 2007



Prepared for:
National Mining Association
101 Constitution Ave., NW
Suite 500 East
Washington, D.C. 20001

Prepared by:

Anthony J. Thompson
Christopher S. Pugsley
Thompson & Simmons, PLLC.
1225 19th Street NW, Suite 300
Washington, D.C. 20036

Tetra Tech, inc.
Uranium Program Group
950 17th Street
Suite 2200
Denver, CO 80202

Katie Sweeney
National Mining Association
101 Constitution Ave., NW
Suite 500 East
Washington, D.C. 20001

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Due to time constraints, all detailed references were not available at the time of publication. An errata sheet will follow.

ACRONYMS AND ABBREVIATIONS

^oC	Degrees Celsius
^oF	Degrees Fahrenheit
AA	Already Assessed
ACL	Alternate Concentration Limit
AEA	Atomic Energy Act of 1954, as amended
AEC	Atomic Energy Commission
ALARA	As Low as Reasonably Achievable
AOR	Area of review
ASLBP	Atomic Safety and Licensing Board Panel
ASME	American Society of Metallurgical Engineers
ASTM	American Society for Testing and Materials
BIA	Bureau of Indian Affairs
BLM	United States Bureau of Land Management
Bq/yr	Becqere/year
CBR	Crowe Butte Resources, Inc.
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
Ci/yr	Curies per year
cm	Centimeter
CUP	Crownpoint Uranium Project
dB	Decibels
dBA	A-weighted Decibel
D&D	Decommissioning and decontamination
DEIS	Draft Environmental Impact Statement
DOE	United States Department of Energy
DOT	United States Department of Transportation
E	East
EA	Environmental Assessment
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
EPA	United States Environmental Protection Agency
ER	Environmental Report
FEIS	Final environmental impact statement
Fed. Reg.	*Federal Register*
F_{eq}	Fractional ingrowth
ft	Foot
ft/d	Feet per day
ft/mi	feet per mile
ft/ft	Feet per foot
ft/yr	feet per year

ACRONYMS AND ABBREVIATIONS (Continued)

g/L	Grams per liter
gal/day/ft	Gallons per day per foot
GEIS	Generic environmental impact statement
GER	Generic environmental report
gpm	Gallons per minute
Ha	Hectares
HDPE	High-density polyethylene
HEPA	High-efficiency particulate air
hr	Hour
HRI	Hydro Resources, Inc.
IAEA	International Atomic Energy Association
ID Checklist	Interdisciplinary Team Record Checklist
in	Inches
ICRP	International Commission on Radiological Protection
ISL	In situ leach
ISR	In Situ Uranium Recovery
IX	Ion exchange
kg	Kilogram
km	kilometer
lb/hr	Pound per hour
L	Liters
L/min	Liters per minute
LISS	Lower Irigaray Sandstone
LNT	Linear no-threshold
LPG	Liquified petroleum gas
LSA	Low specific activity
m	Meter
m^3	cubic meters
m/s	Meter per second
mCi/yr	MilliCuries per year
MCL	Maximum Contaminant Limit
mg/L	Milligrams per liter
mi	mile
MIT	Mechanical Integrity Test
mmho/cm	Millimho per centimeter
MOV	Memoranda of Understanding
mph	Miles per hour
mrem	Millirem
mrem/yr	Millirems per year
mSv	Millisievert
MW	Megawatt
N	North
NA	Not applicable

ACRONYMS AND ABBREVIATIONS (Continued)

NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NCRP	National Council on Radioactive Protection and Measurement
NDR	Canadian National Dose Registry
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NIRL	Negligible individual risk level
NMA	National Mining Association
NMSS	Nuclear Material Safety and Safeguards
NOI	Notice of Intent
NORM	Naturally occurring radioactive material
NP	Not present
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulations
NPS	National Park Service
NRC	United States Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSR	New Source Review
NUREG	United States Nuclear Regulatory Commission Regulation
OELD	Office of the Executive Legal Director
OSHA	Occupational Health and Safety Administration
pCi	picoCuries
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
pCi/m^2/s	picoCuries per square meter per second
PM_{10}	Particulate matter with an aerodynamic diameter of 10 micrometers or less
PPE	Personal Protective Equipment
ppm	Parts per million
PRB	Powder River Basin
PS	United State Department of Commerce Voluntary Product Standard
PSD	Prevention of Significant Deterioration
psi	Pounds per square inch
psig	Pounds per square inch gauge
PV	Pore volume
PVC	Polyvinyl chloride
RAP	Restoration Action Plan
RCRA	Resource Conservation and Recovery Act
Reg. Guide	Regulatory Guide
RMD	R.M.D. Operations, LLC
RO	Reverse osmosis
RSO	Radiation Safety Officer
§	Section
SE	Southeast

ACRONYMS AND ABBREVIATIONS (Continued)

SS	Site Specific
SSE	South-southeast
SDWA	Safe Drinking Water Act of 1974
SER	Safety Evaluation Report
SERP	Safety and Environmental Review Panel
SHPO	State Historic Preservation Officer
SOP	Standard operating procedures
SRM	Staff Requirements Memorandum
SRP	Standard Review Plan
SX	Solvent extraction
TDS	Total dissolved solids
TEDE	Total estimated dose equivalent
TENORM	Technologically enhanced naturally occurring radioactive material
μCi	microCuries
μCi/yr	microCuries per year
μg/L	microgram per liter
$\mu g/m^3$	micrograms per cubic meter
μmhos/cm	micromhos per centimeter
UCL	Upper control limits
UES	Uranium Environmental Subcommittee
UISS	Upper Irigaray Sandstone
U.S.C.	United States Code
UIC	Underground injection control
UMTRCA	Uranium Mill Tailings Radiation Control Act
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
URI	Uranium Resources, Inc.
USACE	United States Army Corps of Engineers
USDA-FS	United States Forest Service
USDW	Underground sources of drinking water
USFWS	United States Fish and Wildlife Service
UV	Ultraviolet
Vol.	Volume
VRM	Visual Resource Management
W	West
WCS	Waste control specialists
WLM	Working level month
WMA	Wyoming Mining Association
YDR	Yellowcake drum reaction

NATIONAL MINING ASSOCIATION

GENERIC ENVIRONMENTAL REPORT IN RESPONSE TO NOTICE OF INTENT TO PREPARE A GENERIC ENVIRONMENTAL IMPACT STATEMENT FOR IN SITU URANIUM RECOVERY FACILITIES

PREAMBLE SECTION

I. INTRODUCTION

The United States uranium recovery industry has been subject to both periods of significant growth and decline over the past sixty years. More recently, the domestic uranium recovery industry has endured a steep decline that forced most domestic uranium recovery companies to cease active operations, and very nearly destroyed the industry as a whole. Reduced to annual uranium production of about two-plus million pounds, the domestic uranium recovery industry is now experiencing an opportunity for significant expansion and development. Indeed, there are indications that over 400 new companies have been formed to take advantage of this opportunity. Although it is presumed that only a fraction of these companies ultimately will actually recover uranium, nevertheless, the United States Nuclear Regulatory Commission (NRC or the Commission) (and its Agreement state counterparts) likely will receive multiple license applications for new uranium recovery facilities in a relatively short period of time. Accordingly, NRC has determined that it will need to be prepared to provide timely review, denial, approval, or approval with conditions of license applications for new uranium recovery facilities.

Since indications from industry are that a large number of such applications will be for *in situ* uranium recovery (ISR) facilities, NRC has determined that it will create a new generic environmental impact statement (GEIS) for ISR facilities (ISR GEIS) to provide NRC, its Agreement States, and potential license applicants with a generic assessment of the technical requirements for, and potential environmental and public health impacts of, ISR facility development, operation/production, and decommissioning and decontamination (D&D). The proposed ISR GEIS, however, will in no way obviate the need for site-specific analyses for individual ISR license applications, but will allow such analyses to "tier" off the ISR GEIS as appropriate.

The National Mining Association (NMA) and the members of its Uranium Environmental Subcommittee (UES) strongly support the creation of an ISR GEIS. NMA believes that it can provide significant support for the creation of the ISR GEIS by providing NRC with the benefit of NMA member companies' more than 30 years of experience with the technical and environmental issues associated with ISR operations through its generic scoping comments and this generic environmental report (GER), which contain extensive analyses of the various aspects of ISR projects. This GER demonstrates that, for all practical purposes, surface facilities and sub-surface geological and hydrological conditions where ISR-amenable uranium deposits are located are essentially identical. As a result, an ISR GEIS will provide a particularly useful foundation upon which NRC and licensees can evaluate individual license applications. NMA begins its GER with a description of ISR processes and the relative potential risk and impacts of ISR operations and a generic overview of the domestic uranium recovery industry and its associated statutory and regulatory programs.

II. CURRENT URANIUM MARKET CONDITIONS AND THE NEED FOR NEW URANIUM PRODUCTION

In recent years, the domestic uranium recovery industry has been producing approximately 2 to 3 million pounds of uranium per year, but prospects for an upturn appear strong as the international market for uranium is experiencing a significant shortfall of supply from primary production, which is not expected to be alleviated in the near future. Moreover, given that the United States alone has 104 operating nuclear reactor units requiring an average of 500,000 pounds of uranium per year to operate (i.e., 51 to 52 million pounds consumed per year), and new reactor unit construction will require approximately two million pounds of uranium per unit for base start-up, the availability of a viable domestic uranium recovery industry is an even more critical issue from the perspective of the country’s current dependence on foreign sources of energy.

Beginning in 2005 with the announcement of a new national policy to encourage the development of new nuclear reactors to meet emerging domestic energy requirements, the nuclear industry has begun a renaissance that has sparked, among other things, the potential for submission of multiple reactor and uranium recovery license applications. Given the continued worldwide need for increased primary uranium production operations, the spot-market price of uranium has increased from a low of approximately $7.00/pound to as high as $140/pound. The increases in uranium prices have led to potential license applicants identifying uranium reserves, obtaining the appropriate mineral rights to such reserves, and evaluating data for such reserves on the way to preparing license applications for new ISR and/or conventional uranium recovery projects.

III. THE CURRENT DOMESTIC URANIUM RECOVERY INDUSTRY: URANIUM RECOVERY METHODOLOGIES

A. CONVENTIONAL URANIUM RECOVERY

The first form of primary uranium production is conventional uranium mining and milling. This technique involves the identification of uranium deposits that can be removed from the earth using “conventional” mining processes such as underground or surface mining. The uranium-bearing ore that is removed from the earth is then taken to a uranium “mill” where it undergoes “processing” activities such as grinding and crushing. Then, mill processes extract and refine the uranium from the ore and produce a product called “yellowcake,” (“yellowcake” is the industry term for the produced form of uranium prior to conversion, fabrication, and enrichment into commercial nuclear fuel). Conventional milling processes result in substantial amounts of tailings and other wastes (known as 11e.(2) byproduct material) that are stored in on-site surface tailings impoundments which, after active operations cease, must be reclaimed to satisfy extremely conservative closure and containment requirements. Ultimately, the reclaimed tailings and any other property necessary for safe containment and control of 11e.(2) byproduct material must be transferred to the United States Department of Energy (DOE) or the state in which the impoundments reside, as an NRC licensee in perpetuity, for long-term surveillance and monitoring.

B. IN SITU URANIUM RECOVERY

The second form of primary uranium production, ISR, leaves the underground ore body in place and continuously re-circulates native groundwater, which has been fortified with oxygen and carbon dioxide, through the aquifer in which the ore body. ISR operations first were tried on an

experimental basis in the early 1960s with the first commercial facility commencing operations in 1974. Uranium deposits amenable to the ISR process occur in permeable sand or sandstones that are confined above and below by less permeable strata. These formations may either be tabular or C-shaped deposits within a permeable sedimentary layer formed as "roll-fronts." These uranium-bearing formations were formed by the lateral movement of groundwater bearing minute amounts of oxidized uranium in solution through the aquifer with precipitation of the uranium occurring when oxygenated waters encounter a low oxygen reducing interface, causing precipitation of uranium minerals along that boundary. *Currently, uranium roll-front deposition that has taken place over millions of years is ongoing on a regional basis every day.* Regional roll-fronts require broad areas of upgradient oxidation to keep uranium mobile until the oxidized water moves downgradient and encounters a zone with sufficient reductant. It is at this regional *redox interface,* where the oxygenated water is reduced and uranium is deposited in a reduced mineral phase in what is known as a *redistributed* ore body, in which ISR operations are conducted. ISR operations must be conducted in *redistributed* ore. Most, if not all, of these *redistributed* ore deposits are present in sediments that have fluvial origins, which are common to ISR-amenable deposits in the states of Nebraska, Texas, Wyoming, South Dakota, Colorado, and New Mexico.

Uranium mineralization leaves a distinct radiochemical footprint or signature in the host rock and surrounding groundwater—that is, uranium is present not only upon the rock matrices, but also within the groundwater in the ore body. In other words, given natural dissolution processes, uranium and uranium progeny that have accumulated on the host sands also occur naturally in surrounding groundwater media. For a uranium ore body to be amenable to the ISR process using the typical recovery chemistry noted above, the ore zone must be saturated with relatively fresh water and the rock must have enough transmissivity for water to flow from injection to extraction wells. In other words, for the ISR process to work, the ore must be situated in a saturated, water-bearing interval referred to as an aquifer. *There are no ISR operations in ore bodies that are not in aquifers.*

Techniques for ISR recovery have evolved to the point where it is a controlled, safe, and, indeed, an occupationally and environmentally *benign* method of uranium recovery that does not result in any significant, potential adverse impacts to workers, the surface (lands) or the subsurface (groundwater), including *underground* sources of drinking water (USDWs). Initially, the geologic structure and conditions in an ISR-amenable uranium ore body provide adequate natural safeguards against potential environmental impacts. The natural mineralization processes that produce a local uranium ore body occur over millions of years. The regional uranium roll-front deposits described above require broad areas of upgradient meteoric oxidation to keep uranium mobile until that oxidized water which moves downgradient slowly encounters a zone of abundant reductant downdip. It is at this regional redox interface where the oxygenated water is reduced and uranium is deposited. The ISR process requires that the operation temporarily reverse the reduced condition (that is, temporarily create an oxidizing environment) in order to recover the uranium. After the uranium recovery and groundwater restoration operations cease, reducing conditions return over time. The same reducing processes that originally minimized the mobility of uranium and created the ore zone, continue to minimize its mobility after operations are complete. As a result, the uranium and other minerals remain in close proximity to the ore zone. Thus, it is unreasonable to conclude that a regional aquifer maintains capacity to absorb meteoric oxygen from expanses of slow-moving ground water on a grand scale, yet this same redox interface will be unable to absorb oxygen in similar form on a far smaller scale from slow-moving groundwater that may exist after restoration from an ISR project site. This recovery zone is extremely small as compared to the size of the regional aquifer, and it is logical that the regional reducing capacity of the aquifer will

prevail over any small pockets of residual oxidation that may persist after post-recovery groundwater restoration by the ISR operator.

Next, the operational process of developing an ISR project site provides further safeguards against potential environmental impacts. After an ore body that is amenable to ISR is identified, the licensee develops well field designs to progressively remove uranium from the identified ore body. Well field design is based on grids with alternating extraction and injection wells, monitor wells above and below the recovery zone, and a ring of monitor wells surrounding the entire recovery zone to detect any potential *excursions* of recovery solutions from the uranium recovery production zone.

ISR operations, by definition, are iterative and “phased” in nature. The sequential development of ISR well fields is an example of the iterative, “phased” nature of ISR projects. The development of these well fields and the accumulation of a complete sampling database cannot take place until a project operator installs baseline, production, and monitor wells. Engineers and geologists continually assess data as it is obtained, applying this new information to the next phase or activity, thus ensuring that subsequent exploration and delineation is based on the most up-to-date information possible to ensure proper well placement. Prior to placing monitor wells, additional exploration and delineation must be conducted to assure proper placement of the wells. As well fields are developed, all wells, including monitor wells, are pump tested to assure that they function appropriately prior to being sampled. Sampling establishes water quality within and outside of the ore zone (i.e., at the monitor wells) enabling the licensee to determine readily if an excursion occurs. A “lessons learned” approach is implemented, as the results in one well field may cause the site engineer or geologist to change design in the next. This process is both iterative and “phased,” as each well field is developed and tested with the mineral being progressively depleted from different parts of the ore body. In addition, as will be shown below, this process is conducted with redundant safeguards including an engineered well field that is operated in balance, over-extraction (bleed) causing water to migrate towards the recovery zone rather than outwards toward adjacent, non-exempt aquifers, and monitor wells to verify effectiveness of these operational controls so that the activity has no impact on adjacent drinking water resources.

During active operations, native groundwater from the recovery zone in the aquifer is pumped to the surface for fortification with oxygen and carbon dioxide. This fortified water, which is similar to soda water (i.e., not water fortified with toxic chemicals), is then circulated in the recovery zone through a series of *injection* wells in varying patterns in the well fields. The volume of water withdrawn from *extraction wells* in these patterns exceeds the volume injected into the patterns creating a “cone of depression” that assures a net inflow of water into the recovery zone. This ensures no horizontal or vertical water movement from the small portion of the aquifer where ISR operations will occur, towards adjacent, non-exempt USDWs. The process also continually flushes fresh water into the recovery zone helping to inhibit the build-up of contaminants that could reduce the efficiency of recovery operations.

The extraction pumping causes the injected recovery solutions to move through the uranium ore body oxidizing and solubilizing the uranium present in the host sandstone. The water from the extraction wells is then run through ion exchange (IX) columns containing synthetic resins, which remove the uranium in a process essentially identical to that used to remove minerals from “hard” drinking water in a conventional home water softener. The uranium is first stripped from the IX resins using a brine solution (again similar to the backwash that takes place in a home water softener) and then precipitated chemically. This product is dewatered and dried to produce saleable *yellowcake.*

After uranium removal in the IX column, the water in the circuit is re-fortified and re-injected as part of a continuous process until the uranium in the ore zone is exhausted. Since water from the ore body, already containing naturally occurring uranium, its progeny, and associated heavy metals and/or other minerals, is continuously refortified with oxygen and re-circulated through the sandstone to enhance uranium values removed in the IX columns, injection is balanced with extraction (i.e., extraction slightly exceeds injection to maintain an inward hydraulic gradient). Injection cannot proceed without an equal or greater amount of extraction; therefore, over-injection across the area cannot take place. To help keep the continuously operating system in balance, the extra water that is extracted is removed from the circuit as a "bleed." The "bleed," which contains elevated levels of radium, can be treated in settlement ponds or by filtration to remove the radium using a barium-radium sulphate precipitation method. Ultimately, the treated or untreated water is discharged to holding ponds or tanks and from there it must be disposed of using Class I UIC deep well injection, solar evaporation or some combination of these methods. As noted above, the loaded IX resins are eluted (backwashed) with a brine solution and the uranium is precipitated out of solution, dried, and packaged and shipped as yellowcake.

After active ISR operations cease, the groundwater in the recovery zone is restored *consistent with baseline* or other water quality criteria that are approved by NRC prior to the commencement of active ISR operations. Upon completion of groundwater restoration, wells are sealed or capped below the soil surface using approved plugging methods. Surface process facilities are decontaminated, if necessary, and removed, and any necessary reclamation and re-vegetation of surface soils is completed. As a result, after site closure is completed and approved, there is no visual evidence of an ISR site, and the decommissioned site will be available for unrestricted (i.e., any future) use.

Liquid waste is generated during groundwater restoration when uranium recovery operations have ceased. Groundwater sweep uses existing injection and extraction wells to remove water from the ore zone, drawing natural groundwater flow into the recovery zone to replace water in the recovery zone after ore removal. Alternatively, removed groundwater may be treated using reverse osmosis (RO) to create *de-ionized* water which is re-injected to accelerate groundwater restoration. In fact, more recent groundwater restoration efforts have often used a combination of these two techniques and, possibly, the injection of a reductant and pH modifier to optimize results. Groundwater restoration returns water within the depleted recovery zone to approved levels determined by NRC to be adequate to minimize or eliminate the potential for post-restoration migration of contaminants and any potentially significant, adverse impacts to adjacent, non-exempt USDWs.

In over three decades of operations, there have been *no significant, adverse impacts to adjacent, non-exempt USDWs* outside the recovery zone and into the related area of review (AOR)[1] from ISR operations in the United States. Well field balancing, including the process "bleed," pump tests, and monitoring at ISR sites have been highly successful in assuring that recovery solutions are contained within the ore (recovery) zone. Before monitoring ceases,

[1] The "area of review" is essentially a "buffer zone" prescribed by EPA's underground injection control (UIC) program to provide additional protection for USDWs during ISR operations. 40 Code of Federal Regulations (CFR) § 146.6 requires that all ISR licensees must establish a fixed radius of not less than ¼ mile for the area surrounding the recovery zone. The regulation also states:

> "In determining the fixed radius, the following factors shall be taken into consideration: Chemistry of injected and formation fluids; hydrogeology; population and ground-water use and dependence; and historical practices in the area."

40 CFR § 146.6.

restoration is completed to minimize or eliminate the potential risk of excursion that could result in the migration of recovery solutions from the exempted recovery zone portion of the aquifer to adjacent, non-exempt portions of the aquifer.

ISR projects can be operated in one of two facility types. First, an ISR project can be operated using a central processing facility and well fields that are directly adjacent to the processing facility. This allows the operator to license a defined site footprint and to construct adjacent well fields from which pregnant lixiviant may be directly pumped to the central processing facility. This recovery approach is best utilized when the identified and defined uranium ore body contains enough uranium to make the licensing, construction, and operation of a complete central processing facility economically viable.

In instances where uranium ore bodies do not contain enough uranium to justify licensing, construction and operation of central processing facilities, ISR operators may use satellite or so-called "remote IX" technology to develop well fields that can be at considerable distances from a central processing facility.[2] "Remote IX" has been utilized to recover uranium in South Texas as early as 1980 and is currently used by various ISR companies in Wyoming and Texas. Each "remote IX" is a self-contained, stand-alone unit that recovers uranium using IX columns and resins. After uranium is recovered on the IX resins, they are pumped into transport conveyances, typically tanker trucks, for transport to a central processing facility where they undergo the same processes described above. The use of "remote IX" technology has become increasingly popular given that many uranium deposits (e.g., deposits with 2 to 3 million pounds) cannot justify the cost of licensing and constructing a central processing facility. In addition, recently, there have been some indications that ISR operations using each individual well field's water, as "remote IX" does, results in more production efficiency.

IV. HISTORICAL OVERVIEW OF THE DOMESTIC URANIUM RECOVERY INDUSTRY

A. ATOMIC ENERGY ACT

The history of the domestic uranium recovery industry begins with the enactment of the Atomic Energy Act of 1946 and 1954 (AEA). As will be described below, the statutory framework and its implementing regulatory regime for the domestic uranium recovery industry has evolved over a period of more than sixty years and will continue to evolve with the preparation of a new ISR GEIS.

After World War II, recognizing the strategic value of having a secure supply of uranium for national defense purposes, Congress passed the 1946 version of the AEA. This version of the AEA created the Atomic Energy Commission (AEC) and provided the AEC with substantial power over the development and regulation of uranium recovery operations. In the AEA, Congress provided the AEC with the authority not only to procure uranium, but also to stimulate the development of a domestic uranium production capacity for the nuclear weapons program and the nuclear power industry.

Initially, the United States atomic weapons program was almost completely dependent on uranium from the Belgian Congo. To correct this strategic weakness, the AEC set out to stimulate the development of a viable domestic uranium recovery industry. As a starting point,

[2] Hereinafter, the term "satellite" will apply to well fields not directly tied to the central processing facility, including so-called "remote IX" well fields from which uranium-loaded resins are transported to the central processing facility by tanker truck.

the AEC initiated development of policies to encourage private companies and individuals to explore for uranium and to develop any located reserves. Given that the costs associated with exploration, development, production, and milling of uranium were substantial, and potentially could provide an economic disincentive, the AEC guaranteed prices for uranium ore production, provided bonuses for the initial production from new mines, and reimbursed producers for transportation costs. These incentives were provided through a series of AEC "Domestic Uranium Production Circulars." In addition, the AEC established a number of uranium ore-buying stations in areas of anticipated production.

To spark the development of a domestic uranium milling capacity, the AEC provided incentives to private entities in the form of AEC agreements/contracts to purchase processed uranium on terms that allowed private companies to recover the cost of constructing and operating a uranium mill during the life of the contract. Thus, such privately constructed uranium milling facilities operated pursuant to AEC contracts under which the AEC committed to purchases of uranium concentrate that effectively returned the costs of mill construction and operation plus a reasonable return on investment to the mill operator.

Under the AEA, Congress also granted the AEC/NRC jurisdiction over specific categories of materials---namely, source material, special nuclear material, and byproduct material.[3] Source material is defined by the AEA as:

> "(1) uranium or thorium, or any combination thereof, in any physical or chemical form or (2) *ores* which contain by weight one-twentieth of one percent (0.05 percent) or more of: (i) uranium, (ii) thorium or (iii) any combination thereof. *Source material* does not include special nuclear material."[4]

Section 62 of the AEA limits the amount of source material that may be subject to NRC's regulatory scheme (i.e., licensing)[5] by stating that a person is exempt from obtaining a license for receiving, possessing, using, transferring or delivering "unimportant quantities" of *source material* which the Commission has determined to be less than 0.05 percent by weight of a mixture, compound, solution, or alloy.[6] This statutory and regulatory exemption, however, does not include *byproduct* material as defined in Section 62 of the AEA and 10 Code of Federal Regulations (CFR) Part 40.[7] Regulation of the process for recovering source material uranium using conventional or ISR processes also is strictly limited by Section 62 of the AEA, which states that NRC has licensing authority over the transfer, receipt, delivering, possession, and/or use of source material only "after removal from its place of deposit in nature…."[8] In its

[3] 42 United States Code (U.S.C.) § 2014 *et seq.* For purposes of this GER, a discussion of "special nuclear material" is not relevant.
[4] 42 U.S.C. § 2014(z).
[5] NRC's Office of General Counsel has also evaluated the terms of Section 62 and determined that its provisions are *mandatory*. *See* Letter to H. L. Price, Director, Division of Licensing and Regulation from Neil D. Maiden, Acting General Counsel, Atomic Energy Commission, *Re: Mill Tailings* (December 7, 1960).
[6] *See* 10 CFR Part 40.13.
[7] In a letter from Ramon Hall, Director of the Uranium Field Recovery Office. Region IV, it was stated that, under 10 CFR 40.51 promulgated pursuant to Section 83 of the AEA, as amended by Uranium Mill Tailings Radiation Control Act (UMTRCA), even "small quantities of tailings that would be sent to a laboratory for testing or to any other facility" would require a license to be transferred "because there is no provision to exempt *byproduct material* from licensing requirements." This implies that there is no *de minimis* quantity of *byproduct material* that can be transferred to another party without a license.
[8] 42 U.S.C. § 2092.

1980 GEIS, NRC interpreted this portion of Section 62 stating that it "has no direct authority over *uranium mining or mine wastes*."[9] This interpretation has been recognized by NRC's Atomic Safety and Licensing Appeal Board in *In the Matter of Rochester Gas and Electric*:

> "The Atomic Energy Commission's jurisdiction in this area was transferred to NRC on January 19, 1975, by the Energy Reorganization Act of 1974, 42 United States. § 5841(f). As the quoted observation indicates, the Commission's authority over uranium ore and other 'source material' attaches only '*after* removal from its place of deposit in nature,' and *not when the ore is mined*."[10]

This limit on NRC's jurisdiction over source material is also reflected in its 10 CFR § 40.4 definition of "unrefined and unprocessed ore." 10 CFR § 40.4 defines this term to mean "*ore* in its natural form prior to any processing, such as grinding, roasting or beneficiating, or refining. Such "unrefined and unprocessed ores" are specifically exempt from licensing in 10 CFR § 40.13(b). The definition of *unrefined and unprocessed ore* contained in 10 CFR 40.4 and the exemption for it contained in Part 40.13 derive from Section 62 of the AEA. As a result, natural *ore* (even if containing concentrations of uranium greater than the 0.05 percent *licensable source material* level set forth in Part 40.4) only becomes subject to NRC jurisdiction when it arrives at a licensed uranium mill.

Thus, NRC does not regulate conventional surface or underground *mining* processes.

B. URANIUM MILL TAILINGS RADIATION CONTROL ACT OF 1978

In addition to control of source material, the evolution of the management and control of uranium mill tailings and other associated wastes is crucial to a clear understanding of NRC AEA regulatory program. The key statutory provisions governing the management and disposal of uranium mill tailings are set out in the Uranium Mill Tailings Radiation Control Act of 1978 ("UMTRCA"), which amended and was made part of the AEA. Congress enacted UMTRCA with the specific intent of remedying a perceived lack of authority on the part of the AEC, and later NRC, to regulate uranium mill tailings and other uranium recovery wastes after the cessation of *active* source material processing operations under then-existing authorities contained in the AEA. For example, Section 2 of UMTRCA states that one of its purposes is to establish:

> "a program to regulate mill tailings during uranium or thorium *ore* processing at active mill operations and after termination of such operations in order to stabilize and control such tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public."[11]

The legislative history of UMTRCA reveals that, prior to its passage, NRC believed that it was without authority to regulate mill tailings *per se* (except as part of the *active* milling process). It also reflected Congress' intent to provide NRC and its federal agency partners (which will be

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[9] United States Nuclear Regulatory Commission, *Generic Environmental Impact Statement on Uranium Milling,* NUREG-0706, Vol. 1 at A-94 (1980).
[10] 1978 NRC LEXIS 16, *5, n.7 (November 17, 1978).
[11] 42 U.S.C. § 7901. Congress also directed NRC to evaluate the management of mill tailings in light of the potential costs associated with a proposed licensing action and, as a result, environmental evaluations of 11e.(2) byproduct material-related licensing actions utilize a cost-benefit analysis.

discussed later) with the authority to regulate both the clean-up of abandoned, *inactive* mill sites and the management and disposal of mill tailings at licensed, *active* mill sites. For example, the report on the legislation prepared by the House Interior and Insular Affairs Committee explained that:

> "Without the authorities included in H.R. 13650 [the bill will eventually be enacted as UMTRCA], the conditions addressed by the remedial program [to clean up abandoned mill tailings sites] will be left without remedy, and the authority of the Commission to establish uniform rational standards for waste disposal from uranium mills will not be clear."[12]

Thus, in order to establish a clear basis for NRC jurisdiction, Congress created a new type of AEA material. Section 201 of UMTRCA modified the then-AEA definition of "byproduct material" to include a new subsection—Section 11e.(2)—which defined such "byproduct material" to mean "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any *ore* processed *primarily* for its source material content."[13] Because this new definition of "*byproduct material*" was enacted as AEA Section 11e.(2), uranium mill tailings and other uranium processing wastes frequently are referred to as "11e.(2) byproduct material."

As noted above, UMTRCA was intended to serve two broad purposes. First, it was designed to facilitate the remediation of abandoned, *inactive* mill tailings sites that were no longer operated under an *active* license issued under the AEA. The provisions addressing these abandoned, *inactive* sites are contained in Title I of UMTRCA. The second broad purpose of UMTRCA was to provide NRC with the authority to regulate the management and disposal of mill tailings at so-called "*active*" sites—i.e., sites that were operated under an *active* license issued by NRC pursuant to the AEA. The provisions addressing *active* milling sites are contained in Title II of UMTRCA.

As an initial step in the development of a domestic uranium recovery regulatory program, in April of 1979 and in response to a petition filed by the Natural Resources Defense Council four years earlier, NRC prepared and issued a Draft Environmental Impact Statement on Uranium Milling (DEIS) examining the environmental ramifications of uranium milling activities and possible regulatory provisions for those activities. A few months after issuing its DEIS, in August of 1979, NRC published proposed regulations governing uranium milling and mill tailings.[14] The United States Environmental Protection Agency (EPA) objected to the promulgation of these regulations arguing that NRC was required to conform its regulations to EPA's *generally applicable standards*, which had not yet been promulgated.

Then, in the fall of 1980, NRC published its final regulations for uranium milling activities and also announced the availability of the Final Generic Environmental Impact Statement (1980 GEIS) for uranium milling. NRC's final regulations adopted conservative standards for the management and disposal of uranium mill tailings. In addition, the final regulations were directed for the most part at abating radon emissions, which at the time was seen to be the primary potential threat to health posed by uranium mill tailings and related wastes. Notably, groundwater protection issues were left to be addressed on a site-by-site basis.

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[12] H.R. Rep. No. 95-1480, 95th Cong., 2d Sess. 12 (1978) (emphasis added).
[13] 42 U.S.C. § 2014(e)(2) (emphasis added).
[14] 45 Fed. Reg. 65,521 (1980).

NRC's early focus on radon emissions as the primary threat from uranium mill tailings is evident in the 1980 GEIS, where NRC noted that, with respect to health risks to individuals:

> "Total exposure estimates, which include radon and daughters, indicate that radon is the single greatest contributor to risk."[15]

Interestingly, NRC's estimates of total radon exposure contained in the 1980 GEIS were based on the assumption that by the year 2000, 53 additional conventional uranium mills would be constructed and operating.[16]

1. TITLE I PROGRAM FOR INACTIVE SITES

While not directly applicable to active ISR operations, the development of EPA's *generally applicable standards* for "inactive" sites is integral to the development of NRC's regulatory program for uranium recovery facilities. In 1983, three years after NRC issued its 1980 GEIS and promulgated initial regulations for uranium milling, EPA promulgated its first set of *generally applicable standards* which were directed at *inactive sites* under Title I of UMTRCA. EPA's *generally applicable standards* concluded that a design standard limiting radon emissions from mill tailings to 20 picoCuries per square meter per second (pCi/m^2/s) was adequately protective of public health and safety, as compared to the 2 pCi/m^2/s standard adopted by NRC. EPA's regulations also did not include any specific standards for radon barriers although its rulemaking analysis indicated that its 20 pCi/m^2/s radon standard was premised on the use of thick barriers. By contrast, NRC's regulations required the use of an earthen barrier at least 10 feet thick.

EPA's *inactive* site regulations also established what has come to be known as the "5/15" clean-up standard for radium-226 in soil. Under this standard, radium concentrations in soil are to be reduced to levels of no more than 5 picoCuries per gram (pCi/g) above background in the first 15 centimeters (cm) soil horizon and no more than 15 pCi/g above background in subsequent 15 cm soil horizons.

In addition, EPA required that disposal systems be designed to provide "reasonable assurance" of achieving the design standard for 1,000 years, but no less than 200 years, without reliance on "active" maintenance. Finally, EPA did not, in its inactive sites regulations, establish any generally applicable standards for groundwater contamination because, in its view at the time, the risks from groundwater contamination were not sufficiently significant to require the development of such standards. Thus, in the preamble to its *inactive* sites regulations, EPA explained that:

> "We do not believe that the existing evidence indicates that groundwater contamination from inactive mill tailings is or will be a matter of regulatory concern. We have decided, therefore, not to establish general substantive standards on this subject."[17]

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[15] GEIS at Vol. 1 at 2.

[16] However, since the issuance of the 1980 GEIS, there has been a steady decrease in the number of operating conventional mines and mills, so that as of April, 1998, only one conventional mill is operating of the more than 20 mills that were in operation in 1980. In addition, during the over twenty years that have elapsed since the issuance of the 1980 GEIS, ISR operations has now become the dominant method of uranium recovery.

[17] 48 Federal Register (Fed. Reg.) 590, 599 (1983).

Consequently, instead of establishing groundwater standards of general applicability in its *inactive* sites regulations, EPA concluded that groundwater issues would have to be addressed by the DOE on a site-by-site basis, taking into account various site-specific factors.[18]

2. TITLE II PROGRAM FOR ACTIVE SITES

As stated above, the statutory provisions pertaining to the regulation of uranium mill tailings (11e.(2) byproduct material) at *active* conventional uranium recovery facilities sites are set forth under Title II of UMTRCA. Section 206 of UMTRCA (which added a new Section 275 to the AEA), directs EPA to establish *standards of general applicability* for the protection of public health, safety, and the environment from the potential hazards—both radiological and *non*-radioactive—associated with the processing, possession, transfer, and disposal of 11e.(2) *byproduct material*.[19] While EPA is directed to establish *generally applicable standards* for the protection of health and the environment, NRC is directed to *implement* those standards with respect to individual licensees under the AEA. Thus, Section 275(d) of the AEA provides that "[i]mplementation and enforcement of the standards promulgated [by EPA] pursuant to subsection (b) of this section shall be the responsibility of the Commission in the conduct of its licensing activities under this Act."[20]

NRC, in addition to implementing the health and environmental standards developed by EPA, is granted expanded general authority in Section 84 of the AEA (which was added by Section 205 of UMTRCA) to develop its own requirements for the management of 11e.(2) byproduct material, to protect public health, safety, and the environment. Specifically, Section 84(a) directs NRC to ensure that any 11e.(2) byproduct material is managed in a manner:

i. that the Commission deems appropriate to protect health, safety, and the environment from the potential radiological and *non*-radioactive hazards associated with such materials;[21]

ii. that conforms with the generally applicable standards developed by EPA; and

iii. that conforms with the general requirements established by NRC, comparable to standards applicable to similar hazardous materials regulated under the Solid Waste Disposal Act [42 United States Code (U.S.C.) § 6901 et seq.] (emphasis added).[22]

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[18] *Id.* at 599-600.
[19] 42 U.S.C.§ 2022(b).
[20] 42 U.S.C. § 2022(d).
[21] It is clear that UMTRCA and its legislative history reflect Congress' intent that NRC regulate the potential *radiological* hazards associated with 11e.(2) *byproduct material*. This is entirely appropriate since a substantial share of the potential hazards associated with 11e.(2) *byproduct material* are, in fact, radiological. However, it is also clear that UMTRCA and its legislative history unequivocally address authority over potential *non*-radioactive hazards associated with 11e.(2) *byproduct material*. For example, Section 206 of UMTRCA (which amended the AEA by adding Section 275) directs EPA to promulgate *generally-applicable standards* to protect public health and the environment from *both* radiological and *non*-radioactive hazards associated with 11e.(2) *byproduct material*. In promulgating standards applicable to the *non*-radioactive hazards associated with 11e.(2) materials, EPA is directed to be consistent with requirements established under the Resource Conservation and Recovery Act (RCRA) applicable to similar hazards. Moreover, as noted above, under Section 205 of UMTRCA (which added Section 84 to the AEA), NRC is required to ensure that management of 11e.(2) materials *conforms with* EPA's standards for protection of the general environment—which, as indicated, encompass *both* radiological and *non*-radioactive concerns.

Section 84(a) further provides that the Commission will take "into account the risk to the public health, safety, and the environment, with due consideration of the economic costs and such other factors as the Commission determines to be appropriate."[23] As Congress explained in the legislative history of UMTRCA, as amended:

> "The conferees are of the view that the economic and environmental costs associated with standards and requirements established by the agencies [EPA and NRC] will bear a reasonable relationship to the benefits expected to be derived."[24]

Thus, the statutory system applicable to Title II sites results in EPA and NRC regulations for uranium recovery facilities generating, managing and/or disposing of 11e.(2) *byproduct material* with NRC implementing them on a site-specific basis.

Along with these general provisions governing the management of 11e.(2) *byproduct material*, Section 83 of the AEA (which was added to the statute by Section 202 of UMTRCA) provides a more specific framework for regulating the long-term management and disposal of uranium mill tailings. The central feature of this statutory framework is the requirement that, prior to license termination, title to byproduct material and the land used for its disposal must be transferred to either the United States or to the states. Specifically, Sections 83(a & b) provide that ownership of any 11e.(2) byproduct material that resulted from a licensed activity must be transferred to either the United States (traditionally DOE) or, at the option of the state, to the state in which the licensed activity occurred.[25] These Sections provide for the transfer of land used for the disposal of 11e.(2) byproduct material generated as a result of a licensed activity.[26] Such land is to be transferred for long-term surveillance and monitoring, unless NRC determines that transfer is not necessary or desirable to protect public health and safety and the environment.[27]

Under Section 83(a), a licensee must comply with all pertinent decontamination, decommissioning, and reclamation standards prescribed by the Commission before its license can be terminated. NRC is granted sole authority under the AEA for determining whether the licensee has complied with all applicable standards and requirements and whether a license can be terminated.[28] Once NRC makes such a determination, title to *byproduct material* (and title to the land used for its disposal) will be transferred to the United States or to the state (unless, as noted above, NRC determines that such transfer is not required), and the license can be terminated.[29] Once title to 11e.(2) *byproduct material* and its disposal site is transferred, the site and materials must be maintained in perpetuity, pursuant to a general license issued by NRC.[30] Under Section 83(b)(5) of the AEA, NRC can require the state or federal agency that takes custody of tailings and their disposal site to undertake monitoring, maintenance, and any other measures that may be needed either to protect public health and safety and the environment or to otherwise comply with the health and safety standards developed by the

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22 42 U.S.C. § 2114(a).
23 42 U.S.C. § 2114(a).
24 H.R. Rep. No. 884 (Conference Report), 97th Cong., 2d Sess. 47 (1982).
25 42 U.S.C. § 2113(a).
26 42 U.S.C. § 2113(b).
27 *Id*.
28 42 U.S.C. § 2113(c).
29 42 U.S.C. §§ 2113(b)(2) & (3). Thus far, *no* state has indicated any intention of becoming the long-term governmental custodian for any Title II mill tailings site.
30 *Id*.

Commission under Section 84 of the AEA.[31] This transfer of ownership to the federal government provides an additional level of assurance that, following closure of the tailings pile and termination of a license, the site will be appropriately monitored and maintained. Since ISR facilities do not, at this time, have waste disposal impoundments for 11e.(2) byproduct material generated by uranium recovery operations, these statutory requirements are not relevant to ISR facilities that generate 11e.(2) wastes as currently 10 CFR Part 40, Appendix A, Criterion 2 requires disposal of such wastes in an existing conventional mill tailings impoundment. Additionally, NRC has specifically recognized that deep well disposal of 11e.(2) wastes likely will not require long-term surveillance and monitoring or land transfer.[32] However, in the future, if an ISR facility operator seeks, and is granted, a license for an 11e.(2) disposal impoundment(s), such operator's 11e.(2) facility will be subject to these statutory requirements.

Another critical feature of the statutory framework for regulating 11e.(2) *byproduct material* is the provision in Section 84 of the AEA that allows NRC to consider, on a site-specific basis, *alternatives* to the existing, *generic* standards and other requirements enforced by the Commission under the authorities discussed above. Specifically, Section 84(c) provides that, when regulating a site at which 11e.(2) byproduct material is *generated* or disposed of, a licensee may propose and NRC may approve *alternatives* to the requirements that would otherwise be enforced by the Commission, based on site-specific considerations such as local or regional geology or hydrology, provided that the *alternatives* will achieve a level of protection of public health, safety, and the environment that is *at least equivalent* to that which would be achieved by the standards that would otherwise be enforced by the Commission. In effect, Section 84 of the AEA allows NRC to tailor its regulation of 11e.(2) byproduct material to accommodate site-specific conditions, and to approve an *alternative* proposed by a licensee in circumstances where the alternative makes more sense than requiring compliance with existing, *generic* requirements that would otherwise be applicable.[33] Thus, when it evaluates the adequacy of a licensee's proposed activities for a given site, NRC is not constrained to mechanically apply its existing requirements in circumstances where it would be unreasonable or inappropriate to do so. Instead, the statute specifically provides that the Commission can approve *alternatives* proposed by a licensee, provided that those *alternatives* provide a *reasonable assurance* that public health and safety and the environment will be adequately protected. Thus, NRC's regulatory program for uranium recovery activities has a statutory basis for incorporating "flexibility" to consider site-specific factors into its regulatory approach.

One final statutory provision that is important to understand involves so-called Agreement State programs. An Agreement state is any state with which the AEC or NRC has entered into an effective agreement under Subsection 274(b) of the AEA, as amended by UMTRCA, which results in AEC/NRC withdrawal from, and the state's acceptance of, primary regulatory authority over certain *specified* AEA materials and activities.[34] Agreement States are permitted to accept regulatory authority over a variety of AEA materials and processes, including uranium recovery and the management of 11e.(2) byproduct material. However, NRC retains the authority to approve final site reclamation at AEA-licensed uranium recovery sites and to authorize license termination at Agreement State-regulated sites.

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[31] 42 U.S.C. § 2113(b)(5).
[32] *See* NRC Regulation (NUREG)-0706, Vol. II, p. A-65.
[33] The availability of site-specific alternatives for regulation of mill tailings under Section 84 of the AEA is consistent with the position that NRC articulated to Congress during consideration of UMTRCA, that site-specific flexibility is an absolutely necessary feature of mill tailings regulation.
[34] States are not permitted to accept regulatory authority over other AEA processes such as the construction and operation of nuclear power plants.

V. HISTORICAL OVERVIEW OF REGULATORY/LICENSING ENVIRONMENT

As noted above, although the management and control of 11e.(2) byproduct material impoundments currently are not issues for ISR licensees, it is important for such licensees or license applicants to understand the basis for NRC/Agreement State authority over the recovery of source material uranium and the wastes (11e.(2) byproduct material) generated, as such licensees necessarily will be authorized to generate, possess, and be responsible for disposal of such wastes.

A. EVOLUTION OF NRC REGULATORY PROGRAM FOR URANIUM RECOVERY FACILITIES: 10 CFR PART 40, APPENDIX A, AND ASSOCIATED REGULATIONS AND GUIDANCE

When NRC created its regulatory program for uranium recovery facilities and the management and control of 11e.(2) byproduct material, its regulations generally were geared toward conventional uranium recovery facilities (i.e., uranium mills and mill tailings facilities). Indeed, as stated above, NRC's 1980 GEIS predicted that a significant number of additional conventional uranium recovery facilities would be constructed and assumed that ISR would be a minimal contributor to overall uranium production. As a result, the promulgation of its 10 CFR Part 40 regulations and accompanying Appendix A Criteria were designed primarily to address conventional uranium recovery facilities. However, in recent years, ISR facilities have emerged as a significant form of uranium recovery in the United States, and NRC has determined that various aspects of Appendix A's Criteria will be applied "as relevant and appropriate" to ISR operations.

Appendix A Criteria are broad, performance-oriented *Criteria* that govern uranium recovery activities and waste disposal. At a time when emerging environmental regulations were frequently extremely prescriptive, Appendix A can be classified as somewhat "ahead of its time," because NRC sought to develop performance-oriented *Criteria* rather than prescriptive regulations so that uranium recovery licensees could address site-specific circumstances effectively.[35] In total, Appendix A contains thirteen criteria designed to allow licensees to properly locate, operate, and decontaminate and decommission their sites.

As noted, NRC's broad, performance-oriented criteria in Appendix A and applicable guidance are specifically designed to allow licensees to take into account site-specific conditions. The Introduction to Appendix A states:

> "In many cases, *flexibility* is provided in the criteria to allow achieving an optimum tailings disposal program on a site-specific basis…Licensees or applicants may propose *alternatives* to the specific requirements in this appendix. The *alternative* proposals may take into account local or regional conditions, including geology, topography, hydrology, and meteorology."[36]

Since Appendix A was promulgated with the intention of maintaining *flexible* performance-oriented criteria and Section 84(c) of the AEA, as amended by UMTRCA, specifically authorizes

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[35] For example, NRC staff developed these Appendix A Criteria "mindful of the fact that the problem of mill tailings management is highly site-specific. The precise details of a program can be worked out only when the unique conditions of a site are known." Indeed, the word "requirements" in the Introduction to "Appendix A" was replaced with the word "criteria", NUREG 0706, Volume II A-81, 82.

[36] See 10 CFR Part 40, Appendix A (emphasis added)

it, NRC will evaluate site-specific *alternatives* proposed by a licensee in conjunction with a licensee's operations or decommissioning proposals. As stated in the Introduction to Appendix A,

> "the Commission may find that the proposed *alternatives* meet the Commission's requirements if the *alternatives* will achieve a level of stabilization and containment of the sites concerned, and a level of protection for public health, safety, and the environment from radiological and *non*-radioactive hazards associated with the sites, which is equivalent, to the extent practicable, or more stringent than the level which would be achieved by the requirements of this appendix and the standards promulgated by the Environmental Protection Agency in 40 CFR part 192, subparts D and E."[37]

- Criterion 1 discusses the general goals and broad objectives for locating a uranium recovery and/or tailings disposal site. Generally, proper location of a site will be based on the "permanent isolation of tailings and associated contaminants by minimizing disturbance and dispersion by natural forces, and to do so without ongoing maintenance." Criterion 1 also prioritizes the location and isolation of a site's tailings over any short-term conveniences or potential impacts that might occur from site selection.[38] Given that ISR facilities do not require the use of surface tailings impoundments for storage and disposal of 11e.(2) byproduct material, Criterion 1 generally is not relevant. However, in the event that the demand for additional 11e.(2) disposal capacity is required in the future and ISR licensees determine that new capacity needs to be licensed, Criterion 1 then will be relevant, as will Criterion 2 below, which could require revision or re-interpretation;
- Criterion 2 briefly addresses the disposal of wastes from uranium recovery activities at remote and/or small sites and the need for transportation of waste for disposal versus the costs of such transportation. Criterion 2 states that *byproduct material* from various types of uranium recovery operations such as from small above-ground uranium recovery operations or ISR facilities are to be disposed of at *existing* large mill tailings sites rather than establishing and characterizing new disposal sites. NRC has interpreted this Criterion to require effectively that 11e.(2) byproduct material generated at ISR facilities must be disposed of in existing, licensed 11e.(2) disposal impoundments;[39]
- Criterion 3 discusses the primary options for disposal of 11e.(2) byproduct material in below-grade or above-grade surface impoundments. As is the case with Criterion 1, unless ISR licensees determine that additional 11e.(2) disposal capacity is needed, Criterion 3 is not relevant;

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[37] (Emphasis added). To be successful, licensee-proposed *alternatives* to NRC or EPA regulatory *requirements* likely will require substantial justification, thorough review by NRC staff, a public hearing, and, ultimately, a decision by the Commission.
[38] For example, the Sweetwater Mill and the proposed Ur-Energy Lost Creek ISR project fit the requirements under Criterion 1 in that it is geographically isolated from populated areas and lies in an arid, hydrologically enclosed basin (the Great Divide Basin).
[39] United States Nuclear Regulatory Commission, Memorandum from Richard L. Bangart , Director, Division of Low-Level Waste Management and Decommissioning, to A. Bill Beach, Director, Division of Radiation Safety and Safeguards, Region IV, *Interim Position on Disposal of In-Situ Wastes* (August 29, 1990).

- Criterion 4 lists site and design criteria that must be followed regardless of whether the tailings are disposed above or below grade. Again, this Criterion is not relevant to ISR operations, except to the extent that issues such as seismology, surface reclamation using vegetation, and erosion issues for evaporation ponds are pertinent;

- Criterion 5 incorporates the basic groundwater protection standards as promulgated by EPA in 40 CFR Part 192, Subparts D and E, which incorporate Resource Conservation and Recovery Act (RCRA) standards in 40 CFR Part 264 *et. seq.* and which apply both during operations and to final closure. The *primary* standard in Criterion 5 focuses on the type of liner necessary to protect groundwater during the management of uranium or thorium mill tailings. It addresses liner construction and surface impoundment design, construction, and operation.

  Additionally, a *secondary* groundwater standard is provided requiring that hazardous constituents entering groundwater not exceed concentration limits in the "uppermost aquifer beyond the point of compliance during the compliance period." Criterion 5 prescribes a specific course of action for compliance with groundwater standards (i.e., baseline or a maximum contaminant level (MCL),[40] whichever is higher, or an alternate concentration limit (ACL), which is a site-specific, constituent-specific, risk-based contaminant limit).[41] Currently, while able to seek the functional equivalent of an ACL if baseline/background or an MCL cannot be achieved during groundwater restoration, ISR licensees do not have the *legal right* to apply for ACLs. Other groundwater *criteria* including the classification of hazardous constituents and whether they may be exempted from the regulation also are discussed.

- Criterion 6 addresses the construction and compliance of a "final radon barrier" for a surface tailings impoundment. Generally, this Criterion is not relevant to ISR licensees, except that within this Criterion, NRC included what has became known as the "5/15" standard in Criterion 6(6), which states that, when averaged over areas of 100 square meters, radium in soil concentrations above background are limited to: "(i) 5 pCi/g of radium-226…averaged over the first 15 cm below the surface, and (ii) 15 pCi/g of radium-226…averaged over 15-cm thick layers more than 15 cm below the surface." NRC also modified Criterion 6(6) to address surface clean up requirements for radionuclides other than radium, such as uranium and thorium, found in soils at such facilities. The dose from the 5/15 radium-in-soil standard provides a *benchmark* dose for cleanup concentrations of other radionuclides.[42] This standard is applied to spills or leaks of radionuclides contaminating soils at ISR facilities. While this standard was originally developed primarily to address windblown mill tailings and later spills or leaks at conventional mills, it is a good example of how NRC staff currently applies Appendix A Criteria to ISR facilities "as relevant and appropriate;"[43]

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[40] It is important to note that an MCL, by definition, is an enforceable water quality standards that establishes *the highest permissible concentration level of a particular contaminant in public water supplies*. Thus, levels of contaminants in water supplies exceeding an MCL are illustrative of a water source that would be harmful to human health if consumed.
[41] As will be described in Section V(F) *supra.*, an NRC ISR rulemaking likely will grant such licensees the legal right to apply for ACLs.
[42] *See* 10 CFR Part 20, Subpart E, §1401 et seq.
[43] Radon emissions at "*active*" mill sites also are covered by 40 CFR Part 61, Subpart W. Though this subpart covers the owners and operators of sites licensed to manage uranium byproducts while they are processed and after their processing, Subpart W does not apply to their final disposal. 40 CFR Part 61,

- Criterion 7 requires that at least one year prior to major site construction and operations, a monitoring program must be conducted providing complete baseline data on a mill site's conditions. Criterion 7's requirements have been applied to require ISR licensees to sample and monitor for a period of at least one year for data to characterize the site's conditions, including but not limited to, water quality, soil sampling, and meteorology;
- Criterion 8 summarizes its primary purposes by stating that "milling operations must be conducted so that all airborne effluent releases are reduced to levels as low as is reasonably achievable (ALARA)." Emissions controls will be the primary method to control such effluent releases and institutional controls such as extending the boundaries of the site may also be employed as they become necessary. It also contains 40 CFR Part 190[44] 25 mrem/yr dose standard which at ISR facilities only addresses the potential for yellowcake emissions from dryers. Monitoring airborne effluent releases to achieve ALARA is required for all ISR licensees;
- Criterion 9, which has become an increasing source of potential regulatory scrutiny in recent years, deals with the financial arrangements to assure that sufficient funds will always be available to carryout final D&D at the site. Though somewhat ambiguous in its language, Criterion 9 requires that a licensee post a surety bond or other financial instrument to guarantee that proper funding will be available for an *independent contractor* to perform reclamation activities at the site according to an *approved* reclamation plan, when the licensee either can no longer continue licensed activities or goes into bankruptcy.[45] The surety bond or other financial assurance instrument must be updated annually to adjust for changes in inflation, reclamation activities, or any other factors that might influence costs. This must be done pursuant to a Commission-approved license amendment which carries with it the potential for interested parties to seek a public hearing on any such amendment. As discussed in Section V(E) *infra,* the recent Hydro Resources, Inc. (HRI)[46] administrative litigation further clarified the applicability of Criterion 9 to ISR project financial assurance cost estimates;
- Criterion 10 mandates that a minimum of $250,000 in 1978 dollars be paid to the United States General Treasury or to the appropriate state agency prior to the termination of a uranium or thorium mill license for long-term site surveillance. Given that ISR licensees currently do not dispose of 11e.(2) byproduct material in on-site disposal impoundments, this Criterion is not relevant to such licensees;
- Criterion 11 states that any uranium or thorium mill license must contain Commission-approved requirements that ensure the licensee's compliance with ownership requirements.

Subpart T, which was applicable to reclaimed Title II mill tailings impoundments, was rescinded and Criterion 6(6) was modified by NRC to satisfy EPA concerns about expeditious tailings reclamation.

[44] Under 40 CFR Part 190, the annual dose (excluding radon) to the entire body of a human being from nuclear fuel cycle facilities must not exceed 25 millirems, 75 millirems to the thyroid, and 25 millirems to any other organ of a member of the public. These standards apply to doses associated with uranium recovery facilities as of December 1, 1980.

[45] NRC is especially sensitive to inadequate surety concerns in light of the American Nuclear and Atlas Corporation bankruptcies. For ISR licensees, groundwater restoration in the recovery zone is, by far, the largest cost D&D item and, therefore, particularly important for estimating financial assurance.

[46] HRI is a wholly-owned subsidiary of Uranium Resources, Inc. (URI), which is a current member of NMA and its UES.

- Criterion 12 requires that ongoing *active* maintenance *will not be necessary* to preserve isolation of the tailings after final disposition. This Criterion is not relevant to ISR projects, because ISR project sites can be released for unrestricted use after completing site D&D;
- Criterion 13 contains EPA's RCRA hazardous constituents list with which the *secondary* groundwater standards discussed in Criterion 5 must comply. The list of hazardous constituents shown in this Criterion are not considered exhaustive and any other prospective hazardous constituents must be evaluated on a case-by-case basis independent of EPA's listing in 40 CFR Part 192. This Criterion is directly applicable to ISR licensees, as they are required to address the potential mobilization of these constituents in 11e.(2) byproduct material in groundwater in the recovery zone.

NRC also has interpreted its AEA authority and 10 CFR Part 40, Appendix A Criteria to require ISR operators to restore site groundwater within the uranium recovery zone *consistent with pre-operational (baseline) water quality levels*. NRC has defined its ISR licensing process to require several steps as part of an iterative, "phased" process. First, as part of its license application, an ISR operator must submit baseline water quality data based on pre-operational activities not prohibited by 10 CFR § 40.32(e). After a license is granted, the ISR operator must develop and submit detailed sampling data from well field and monitor wells. After a review of the data, NRC staff determines what water quality levels are appropriate.

B. EVOLUTION OF NRC REGULATORY PROGRAM FOR URANIUM RECOVERY FACILITIES: 10 CFR PART 20 RADIATION PROTECTION STANDARDS

ISR licensees also are required to comply with relevant 10 CFR Part 20 radiation protection requirements. Part 20 sets limits on radiation doses defined as "total effective dose equivalents (TEDEs)" from licensed operations to individual workers and members of the public that are increments above "background radiation." For members of the public, NRC regulations state:

> "The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 millisievert [mSv]) in a year, *exclusive of the dose contributions from background radiation*, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under §35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with §20.2003…."[47]

Thus, the calculation of TEDE for a particular licensed site is the radiation dose to individual workers or members of the public *exclusive of the dose contributions from background radiation*. "Background radiation" is defined as:

> "radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation *and are not*

[47] 10 CFR § 20.1301(a)(1) (emphasis added). 10 CFR § 20.1201 also prescribes TEDE limits for site workers of 5 rem/year (i.e., 5,000 millirem per year [mrem/yr]). *See* 10 CFR § 20.1201.

under the control of the licensee. *"Background radiation"* does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission."[48]

The application of 10 CFR Part 20 radiation protection standards is crucial to an ISR licensee's or license applicant's efforts to characterize a given site's baseline/background dose and the estimated TEDE for the site during active operations and D&D.

Pursuant to NRC's 10 CFR Part 20 regulations, as well as those denoted in 10 CFR part 40, Appendix A, ISR licensees must provide adequate protection of public health and safety from potential radiological impacts, although the potential risk associated with radiation dose from licensed ISR operations is frequently misunderstood or overstated by interested stakeholders. As a result, it is important that all interested stakeholders properly understand the potential radiation dose risk associated with such operations and how they compare with those from conventional uranium recovery and background exposures.

Naturally occurring sources of background ionizing radiation (as referenced in 10 CFR § 20.1003) include cosmic radiation, internal radiation from the inhalation or ingestion of naturally occurring radionuclides, external gamma radiation from terrestrial sources and importantly, the inhalation of radon, including its decay products. "Everything on the planet, including every living thing, is [and always has been] bathed in a sea of radiation" [NRC, 1994]. However, as noted above, NRC defines "background radiation" somewhat more broadly to account for anthropogenic sources outside of a licensee's control, by combining naturally occurring and anthropogenic sources of background radiation.

The National Council on Radiation Protection and Measurement (NCRP) describes the exposure of people in the United States to natural background radiation (NCRP, 1987). According to NCRP, the annual average radiation dose to someone living in the United States is about 300 mrem per year (mrem/yr)[49]. (NCRP, 1987) The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), in compiling world-wide data, provides the following estimates of dose (and range of dose) from naturally occurring background sources of radiation and radioactivity:

Source	Worldwide Average Annual Effective Dose (mSv [mrem])	Typical Range (mSv [mrem])
External Exposure		
Cosmic rays	0.4 (40)	0.3 – 1.0 (30-100) [a]
Terrestrial gamma rays	0.5 (50)	0.3 – 0.6 (30-60) [b]
Internal Exposure		
Inhalation (mainly radon)	1.2 (120)	0.2 – 10 (20-1000) [c]
Ingestion	0.3 (30)	0.2 – 0.8 (20-80) [d]
Total	2.4 (240)	1 to 12.4 (10 to 12400)

Notes:
a Increases with altitude
b Depending on radionuclides in soils and building materials
c Depends on dwelling and can be much higher
d Depends on radionuclides in foods and drinking water

[48] 10 CFR § 20.1003.
[49] Millirem is a measure of radiation dose, given in units of total effective dose equivalent or TEDE dose, that is used by NRC.

As illustrated in the above table, doses from naturally occurring background sources are highly variable. Indeed, Dr. Gail de Planque, a former NRC Commissioner, also has commented on the variability in dose from naturally occurring background sources. For example, Dr. de Planque noted that the dose from cosmic radiation in Denver, Colorado, at an elevation of about one mile (5,280 feet), is about a factor of two (2) higher than the national average. She also noted that, due to natural variations in the concentration of uranium and other radionuclides in soils, the natural background gamma radiation can easily vary by a factor of ten (10) across the country (de Planque, 1994).

The recovery of uranium for nuclear power generation purposes has been carried out in the United States for more than 50 years. Traditionally, uranium mining has followed practices similar to those used to mine other minerals, namely open-pit or underground mines. These types of mining activities involve excavation of overburden and waste rock (the rock matrix in which the mineral of interest is found), processing ores to recover the uranium content of the ore (referred to as milling), and management of both the waste rock that results from the mining and the tailings that result from the milling of the uranium ores. In arid climates, the potential environmental issues primarily arise from releases of radon and dust to the atmosphere and concerns with leaching from tailings or waste rock to groundwater. The doses to the *hypothetical maximally exposed individual*, from all exposure pathways combined, have been estimated to be (approximately) 50 mrem or less, well within the lower range of variation in natural background radiation and well below NRC's 100 mrem/yr maximum dose for members of the public from NRC-licensed facilities [NRC, 1980, Chambers et. al. 1989].

For ISR facilities, many of the pathways relevant to conventional uranium mining/milling do not apply and potential doses to actual members of the public who live near ISR facilities will be significantly lower, on the order of 1 mrem/yr.

In the United States, conventional uranium mining by open pit methods has not taken place for many years and mining by underground methods has resumed only recently; however, current data on doses to uranium mine and mill workers in Canada is available [NDR, 2007]. These data show the average total dose (TEDE) dose per year for underground miners for the period 1997 to 2005 is about 3.3 mSv, equivalent to 330 mrem/yr, which is approximately equal to the average dose received from natural background radiation in the United States and is approximately, $1/17^{th}$ of the annual worker dose limit in the United States of 5,000 mrem/yr.

Mill workers in Canada received an average dose of 186 mrem, and surface mining personnel received an average dose of 47 mrem. In 1975, 7 of 17 uranium mills in the United States reported an average whole body dose of 380 mrem/yr [NRC, 1980]. This value although somewhat higher than the current value reported for Canadian mills, is well within regulatory limits and, again, is comparable to the dose received from natural background. Exposures to workers at ISR facilities in general will be expected to be lower than at conventional mining/milling facilities since no ore or waste rock is brought to the surface and there are no tailings associated with ISR activities.

A number of epidemiological investigations provide further context on the potential risks to uranium mill workers and people living near uranium mining and milling operations. Pinkerton et al. [2004] reports on an evaluation of 1,484 men who worked in uranium mills on the Colorado plateau for at least one year. These authors found that mortality from cancer was less than expected based on United States cancer mortality rates. A recent update of an epidemiological study of uranium miners and processors, including uranium millers at the Beaver Lodge Uranium Mine in northern Canada, provides additional information on potential risks to mill

workers found that there was no elevation in cancer risks compared to comparison data for Canada as a whole [Howe et al 2006].

Several epidemiological studies also have been carried out on communities living near to uranium mining/milling activities. Boice et al. [2003] investigated the cancer mortality in Karnes County Texas, a county with a history of uranium mining and milling activities that includes 3 mills and over 40 mines. In brief, this paper concluded that there were no unusual patterns of cancer mortality among people living in Karnes County suggesting that uranium activities had not increased the risk of cancer. In a separate paper, Boice et al. [2007a] report a geographical correlation study of cancer and non-cancer mortality in people living near uranium and vanadium mining and milling operations in Montrose County Colorado between 1950 and 2000. These authors found that cancer and non-cancer mortality rates among people who lived in Montrose County were comparable to those counties not affected by uranium mining. The authors report on a number of occupational and environmental factors. In particular, no statistically significant increases in total risks of cancer or non-malignant respiratory diseases were observed. The authors found an increased risk of lung cancer but suggested they could be a result of cigarette smoking. Overall, the authors concluded that there was no evidence that people who lived in Montrose County experienced an increased risk from environmental exposures arising from uranium or vanadium mining/milling. Finally, another paper by Boice et al. [2007b] discusses the mortality of people who lived in Uravan, Colorado, a town built around a uranium mill. This study found no increased risk of lung cancer in female residents of the town or in mill workers. Moreover, the authors also report that their study found no evidence that elevated above background radiation exposures associated with the operations of the Uravan uranium mill increased the risk of cancer to people living in Uravan.

Overall, the doses to workers at uranium mining/milling facilities are well within the range of natural background exposures and far below NRC's annual exposure limit for workers. Additionally, based on the review of the *peer-reviewed* studies noted above and with respect to incidence of cancer in populations within close proximity to conventional uranium mining and milling facilities, the potential increased dose to members of the public has led to no observable adverse impact on human health. Due to the nature of the ISR process which do not involve bringing conventional ore to the surface for processing to recover uranium, the , exposures to sources of radioactivity at or near ISR facilities will necessarily be lower, doses will be lower and hence risks to workers and nearby public also will be lower.

C. EVOLUTION OF NRC REGULATORY PROGRAM FOR URANIUM RECOVERY FACILITIES: 10 CFR PART 51 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 REQUIREMENTS

In 1969, Congress enacted the National Environmental Policy Act (NEPA) to require federal agencies to properly assess the potential environmental impacts associated with "major federal actions." NEPA established a *process* to consider the environmental consequences of proposed "major federal actions." This goal is "realized through…procedures that require agencies to take a "hard look" at environmental consequences,"[50] thus, NEPA imposes *procedural*, rather than *substantive* requirements. So long as the potential adverse impacts of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh potential environmental costs.[51]

[50] *Robertson v. Methow Valley Citizens Council*, 490 United States 332, 350 (1989).
[51] *Id.*

As an independent regulatory agency, NRC is not bound by regulations promulgated by the Council of Environmental Quality (CEQ) under NEPA.[52] As stated in the Federal Register in 1984:

> "as a matter of law, NRC as an independent regulatory agency can be bound by CEQ's [Council on Environmental Quality's] regulations only so far as those regulations are procedural or ministerial in nature. NRC *is not bound* by those portions of CEQ's regulations which have a substantive impact on the way in which the Commission performs its regulatory functions."[53]

However, NRC promulgated regulations in 10 CFR Part 51 designed to facilitate compliance with NEPA. Pursuant to these regulations, NRC requires a detailed environmental evaluation of the potential impacts of, and alternatives to, proposed uranium recovery operations.[54] Unless mandated by regulation to perform an environmental impact statement (EIS), NRC staff is required to conduct an initial environmental assessment (EA) and to determine whether the potential impacts of the proposed action warrant a finding of no significant impact or an EIS.[55] In the event that an EIS is warranted, NRC first prepares a draft EIS for issuance and public comment and, upon completion of the public comment period, NRC responds to comments and issues a final EIS (FEIS).

As part of the review process, NRC also requires an applicant to submit detailed procedures, protocols, and other data and information demonstrating that the applicant is capable of performing the proposed action under the conditions and requirements prescribed by NRC. For example, NRC requires that an applicant provide adequate information demonstrating that it is financially qualified to perform NRC license requirements and that its procedures and protocols are technically sufficient. Based on the FEIS and the applicant's license application, NRC determines whether to issue a license or not and what, if any, appropriate conditions to add to the applicant's proposed license.

Prior to the Commission's decision in 2000 classifying restoration fluids from ISR operations as 11e.(2) byproduct material because restoration is so closely associated with uranium recovery/processing, NRC generally conducted its environmental review of proposed ISR projects using a site-specific EA rather than an EIS. Since the mid-1980s, the only example of an ISR project for which a site-specific EIS was conducted was the HRI Crownpoint Uranium Project (CUP). Moreover, a site-specific EIS was conducted for the entire CUP because one of the proposed project sites (Crownpoint Unit One) is located on Bureau of Indian Affairs (BIA)-managed allotted land which would have required a separate EIS pursuant to BIA regulations. As a result, HRI and NRC staff decided to combine all four proposed project sites into one EIS.

Due to the Commission's 2000 decision noted above, NRC staff has determined that 10 CFR § 51.20 (b)(8) mandating that an EIS must be prepared for the "[i]ssuance of a license to possess and use source material for uranium milling…" now applies. While the domestic uranium recovery industry has consistently argued that the removal of uranium from an underground ore body using ISR techniques does not fall under the ambit of this regulation, the Commission's 2000 decision is being interpreted to mean that ISR subsurface activities are "processing" or

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[52] 42 U.S.C. § 4321 *et seq*.
[53] 49 Fed. Reg. 9352 (March 12, 1984) (emphasis added).
[54] *See generally* 10 CFR Part 51.
[55] 10 CFR §§ 50.20-51.21; *see also* United States Nuclear Regulatory Commission, NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (August, 2003).

“milling” uranium rather than “mining” uranium.[56] Whether this will hold true for satellite well fields or so-called “remote IX” facilities is still an open question. Whether it should apply to a full-scale ISR project is one important reason to assess the potential impacts of ISR on a generic basis.

D. RISK-INFORMED, PERFORMANCE-BASED LICENSING FOR ISR OPERATIONS

As stated above, Congress enacted the AEA to promote national security and peaceful uses of atomic energy in the United States. At the time of the AEA’s passage, the AEC’s primary focus was the development of nuclear weapons, but that focus expanded to regulation of construction and safe operation of civilian nuclear power reactor facilities. In order to regulate adequately the highest potential risk activity in the civilian nuclear fuel cycle, the AEC expended considerable resources to quantify systematically the risks associated with nuclear power reactors. AEC, and later NRC, promulgated and implemented a detailed and restrictive regulatory program (10 CFR Part 50) so that such facilities could be operated efficiently with the necessary assurance that public health and safety and the environment will be protected adequately.

However, even in the context of this higher potential risk activity, NRC determined that certain reactor-related activities involve levels of risk that are sufficiently low to justify “scaled-down” NRC regulatory oversight (i.e., *active day-to-day* oversight is not necessary).[57]

Since NRC’s regulatory regime includes a wide range of licensed activities involving various ranges of potential risk, NRC decided to analyze design and operational issues in conjunction with relative levels of risk. Using this “risk-informed” approach, NRC evaluated a wide range of challenges to the safety aspects of various licensed activities, including prioritizing potential risks based on operating history and industry experience, engineering judgment and consideration of relative levels of uncertainty in safety and environmental analyses for specific activities. As stated by NRC, “[w]here appropriate, a risk-informed regulatory approach can also be used to reduce unnecessary conservatism in deterministic approaches, or can be used to identify areas with insufficient conservatism and provide the bases for additional requirements or regulatory actions.” *See* United States Nuclear Regulatory Commission, SECY-98-144, *White Paper on Risk-Informed and Performance-Based Regulation* (June 22, 1998).

NRC married another regulatory oversight concept with its efforts to “risk-inform” its program — i.e.; performance-based regulation. Former NRC Chairman Shirley Jackson initiated NRC’s

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[56] United States Nuclear Regulatory Commission, SRM-SECY-99-0013 (July 26, 2000).

[57] An example of “scaled down” regulatory oversight in the 10 CFR Part 50 reactor regulatory program is 10 CFR § 50.59 entitled *changes, tests and experiments.* Furthermore, Section 50.59(c)(1) states, in pertinent part “A licensee may make changes in the facility as described in the final safety analysis report (as updated), make changes in the procedures as described in the final safety analysis report (as updated), and conduct tests or experiments not described in the final safety analysis report (as updated) without obtaining a license amendment pursuant to §50.90 *only if*….” (emphasis added)

(i) a change to the technical specifications incorporated into the license is not required; and

(ii) the change test or experiment does not meet any of criteria in paragraph c(2) of this section - - e.g:
(i), (iii) & (iv) if it results in more than a minimal increase in the frequency of occurrence, consequences, or type of accident or
(ii), (iv) & (vi) if it results in more than a minimal increase in likelihood of occurrence, consequences or result of a malfunction.

1995 Strategic Assessment and Rebaselining Initiative, to promote a more risk-informed regulatory approach to NRC licensing and oversight and to consider broader uses of performance-based licensing concepts. Performance-based licensing, as opposed to conventional prescriptive licensing, is designed to minimize the amount of active regulatory oversight over a licensed activity by providing "performance" criteria or requirements for licensees while, at the same time, assuring that public health and safety will be protected adequately. As stated by NRC staff in SECY-98-144:

> "A performance-based requirement relies upon measurable (or calculable) outcomes (i.e., performance results) to be met, but provides more flexibility to the licensee as to the means of meeting those outcomes. A performance-based regulatory approach is one that establishes performance and results as the primary basis for regulatory decision-making, and incorporates the following attributes: (1) measurable (or calculable) parameters (i.e., direct measurement of the physical parameter of interest or of related parameters that can be used to calculate the parameter of interest) exist to monitor system, including licensee, performance against clearly defined, objective criteria, (2) licensees have flexibility to determine how to meet the established performance criteria in ways that will encourage and reward improved outcomes; and (3) a framework exists in which the failure to meet a performance criterion, while undesirable, will not in and of itself constitute or result in an immediate safety concern. The measurable (or calculable) parameters may be included in the regulation itself or in formal license conditions, including reference to regulatory guidance adopted by the licensee."

See id.

NRC has determined that "risk-informed, performance-based" regulation is an approach under which risk insights, engineering analysis and judgment, and performance history are used, to (1) focus attention on the most important activities, (2) establish objective criteria based upon risk insights for evaluating performance, (3) develop measurable or calculable parameters for monitoring system and licensee performance, and (4) focus on the results as the primary basis of regulatory decision-making." *Id.*

One benefit of performance-based licensing is that it may be implemented "without the need to develop risk insights" at every stage. *Id.* Risk-informed analyses and experience have provided a framework within which objective performance criteria for licensed activities can be established and licensees can be given flexibility regarding management of their technologies or processes so long as the performance criteria are satisfied. Performance criteria, which are focused more on results rather than processes, also can be combined with prescriptive requirements (i.e., mandatory license conditions) to create a licensing approach that more efficiently fits a particular licensed activity. As stated by NRC, a "performance-based approach does not supplant or displace the need for compliance with NRC requirements, nor does it displace the need for enforcement action, as appropriate, when noncompliance occurs." *Id.*

This "marriage" of concepts led NRC to conclude that, for lower-risk activities, these "concepts and definitions should prove equally suitable provided that NRC adopts a flexible framework for the implementation of risk-informed, and ultimately performance-based regulation across the full spectrum of the materials, processes, and facilities regulated by NRC." *Id.*

During the late 1990s, NRC staff began consideration of performance-based licenses and license conditions in the context of conventional and ISR licenses. As a result, uranium recovery licensees utilize performance-based license conditions and, indeed, even Energy Solutions' 11e.(2) byproduct material disposal facility license contains a performance-based license condition. Thus, use of such concepts is based on existing precedent for a range of AEA licensed activities from uranium recovery facilities to nuclear power reactors.

Assuming the issuance of a performance-based license, an important component of that license will be the safety and environmental review panel (SERP). A SERP generally consists of a minimum of three (3) permanent members, each of which possesses expertise in a relevant area of concern for the proposed licensed activity. For example, permanent SERP members will require expertise in: (1) business management affairs, (2) engineering and/or technical issues, and (3) environmental/radiation safety (i.e., RSO [Radiation Safety Officer]). SERPs also may include additional permanent members with expertise in health physics or other relevant subject-matters, as well as temporary members with expertise in legal and regulatory affairs.

The SERP's primary function is to monitor ongoing licensee operations and determine whether the licensee can, in its discretion, engage in a particular activity without violating its mandatory license conditions. Any activities assessed by the SERP and determined to be within the scope of approved license conditions must be documented and made available to NRC inspectors upon request.[58] NRC also requires an annual report of SERP actions for review by NRC staff. SERPs may not alter or amend prescriptive requirements or engage in activities outside the scope of mandatory license conditions without NRC approval through a license amendment.

The use of performance-based licensing is especially appropriate for ISR licenses as such operations are, by far, the lowest risk operations in the nuclear fuel cycle. As stated above, the use of performance-based licensing was originally implemented for nuclear power reactor licenses to allow for the conduct of purely ministerial or other low-risk activities without the need for cumbersome review and licensing processes. Given that ISR involves far fewer regulatory controls and orders of magnitude less risk, the use of performance-based licensing in this context provides NRC/Agreement States and licensees with the ability to conserve human and financial resources while continuing to assure adequate protection of public health and safety and the environment.

E. EVOLUTION OF NRC REGULATORY PROGRAM FOR URANIUM RECOVERY FACILITIES: AGENCY GUIDANCE

1. NUREG-1569 STANDARD REVIEW PLAN FOR IN SITU URANIUM RECOVERY FACILITIES

Since 10 CFR Part 40, Appendix A's Criteria for uranium recovery facilities were focused primarily on conventional uranium milling facilities, ISR projects have been licensed largely through licensee-specific license conditions. As a result, to facilitate the submission of complete license applications for new ISR operations, NRC created an ISR Standard Review Plan (SRP)

[58] Failure to fulfill SERP requirements or to document activities within the scope of performance criteria can result in enforcement action. SERP decisions and actions based thereon are *at the licensee's risk* as inappropriate decisions also can lead to NRC enforcement action "after-the-fact."

entitled *Standard Review Plan for In Situ Uranium Extraction License Applications* (Regulation NUREG-1569; NRC, 2003).[59]

As a general proposition, NUREG-1569 recognizes that ISR projects are process-oriented, "phased" projects, as demonstrated, with clarity, by SRP Chapter 2 entitled *Site Characterization* and Chapter 5 entitled *Operations*. Chapters 2 and 5 of NUREG-1569 demonstrate that ISR projects are developed through a process-oriented, "phased" process involving general *pre-operational* site characterization followed by detailed, progressive *operational* site development that occurs only after licensing is complete. As noted above, this iterative, "phased" approach is reflected in the sequential development of ISR well fields, baseline water quality, upper control limits (UCLs), monitor wells to protect water quality, and appropriate financial assurance.

2. NUREG-1748 ENVIRONMENTAL REVIEW GUIDANCE

In an effort to facilitate the preparation of timely and high-quality license applications for NRC licenses, which must include the evaluation of potential environmental impacts, NRC developed NUREG-1748 to provide guidance to license applicants as to the proper contents of EISs, EAs, and more importantly, environmental reports (ERs)

Chapter 6 of NUREG-1748 entitled *The Environmental Report: Format and Technical Content* provides ISR license applicants with appropriate guidance for the preparation of ISR project license applications/ERs. As part of a "complete" ISR license application and, as stated by NRC, a general following of "the outline of an EIS," the guidance provided in NUREG-1748 provides the specific format for a site-specific ER for new ISR projects. The requirements in NUREG-1748 are intended to facilitate general compliance with 10 CFR Part 51 NEPA requirements for new NRC licenses, including ISR projects.

Chapter 5 of NUREG-1748 entitled *Preparing an Environmental Impact Statement: Format and Technical Content* also provides ISR license applicants with guidance as to the format and contents of site-specific EISs, so that, in the event that an EIS or supplemental EIS is required, the license applicant will be able to address any issues that may require immediate attention in its site-specific ER.

3. REGULATORY GUIDE 4.14

On April 25, 1980, NRC staff issued Regulatory Guide 4.14 (Reg. Guide 4.14) entitled *Radiological Effluent and Environmental Monitoring at Uranium Mills* to provide license applicants for conventional uranium recovery projects with guidance as to how properly to measure site background radiation levels and water quality levels and how to create radiation monitoring programs for radiological releases from such facilities. In NUREG-1569, NRC staff expressly directs ISR license applicants to utilize the provisions of Reg. Guide 4.14 to the extent "relevant and appropriate" to their proposed project sites. For example, Reg. Guide 4.14 prescribes a methodology for soil sampling and air monitoring, as well as water quality sampling, at licensed sites to determine baseline/background radiation levels, so that site TEDE calculations may be ascertained to comply with 10 CFR Part 20. This Reg. Guide is used for proposed ISR license applications, as ISR license applicants are required, pursuant to Criterion

[59] United States Nuclear Regulatory Commission, NUREG-1569, *Standard Review Plan for In Situ Leach Uranium Extraction License Applications* (June, 2003).

7, to have at least one year of data regarding radiation levels in soil and air at proposed project sites.

4. REGULATORY GUIDE 8.31

In May of 2002, NRC staff issued Revision 1 of Reg. Guide 8.31 entitled *Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium recovery Facilities Will Be As Low As Reasonably Achievable* (Reg. Guide 8.31) to provide “guidance on design criteria and administrative practices acceptable to NRC staff for maintaining occupational exposures as low as reasonably achievable…in uranium recovery facilities….” The Preamble to this Reg. Guide explicitly states that it is applicable to uranium recovery facilities, including ISR facilities.

Reg. Guide 8.31 “is directed toward occupational health protection from radiologic and toxic hazards from airborne particulates of uranium and its daughters,” as well as potential dose exposure from external radiation. The policies and programs articulated in Reg. Guide 8.31 focus primarily on maintaining potential doses in accordance with the ALARA principle, as discussed in Criterion 8. NUREG-1569 specifically references Reg. Guide 8.31 as a guidance document to assist license applicants in preparing ISR license applications.

A major component of Reg. Guide 8.31 is the requirement that ISR licensees maintain standard operating procedures (SOPs) for any activities that involve the handling, processing, and/or storage of radioactive materials. This requirement directly applies to all aspects of ISR facility operations from air monitoring to yellowcake production, storage, and transport. These SOPs also require periodic ALARA inspection and audit programs by the RSO to ensure that all radiation protection programs satisfy appropriate NRC regulations and license conditions.

5. AGENCY INTERPRETATIONS FROM HYDRO RESOURCES, INC. ADMINISTRATIVE LITIGATION AND DECISIONS

In 1988, pursuant to NRC regulations at 10 CFR Parts 20, 40, including Appendix A Criteria, and 51, as well as applicable NRC guidance, HRI submitted a license application for a uranium recovery license to conduct ISR operations at four individual project sites, two at Church Rock (Sections 8 and 17) and two at or near Crownpoint (Unit One and Crownpoint), in the State of New Mexico (the CUP).

On November 14, 1994, NRC staff prepared a DEIS for HRI’s license application and published a notice in the Federal Register detailing its availability.[60] This Federal Register notice provided potentially affected parties with an opportunity to request a hearing in accordance with 10 CFR § 2.1205. Several parties filed hearing requests with NRC and a panel of administrative law judges and technical experts was appointed by NRC’s Atomic Safety and Licensing Board Panel (ASLBP) on December 21, 1994.[61] The administrative panel held all aspects of the proceeding, including final determinations of the threshold issue of the filing party(ies)’s *standing* to participate in an NRC administrative hearing in abeyance until NRC staff completed its review of HRI’s license application and issued its FEIS for the CUP project sites. On March 21, 1997, NRC staff announced the availability of its FEIS[62] and, on January 5, 1998, NRC staff approved HRI’s license application and granted HRI License No. SUA-1508.

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[60] *See* 59 Fed. Reg. 56,557 (November 14, 1994).
[61] *See* 59 Fed. Reg. 66,979 (January 8, 1995).
[62] *See* 62 Fed. Reg. 13725 (March 21, 1997).

On May 13, 1998, NRC's ASLBP granted certain parties standing to intervene to challenge HRI's license under NRC's 10 CFR Part 2, Subpart L provisions for "informal hearings."[63] Additionally, in September of 1997, NRC staff requested leave to participate as a party in the hearing process in accordance with 10 CFR §§ 2.1213 & 2.1237.

Initially, the ASLBP bifurcated the hearing process so that the issues for each CUP uranium recovery site could be litigated separately. The Church Rock Section 8 site was addressed first and the ASLBP requested written presentations from all parties regarding Intervenors' contentions to determine whether HRI's license should be approved as issued, approved with conditions or revoked. With respect to the Section 8 site, the following issues were litigated during the hearing process: (1) groundwater protection/restoration, and financial assurance, (2) historic and cultural resource preservation, (3) radiological air emissions, (4) environmental impact statement adequacy, (5) financial and technical qualifications, (6) environmental justice, (7) surface water protection and liquid waste disposal.

From 1999 to 2007, the ASLBP issued a series of decisions sustaining HRI's proposed ISR operations. Several of these decisions were appealed to the full Commission and, in each instance, the Commission sustained, with or without conditions, HRI's proposed ISR operations for Section 8. The substance of these decisions provides important guidance to potential ISR license applicants.

First, as stated throughout NMA's scoping comments and this GER, from a technical and environmental perspective, the most important issue associated with ISR operations is protection of USDWs. In the HRI case, the regulatory requirements for protection of such groundwater sources were further clarified by the Commission when it imposed a requirement for a restoration action plan (RAP) on ISR license applicants to provide adequate assurance of protection of USDWs adjacent to aquifer zones where licensed uranium recovery operations are to take place. While HRI already had received an NRC license for its proposed project sites, the Commission determined that the issuance of such a license will be preconditioned on the preparation and approval of a RAP demonstrating the process by which groundwater restoration will be achieved and the corresponding financial assurance cost estimates for the conduct of restoration activities.[64] However, the Commission also mandated that, while the RAP will be submitted and approved prior to the issuance of a license, an ISR licensee is not required to have the actual financial assurance mechanism in place until it is time to begin injecting recovery solutions into the ore body.

In addition, with respect to financial assurance, the ASLBP also issued a decision stating that HRI could not calculate financial assurance cost estimates by assuming that: (1) site employees would be permitted to perform multiple, unrelated tasks during groundwater restoration and site D&D and (2) major site equipment would be available for use during groundwater restoration and site D&D.[65] However, on appeal, HRI and NRC staff argued that standard industry practices, which NRC encourages license applicants to use in composing license applications,[66] indicate that these two assumptions are fundamental components of financial assurance cost

[63] *See In the Matter of Hydro Resources, Inc.* (Crownpoint Uranium Project), LBP-98-9, 47 NRC 261 (May 13, 1998).
[64] *See In the Matter of Hydro Resources, Inc*. (Crownpoint Uranium Project), CLI-00-08, 51 NRC 277 (May 25, 2000).
[65] *See In the Matter of Hydro Resources, Inc.* (Crownpoint Uranium Project), LBP-04-03, 59 NRC 84 (February 27, 2004).
[66] *See generally* NUREG-1569.

estimates. The Commission reversed ASLBP's finding and agreed with HRI and NRC staff's position that 10 CFR Part 40, Appendix A, Criterion 9 permits these two assumptions to be used when calculating financial assurance cost estimates. Thus, ISR license applicants have been provided with further clarification on the proper interpretation of Criterion 9's financial assurance provisions.

Second, an essential part of an ISR license application is the calculation of estimated TEDE for members of the public from recovery operations. As part of HRI's license application, a TEDE calculation was performed for the aforementioned Church Rock Section 17, which classified certain mining spoils from previous conventional mining operations as "background radiation" under 10 CFR § 20.1003. As a result, the dose from such mining spoils was excluded from the estimated site TEDE in both HRI's license application and NRC-prepared FEIS for the CUP project sites. The exclusion of the dose from these mining spoils was challenged and both ASLBP and the Commission agreed that the dose from materials outside the jurisdiction of NRC (e.g., mining spoils) are excluded from site TEDE calculations as "background radiation." Thus, when preparing ISR license applications, potential applicants are entitled to calculate estimated site TEDE without including the dose from materials from previous mining operations or from any materials that are not within the jurisdictional authority of NRC (i.e., Naturally Occurring Radioactive Materials/Technologically Enhanced Naturally Occurring Radioactive Materials [NORM/TENORM]).[67]

Third, the HRI administrative litigation further endorsed the concept of ISR operations being based on an iterative, "phased" process. For example, one of the most contested issues in the proceeding was the viability of NRC staff's initial pore volume estimate for groundwater restoration and the development of site-specific baseline water quality parameters and UCLs. Challengers to the process of developing such parameters claimed that HRI and NRC staff were required to have such parameters developed for each potential well field prior to licensing rather than just initial basic characterization data for the first project site(s). HRI responded by stating that ISR projects are driven by an iterative, "phased" process that requires additional data gathering and analysis prior to finalizing site-specific water quality parameters such as baseline values and pore volumes required for groundwater restoration. HRI's response was supported by a number of factors, including 10 CFR § 40.32(e) which states that:

> "Commencement of construction prior to this conclusion is grounds for denial of a license to possess and use source and byproduct material in the plant or facility. As used in this paragraph, the term "commencement of construction" means any clearing of land, excavation, or other substantial action that would adversely affect the environment of a site. The term does not mean site exploration, roads necessary for site exploration, borings to determine foundation conditions, or other preconstruction monitoring or testing to establish background information related to the suitability of the site or the protection of environmental values."

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[67] Naturally occurring radioactive material ("NORM") have been defined as a subset of materials known as NARM (naturally occurring *and* accelerator-produced radioactive materials [i.e., materials made radioactive in nuclear accelerators]). NARM includes NORM, but NORM does not include the accelerator-produced portion of NARM. Technologically enhanced NORM (TENORM) means NORM-containing materials produced when human activity, such as uranium mining or sewage treatment, concentrates or exposes to the environment radionuclides that occur naturally in *ores*, soils, water, or other natural materials.

Further, as a practical matter, it is impossible for an ISR licensee to have full and complete information on the nature of the ore body to be recovered and the site-specific water quality parameters until the well fields are developed and final pump and other testing is complete. Indeed, NUREG-1569 acknowledges this by stating:

> "Reviewers should keep in mind that the development and initial licensing of an *in situ* leach [recovery] facility is not based on comprehensive information. This is because *in situ* leach facilities obtain enough information to generally locate the ore body and to understand the natural systems involved….reviewers should not expect that information needed to fully describe each aspect of a full operation will be available in the initial application."[68]

Based on this, NRC determined that initial basic characterization estimates for ore body characteristics, water quality parameters and restoration values are sufficient to sustain the issuance of a license.

This iterative, "phased" approach also is reflected in NRC determination that historic and cultural resource preservation issues will be handled using "phased" compliance. While NRC regulations and guidance require that ISR applicants conduct specific surveys of the proposed licensed site, it may not be possible for such applicants to identify each and every potential item with historical or cultural significance prior to the development of the site, including its well fields. Thus, NRC generally prescribes a system of "phased" compliance that involves the imposition of specific license conditions requiring that, in the event an unknown item of historical and/or cultural significance is discovered, a licensee must cease all potentially impacted site development activities and assess what, if any, potential actions must be taken to preserve the discovered item(s). This approach was challenged but was sustained by ASLBP and the Commission. As a result, ISR licensees must be prepared to assess potentially unknown items of historical and/or cultural significance on a continuing basis during site development, operation, and restoration.

Finally, the HRI administrative litigation further solidified the iterative, "phased" approach by endorsing performance-based licensing for ISR projects. As stated above, various aspects of ISR projects require iterative analysis and NRC regulations prohibit certain types of operations that must be conducted to complete a project database prior to the issuance of a license.[69] ASLBP agreed with HRI and NRC staff that the performance-based aspects of HRI's NRC license were adequate to protect public health and safety and, thus, were compliant with NRC's regulatory program.[70] The Commission affirmed and, thus, sustained ASLBP's findings.[71]

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[68] NUREG-1569 at 1-1.
[69] 10 CFR § 40.32(e).
[70] *See In the Matter of Hydro Resources, Inc.* (Crownpoint Uranium Project), LBP-99-10, 49 NRC 145 (February 19, 1999).
[71] *See In the Matter of Hydro Resources, Inc.* (Crownpoint Uranium Project), CLI-99-22, 50 NRC 3 (1999).

F. IN SITU URANIUM RECOVERY RULEMAKING

As the ISR process has evolved into the dominant form of uranium recovery in the United States, NRC staff has determined that the existing regulatory regime for uranium recovery facilities does not properly address some aspects of ISR projects. As stated above, the original 10 CFR Part 40, Appendix A Criteria and the environmental assessments conducted in the 1980 GEIS were specifically tailored towards conventional uranium recovery facilities, as ISR processes were not deemed to be a significant contributor to domestic uranium production. However, as ISR processes developed into the dominant form of domestic uranium production, NRC has determined that its regulatory program must better address the effective and efficient licensing of such processes.

Initially, NRC staff proposed the development of a new 10 CFR Part 41 for the regulation of ISR facilities. The creation of a new regulatory program for ISR licensees was seen as an opportunity to differentiate between ISR and conventional recovery processes, as well as to refine and clarify the applicability of specific portions of 10 CFR Part 40, Appendix A to ISR licensees. However, at the time NRC staff considered the promulgation of a new Part 41, the domestic uranium recovery industry was experiencing a severe economic decline and, thus, could not afford the fees associated with the rulemaking to develop a new Part 41. As a result, on behalf of industry members, NMA submitted a request to NRC that it postpone its Part 41 rulemaking process due to the financial difficulties of the uranium recovery industry. Since, by statute, NRC is mandated to recover most of its budget during any specific fiscal year,[72] NMA was concerned that a new Part 41 rulemaking would force uranium recovery licensees to pay significant NRC fees which they could ill afford to pay. So that the industry could remain viable, which NRC has already noted is in the public interest[73], NRC decided to forego the Part 41 rulemaking and, instead, to address changes in potential regulatory applications involving ISR and other uranium recovery issues, including alternate feed processing and direct disposal through NRC staff documents that were being prepared in any event.

Over the course of several years after the development of a new Part 41 was abandoned, the States of Wyoming and Nebraska sought to establish memoranda of understanding (MOUs) with NRC to allow for deferral of active NRC regulation of groundwater protection at ISR facilities in these two *non*-Agreement States that deem themselves to have adequate groundwater protection programs as authorized by EPA. However, the process of composing appropriate MOUs with which all parties could agree proved to be extremely difficult, in spite of the fact that the Commission determined that the manner in which NRC currently regulates ISR facilities "is both complex and unmanageable."[74]

In light of the apparent failed negotiations regarding MOUs, the Commission issued a Staff Requirements Memorandum (SRM) approving the commencement of a rulemaking to

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[72] Pursuant to the FY 2001 Energy and Water Development Appropriations Act, NRC is only required to recover 98 percent of its budget as compared to 100 percent the prior fiscal year. This percentage will decrease by two (2) percent per year until 2005. Currently, NRC is required to recover 90 percent of its budget.

[73] "The continued existence of the [Sweetwater] mill is in the public interest as it is one of only six uranium mills remaining in the United States and the only one remaining in Wyoming." Letter from Melvyn Leach, Acting Chief, Fuel Cycle Licensing Branch, division of Fuel Cycle Safety and Safeguards, Office of Nuclear Material Safety and Safeguards, to Oscar Paulson, *Re: Sweetwater Uranium Mill (SUA-1350)-Five (5) Year Postponement of Initiation of Decommissioning*, July 17, 2001

[74] *See* United States Nuclear Regulatory Commission, COMJSM-06-0001, *Regulation of Groundwater Protection at In Situ Leach Uranium Extraction Facilities* (January 17, 2006).

promulgate new regulations specifically to address avoidance of duplicative regulatory oversight of ISR facilities, particularly with respect to approving final groundwater restoration.[75] The Commission directed NRC staff to continue to pursue MOUs with the States of Wyoming and Nebraska and to exercise enforcement discretion to permit current licensees to meet appropriate state groundwater requirements through license amendments allowing states to determine that groundwater restoration efforts were satisfactory.[76]

Over the past year, NMA uranium recovery members, NRC staff, and EPA have met to discuss various issues associated with this proposed rulemaking. The primary issue in this rulemaking will be establishment of final restoration standards for ISR licensees. NMA understands that revisions will be proposed to Criterion 5 to make the groundwater restoration standards currently applicable to conventional uranium mill facilities (including the *legal right* to obtain a constituent-specific ACL to complete groundwater restoration at a given facility) applicable to ISR licensees. Currently, ISR licensees are permitted to apply for constituent-specific variances (i.e., the functional equivalent of an ACL for given site-specific parameters), but such licensees do not have a *legal right* to apply for an ACL under 10 CFR Part 40, Appendix A, Criterion 5. To the best of NMA's knowledge, this proposal has been agreed-upon by NRC and EPA.

G. CONCURRENT JURISDICTION DECISION

In 1980, NRC's Office of Executive Legal Director "(OELD)" issued an advisory legal opinion concluding that the AEA, as amended by UMTRCA, does not preempt the exercise of *non*-Agreement State authority over the *non*-radioactive components of 11e.(2) *byproduct material*. In reaching this conclusion, OELD conceded that:

> [W]e conclude that the question is *so close* that the Commission *could reasonably choose either interpretation*, but that *the better legal view* is that non-Agreement States and NRC have concurrent jurisdiction to regulate the *non*-radioactive hazards of mill tailings, both before and after the November 8, 1981 date upon which the Mill Tailings Act becomes fully effective.[77]

Thus, even at the time the opinion was issued,[78] OELD believed that the arguments favoring federal preemption of *non*-Agreement State regulation were persuasive. Nevertheless, in the end, the legal staff chose to support the opposite interpretation, concluding that *non*-Agreement States can exercise concurrent jurisdiction over the *non*-radioactive aspects of 11e.(2) *byproduct material*.

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[75] *See* SRM-COMJSM-06-0001 (March 24, 2006).

[76] *Id.*

[77] Memorandum from Howard K. Shapar, Executive Legal Director, NRC, to Chairman Ahearne, NRC re: OELD Legal Opinion on Two Questions Relating to the Operation of the Uranium Mill Tailings Radiation Control Act of 1978, Attachment B, 2-3 (April 28, 1980) (emphasis added).

[78] NRC's legal staff subsequently reaffirmed this position in a letter dated October 28, 1993 to the Attorney General of the State of Wyoming. *See* Letter from William L. Brown, Regional Counsel, NRC, to Mike Barrash, Senior Assistant Attorney General, Wyoming (October 28, 1993). Interestingly, the Attorney General of Wyoming concluded in 1979 that UMTRCA preempted State regulation of *both* radiological and *non*-radioactive hazards associated with mill tailings. *See* Memorandum from John D. Troughton, Attorney General, State of Wyoming to Ed Herschler, Governor, State of Wyoming (December 1, 1979) (emphasis added).

In response to significant potential regulatory problems for uranium recovery licensees as a result of the OELD advisory opinion, in a White Paper,[79] NMA presented a detailed analysis arguing that the advisory opinion's conclusion was incorrect and not nearly so close a question "when viewed through the lens of today's regulatory environment." More specifically, with respect to ISR licensees, the OELD opinion would permit *non*-Agreement States to impose alternative standards for site reclamation and the handling, storage, and disposition of all 11e.(2) byproduct material generated during and after cessation of active operations. Further, if *non*-Agreement States were allowed to exercise concurrent jurisdiction over *non*-radioactive aspects of 11e.(2) *byproduct material*, then *non*-Agreement States could force licensees to perform remedial actions *above and beyond* those required by NRC, regardless of the net risk, cost, or environmental impact and, conceivably, even after license termination was granted by NRC.[80] Under this policy, the Commission would be unable to weigh the impacts of state imposed actions with the other factors mandated for consideration by the statute, thereby potentially leading to inappropriate management of 11e.(2) *byproduct material*, in contravention of Section 84 of the AEA.

After careful consideration of the uranium recovery industry's viewpoints as presented in NMA's White Paper challenging the OELD's opinion and the position of NRC staff in SECY-99-277[81] supporting OELD's opinion, in 2000, the Commission (voting 3 ½ to 1 ½) voted to overturn OELD's opinion and held that the Commission indeed possesses exclusive jurisdiction over both the radiological *and non*-radioactive aspects of 11e.(2) byproduct material.[82]

As a result of the Commission's "concurrent jurisdiction" opinion, the regulation of both the radiological and *non*-radioactive components of 11e.(2) byproduct material generated from ISR operations is now under the exclusive jurisdiction of NRC or Agreement States. Moreover, after the Commission's 2000 decision that ISR restoration fluids and related solids are 11e.(2) byproduct material, groundwater restoration now includes active NRC regulation of the radiological and *non*-radioactive components of such constituents in recovery zone groundwater. Although, as noted above, the AEA gives the Commission authority to approve final site reclamation, including groundwater restoration and license termination, (even in an Agreement State) for ISR licensees, the "concurrent jurisdiction" decision makes it clear that this authority extends to restoration of *non*-radioactive 11e.(2) constituents in groundwater and associated wastes generated by groundwater restoration activities.

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[79] *See* National Mining Association, *Recommendations for a Coordinated Approach to Regulating the Uranium Recovery Industry* (1998-1999).

[80] Indeed, potential *non*-Agreement state assertions of regulatory authority over *non*-radioactive constituents after license termination is a matter of particular concern to DOE as the long-term custodian. In particular, DOE could refrain from taking title to 11e.(2) disposal sites because of the possibility that the additional regulatory burdens imposed by the *non*-Agreement State, and the economic costs associated with those regulatory burdens, would conflict with the directive contained in Section 83 of the AEA, which requires that the transfer of title to DOE occur *without cost to the government* other than administrative and legal costs associated with the transfer itself. This reluctance is, in part, based on the waiver of sovereign immunity under the Federal Facilities Compliance Act with respect to the management of hazardous (i.e., *non*-radioactive) substances under state law or delegated authority.

[81] United States Nuclear Regulatory Commission, SECY-99-277, *Concurrent Jurisdiction of Non-radioactive Hazards of Uranium Mill Tailings* (December 2, 1999).

[82] United States Nuclear Regulatory Commission, SRM-SECY-99-277, *Concurrent Jurisdiction of Non-Radioactive Hazards of Uranium Mill Tailings* (August 11, 2000).

H. ALTERNATE FEED POLICY: PROCESSING OF ORES OTHER THAN CONVENTIONAL ORES[83]

When the price of uranium sharply declined in the early 1980s, conventional uranium mills were forced to seek alternative sources of feedstock to maintain the viability of these facilities. Thus, prior to 1992, NRC received, and in some cases approved, several requests from uranium mills to process feed material that was not *natural* uranium *ore*, and to dispose of the resulting waste in the mill's tailings impoundment. For example, between 1982 and 1987, NRC approved several amendments to the source material license for the Rio Algom uranium mill in Lisbon, Utah enabling the mill to receive secondary processing wastes from a uranium hexafluoride conversion facility, a niobium-tantalum recovery facility, and an yttrium-lanthanides recovery facility.[84] Likewise, in 1987, NRC permitted the Quivira Mining Company to process sludge from a uranium hexafluoride conversion plant. The uranium content of these wastes, ranging from 0.6 to 1.17 percent, was typically higher than that of the average *natural ore*, thus making them particularly attractive candidates for process feed. In addition to processing wastes from other mining operations, some mills also have sought NRC approval to process wastes generated during the treatment of uranium mine wastewater containing significant concentrations of uranium.

After issuing a draft policy to address the receipt and processing of these alternate feed materials and soliciting input from various stakeholders, including NMA, NRC issued a final alternate feed policy in 1995. This policy imposed three key requirements on any uranium recovery facility seeking to process an alternate feed material:

> (1) the proposed material must qualify as "ore;"
> (2) the proposed material must not contain any *listed* hazardous wastes; and
> (3) the proposed material must be processed primarily for its source material content.[85]

A focal point of the alternate feed policy was the creation of a definition of "ore." Congress did not provide NRC with a definition of "ore" within the context of the definition of "source material" or "11e.(2) byproduct material" in the AEA. As a result, under its power to interpret the provisions of the AEA, NRC created the following definition of "ore:"

> "[A] natural or native matter that may be mined and treated for the extraction of any of its constituents or *any other matter* from which source material is extracted in a licensed uranium or thorium mill."[86]

This definition of "ore" was intended to be sufficiently expansive to cover a broad range of potential feed materials. Indeed, NRC staff concluded that

> "The fact that the term "*any ore,"* rather than *unrefined and unprocessed ore*, is used in the definition of 11e.(2) byproduct material implies that *a broader range of feed materials*

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[83] NMA also presented arguments regarding NRC's policy for the direct disposal of *non*-11e.(2) byproduct material in uranium mill tailings impoundments. However, since this policy does not directly apply to ISR facilities, it will not be addressed in this Preamble.
[84] 57 Fed. Reg. 20,531 (1992).
[85] *See generally id.*
[86] *See* 57 Fed. Reg. 20531 (1992).

> *could be processed in a mill*, with the wastes still being considered as 11e.(2) byproduct material.[87]

In 1998, NMA submitted comments on the alternate feed policy requesting that NRC re-visit the policy and amend specific portions. In response to this request, the Commission issued a SRM and a Regulatory Issue Summary and added a fourth requirement requiring all licensees to process alternate feed materials in accordance with 10 CFR Part 40 and Appendix A Criteria.[88] In addition, this policy has been given the force and effect of law by ASLBP and the Commission's decision in recent International Uranium (USA) Corporation (now "Denison Mines") administrative litigation.[89]

A key component of NRC's current implementation of its alternate feed policy is the requirement that each new stream of alternate feed materials sought to be processed by a licensee, presumably whether conventional or ISR, must be analyzed in an EA. NRC imposed this requirement, because alternate feed materials processing was not assessed in the 1980 GEIS and, as a result, independent environmental review is required prior to the issuance of a license amendment *to process* such materials. Thus far, the policy and the EA requirement have been relevant primarily to alternate feed processing at conventional uranium recovery facilities.

However, in the context of ISR facilities, the alternate feed policy may apply to specific streams of alternate feed materials such as IX resins from mine de-watering or other water treatment operations. For example, in the context of the recently issued R.M.D. Operations, LLC performance-based, multi-site license for drinking water treatment facilities (and potentially other water treatment operations), significant amounts of uranium-laden IX resins (which are essentially identical to those used at ISR facilities or conventional milling facilities with IX recovery circuits), will be generated that will require final disposition in the form of disposal in a licensed disposal facility or processing in an IX stripping circuit in a conventional milling or ISR facility. Given the increase in demand for domestic uranium production, it is not only common sense but also good economic/energy policy to encourage processing of such resins. However, IX resins produced by mine de-watering or other water treatment operations are classified as alternate feed materials and, pursuant to NRC staff policy, apparently must be assessed in an EA prior to be legally acceptable for processing. NMA believes that NRC staff's policy requiring EAs for each new stream of alternate feed materials in the form of uranium-laden IX resins is unnecessary and should be modified for such resins.

As a practical matter, the basis for NRC staff's requirement for EAs for alternate feed processing (i.e., not previously assessed in the 1980 GEIS) already may have been satisfied for IX resins from water treatment operations. First, the 1980 GEIS did evaluate the extraction of uranium from water sources and the use of IX resins to concentrate uranium in ISR and conventional uranium recovery circuits.[90] For example, the 1980 GEIS also states "the resulting impure dilute leach solutions have to undergo *concentration* and *purification* as a prerequisite to the production of a final, high-grade, uranium product. A number of major techniques are used

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[87] 57 Fed. Reg. at 20532.
[88] United States Nuclear Regulatory Commission, Regulatory Issue Summary, RIS-00-023, *Recent Changes to Uranium Recovery Policy* (November 30, 2000).
[89] *See e.g., In the Matter of Hydro Resources, Inc.* (Crownpoint Uranium Project), LBP-02-19, 56 NRC 113 (August 28, 2002).
[90] "Nonconventional recovery processes include *in situ extraction of ore bodies…uranium recovery from mine water*, copper dump leach liquor, or wet process phosphoric effluents." 1980 GEIS at Summary 3, pp. 3-4-3-10 (emphasis added); *see also* Volume II at B-9 –B-10.

to affect this stage of the milling process. They are: *ion exchange…solvent extraction*…."[91] Thus, the 1980 GEIS expressly has considered uranium recovery from IX resins and has explicitly acknowledged IX resin usage as a "major technique" in the uranium recovery process.

Further, NRC staff has determined that residues from mine water treatment to remove uranium are a "refined and processed" *ore* under its regulatory program. Prior to the issuance of its final alternate feed policy in 1995, NRC staff stated:

> "The Nuclear Regulatory Commission (NRC) and Agreement States have received, and in some cases approved, requests to allow a uranium mill to *process* feed material that was not natural (native, raw) uranium ore and dispose of the resulting waste in the facility's tailings impoundment. In those cases, the feed material was generally either processing wastes from other extraction procedures or *the residues from mine-water treatment. T*hese requests were handled on a case-by-case basis, and approvals were based on the interpretation that the proposed feed material was *refined or processed ore.*"[92]

Thus, IX resins generated from water treatment operations, while a "refined and processed" *ore*/alternate feed material, have been assessed by NRC in both the GEIS and in its discussion of its then-developing alternate feed policy. As a result, NRC should re-evaluate its position on EAs for IX resins from water treatment operations and should issue a revision to its policy stating that:

(1) IX resins from mine de-watering or other water treatment operations that are essentially identical to uranium-loaded resins from ISR operations or conventional mill IX circuits can be received, stored, *and processed* at an ISR facility or conventional uranium recovery facility with an IX stripping circuit without the need for a license amendment or an EA; unless

(2) There is some unique characteristic(s) (e.g., high constituent levels of arsenic) associated with a batch of uranium-laden IX resins, that an EA and license amendment could still be required. The licensee's SERP would have to determine that any potential impacts due to the unique characteristic(s) will be *de minimis*.

I. OTHER APPLICABLE STATUTORY AND REGULATORY PROGRAMS: THE SAFE DRINKING WATER ACT

To assure safe and effective underground injection throughout the United States, the United States Congress enacted the Safe Drinking Water Act of 1974 (SDWA),[93] which, in part, authorized establishment of the UIC program so that injection wells will not endanger current and future USDWs. The SDWA empowered EPA with the primary authority to regulate underground injection to protect current and future sources of drinking water. EPA also was authorized to provide states with the opportunity to assume primary authority over UIC programs in accordance with final regulations promulgated by EPA in 1980, which set minimum

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[91] 1980 GEIS at B-9.
[92] 57 Fed. Reg. 20525, 20532 (May 13, 1992) (emphasis added).
[93] *See* 42 United StatesC. § 300j-9(i) *et seq.*

standards for state programs to meet to be delegated primary enforcement responsibility (primacy) for such programs.[94]

Between 1981 and 1996, EPA granted primacy to 34 states for all injection wells (except those on Tribal lands). EPA implements the UIC program directly in 10 states and shares responsibility in six other States. EPA directly implements UIC programs for all Native American lands. Unless authorized by rule or by permit, any underground injection is unlawful and is in violation of the SDWA and UIC regulations.

Underground injection is broadly defined as the process of placing fluids underground in porous formations of rocks through wells or other similar conveyance systems. Before NRC-licensed ISR operations can commence at any ISR project site, an ISR licensee must have obtained two UIC authorizations: (1) an aquifer exemption for the aquifer or portion of the aquifer wherein ISR operations will occur and (2) a UIC permit.[95]

1. AQUIFER EXEMPTIONS

As noted above, the UIC program was created to protect current or future USDWs. A USDW is defined as an aquifer, or portion thereof, which serves as a source of drinking water for human consumption, or contains a sufficient quantity of water to supply a public water system, and contains fewer than 10,000 milligrams per liter (mg/liter) of total dissolved solids (TDS). The broad definition of a USDW was mandated by Congress in Section 1421(d)(2)[96] of the SDWA to ensure that future USDWs will be protected, even where those aquifers currently are not being utilized as a drinking water source or could not be used without some form of water treatment.

Within this regulatory framework, however, some aquifers or portions of aquifers, which can satisfy the broad regulatory definition of a USDW, may not reasonably be expected to serve as a current or future source of drinking water. As a result, the UIC program regulations allow EPA to *exempt* portions of an aquifer from delineation as a USDW and allow for injection into such aquifers or portions thereof. EPA regulations at 40 CFR § 146.4 state:

> "An aquifer or a portion thereof which meets the criteria for an 'underground source of drinking water' in § 146.3 may be determined under 40 CFR § 144.7 [sic] to be an *'exempted aquifer"* if it meets the following criteria:
>
> a. *It does not currently serve as a source of drinking water; and*
> b. *It cannot now and will not in the future serve as a source of drinking water*…or
> c. The TDS content of the groundwater is more than 3,000 and less than 10,000 mg/L and it is not reasonably expected to supply a public water system."[97]

According to EPA, aquifers meeting one or more of these criteria are generally associated with *in situ* mineral and enhanced oil recovery. If an operator, licensee or permittee wishes to inject into a USDW for the purpose of recovering minerals (e.g., uranium), a demonstration must be

[94] *See* 42 U.S.C. § 300h(1).
[95] *See e.g.,* United States Nuclear Regulatory Commission, Hydro Resources, Inc., SUA-1508, License Condition 9.14.
[96] *See* 42 U.S.C. § 300h(b)(1).
[97] *See* 40 CFR § 146.4 (emphasis added).

made that the proposed aquifer meets at least one of the exemption criteria.[98] To the best of NMA's knowledge, there is no provision in the SDWA nor has EPA promulgated implementing regulations establishing criteria for revocation of an approved aquifer exemption granted pursuant to 40 CFR § 144.8, nor has EPA ever actually revoked such an exemption.

Therefore, logically, EPA does not prescribe specific groundwater *restoration* standards for exempted aquifers, because such exempted aquifers will never be used as drinking source at any point before, during or after ISR operations are complete. However, as described in 40 CFR § 146.7, EPA can require corrective action/remediation of any contamination of *adjacent, non-exempt* aquifers in accordance with the purpose of the SDWA and the UIC program to protect USDWs.[99] For each individual ISR project seeking to use injection wells, an aquifer exemption is required for both Class I UIC deep injection wells and Class III UIC injection wells for uranium recovery.

2. UNDERGROUND INJECTION CONTROL PERMITS

UIC regulations establish specific performance criteria for classes of wells (ISR wells are Class III wells) to assure that drinking water sources, actual and potential, are not rendered unfit for such use by underground injection of the fluids common to that particular category of wells.

To obtain a permit for a new Class I UIC deep injection well to dispose of 11e.(2) byproduct material and other wastes or Class III UIC uranium recovery wells, the owner/operator or licensee must file an application with the UIC Director for the relevant jurisdiction containing specific information listed in 40 CFR Part 146 or in applicable state requirements. Once a UIC permit application has been reviewed, the applicant will be notified of the items needed to complete the application, if any. After a complete application is received, an initial decision to grant or deny the permit is issued. UIC regulations also provide opportunities for public participation and comment.

A UIC permit(s) is required for each individual ISR project—a Class III UIC permit for uranium recovery wells and, if the licensee/permitee seeks to use this method of disposal, a Class I UIC permit for a deep injection well. As stated above, such permits necessarily assume the existence of an aquifer exemption for that portion of the aquifer to be used for underground injection—*water that cannot now or in the future be used as a USDW.*

Pursuant to an NRC/Agreement State license, however, ISR licensees will be required to *restore* mining zone groundwater (exempted aquifer groundwater) consistent with approved *pre-mining water quality* or *secondary* standards (e.g., MCLs prescribed for given constituents pursuant to the SDWA or relevant state standards).[100] However, if neither restoration goal referenced above is "*reasonably achievable*," a licensee is permitted to request a constituent-specific ACL-equivalent upon showing that there will be no significant adverse impacts on public

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[98] In other words, a proposed ISR operation can only be conducted in an aquifer or portion thereof that cannot now or in the future serve as a source of drinking water due to the presence of significantly elevated concentrations of *naturally occurring radionuclides and/or other hazardous constituents*. Thus, it is incorrect for members of the public or organizations to assert that the conduct of ISR operations take place in and result in a degradation of "pristine" or otherwise potable sources of water.

[99] *See* 40 CFR § 146.7.

[100] *See e.g.,* United States Nuclear Regulatory Commission, Hydro Resources, Inc. Materials License, SUA-1508, License Condition 10.21.

health and safety.[101] This flexibility is reasonable and appropriate to assure adequate protection of public health and safety, since the goal of restoration is not to create a USDW where one did not previously exist, but rather to minimize or eliminate the potential for post-closure impacts on adjacent, non-exempt USDWs. Moreover, this flexibility is appropriate, because, at some point, the potentially significant water consumption and financial resource impacts of continued restoration pumping to reduce constituents, (which may not even be hazardous to human health) [e.g., chlorides and sulfates] or which satisfy state class-of-use limits), to baseline or secondary limits in a portion of an aquifer that can never be a USDW cannot be justified *reasonably*. Indeed, as noted above, NRC will be proposing revisions to Criterion 5 to make the EPA RCRA/NRC Criterion 5 groundwater cleanup requirements applicable to groundwater restoration at ISR facilities.

[101] This approach, as set forth in NUREG-1569, Chapter 6, Section 6-9, is essentially identical to EPA's RCRA standards for groundwater cleanup, incorporated in 10 CFR Part 40, Appendix A, Criterion 5, that are applied to conventional uranium milling licensees. Criterion 5 which allows groundwater remediation to background or MCLs, whichever is higher, or to constituent-specific *alternate concentration limits* (ACLs) upon a demonstration that the latter will not result in any adverse impacts on public health, safety, and the environment. *See* 40 CFR § 192.32, *incorporating* 40 CFR § 264.92. In addition, NRC proposed rulemaking for ISR facilities potentially likely will grant ISR licensees the *legal right* to apply for constituent-specific ACLs for groundwater restoration.

1.0 INTRODUCTION

The National Mining Association (NMA) has developed this Generic Environmental Report (GER) as an appendix to its scoping comments in response to the proposed development of a Generic Environmental Impact Statement (GEIS) by the United States Nuclear Regulatory Commission (NRC) for the licensing, construction, operation, and decommissioning (the lifecycle) of in situ uranium recovery (ISR) facilities (hereinafter "ISR GEIS"). NMA is submitting its scoping comments and this GER to NRC during its public scoping period, in response to the solicitation of public comments on the intent to prepare the ISR GEIS.

Pursuant to the Atomic Energy Act of 1954 (AEA), as amended by the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), NRC has statutory responsibility for the protection of public health and safety and the environment related to the possession and use of AEA materials (i.e., source (uranium and thorium), 11e.(1) and 11e.(2) byproduct, and special nuclear material). NRC exerts its statutory responsibilities through a comprehensive regulatory program, which includes regulations and guidance and the use of license conditions. Two fundamental components of this licensing scheme are delineated in 10 Code of Federal Regulations (CFR) Part 40, including Appendix A which authorize NRC to issue licenses allowing entities to "receive title to, receive, possess, use, transfer, or deliver any source material after removal from its place of deposit in nature" (10 Code of Federal Regulations [CFR] §§ 40.1 & 40.3) and to possess, use, and ensure the safe management and control of 11e.(2) byproduct material associated with source material uranium recovery operations (10 CFR § 40, Appendix A).

As part of its overall Part 40 and Appendix A licensing scheme, NRC conducts detailed technical and environmental reviews of proposed licensing actions, including ISR projects. NRC's detailed environmental reviews are conducted pursuant to its 10 CFR Part 51 regulations as part of its voluntary compliance with the National Environmental Policy Act of 1969 (NEPA). NEPA requires all federal agencies to assess the potential environmental, social, and economic impacts resulting from "major federal actions." These analyses help to inform federal decision-makers regarding the potential impacts resulting from an identified, proposed "major federal action."

NMA understands that NRC intends to perform a generic, programmatic analysis pursuant to NRC regulations at 10 CFR Part 51 and associated guidance to address the potential impacts on human health and the environment resulting from ISR operations licensed by NRC or Agreement States in the United States. The ISR GEIS can, in turn, provide a generic platform upon which site-specific studies, investigations, and compliance documentation for individual licenses can be based. Specifically, documentation to ensure compliance with NEPA will be "tiered" off the ISR GEIS in accordance with applicable regulations.

Therefore, NMA prepared this GER in accordance with NEPA (42 United States Code [U.S.C.] 4321), applicable Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), applicable NRC regulations (e.g., 10 CFR Parts 20, 40 & Appendix A & 51), and the following primary guidance documents:

- *Environmental Review Guidance for Licensing Actions Associated with Nuclear Material Safety and Safeguards (NMSS) Programs, Final Report* (NRC Regulation [NUREG]-1748), NRC, August 2003.

- *Standard Review Plan for In Situ Leach Uranium Extraction License Applications, Final Report* (NUREG-1569), NRC, June 2003.

- *A Baseline Risk-Informed, Performance-Based Approach for In Situ Leach Uranium Extraction Licenses* (NUREG/CR-6733), NRC, September 2001.

Section 1.0 of this GER presents a short description of the proposed action; a description of the purpose of and need for the proposed action; the scope of the GER and method of assessment (including issues studied in detail and issues eliminated from detailed study); a description of the scoping process; applicable regulatory requirements, licenses/permits, any federal, regional, state, local, and/or Tribal involvement and consultations (e.g., cooperating agencies).

The remainder of this GER is organized into 11 additional sections, as described below:

Section 2, Alternatives: This section provides more information about the proposed action and alternative methods for achieving the purpose and need for the action. Alternatives were developed based on relevant issues identified in Section 1.0.

Section 3, Description of the Model Region for ISR Operations: This section describes the model region and affected environment in which ISR facilities generally are constructed and operated. This section is organized according to the resources affected by the proposed action and other alternatives.

Section 4, Potential Environmental Impacts: This section describes the potential environmental impacts of implementing the proposed action and other alternatives. The potential direct, indirect, and cumulative impacts on physical (e.g., land use, geology, surface and groundwater), ecological, and socio-economic resources are presented.

Section 5, Mitigation Measures: This section describes measures to mitigate or reduce the potential impacts described in Section 4.0.

Section 6, Environmental Measurements and Monitoring Programs: This section describes environmental measurement and monitoring programs that are required by applicable regulations to implement and manage the mitigation measures outlined in Section 5.0.

Section 7, Cost-Benefit Analysis: This section presents the programmatic cost-benefit analysis and describes the guidelines for conducting cost-benefit analyses on a generic basis for proposed ISR facilities.

Section 8, Summary of Potential Impacts: This section presents a summary of the potential impacts presented in Section 4.0. The primary summary is presented in tabular format.

Section 9, List of Preparers: This section presents the names, contact information, and qualifications of the professionals who prepared NMA's scoping comments and this GER.

Section 10, Distribution List: This section is reserved for use by NRC to document the public distribution of the ISR GEIS, once developed.

Section 11, References: This section presents all references used to develop NMA's GER in a bibliographic format.

1.1 Description of the Proposed Action

Under the AEA, licensees have the primary responsibility for the safe possession and management of AEA materials, including source material uranium recovered from licensed ISR operations, in a manner that assures adequate protection of public health and safety and the environment. Accordingly, licensees or license applicants are required to present NRC with proposals for licensing actions which NRC reacts to by approving in whole, approving with conditions or denying such proposals. *See generally* 49 Federal Register (Fed. Reg.) 9352 (March 12 1984). Thus, the proposed action(s) to be addressed in NMA's ISR GER and NRC's proposed ISR GEIS is the licensing of multiple ISR projects (including license and license amendment applications),which NRC must review for technical acceptability and assess for potential impacts on public health and safety and the environment. This review process begins with an initial "acceptance review" to determine if the applicant's license or license amendment application is sufficient to warrant detailed technical and environmental review. If the application is deemed sufficient, then NRC proceeds to conduct its detailed technical and environmental review. If the application is deemed insufficient, it is returned to the applicant with an explanation of data, analyses, and other information that is needed to make the application sufficient. Figure 1.1 presents a flowchart of the ISR license application process.

Any entity seeking to recover uranium using ISR processes is required to obtain a uranium recovery license from NRC or an Agreement State pursuant to 10 CFR Part 40 regulations and Appendix A Criteria (NRC 2003a) or applicable Agreement State regulations. Any applicant for a new ISR license, license renewal, or license amendment must provide NRC with detailed information pertaining to proposed equipment, facilities, operations, and decommissioning. The procedure for acquiring a new license, renewal, transfer, or amendment is described in 10 CFR Part 2, Subpart A, and 10 CFR 40.31 provides guidance for filing such applications. Additionally, the applicant must provide NRC with an environmental report, pursuant to 10 CFR Part 51 and NUREG-1748 guidance assessing the potential impacts on public heath and safety and the environment (NRC 2003a). NUREG-1569 also provides guidance on the preparation of ISR license applications.

A generic technical description of the ISR process is provided in the preamble to these generic scoping comments. A detailed description of ISR facilities, processes, and technical approaches currently used by industry, as well as those that have been used in the past and that could be used in the future, is provided in Section 2.0.

1.2 Purpose and Need for the Proposed Action

The purpose of the proposed action is to provide a generic, programmatic assessment of the potential impacts and benefits of ISR operations in their complete lifecycle. This GER will evaluate the substantial common elements associated with ISR operations in different regional geographic locations, as well as any notable differences likely to be encountered so that license applicants preparing site-specific license applications and NRC staff considering such applications have a fundamental generic platform from which to review such applications and prepare site-specific assessments. Thus, when evaluating such license applications, NRC staff can determine that, where the site-specific proposed action is within the bounds evaluated and the conclusions reached in the ISR GEIS, each and every component of such applications need not be reviewed *ab initio*. In other words, site-specific applications can "tier" off of the generic evaluations and conclusions presented in the ISR GEIS and NRC, therefore, can focus on detailed evaluation of relevant site-specific issues.

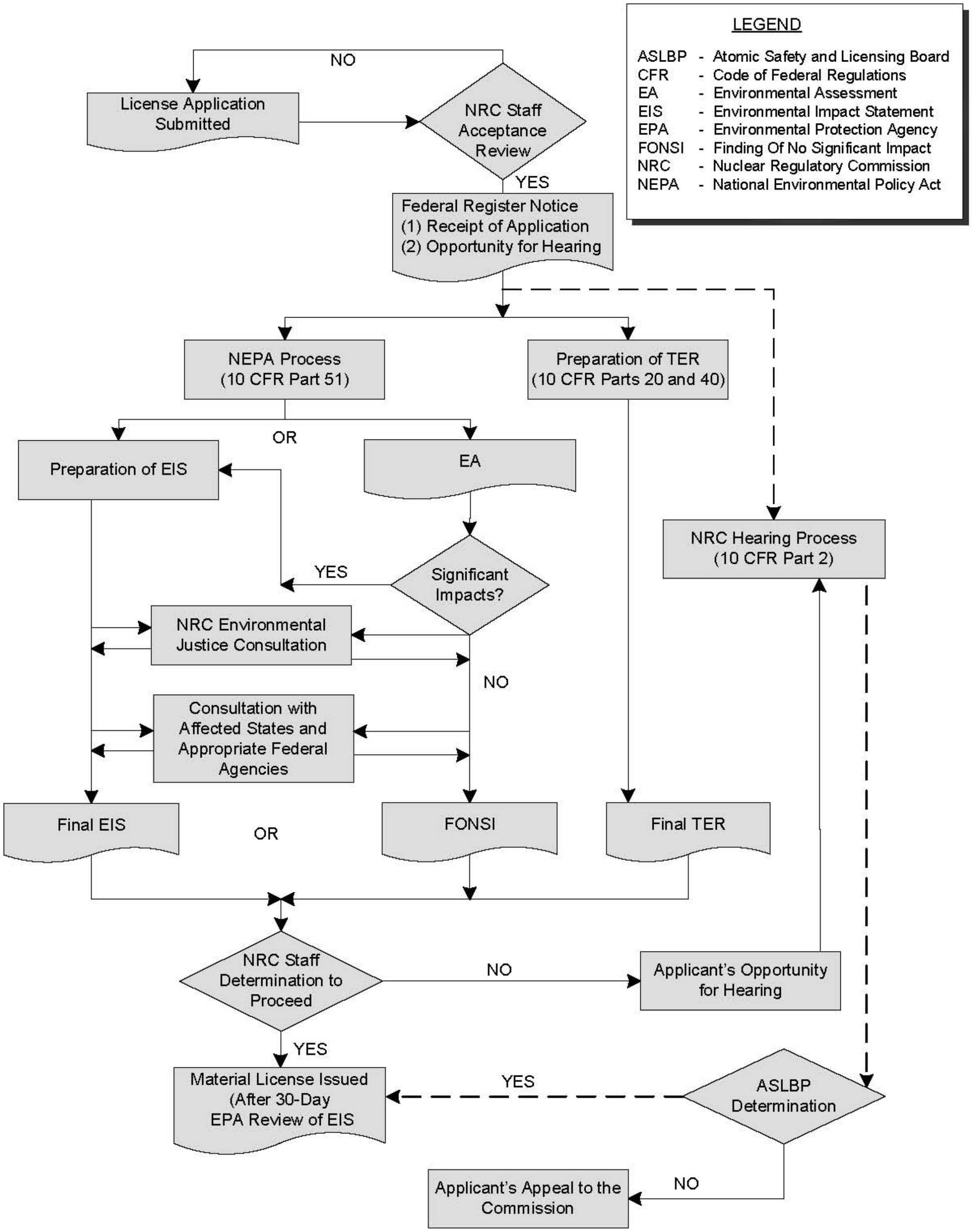

Figure 1.1 Application Flow Chart

NRC's need for action on an ISR GEIS is based on its statutory responsibility to efficiently and effectively license the beneficial use of AEA materials while, at all times, assuring adequate protection of public health and safety and the environment. NRC must be able to respond to multiple new license applications for ISR operations resulting from the current worldwide market demands for new production of uranium, which are driving a growing nuclear industry in the United States. Many nations throughout the world that currently operate nuclear reactors are seeking to expand their existing power generation capacities, while many others seek to develop new nuclear power generation capacity. These nations include China, India, Indonesia, Vietnam, and others. This trend only can be seen as increasing as nations work to reduce greenhouse gas emissions and meet Kyoto Protocols, where applicable. Nuclear power currently produces 16 percent of the world's electricity and approximately 20 percent of the electricity generated in the United States. The United States currently has 104 operating nuclear reactors, and the current national policy suggests that such capacity should be expanded considerably (NRC anticipates the receipt of applications for up to 30 new nuclear reactor units over the next 15 years). The average 1,000-megawatt (MW) nuclear reactor unit uses approximately 500,000 pounds of uranium per year and requires approximately 2 million pounds for initial startup (NMA, 2007). Thus, new sources of uranium production must be identified and developed to meet these requirements.

In 2006, all uranium producing countries produced an estimated 103 million pounds of uranium (58 percent from primary production, 42 percent from secondary production, and 9 percent from byproduct/sidestream production). With respect to primary production, 25 percent of produced uranium used ISR processes and 66 percent used conventional mining/milling. On an international basis, this level of production could result in a future uranium shortfall of approximately 75 million pounds annually. On a domestic basis, the United States produced approximately 4 million pounds of uranium in 2006 and required approximately 48.5 million pounds to operate its nuclear power reactor industry (Energy Information Administration, 2007a); therefore, domestic nuclear power reactors have been forced to obtain virtually all of their uranium from foreign producers, resulting in a significant United States dependence on foreign energy sources in an ever tightening international market. The current market has caused a dramatic increase in the price of uranium from $7 to 8 per pound (2002) to $80 to $140 per pound (2007) (NMA, 2007).

The current international market, the need to counter dependence on foreign energy sources, and the high prices paid for uranium are driving a rapidly expanding United States uranium recovery industry, which NRC anticipates will result in a significant number of new uranium recovery license applications, primarily for ISR projects, in the coming years (NRC 2007e). In order to develop an effective and efficient NEPA review process while at all times assuring adequate protection of public health and safety and the environment, NRC is taking proactive steps to maximize the efficiency of its ISR licensing process, including the development of an ISR GEIS.

Evaluation of proposed ISR projects will involve assessment of multiple procedural and substantive issues, including, but not limited to, development of baseline water quality standards and upper control limits (UCLs), implementation of adequate radiation protection programs, preservation of traditional cultural properties and historic resources, and environmental justice relevant to site-specific circumstances. These types of issues are assessed using well-understood procedures that reflect the iterative, "phased" nature of ISR project development, operation, and decommissioning. Sometimes, the public at-large does not understand the iterative, "phased" nature of ISR projects and concludes erroneously that insufficient attention is being paid to important issues, because such issues routinely are addressed in an iterative,

“phased” manner. Indeed, ISR projects are, by definition, iterative, “phased,” projects, and NRC should explain in the ISR GEIS how the ISR licensing process routinely addresses these issues in this context.

In addition, NMA and the uranium recovery industry understand the perception that the most important potential impact associated with ISR projects is potential degradation of groundwater quality outside the recovery zone and, in particular, drinking water sources. This perception appears to be based, in part, on the wide-spread ignorance about, or refusal to address the statutory and regulatory safeguards for ISR recovery under the AEA, as amended, and the Safe Drinking Water Act of 1974 (SDWA) and its Underground Injection Control (UIC) program for any authorized underground injection activities. The aquifers or portions thereof where ISR operations are conducted are not suitable for drinking (i.e., pre-operations, during operations, or post-operations) and must be designated as “exempt aquifers” pursuant to United States Environmental Protection Agency (EPA) UIC regulations prior to the commencement of any NRC and/or Agreement State-licensed ISR operations. During the thirty plus year history of ISR operations in the United States, there have been no significant, adverse impacts on adjacent, non-exempt underground sources of drinking water (USDWs) as a result of the migration of ISR recovery constituents to such adjacent, non-exempt USDWs. The commonality of geologic and hydrologic conditions at ISR project sites are frequently misinterpreted or misunderstood by the public at-large, thereby generating opposition to an otherwise environmentally benign form of mineral recovery. It is crucial that NRC dispel the mistaken belief that ISR recovery takes place in “pristine” drinking water sources and make it clear that adequate safeguards under NRC’s AEA and EPA’s UIC regulatory programs exist to protect adjacent, non-exempt USDWs from contamination during ISR operations and after groundwater restoration is complete.

Therefore, in summary, NMA and its members strongly support NRC’s efforts to develop the ISR GEIS and submit their scoping comments and this GER to support its development.

1.3 Scope of the GER and Method of Assessment

As noted above, under NEPA, federal agencies must consider the potential impacts of “major federal actions” on the environment using a systematic interdisciplinary approach (42 U.S.C. 4321, Section 102(a)). Section 102(1) requires that the policies, regulations, and public laws of the United States be interpreted and administered in accordance with the policies set forth in NEPA. Thus, it is NEPA’s intent to have federal agencies incorporate consideration of environmental issues, including public input thereon, into their decision-making processes.

NMA’s GER evaluates concerns, opportunities, and issues on a generic, programmatic basis; considers alternatives; and evaluates the potential impacts of the activities proposed in these alternatives. It provides valuable data, analyses, and other information to assist NRC in the development of an ISR GEIS and in the review of site-specific license applications submitted prior to and after the completion of the ISR GEIS.

On the basis of significant quantities of data and analyses generated over more than thirty years of ISR research and development and commercial operations, this GER identifies, evaluates, and documents in a programmatic fashion the potential environmental and socio-economic impacts of ISR operations to assist NRC’s development of an ISR GEIS in a timeframe consistent with its public commitment to have a draft available by Spring of 2008. As a result, future site-specific NEPA analyses will be able to “tier” off the data, analyses, and conclusions in the ISR GEIS, while focusing detailed analysis on relevant site-specific issues.

A generic, programmatic impact analysis of the proposed action is accomplished by identifying the nature and magnitude of potential impacts generically and irrespective of where these ultimately may be encountered. It is reasonable to apply this generic, programmatic approach to ISR operations, because more than thirty years of ISR industry experience demonstrates that ISR operations take place at sites with substantially similar features, including, but not limited to: (1) similar hydrogeologic conditions including extremely poor baseline water quality due to naturally occurring radionuclides and other heavy metals in zones containing the uranium resources to be recovered, (2) similar geology and mineralology, as well as uranium genesis; (3) similar, if not identical, surface and subsurface conditions and facilities, (3) similar, if not identical, labor requirements due to highly automated nature of operations, and (5) similar, if not identical, reclamation cycles. The very nature of the ISR process and the geologic/hydrologic/geochemical conditions in which it can be utilized means that the recovery sites are substantially similar in the subsurface since the process only works in a certain class of uranium deposits (i.e., deposits in sandstone aquifers).

The methodology used to assess the common elements of, and potential impacts associated with, ISR processes includes the following. NMA has prepared a full description of the ISR processes and technical approaches based on ISR facilities currently in operation and those that may be licensed within the foreseeable future (see Section 2.0), and has developed a model ISR site compiled from the general characteristics of existing ISR operation locations in various regions of the United States (see Section 3.0). Most potential environmental impacts resulting from ISR processes are similar from one site to another, and therefore, the Model ISR Site description is adequate to support decision-making and "tiering" of site-specific NEPA documents. Model ISR site descriptions are based on averages of the characteristics of the regions where uranium is recovered by the ISR process, which are predominantly in the western United States. The application of ISR processes and technical approaches to the Model ISR Site forms a basis for analyzing potential, generic impacts (see Section 4.0). The analyses of potential impacts were prepared by an interdisciplinary staff with the appropriate backgrounds relative to the scope and nature of the issues identified below (40 CFR § 1502.6).

The ultimate goal of the ISR GEIS is to provide NRC with assistance in developing a generic, programmatic platform (a single resource) from which site-specific environmental assessments (EAs) can be "tiered" for individual license applications. "Tiering" (defined in 40 CFR § 1508.28 and described in 40 CFR § 1502.20 and NUREG-1748, Section 1.6.2) is a procedure by which more specific or more narrowly focused environmental documents can be prepared without duplicating relevant parts of previously prepared programmatic or generic documents. "Tiering" is used by all federal departments and agencies to comply with NEPA while minimizing or eliminating redundant and duplicative analyses to streamline NEPA processes and to address potential cumulative impacts (The NEPA Task Force 2003). Site-specific environmental documents can incorporate by reference the general data, analyses, and conclusions from the ISR GEIS and focus on the issues and potential impacts of the project unique to each given site. Any site-specific environmental report, however, must demonstrate that the proposed activity falls within the scope and conclusions of the ISR GEIS, and such reports cannot change or modify the conclusions in the ISR GEIS. Site-specific environmental reports also must identify the ISR GEIS as the document from which it is tiered and both documents must be available for public review (NRC 2003b).

NRC currently uses other final NEPA documents to assess agency actions related to the uranium recovery industry, and therefore, the following documents are hereby incorporated by reference:

- *Final Generic Environmental Impact Statement on Uranium Milling* (NUREG-0706), NRC, September 1980.
- *Final Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites* (EPA 520/4-82-013-1), EPA, 1982.
- *Final Environmental Impact Statement for Standards for the Control of Byproduct Materials from Uranium Processing (40 CFR 192)*, (EPA 520/1-83-008-1), EPA, Office of Radiation Programs, September, 1983.
- *Regulatory Impact Analysis of Environmental Standards for Uranium Mill Tailings at Active Sites* (EPA 520/1-82-023), EPA, Office of Radiation Programs, March, 1983.

The process described below is proposed as a systematic interdisciplinary approach to facilitate "tiering" and streamline NRC's NEPA review process. This GER attempts to frame a set of broad, generic conditions to which site-specific conditions addressed in future applications can be compared, and from which site-specific studies can be tiered. The discussion below offers a mechanism to:

- standardize the comparison of site specific operating conditions to the conditions anticipated in the ISR GEIS
- standardize the comparison of site specific environmental conditions to the conditions addressed in the ISR GEIS
- streamline the license application preparation process
- streamline NRC's environmental review process by minimizing the application of NRC resources to those issues that are addressed already, and focusing NRC resources on review of issues, resources, and potential impacts that are unique, site specific, or of significant concern to one or more stakeholders
- enable NRC to provide timely responses to applicants or stakeholders while ensuring adequate protection of public health, safety and environment.

To meet these goals, NMA recommends that NRC consider adopting a process from a sister federal agency that has already been used in multiple states and settings to evaluate potential environmental impacts from natural resource development, including oil and gas, and conventional uranium recovery. The United States Bureau of Land Management (BLM) has developed a systematic approach to scoping and tracking the environmental review process (BLM, 1988) which has been formalized in the Utah BLM Guidebook (BLM 2006), that is based on use of an Interdisciplinary Team Record Checklist (ID Checklist).

BLM guidance recommends use of the ID checklist for:

- tracking and confirming that all pertinent environmental resources have been identified,
- determining that suitable baseline assessments have been developed for all resources,
- confirming that potential impacts have been identified and evaluated,
- determining which potential impacts on resources require detailed analysis in an environmental assessment (EA) or environmental impact statement (EIS),
- documenting that a qualified resource specialist from the appropriate agency has accepted the determination.

NMA has selected an approach paralleling the BLM approach for the following reasons. First, the BLM approach already has been successfully used since its inception at numerous sites in the same (western United States) or similar regions, and for the same purpose (development of energy resources, among others) as NRC's ISR regulatory program. Second, it is anticipated that a number of ISR license applications will involve coordination of environmental evaluation between NRC and the federal agency or other entity that serves as a landowner or steward of the property upon which ISR operations will occur. In the regions where ISR operations are expected to occur, the landowner is, in many cases, the BLM. Using a set of tools already recognized by this agency is expected to simplify the applicants' and NRC's interagency coordination.

NMA also recommends that NRC consider a modification and adaptation of the BLM process and its tools and templates for conducting site-specific analyses to be tiered from the ISR GEIS, as follows:

Step 1: Confirm whether the scope of the site-specific proposed action is or is not within the range of conditions for the proposed actions addressed in this GER and the ISR GEIS;

Step 2: Assess whether the baseline conditions for each environmental resource are or are not within the scope of conditions anticipated in this GER and the ISR GEIS;

Step 3: Identify those resources or environmental conditions that are to be carried forward to a site-specific evaluation (EA or EIS);

Step 4: Develop the site-specific evaluation as a document "tiered" to the ISR GEIS and focused on those site-specific issues that are outside the scope of the ISR GEIS. The site-specific documents will refer to the ISR GEIS and incorporate it, or relevant sections of it, by reference.

Table 1.1, below, provides a basis for Steps 1 through 3. Column 1 of this table utilizes the environmental resource titles identified in NUREG-1748. For reference, an additional column (Column 2) has been included which matches NRC references relevant to the comparable resource(s) to the same resources as they are titled in BLM guidance. Column 3 lists the completeness evaluation criteria from NUREG-1569 and NUREG-1748 for each title. Column 4 summarizes the operational and environmental conditions within the scope of this GER. This column provides a basis for comparison of site-specific conditions in each application, to determine whether each is or is not within the scope of this GER.

Table 1.1
Framework for "Tiering" and Checklist for Environmental Resources

NRC Resource Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed Under this Title	Criteria for Assessing Completeness of Characterization	Criteria for Assessing Whether Impact is within Scope of this GER/ISR GEIS
Description of Alternatives			
Description of Proposed Action		NUREG – 1748 Section 5.2.2 NUREG – 1569 Sections 1.3, 2.1.3, 3.1.3, 3.2.3, 3.3.3, 4.1.3, 4.2.3, 4.3.3	See specific resources below
No Action Alternative		NUREG – 1748 Section 5.2.3	NA
Other Reasonable Alternatives		NUREG – 1748 Section 5.2.4	NA
Description of Alternatives Considered but Eliminated		NUREG – 1748 Section 5.2.5	• Conventional uranium mining/milling including heap leaching • Byproduct/sidestream recovery from other mineral recovery operations
Description of the Affected Environment			
Land Use	BLM Lands/ Access BLM Fuels/Fire Management BLM Recreation BLM Woodland/Forestry BLM Farmlands (Prime or Unique) BLM Wilderness BLM Wilderness Characteristics BLM Livestock/Grazing BLM Rangeland Health Standards and Guidelines	NUREG – 1748 Section 6.3.1 NUREG – 1569 Sections 1.0, 2.1.3, 2.2.3	• Use of land for well fields • Use of land for processing facilities • Use of land for liquid and solid waste storage and management
Transportation		United States Department of Transportation (DOT) Regulations (10 CFR Part 71) NUREG-1748 Section 6.3.2	• Model region consists of eight Midwestern/Rocky Mountain/Gulf Coast states • Waste will be shipped in manageable secure containers by trucks by highway o ISR facilities are located near existing highway infrastructure

Table 1.1
Framework for "Tiering" and Checklist for Environmental Resources

NRC Resource Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed Under this Title	Criteria for Assessing Completeness of Characterization	Criteria for Assessing Whether Impact is within Scope of this GER/ISR GEIS
			o No bulk shipping, freight rail line connections, or navigable waterway transporting methods will be used • Generic regional road conditions i.e. paved, dirt, miles traveled o No anticipated weight restrictions o No new major roadways, rail spurs, or canals needed o Travel congestion and travel routes are not problematic • Next stage processing of uranium recovered currently will occur at conversion facilities located in Port Hope, Ontario or Metropolis, Illinois. (Should new conversion facilities be sited, identified transport routes and distances traveled will be a critical factor) • Potential truck accident assessment includes radioactive scenario, non-radioactive scenario, and accident impacts
Geology and Soils	BLM Soils BLM Geology/Mineral Resources/Energy Production	NUREG – 1748 Section 6.3.3 NUREG – 1569 Sections 1.0, 2.6.3	• Regional geology based on reference material to establish geologic context for an ISR operation • Three primary ISR areas used (1) the "Four Corners Region" which includes CO, UT, NM, and AZ (2) Powder River Basin (3) South Texas o Geologic and soil characteristics of the

Table 1.1
Framework for "Tiering" and Checklist for Environmental Resources

NRC Resource Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed Under this Title	Criteria for Assessing Completeness of Characterization	Criteria for Assessing Whether Impact is within Scope of this GER/ISR GEIS
			Model ISR Site found in Section 3.3
Water Resources	BLM Water Quality (Drinking/Ground) BLM Floodplains	NUREG – 1748 Section 6.3.4 NUREG – 1569 Sections 1.0, 2.2.3, 2.7.3, 3.1.3, 3.2.3, 3.3.3	• Water quality baseline typically not of drinking water standard • Model site meets requirements for an exemption under the SDWA/UIC aquifer exemption requirements • Assume uranium roll-front deposit is well suited for ISR processes with possibility of vadose zone extraction • Additional permitting safeguards • Surface water resources are typical of semi-arid regions of western United States
Ecological Resources	BLM Wetlands/Riparian Zones BLM Fish and Wildlife including Special Status Species BLM Vegetation including Special Status Plant Species BLM Threatened, Endangered or Candidate Plant Species BLM Threatened, Endangered or Candidate Animal Species BLM Invasive, Non-native Species BLM Wild Horses and Burros	NUREG – 1748 Section 6.3.5 NUREG – 1569 Sections 1.0, 2.8.3	• Model region assumes same geographical areas as Geology and Soils section

Table 1.1
Framework for "Tiering" and Checklist for Environmental Resources

NRC Resource Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed Under this Title	Criteria for Assessing Completeness of Characterization	Criteria for Assessing Whether Impact is within Scope of this GER/ISR GEIS
Meteorology, Climatology, and Air Quality	BLM Air Quality	NUREG – 1748 Section 6.3.6 NUREG – 1569 Sections 1.0, 2.5.3, 3.2.3, 3.3.3	• Model region assumes same geographical areas as Geology and Soils section. • Model region assumes attainment areas for Four Corners and South Dakota and, potentially, Wyoming o Potential ISR locations in South Texas model region identified as non-attainment
Noise		NUREG – 1748 Section 6.3.7	• Current ambient noise within the model region is limited to naturally occurring sources, nearby light roadway traffic and off-road motorized sources, and noise from exploration and construction machinery prior to operation and machinery during demolition activities for plant decommissioning
Historic and Cultural Resources	BLM Cultural Resources BLM Paleontology BLM Native American Religious Concerns BLM Environmental Justice	NUREG – 1748 Section 6.3.8 NUREG – 1569 Sections 1.0, 2.4.3	• Generic overview of historic and cultural resource preservation o Inhabited by Native Americans during the Paleo-Indian and Archaic periods and post-contact period o Portions historically settled by Eurasian and African American populations • Nature of historic and cultural resource preservation process
Visual/Scenic Resources	BLM Visual Resources BLM Wild and Scenic Rivers	NUREG – 1748 Section 6.3.9 NUREG – 1569 Sections 1.0, 2.4.3	• Wilderness Areas • Wild and Scenic Rivers • General Regional Aesthetic Conditions

Table 1.1
Framework for "Tiering" and Checklist for Environmental Resources

NRC Resource Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed Under this Title	Criteria for Assessing Completeness of Characterization	Criteria for Assessing Whether Impact is within Scope of this GER/ISR GEIS
Socioeconomics	BLM Socioeconomics	NUREG – 1748 Section 6.3.10 NUREG – 1569 Sections 1.0, 2.3.3	• ISR projects will be a short-term use of the land. • ISR projects do not preclude other types of development and land use following the use of the site for ISR • General demographics • Generic Income Statistics • Generic Earnings and Employment Structures • Generic Housing and Public Infrastructure o Housing o Water and wastewater systems o Police, fire, and emergency protection and response o Education resources
Environmental Justice			• Generic Background and Approach • Generic discussion of minority and low-income or Native American populations in the area of effect • Natural resource consumption by populations • Sensitivity of Native American communities to potential impacts of Proposed Action
Public and Occupational Health – *non-*radioactive		NUREG – 1748 Section 6.3.11 NUREG – 1569 Sections 1.0, 2.10.3, 3.2.3, 3.3.3, 4.1.3, 4.2.3	• Air quality and noise including potential impacts during construction and operation • Potential impacts of groundwater contamination • Potential ecological impacts including impacts

Table 1.1
Framework for "Tiering" and Checklist for Environmental Resources

NRC Resource Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed Under this Title	Criteria for Assessing Completeness of Characterization	Criteria for Assessing Whether Impact is within Scope of this GER/ISR GEIS
			during construction and operation • Potential social impacts • Worker health and safety
Public and Occupational Health – Radiological		NUREG – 1748 Section 6.3.11 NUREG – 1569 Sections 1.0, 2.9.3, 3.2.3, 3.3.3, 4.1.3, 4.2.3	• Background radiation o Definition of "background radiation" o Variation in background o Characterization program o Typical background characteristics • Exposure to workers including exposure calculations • Exposure to the public including exposures from water and air pathways, exposures from external radiation, and total human exposures • Sample exposure to the public regarding data from ISR facilities • Non human biota
Waste Management	BLM Wastes (Hazardous or Solid)	NUREG – 1748 Section 6.3.12 NUREG – 1569 Sections 1.0, 4.2.3, 5.7.6.3	• Wastes generated at ISR facilities (Section 2.2.2) • Management of the waste (Section 2.2.8) • Potential impacts associated with waste management (Section 4.1)

Following comparison of each title or condition with the conditions in Column 4, NRC's project team or evaluator will assign a status category to that resource. Table 1.2 provides a template for appropriate interdisciplinary team members to record their determination for each proposed action component or specific resource, and proposes a set of status category titles for each.

Status Categories for Proposed Action

AA – This category will be assigned to the proposed action or a component of the proposed action if the range of conditions and parameters are within those ALREADY ASSESSED in the ISR GEIS, and a site-specific evaluation of additional conditions and parameters is NOT required.

SS – This category will be assigned to the proposed action if the proposed action includes conditions or parameters beyond those already assessed in the ISR GEIS, and a SITE SPECIFIC evaluation for additional conditions or parameters is required.

Status Categories for Resource Evaluations

NP – This category will be assigned if the resource is NOT PRESENT.

AA – This category will be assigned to the resource if the range of conditions and parameters for that resource are within those ALREADY ASSESSED in the ISR GEIS, and a site-specific evaluation for that resource is NOT required.

SS – This category will be assigned to the resource if the resource baseline evaluation includes conditions or parameters beyond those already evaluated in the ISR GEIS, and a SITE SPECIFIC evaluation for that resource is required.

The intent of the two-step process is to filter the universe of potential operational and environmental factors down to a list of items to be included in a site-specific evaluation. For any resource categorized as "AA", according to the process above, a detailed evaluation will not be required in the site-specific assessment. The site-specific assessment will be "tiered" off the ISR GEIS and for the evaluation for any component of the proposed action categorized as "AA", or any resource categorized as "AA", the site-specific documentation will be limited to a discussion incorporating by reference the ISR GEIS assessment for this component or resource and a brief explanation of the reasons why it falls within the ISR GEIS' analyses and conclusions. Any component of the proposed action or any resource categorized as SS, will require a detailed evaluation in the site-specific documentation, taking into account any applicable data, analyses, and conclusions in the ISR GEIS.

NMA anticipates that using this method to determine which site-specific studies are warranted will:

- result in site-specific evaluations that are focused on issues that are not already addressed adequately elsewhere.

- free NRC and applicant time for assessment of additional issues, if any, which require additional, detailed site-specific analyses.

Table 1.2
Identification (ID) Team Analysis
Record Checklist for Environmental Resources

Section Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed under This Title	Criteria for Assessing Completeness of Characterization	Status of Title in Relation to ISR GEIS	Signature of NRC Evaluator
Description of Alternatives				
Description of Proposed Action	Not applicable (NA)	NUREG – 1748 Section 5.2.2 NUREG-1569 Sections 1.3, 2.1.3, 3.1.3, 3.2.3, 3.3.3, 4.1.3, 4.2.3, 4.3.3		
No Action Alternative	NA	NUREG – 1748 Section 5.2.3	NA	
Other Reasonable Alternatives	NA	NUREG – 1748 Section 5.2.4	NA	
Description of Alternatives Considered but Eliminated	NA	NUREG – 1748 Section 5.2.5	NA	
Description of the Affected Environment (Resources)				
Land Use	BLM Lands/Access BLM Fuels/Fire Management BLM Recreation BLM Woodland/Forestry BLM Farmlands (Prime or Unique) BLM Wilderness & Wilderness Characteristics BLM Livestock/Grazing BLM Rangeland Health Standards and Guidelines	NUREG-1748 Section 6.3.1 NUREG -1569 Sections 1.0, 2.1.3, 2.2.3		
Transportation		10 CFR Part 71; NUREG-1748 Section 6.3.2		
Geology and Soils	BLM Soils BLM Geology/Mineral Resources/Energy Production	NUREG-1748 Section 6.3.3 NUREG-1569 Sections 1.0, 2.6.3		
Water Resources	BLM Water Quality (Drinking/Ground) BLM Floodplains	UIC Program: (40 CFR Part 144-146) NUREG-1748 Section 6.3.4 NUREG-1569 Sections 1.0, 2.2.3, 2.7.3, 3.1.3, 3.2.3, 3.3.3		
Ecological Resources	BLM Wetlands/Riparian Zones BLM Fish and Wildlife	NUREG-1748 Section 6.3.5 NUREG-1569		

Table 1.2
Identification (ID) Team Analysis
Record Checklist for Environmental Resources

Section Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed under This Title	Criteria for Assessing Completeness of Characterization	Status of Title in Relation to ISR GEIS	Signature of NRC Evaluator
	including Special Status Species BLM Vegetation including Special Status Plant Species BLM Threatened, Endangered or Candidate Plant Species BLM Threatened, Endangered or Candidate Animal Species BLM Invasive, Non-native Species BLM Wild Horses and Burros	Sections 1.0, 2.8.3		
Meteorology, Climatology, and Air Quality	BLM Air Quality	NUREG-1748 Section 6.3.6 NUREG-1569 Sections 1.0, 2.5.3, 3.2.3, 3.3.3		
Noise		NUREG-1748 Section 6.3.7		
Historic and Cultural Resources	BLM Cultural Resources BLM Paleontology BLM Native American Religious Concerns BLM Environmental Justice	NUREG-1748 Section 6.3.8 NUREG-1569 Sections 1.0, 2.4.3		
Visual/Scenic Resources	BLM Visual Resources BLM Wild and Scenic Rivers	NUREG-1748 Section 6.3.9 NUREG-1569 Sections 1.0, 2.4.3		
Socioeconomics	BLM Socioeconomics	NUREG-1748 Section 6.3.10 NUREG-1569 Sections 1.0, 2.3.3		
Public and Occupational Health – *non*-radioactive		NUREG-1748 Section 6.3.11 NUREG-1569 Sections 1.0, 2.10.3, 3.2.3, 3.3.3, 4.1.3, 4.2.3		
Public and Occupational Health – Radiological		NUREG-1748 Section 6.3.11 NUREG-1569 Sections 1.0, 2.9.3, 3.2.3, 3.3.3, 4.1.3, 4.2.3		

Table 1.2
Identification (ID) Team Analysis
Record Checklist for Environmental Resources

Section Title from NUREG-1748	Corresponding Sister Agency Resource or Sub-resource Addressed under This Title	Criteria for Assessing Completeness of Characterization	Status of Title in Relation to ISR GEIS	Signature of NRC Evaluator
Waste Management	BLM Wastes (Hazardous or Solid)	NUREG-1748 Section 6.3.12 NUREG-1569 Sections 1.0, 4.2.3, 5.7.6.3		

Notes:

The Resource Evaluator, Interdisciplinary Team Leader or Project Manager will assign one of the following categories following the completeness review of the license application submittal:

Status Categories for Proposed Action

AA – This category will be assigned to the proposed action or a component of the proposed action if the range of conditions and parameters are within those ALREADY ASSESSED in the ISR GEIS, and a site-specific evaluation of additional conditions and parameters is NOT required.

SS – This category will be assigned to the proposed action if the proposed action includes conditions or parameters beyond those already assessed in the ISR GEIS, and a SITE-SPECIFIC evaluation for additional conditions or parameters is required.

Status Categories for Resource Evaluations

NP – This category will be assigned if the resource is NOT PRESENT.

AA – This category will be assigned to the resource if the range of conditions and parameters for that resource are within those ALREADY ASSESSED in the ISR GEIS, and a site-specific evaluation for that resource is NOT required.

SS – This category will be assigned to the resource if the resource baseline evaluation includes conditions or parameters beyond those already assessed in the ISR GEIS, and a SITE SPECIFIC evaluation for that resource is required.

Note: For any resource categorized as "AA", a detailed evaluation will not be required in the site-specific assessment. The site specific assessment may be tiered to the ISR GEIS and the evaluation for this resource may be limited to a discussion incorporating by reference the ISR GEIS assessment for this resource and a brief explanation of the reasons why it falls within the ISR GEIS' analyses and conclusions.

1.3.1 Relevant Issues Studied in Detail

Issues to be addressed are the potential impacts (or potential perceived impacts, risks, or hazards) of the proposed action to physical, ecological, social, or economic resources. NRC regulations indicate that the agency should, "…identify and eliminate from detailed study issues which are peripheral or are not significant or which have been covered by prior environmental review…" (10 CFR Part 51). NMA used the preliminary issues identified by NRC in the Notice of Intent (NOI) and separated the issues into two groups: relevant (significant) and non-relevant (not significant) (NRC 2007d,f). Relevant issues are defined as those that directly or indirectly result from implementing the proposed action. Non-relevant issues are identified as those that are: (1) outside the scope of the proposed action; (2) already decided by law, regulation, or other higher-level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not

supported by scientific or factual evidence. CEQ NEPA regulations further explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" The relevant issues identified by NMA for the ISR GEIS are presented below, and the non-relevant issues are presented in Section 1.3.2. More specific information regarding the formulation of issues from the public comments collected during the scoping process is presented in Appendix A.

Relevant issues identified by NMA include the following:

Issue 1: NRC anticipates a sharp increase in the number of applications for ISR projects in the coming years, driven by the current worldwide market for uranium (see Section 1.2). This GER is a proactive effort to assist NRC in developing and effective and efficient NEPA review process in anticipation of the increased number of license applications.

Issue 2: The United States currently depends heavily on foreign sources of uranium, and, given 104 operating domestic nuclear reactors and the possibility of 30 additional new reactor units, needs to increase domestic uranium production. The United States needs additional nuclear generating capacity to meet future electrical demand while minimizing greenhouse gas emissions.

Issue 3: Potential Impacts on Ecological Resources:

Land Use: Addressing land use plans, policies, and controls.

Geology and Soils: Addressing the geographic, topographic, and geologic characteristics, as well as soil types and characteristics.

Water Resources: Addressing the surface and groundwater hydrology, water use and quality, and potential for water quality and water supply impacts.

Ecology: Addressing wetlands; aquatic, terrestrial, economically, and recreationally important species; and threatened and endangered species.

Air Quality: Addressing meteorological conditions, ambient background, pollutant sources, and the potential for degradation.

Issue 4: Potential Impacts on Social Resources:

Transportation: Addressing transportation modes, routes, quantities, and risk estimates.

Noise: Addressing ambient noises, sources, and sensitive receptors.

Historical and Cultural Resources: Addressing historical, archaeological, and traditional cultural resources.

Visual and Scenic Resources: Addressing landscape characteristics, man-made features, and viewsheds.

Socioeconomics: Addressing the demography, economic base, labor pool, housing, transportation, utilities, public services/facilities, education, recreation, and cultural resources.

Environmental Justice: Addressing potential disproportionately high and adverse impacts on minority and low-income populations.

Waste Management: Addressing the types of wastes expected to be generated, handled, stored, and subject to re-use or disposal.

Issue 5: Potential Impacts on Public and Occupational Health: Addressing the potential public and occupational health consequences from licensing, construction, routine operation, transportation, credible accident scenarios (including natural events), and decommissioning.

Issue 6: Influence of Other Relevant Statutory/Regulatory Programs on ISR Operations: Addressing the application of EPA's SDWA/UIC program as additional requirements for ISR operations and further protection of USDWs during active operations, during groundwater restoration, and after site decommissioning and decontamination (D&D).

These relevant issues are examined in this GER and will be in an ISR GEIS so that licensees/license applicants and project reviewers can consider them when developing site-specific NEPA documentation.

1.3.2 Non-Relevant Issues Eliminated from Detailed Study

For the purposes of this GER, *no* non-relevant issues were eliminated from detailed study. However, as noted above, there likely will be issues or resources that can be eliminated from detailed study in site-specific NEPA documentation based on evaluations and conclusions in the ISR GEIS and existing NRC documents (e.g., 1980 GEIS [NRC, 1980a]). For such issues, the site-specific NEPA documentation must fully explain the issues examined (i.e., why they were eliminated from detailed study), and the methods for analysis and thresholds for eliminating the resources from detailed study.

The absence of a particular resource from a proposed project location eliminates it from further study. That is, during a site-specific assessment, if a resource is determined to be "NP" (not present) according to the criteria in Table 1.2, above, it will not require evaluation in the site-specific NEPA documentation. The applicant or agency resource specialist will document in Table 1.2 the basis for stating that the resource is not present, and surveys or studies supporting the determination may be incorporated by reference in the NEPA documentation. This approach is consistent with CEQ guidance and NRC policy regarding reduction of the bulk of NEPA documents in 48 Fed. Reg. 34263 (1983) and NUREG-1748 Section 1 (NRC 2003b).

1.4 Scoping Process

Scoping is an early and open public process designed to determine the range of actions, alternatives, and potential impacts to be considered in any NEPA evaluation process and to identify the relevant issues related to the proposed action. Scoping is intended to solicit input from the public and other agencies so that the analysis can more clearly focus on issues of genuine concern. The principal goals of the scoping process are to:

- Identify public concerns.
- Ensure that concerns are identified early and are properly studied.
- Identify alternatives that will be examined.
- Identify relevant issues that need to be analyzed.
- Eliminate unimportant issues.

In July 2007, NRC initiated a public scoping process to identify relevant issues to be addressed in the proposed ISR GEIS. A NOI to prepare the ISR GEIS was published in the Fed. Reg on July 24, 2007 (72 Fed. Reg. 40344) (NRC, 2007d). The original NOI established a public comment period of July 24 to September 4, 2007, and announced the dates and locations of two public scoping meetings. A revised NOI was published in the Fed. Reg. on August 31, 2007 (72 Fed. Reg. 50414) (NRC, 2007f). The revised NOI announced a third public scoping meeting and extended the public comment period to October 8, 2007. After the conclusion of this meeting, NRC extended the comment period to October 31, 2007 and, later, to November 30, 2007. 72 Fed. Reg. 61912 (November 1, 2007). The original and revised NOI detailed NRC's intent to proceed with preparation of a ISR GEIS; provided dates and locations for public meetings; provided contact information for NRC officials; and provided supplementary information, including background information, alternatives to be evaluated, potential impact areas to be analyzed, scoping meetings, scoping comments, and the NEPA process.

In addition to the notices published in the Fed. Reg., NRC announced its intention to hold public scoping meetings regarding the ISR GEIS through NRC Office of Public Affairs. The announcements were published in NRC *News* publication on July 23, 2007, and again on September 6, 2007 (NRC 2007g). Three public scoping meetings were held, respectively, on August 7, 2007, in Casper, Wyoming; on August 9, 2007 in Albuquerque, New Mexico; and on September 27, 2007 in Gallup, New Mexico. At these meetings, NRC described its role, mission, and reviewed procedures and responsibilities, as well as an outline of the ISR GEIS. State, local, and tribal government agency representatives and concerned local citizens also provided statements and asked questions at the meetings (NRC 2007e).

After the scoping process is complete, NRC will prepare a draft ISR GEIS. The draft ISR GEIS is scheduled to be published by Spring of 2008. A 45-day public comment period on the draft ISR GEIS is planned, and a public meeting(s) to receive comments will be held approximately three weeks after publication of the draft ISR GEIS. Availability of the draft ISR GEIS, the dates of the public comment period, and information about the public meeting will be announced in the *Federal Register*, on NRC's Web page, and in the local news media. The final ISR GEIS is expected to be published in January 2009 and will incorporate, as appropriate, public comments received on the draft GEIS (NRC 2007b, d).

1.5 Applicable Regulatory Requirements, Permits, and Regional Consultations

In addition to the requirements set forth in NEPA and its applicable CEQ and NRC regulations, this GER will consider and comply with other applicable regulatory requirements, permits, and required regional consultations. Because this GER is intended to assist in the development of an ISR GEIS, the following subsections discuss only procedures for addressing applicable regulatory requirements, permits, and regional consultations in site-specific NEPA documents, as well as historical regulatory developments (to provide context to the necessary actions that will be conducted and analyzed at the site-specific level).

A detailed overview of NRC's statutory and regulatory program for ISR under the AEA, as amended, is presented in the Preamble to this GER. However, the following table of statutory and regulatory authorities provides a detailed list of the robust and comprehensive oversight currently applicable to ISR facilities:

Responsible Agency	Statute	Regulations	Guidance & Policies (this list is not intended to be exhaustive)
Nuclear Regulatory Commission/ Agreement States	• Atomic Energy Act of 1954 • Uranium Mill Tailings Radiation Control Act of 1978 • National Environmental Policy Act of 1969 • Relevant State Radiation Protection Statutes	• 10 CFR Part 2 • 10 CFR Part 20 • 10 CFR Part 40, Appendix A • 10 CFR Part 51 • 10 CFR Part 71 • 10 CFR Part 170 • 10 CFR Part 171 • Relevant State Regulations	• NUREG – 1569 • NUREG – 1748 • Regulatory Guide 4.14 • Regulatory Guide 8.11 • Regulatory Guide 8.30 • Regulatory Guide 8.31 • Regulatory Guide 8.37 • Relevant State Guidance
Environmental Protection Agency/"Primacy" States or Tribes*	• Atomic Energy Act • Uranium Mill Tailings Radiation Control Act • Safe Drinking Water Act • Clean Air Act • Clean Water Act • Resource Conservation and Recovery Act (if applicable) • Toxic Substances Control Act (if applicable)	• 40 CFR Part 61, Subpart W • 40 CFR Part 190; • 40 CFR Part 144-148 • Relevant State Regulations	• Relevant State UIC Plan • Relevant EPA/State Guidance

*Note: Depending on the site specific settings, other agencies may participate as cooperating agencies.

1.6 Cooperating Agencies

There are no cooperating agencies for this GER *per se*; however, NRC may want to include pertinent cooperating agencies in the process of developing the ISR GEIS. In some instances, other federal agencies can serve as cooperating agencies in the NEPA assessment for proposed projects. Cooperating agencies can be federal, state, or local agencies, or a Native American tribe (NRC 2003b). Other agencies can become involved because they have jurisdiction over the mineral rights, the proposed location could be on or adjacent to lands over which the agencies have jurisdiction or the agencies may have regulatory responsibility for other permitting activities. In other cases, an agency may have special expertise in relation to specific issues of concern, and its involvement as a cooperating agency will facilitate the exchange of information and help to ensure that applicable requirements are satisfied (NRC 2003b). NRC typically works with license applicants, licensees, and/or industry organizations during the licensing process to identify and notify any potential cooperating agencies. For such actions and pursuant to the AEA, NRC maintains its status as the lead agency, because NRC ultimately is responsible for AEA licensing actions.

1.7 Other State and Federal Agencies

Other federal and state agencies, such as the BLM, may be involved in reviewing and commenting on license application documentation because of the specific location of the proposed ISR project site(s). Site-specific NEPA documentation will thoroughly involve any other applicable federal or state agencies with jurisdiction over resources potentially impacted at the proposed location or that may be impacted or directly involved due to federal and state laws and regulations. The project proponent will consult with the agencies responsible for implementing these laws and regulations.

Examples of site-specific project applications that may need multiple agency review include projects located on or near federally controlled land (e.g., BLM), those that affect jurisdictional wetlands (e.g., United States Army Corps of Engineers, those in proximity to or upstream from National Parks or National Forests (e.g., National Park Service [NPS] or United States Forest Service [USDA-FS]), in proximity to coastal areas subject to the Coastal Zone Management Act (e.g., the National Oceanic and Atmospheric Administration), or designated as Resource Conservation and Recovery Act (RCRA) or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites by the EPA. Additionally, consultations with Native American tribes will be conducted in a sensitive manner, recognizing the unique government to government relationship that exists based on federal law and treaties (NRC 2003b). Involving other federal and state agencies in the review process also potentially can assist NRC in further streamlining the review process by reducing the complexity of interagency review of site-specific license applications.

2.0 ALTERNATIVES

NMA has selected and assessed a reasonable range of proposed alternatives (including the no action alternative) that respond to the purpose and need statements presented in Section 1.0, that comply with applicable NRC regulations and guidance, that meet the proposal objectives and applicable standards, and that are technically acceptable. Four proposed alternatives are considered in this GER, including the no action alternative, as follows:

- **The proposed action**, which is licensing, construction, operation, and decommissioning of ISR facilities, as described in Section 1.1, and below.

- **The no action alternative**, which would be to not build or license ISR facilities. This alternative will provide a baseline from which to compare the potential impacts and rate of change of each of the other action alternatives, as well as an opportunity to analyze the potential environmental and social impacts of not taking any action related to licensing ISR facilities.

- **Conventional underground and/or surface uranium mining/milling (including heap leaching)**, as described below.

- **Byproduct/sidestream recovery** from other mineral recovery operations, as described below.

The following subsections present information on the process used to formulate alternatives, the proposed action (including all technical options and approaches), the no action alternative, other reasonable alternatives considered but not carried forward for detailed analysis, and preliminary recommendations. As a general matter, NRC has found that *reconnaissance-level* investigation and analysis regarding alternatives is adequate to assure that such alternatives are accorded appropriate consideration. *See* 49 Fed. Reg. 9352 (March 12, 1984).

2.1 Process Used to Formulate Alternatives

NMA selected a reasonable range of alternatives by thoroughly exploring the purpose and need (see Section 1.2) for the proposed action. The equivalent terms "reasonably practicable," and "reasonably achievable" have been defined in the Introduction to 10 CFR Part 40, Appendix A to involve decisions that take into account the state of technology and the economics of improvements in relation to the benefits to public health and safety and other societal and socio-economic considerations in relation to the use of AEA materials in the public interest. Thus, a reasonable alternative will be an alternative that achieves, in large part, the defined purpose and need while not violating any fundamental public health or environmental standards. The purpose is extremely focused and involves only ISR projects; this GER does not evaluate alternative uranium recovery methods, such as conventional uranium mining/milling in detail. Potential environmental impacts from other types of uranium recovery are documented in other NRC GEISs and EISs — for example, potential impacts from conventional uranium milling are analyzed in NUREG-0706, *Final Generic Environmental Impact Statement on Uranium Milling* (NRC, 1980a). Therefore, the reasonable range of alternatives to meet this purpose is focused on ISR projects and consists of the four alternatives identified above and described below. The alternatives were developed based on current and potential future ISR technology, NMA's uranium recovery industry expertise and experience, NRC applicant/licensee submittals, public

input during the scoping process, and interdisciplinary discussions with NRC staff, industry representatives, and consulting experts.

The assessments described in this GER were performed to evaluate a limited number of developmental and operational alternatives considered by NMA for the purpose of evaluating potential environmental and public health impacts. Although this GER has a broad scope, other acceptable developments or operational alternatives may exist which are not precluded, but which have not been assessed fully in this GER. Actions beyond those outlined under each of the alternatives evaluated in this GER may, therefore, require additional assessment to determine potential impacts and acceptability.

2.2 Proposed Action

The proposed action discussed in this GER and in the ISR GEIS is described in Section 1.1 *infra.*

NRC staff review serves as the basis for determining whether a license for a specific ISR project will be issued. NRC staff review is guided by the Standard Review Plan (SRP) (NUREG-1569) (NRC, 2003a), which outlines materials that need to be reviewed, the basis for review, how the review is to be completed by NRC staff, the acceptable parameters for compliance, and conclusions related to Title 10 CFR, as well as NUREG-1748 for preparation of environmental reports (ERs). The review results in three products: (1) a technical evaluation report , (2) a safety evaluation report (SER) where proposed license conditions are listed, and (3) an EA or EIS if deemed necessary, as required under NEPA (NRC, 2003a). The purpose of the technical review process and environmental evaluation is to determine a finding of no significant impact or of potentially significant impact on public heath and/or the environment. The resulting reports (technical review and EA/EIS) include a description of the review, basis for decision, which areas of operation deviate from NUREG-1569, if any, and evaluation of the latter. The reports are then published (NRC, 2003a). Although NUREG-1569 provides NRC staff with general guidance on acceptable methods for compliance within the existing regulatory framework, NUREG-1569 is intended as a guide for licensing and cannot be substituted for NRC or other applicable federal and state regulations. Also, while NUREG-1569 and other applicable NRC regulatory guidance provide acceptable methodologies for regulatory compliance or for meeting NRC expectations for acceptable analytical methodologies, different methodologies can be found acceptable—provided they are determined sufficiently protective of human health and the environment—and, therefore, also can support issuance of a license (NRC, 2003a). Figure 1.1 presents a flowchart of the ISR license.

2.2.1 Principal ISR Operating Characteristics

ISR operations involve the circulation of native groundwater, fortified with oxygen and carbon dioxide, through an identified and defined uranium ore body. This fortified native groundwater is introduced into the uranium ore body using injection wells, where it oxidizes and solubilizes the uranium in the host sandstone as it is drawn through the sandstone to extraction wells, which pump the uranium-bearing groundwater to the surface. Next, the pregnant recovery solution proceeds to ion exchange (IX) for uranium removal and then is re-fortified with oxygen and carbon dioxide and pumped back to the well field for continuous re-injection into the ore body. Re-circulation of the same groundwater occurs continuously, until the uranium in the sandstone is depleted. The native groundwater to which oxygen and/or carbon dioxide have been added is called lixiviant. This process essentially mirrors the process used to remove minerals from “hard water” in a conventional home water softener.

When the IX resins are fully loaded, uranium is stripped using a brine rinse, similar to the process used to strip minerals from resins in a home water softener. After the uranium is stripped from the IX resins, the resulting product is precipitated, filtered, and dried to produce yellowcake. This dried yellowcake is then packaged for shipment to a conversion facility for use in the nuclear fuel cycle.

Table 2.1, Generic ISR Process, and Figures 2.1 and 2.2 present an overview of this process. Figure 2.3, Basic ISR Central Plant Flowsheet and Figure 2.4, Basic ISR Remote IX Flowsheet present schematic drawings of the ISR process.

2.2.2 ISR Recovery Process

ISR operations are possible because of the specific characteristics of uranium deposition that are typically present in every uranium ore body amenable to the ISR process. Hosted as roll-front and/or tabular deposits in permeable sandstones, these subsurface uranium ore bodies normally contain uranium in a reduced, *insoluble* form. As a general matter, ISR operations *must* occur in *redistributed* ore bodies. These *redistributed* ore bodies are the result of a natural refining process through which various trace metals in solution (including uranium) are selectively removed from groundwater. The very presence of these ore bodies in these typical geologic and hydrologic conditions also signals that the native groundwater in contact with the ore zone is of very poor quality, and commonly contains significantly elevated levels of naturally occurring radionuclides [i.e. uranium and radium] and other heavy metals. A typical roll-front is shown at right. The typical ISR process is shown on Figure 2.5.

Roll-front image courtesy of the Wyoming Mining Associations' (WMA's) web site.

2.2.3 Lixiviant Chemistry

Aquifers at ISR project sites cannot now nor in the future provide potable drinking water for their local areas because they are highly mineralized with naturally-occurring uranium and uranium decay products ("progeny") including radium-226 (^{226}Ra) and radon-222 (^{222}Rn), exceeding EPA drinking water maximum contaminant levels (MCLs). Water quality in the aquifer within the adjacent area of review (AOR)[102] surrounding the exempted uranium recovery zones will not be affected by ISR operations because regulations require that injected solutions be limited to the recovery zones. Further, the recovery zones will be monitored to verify that solutions are contained therein.

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[102] 40CFR146.4

Table 2.1
Generic ISR Process

Component	Description
ISR Overview	
ISR Process	1. Produce native groundwater from extraction wells. 2. Prepare lixiviant. a. Pump native groundwater from recovery zone. b. Fortify native groundwater with oxygen and/or carbon dioxide. 3. Inject lixiviant into ore body via injection wells. 4. Recover pregnant lixiviant from ore body via extraction wells. 5. Remove uranium from pregnant lixiviant and concentrate the uranium. a. Resin loading. b. Resin elution. c. Uranium precipitation. d. Radium precipitation (if used). e. Yellowcake washing, filtering, and dewatering. f. Yellowcake drying and packaging. 6. Re-fortify barren lixiviant for return to injection wells. 7. Treat production bleed to reduce volume of liquid waste (unless production bleed can be directly injected into Class I UIC deep-injection wells without treatment). 8. Dispose of AEA solid and liquid wastes as 11e.(2) byproduct material in appropriately licensed facilities. 9. Dispose of non-AEA waste as appropriate. Process Options: • Standard central processing facility with adjacent well fields for uranium recovery; • Satellite well fields with pipeline to central processing facility for uranium recovery ; • Satellite well fields using remote IX technology and shipping uranium-laden IX resins via transport conveyance to central processing facility for uranium recovery; • Well fields generating uranium-laden slurry for shipment to central processing facility for uranium recovery; • Recovery from old stopes leachate; • Toll milling arrangement where licensees with licensed well fields send uranium-laden IX resin or yellowcake slurry to another licensee's central processing facility for uranium recovery
Infrastructure	
Process Wells	• General o Drill well using conventional methods such as mud rotary, reverse circulation or foam drilling o Drill to base of target completion interval o Install casing (fiberglass, steel, polyvinyl chloride [PVC], or polyethylene) with centralizers and potentially a basket, guide, or shoe tremmie pipe and cement to surface

Table 2.1
Generic ISR Process

Component	Description
	o Install gravel packing if required. o Develop all wells to remove drilling mud from the formation, remove fines from around the well screen, and restore natural hydraulic conductivity and geochemical equilibrium in the aquifer. o Collect groundwater samples for analysis and establishment of baseline conditions. • Injection wells o Under-ream wells and install a packer and liner if required, or use well screen attached to the casing across completion interval. o Pressure test casing (Mechanical Integrity Test [MIT]). • Extraction wells o Under-ream wells and install a packer and liner if required or use well screen attached to the casing and install screen and pumps and associated piping and electrical service. o Pressure test casing (MIT)
Monitor wells	• Same as extraction wells
Field Piping	• High-density polyethylene (HDPE), PVC, fiberglass, or steel conveyance pipes typically rated for appropriate temperature and pressure. • Pipes installed below ground, if necessary, to prevent freezing (where applicable) and to reduce wear due to exposure/traffic. • Injection and recovery lines will manifold inside small buildings. • Each injection and recovery line will be metered. • Trunk lines from manifold building connect to satellite or central/main processing plant (The term “satellite” incorporates remote IX recovery facilities or those that require loaded resin to be trucked in tanker trucks to the central processing facility). • Pressure test piping.

Table 2.1
Generic ISR Process

Component	Description

Facility	• General:
	  o Berms around all process equipment to contain spills.
	  o Sump and pump systems to recover spills.
	  o Buildings or controlled access areas will be provided for:
	    ▪ Offices
	    ▪ Control equipment
	    ▪ Piping manifolds and instrumentation
	    ▪ Drying and packaging
	    ▪ Yellowcake storage
	
	• Injection/extraction headers (may be in an enclosed structure [i.e., header houses]):
	  o Manifold piping for injection and recovery
	  o Pressure monitors
	  o Dampness monitors for early seepage/leak detection
	  o Video monitoring from central location
	  o Flow meters
	
	• Satellite plant:
	  o IX system
	  o Pumps
	  o Exhaust system in process equipment area
	  o Chemical addition equipment
	  o Filtration equipment
	  o Reverse osmosis (RO) unit
	  o Transportation vehicles (e.g., tanker trucks) and appropriate packages
	Most remote IX plants consist of wells and IX equipment. Tanker trucks typically are used to transport loaded resin to the central processing plant.
	
	• Processing plant:
	  o IX (columns) system
	  o Elution circuit
	  o Precipitation circuit
	  o Settling tanks
	  o Holding tanks
	  o Dewatering equipment (filter presses, belt filters, centrifuges, thickeners or other)
	  o Vacuum or other dryers (such as multiple hearth roasters)
	  o Dryer stack effluent control systems in the case of multiple hearth roasters

Table 2.1
Generic ISR Process

Component	Description
	o RO system o Brine concentrator o Holding tanks o Pumps o Vapor mitigation equipment: ▪ Bag filters ▪ Condensers o Chemical addition equipment o Packaging equipment o Condenser o Resin transfer o Pressurized vacuums Option: Loaded resin received from satellite plants or "remote IX" trucked back to a central processing plant for elution. If the eluted resin is spent, it will be disposed of as 11e.(2) byproduct waste.
Instrumentation and Control System	• Sensors: o Liquid pressure monitors o Flow meters o Leak detectors in sumps o Dryer unit particle filter differential pressure monitor • Radiation monitors • Flow control devices: o Valves • Well field balance equipment • Control system: o Equipment control panel o Programmable logic controller o Failsafe switches
Uranium Recovery Process Description	
Lixiviant Preparation	Groundwater from the well field is amended with oxygen and/or carbon dioxide to produce lixiviant: 1. Pump native groundwater from ore body. 2. Pass through IX system. 3. Add carbonate (if required): a. Mix carbonate salt, or bicarbonate salt, or b. Inject carbon dioxide (CO_2) gas from a liquid CO_2 storage tank under pressure. 4. Add oxygen:

Table 2.1
Generic ISR Process

Component	Description
	a. Mix hydrogen peroxide, and/or b. Inject oxygen gas (O_2) from a liquid O_2 storage tank. 5. Pump lixiviant to well field.
Uranium Recovery	Recover uranium from subsurface: 1. Inject lixiviant from processing plant into ore body. 2. Recover pregnant lixiviant through extraction wells. 3. Pump pregnant lixiviant from the well field to the satellite or main processing plant.
Resin Loading	Uranium in extraction water from well field is transferred to the IX columns to be captured on IX resins: 1. Pass pregnant lixiviant through IX (anionic) columns. 2. Take loaded resin off line for elution. 3. Return bulk of IX extracted water for lixiviant preparation and return to well field. 4. Reject part (about 1 percent) of IX-produced water as production “bleed” (send to waste stream disposal). Option: Pump uranium in leachate from old stopes to the IX resin.
Resin Elution	Uranium in loaded resin is transferred by pipeline or tanker trucks for elution. Elution occurs as follows: 1. Pass brine solution through loaded resin to remove loaded uranium, similar to the removal of minerals from a water softener. 2. Return stripped resin to IX circuit. (Note: Many ISR operators wash resin with carbonate/bicarbonate solution to reduce buildup of salt in the lixiviant). 3. Send pregnant eluate to precipitation circuit in main processing plant. Option: Plant also can accept loaded resin from other sites if permitted under appropriate license conditions. Option: Elution steps 1 to 3 may be performed within the IX vessel without resin transfer.
Uranium Precipitation	Uranium dissolved in eluate is precipitated: 1. Add acid hydrochloric acid (HCl) or sulfuric acid (H_2SO_4) to break uranyl carbonyl complex. 2. Add hydrogen peroxide to precipitate uranium. 3. Add ammonia, caustic soda or other base to raise pH to a level conducive to uranium precipitation. 4. Send resulting uranium peroxide slurry to a settling tank or filter system (e.g., filter press). 5. Send supernatant (filtrate) to liquid effluent disposal system. 6. Transfer yellowcake slurry to holding tank or to tanker trucks for transport to another processing facility. 7. Send to vacuum dryer / storage. Option: Plant may also accept yellowcake slurry from other sites permitted under appropriate license conditions

Table 2.1
Generic ISR Process

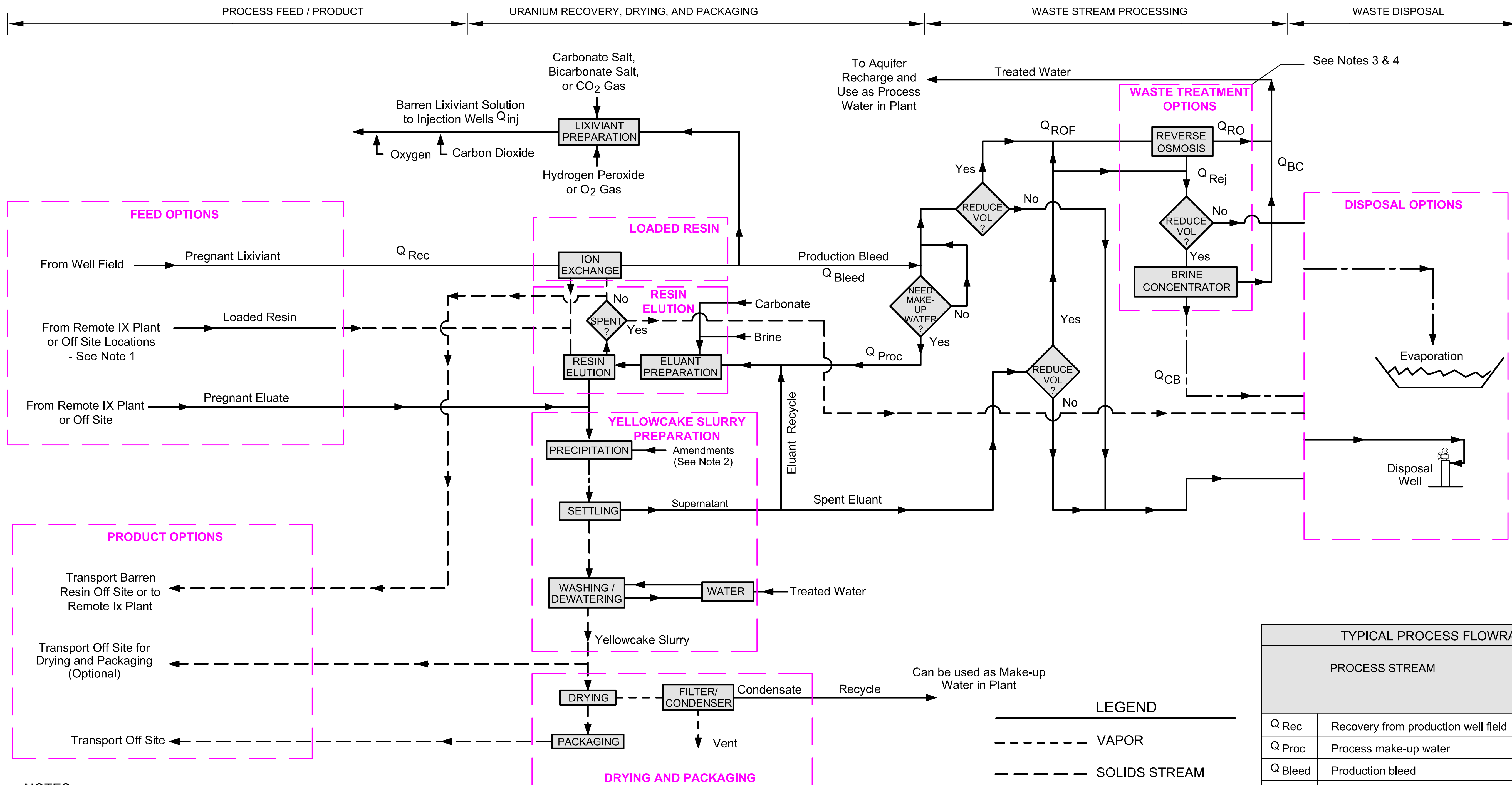
Component	Description
Radium Precipitation (if used)	Liquid from the uranium precipitation circuit can be treated for removal of radium: 1. Add barium to vessel. 2. Allow radium precipitate to settle. 3. Recycle most of supernatant (send to elution circuit). 4. Reject part of supernatant (spent eluant; send to waste stream processing). 5. Remove the precipitate by settling and filtration. 6. Dispose of radium-barium precipitate as 11e.(2) byproduct material.
Yellowcake Washing	Yellowcake is washed to remove chloride and other soluble yellowcake-contaminants: 1. Transfer washed yellowcake slurry to holding tank. 2. Pass yellowcake slurry through filtration unit (filter press or similar) for removal of water. 3. Wash yellowcake with sodium bicarbonate ($NaHCO_3$) or water to meet converter specifications. 4. Transfer washed yellowcake to tanker truck for transport to another processing facility or to dewatering, drying, and packaging circuit. 5. Re-use liquid process stream or sent to waste stream processing (ultimately to ponds or disposal well).
Dewatering, Drying and Packaging	1. Transfer dewatered yellowcake to dryer (vacuum or atmospheric). 2. Package yellowcake in DOT approved drums. Option: Some ISR plants may not have a drying and packaging circuit. Dewatered yellowcake slurry from such plants will be transported off site to another processing facility for drying and packaging.
Waste Stream Processing	Liquid waste from various process circuits is treated to reduce volume of waste stream: • Primary treatment (influent: production bleed): o Treat via RO o Use RO-produced water for: ▪ Various purposes in processing plant. ▪ Aquifer restoration in depleted well field . o Send RO reject stream (about 20 to 25 percent) to secondary treatment, evaporation ponds or deep-well injection. Option: Secondary treatment (used only typically when an evaporation pond is available for liquid waste disposal; influent: RO reject stream and spent eluant): o Treat influent in brine concentrator. o Use brine concentrator-produced water: ▪ For various purposes in processing plant. ▪ For aquifer recharge. ▪ Aquifer restoration in depleted well field. o Send concentrated brine for final disposition. Option: Some plants may only have RO, and others may not treat liquid wastes prior to disposal in evaporation pond or deep well.

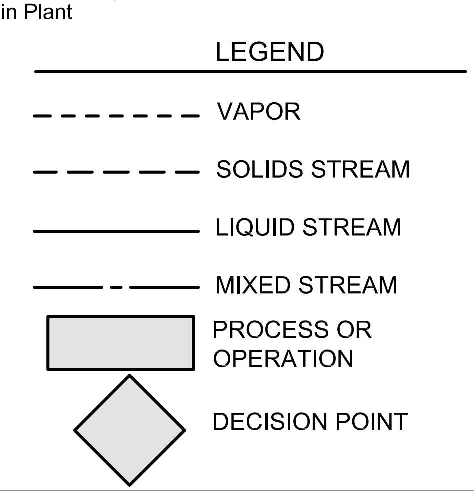
Table 2.1
Generic ISR Process

Component	Description
Liquid Waste Disposal	• Class I UIC deep injection well and/or; • Evaporation ponds; • Other liquid reduction methods.
Solid Waste Disposal	Dispose of as 11e.(2) byproduct material at an appropriately licensed facility. Dispose of non 11e.(2) solid wastes on-site or at an appropriately permitted off site facility.

FIGURE 2.1

TYPICAL FLOWSHEET FOR IN SITU RECOVERY PROCESS AT CENTRAL PROCESSING PLANT





TYPICAL PROCESS FLOWRATES		
PROCESS STREAM		APPROXIMATE FLOWRATE AS PERCENT OF PRODUCTION FLOW
Q_{Rec}	Recovery from production well field	100%
Q_{Proc}	Process make-up water	~0.125%
Q_{Bleed}	Production bleed	~1%
Q_{Rej}	RO reject steam	~0.25%
Q_{Rop}	RO-produced water	~0.625%
Q_{BC}	Brine concentrator - produced water	~0.23%
Q_{CB}	Concentrated Brine	~0.025%
Q_{ROF}	RO feed	~0.875%
Q_{Inj}	Lixiviant injection	~99%

Note: Flowrates vary from one facility to another.

NOTES:

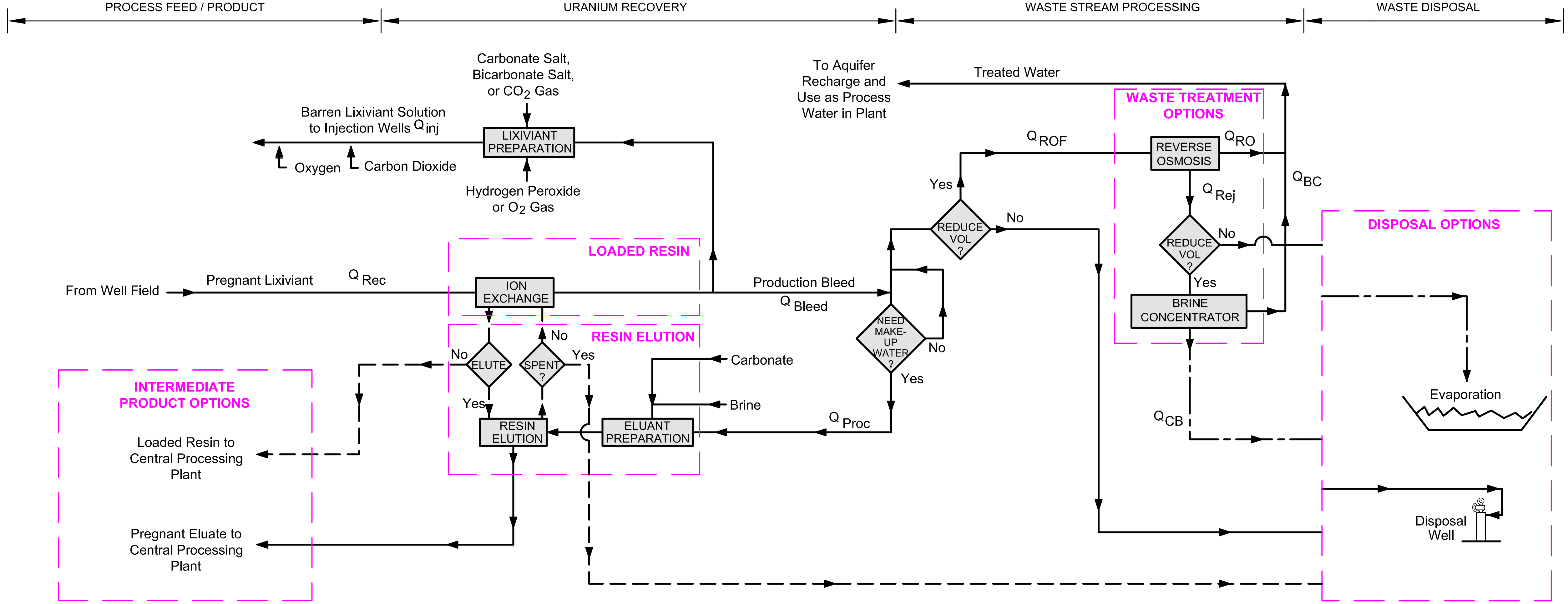
1. Locations may include satellite well-fields, drinking water or other treatment activities, or old stope leaching sites.

2. Can include:
   - Hydrochloric / sulfuric acid
   - Hydrogen peroxide
   - Base
   - Barium

3. Waste treatment circuit is located in central processing plant only when not present at satellite plant.

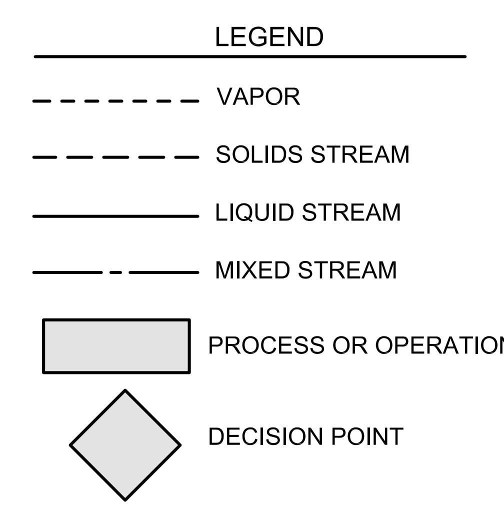
4. Waste treatment may not commence until groundwater restoration phase.

FIGURE 2.2
TYPICAL FLOWSHEET FOR IN SITU RECOVERY PROCESS AT REMOTE IX FACILITIES



TYPICAL PROCESS FLOWRATES		
PROCESS STREAM		APPROXIMATE FLOWRATE AS PERCENT OF PRODUCTION FLOW
Q_{Rec}	Recovery from production well field	100%
Q_{Proc}	Process make-up water	~0.125%
Q_{Bleed}	Production bleed	~1%
Q_{Rej}	RO reject steam	~0.25%
Q_{Rop}	RO-produced water	~0.625%
Q_{BC}	Brine concentrator - produced water	~0.23%
Q_{CB}	Concentrated brine	~0.025%
Q_{ROF}	RO feed	~0.875%
Q_{Inj}	Lixiviant injection	~99%

Note: Flowrates vary from one facility to another.



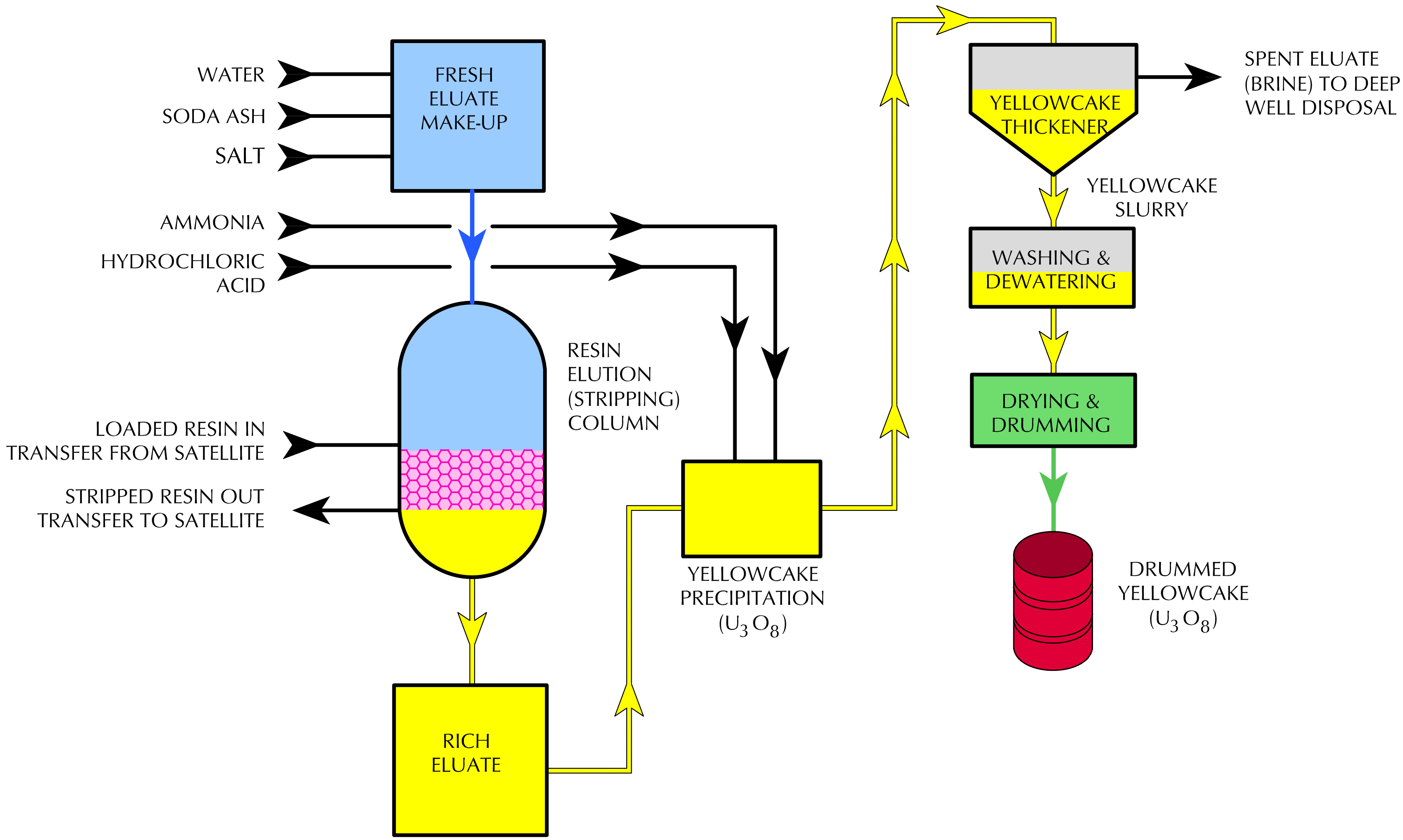


Figure 2.3 Basic ISR Central Plant Flowsheet

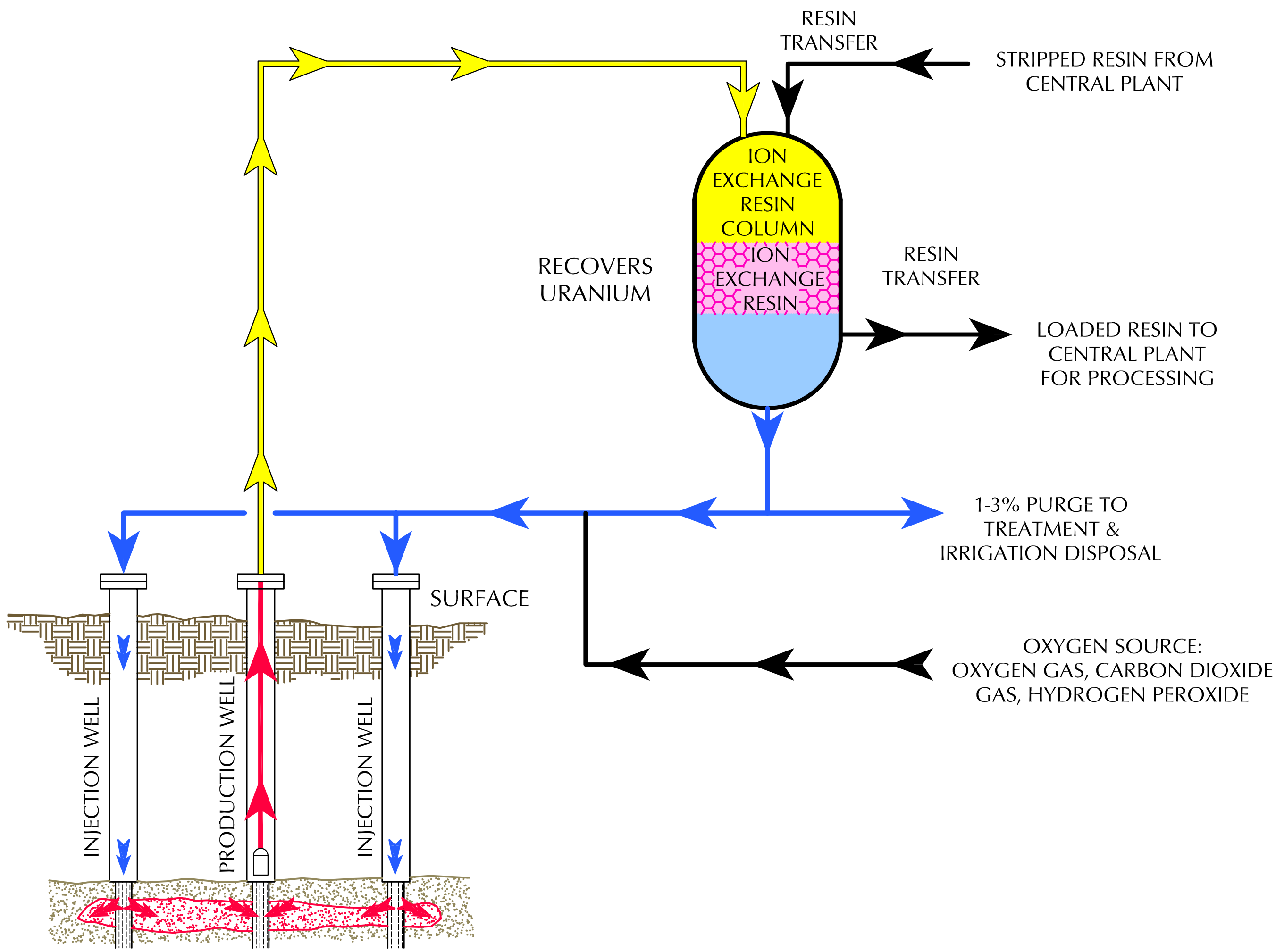


Figure 2.4 Basic ISR Remote IX Flowsheet

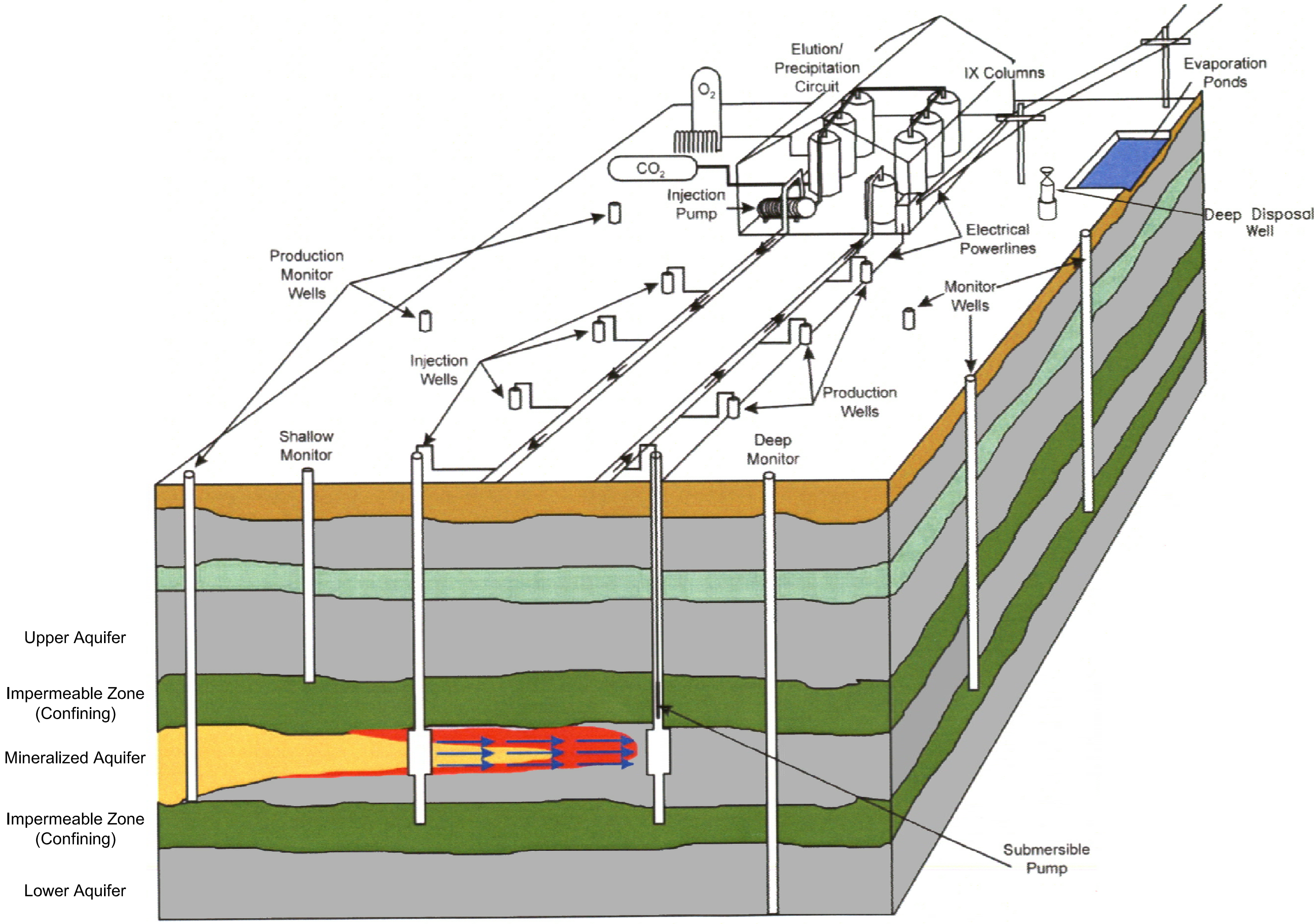


Figure 2.5 Typical ISR Configuration

Monitoring is required in the recovery zones and, if present, in overlying and underlying sands, containing USDWs, until the groundwater restoration process has been completed to the satisfaction of regulatory agencies.

Lixiviant is the “soda-water-like” result of fortifying native groundwater with dissolved oxygen and carbon dioxide. It is, therefore, not a “toxic chemical cocktail.” Indeed, it is not significantly different than native groundwater within the ore body. The radionuclides that limit the pre-ISR use of water (^{226}Ra, ^{222}Rn, radiation and U_3O_8) in uranium-bearing aquifers are also the primary parameters that limit water use during recovery operations and after groundwater restoration. The recovery process does not introduce new chemical species to the groundwater system but does elevate concentrations of certain species that are native to the host aquifer. When lixiviant is injected into the ore body, uranium compounds in mineralized grain coatings become oxidized (see equation 1 below). The oxidized uranium then complexes with bicarbonate ions to form either a uranyl tricarbonate complex (see equation 2 below) or a bicarbonate complex (see equation 3 below), both of which are soluble (Hydro Resources, Inc. [HRI]) (HRI, 1997).

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(1) $2UO_2 + O_2 \rightarrow 2UO_3$

(2) $UO_3 + Na_2CO_3 + 2NaHCO_3 \rightarrow UO_2(CO_3)_3^{\ 4-} + 4Na^+ + H_2O$

(3) $UO_3 + 2NaHCO_3 \rightarrow UO_2(CO_3)_2^{\ 2-} + 2Na^+ + H_2O$

As lixiviant is flushed through the ore body along the forced gradient between injection and extraction wells, it dissolves uranium into solution. The pregnant lixiviant is then pumped to the surface by the extraction wells. Table 2.2, Potential Range of Parameters in Pregnant Lixiviant, presents typical characteristics found in pregnant lixiviant.

2.2.4 ISR Feed Options

Typically, ISR facilities receive their feed for uranium recovery operations from the following sources: (1) well fields operated adjacent to the central processing facility; (2) satellite well fields with pipeline connections to the central processing facility; and (3) satellite well fields using remote IX technology and transportation of loaded IX resins to a central processing facility. However, ISR facilities can receive feed material from sources other than well fields at the facility. Some process feed options include:

- Uranium as byproduct/sidestream recovery from other mineral operations:
  - Pregnant solution. Uranium is sometimes present in copper, molybdenum, and phosphate ores. Therefore byproduct from copper, molybdenum, or phosphate recovery can contain small quantities of uranium. Some copper and phosphate recovery facilities will treat byproduct material to recover uranium. Byproduct/sidestream uranium recovery from a mining operation has occurred in the past (e.g., Florida phosphate mines and the Bingham Canyon Pit). The uranium-containing solution will then be pre-treated and sent to an ISR or conventional uranium recovery facility for further processing. Pre-treatment will meet feed acceptance criteria established by the ISR or conventional uranium recovery facility.

Table 2.2
Potential Range of Parameters in Pregnant Lixiviant

Chemical Species	Anticipated Concentration milligrams per liter (mg/L)
Calcium	100-350
Magnesium	10-50
Molybdenum	0-230
Sodium	500-1600
Potassium	25-250
Carbonate	0-500
Bicarbonate	800-1500
Sulfate	100-1200
Chloride	250-1800
Nitrate	<0.01-0.2
Fluoride	0.05-1
Silica	25-50
Total dissolved solids	1500-5500
Uranium	50-1500
Radium-226 (picocuries per liter [pCi/L])	1000
Other Parameters	
Conductivity (micromhos per centimeter [µmhos/cm])	2,500-7,500
pH (standard units)	7.0-9.0

Notes:

These concentration ranges were estimated by HRI for the Crownpoint ISR facility based on 1993 test data and operational licensing experience (HRI 1997).

- o Loaded resin. Some copper, molybdenum, and phosphate mining facilities may take uranium recovery one step further than described above. They may pass pregnant solution through IX resins, and then transfer the loaded resin to an ISR or conventional uranium recovery facility for further processing. The resin used will be anionic and of similar type used at ISR and conventional uranium recovery facilities. The uranium species in loaded resin will be a uranyl carbonate complex.

- Intermediate product from non-ISR operations:
  - o Leachate from old stopes. Old underground mine stopes can be leached for uranium, and the intermediate product sent to ISR or conventional uranium recovery facilities for further processing. Depending on geochemistry, operators can use oxidized lixiviant, if appropriately licensed/permitted.

Drinking water or other water treatment processes (e.g., mine de-watering, surface water treatment, pit lake remediation, etc.) using IX resins. A variety of water sources require uranium removal to meet relevant federal and/or state water quality standards. Treatment processes utilizing IX resins similar, if not identical, to ISR IX resins generate uranium-loaded IX resins that can be stripped using traditional resin stripping technology at ISR or conventional uranium recovery facilities.

- Intermediate product from other ISR facilities:
  - Loaded resin. It is envisioned and anticipated that some ISR facilities will be equipped only with IX circuits for recovery of uranium from pregnant lixiviant. Such facilities will then depend on other facilities for further processing of their loaded IX resins. The other ISR facilities will be equipped to receive and process such resin through their plants. The eluted resin may either be returned to the originator or be otherwise disposed of by the receiving operator.
  - Loaded resin from satellite plants. An ISR facility can have satellite plants at locations where smaller well fields make it uneconomical to have autonomous facilities for producing yellowcake. Most satellite plants likely will only have IX circuits. These plants will rely on the main processing plant for further uranium recovery. Loaded resin from satellite plants will be transferred to the main plant via truck for elution. Eluted resin that is not spent can be returned to the satellite plant for reuse or, if spent, disposed of by the ISR operator.

As presented in Figure 2.1, some ISR facilities may not have drying and packaging equipment and will therefore not produce dried yellowcake. At these facilities, washed and dewatered yellowcake slurry can be loaded into trucks and transported to a conventional milling facility or to another ISR facility for drying and packaging.

Neither ISR nor conventional uranium recovery facilities will accept feed material that can be detrimental to processing plant operations.

2.2.5 ISR Well fields

The ISR process uses multiple well fields that are progressively advanced across an identified and defined ore body to recover uranium, while depleting the ore body. The spacing between injection and extraction wells and pattern of well placement are largely well field specific, although, as noted, there are a number of commonly applied patterns. Well field patterns are discussed in more detail in Section 2.2.5.1. Well field patterns are developed based upon site-specific testing and hydrologic modeling, which is performed in accordance with license conditions that are based on established standardized industry practices and consistent with NRC guidance.

Recovery solutions are intended to oxidize and solubilize uranium in the recovery zone. Essentially two kinds of lixiviant have been used in the United States and internationally during the history of ISR: bicarbonate and sulfuric acid, respectively. Historically, *only bicarbonate lixiviant has been used in the United States for ISR projects*, although sulfuric acid has been used to recover copper (International Atomic Energy Association [IAEA, 2005]). As a result, this report uses the term lixiviant to refer exclusively to bicarbonate lixiviant.

Lixiviant is produced by utilizing natural carbonate or introducing carbonate, carbon dioxide (CO_2), and/or oxygen (O_2) into *native groundwater* where the ore body is naturally buffered. Where the formation is not naturally buffered, sodium bicarbonate ($NaHCO_3$) or carbon dioxide (CO_2) may be introduced. Sodium carbonate, bicarbonate, or sesquicarbonate may be added to adjust the pH. When oxygen is used, it is introduced into solution either as a pressurized gas or in the form of liquid hydrogen peroxide. The resulting “soda water-like” lixiviant is then injected into the ore body. Extraction wells create a hydraulic gradient, drawing injected lixiviant through the formation.

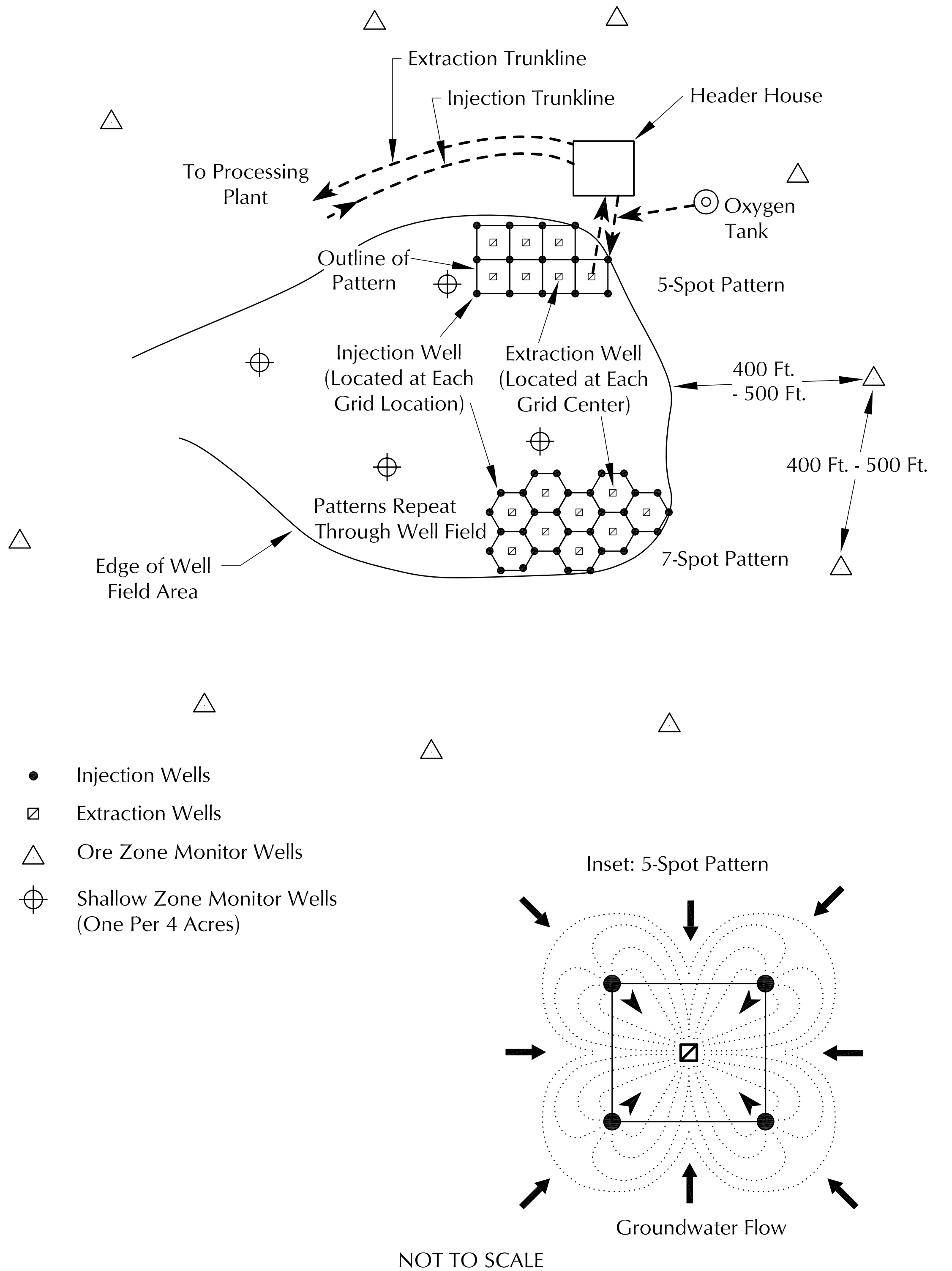
As lixiviant progresses through the ore body, it alters the oxidation/reduction (“redox”) conditions in the formation. This causes the uranium to solubilize and migrate with the lixiviant. *The ISR process temporarily reverses the natural process of uranium deposition.* Pregnant lixiviant is then pumped to the surface through extraction wells and subsequently conveyed through pipes to IX columns either at central processing plant or at a “remote IX” facility. Uranium is extracted from the pregnant lixiviant in IX columns, and the barren lixiviant (amended with carbonate, carbon dioxide, and oxygen and/or hydrogen peroxide) is returned to the well field for reuse. The subsurface recovery process continues until the identified and defined ore body is depleted.

Concentrations of trace metals such as arsenic, selenium, vanadium, iron, manganese, and radium can become elevated during the ISR process, as can chlorides and sulfates. Most water used in the active ISR operations (approximately 99 percent) is recycled in the central processing plant. As a result, the consumptive use of groundwater during ISR operations is low relative to the volume of water cycled through the process. Depending on the length of active uranium recovery operations and the size of the proposed project (i.e., the areal extent of well fields), the volume of water consumed can be in the range of 25 to 430 gallons per minute (gpm), although most sites typically use 150 to 250 gpm.

2.2.5.1 Well Field Design

Multiple uranium horizons are delineated by drilling exploration boreholes and are mapped as “recovery zones.” Injection and extraction wells are drilled, cased, cemented, pressure tested, and completed in the recovery zones. Well fields are generally installed as “recovery zones” or “production areas” that are surrounded by monitor well rings at an approved distance. Monitor wells also are typically installed in the water bearing zones immediately above and below the recovery zone at an approved density (e.g., one well per four acres). The well field areas are divided into recovery zones for scheduling development and for establishing baseline data, monitoring requirements, UCLs, and restoration criteria. There can be a number of units in various stages of development, recovery, and restoration at any one time. Restoration will begin as soon as active recovery options cease and will occur at the same time as other recovery zones are developed and produced (IAEA, 1999).

In the well field, injection wells are arranged around extraction wells in patterns designed for optimum uranium recovery. Figure 2.6 shows a typical well field layout. Typically, well patterns used for ISR operations can include alternating single line drive, staggered line drive, 5-Spot, and 7-Spot patterns. Figure 2.7 illustrates these four basic patterns. Figures 2.8 and 2.9 illustrate, in more detail, single line drive and staggered line drive patterns, respectively. As noted above, each well field pattern is selectively modified to fit the actual characteristics of the ore body, and any combination of these methods can be used, as shown in Figure 2.10.



Schematic diagram of a wellfield showing injection/extraction well patterns and monitor wells.

Figure 2.6 Typical Wellfield Layout

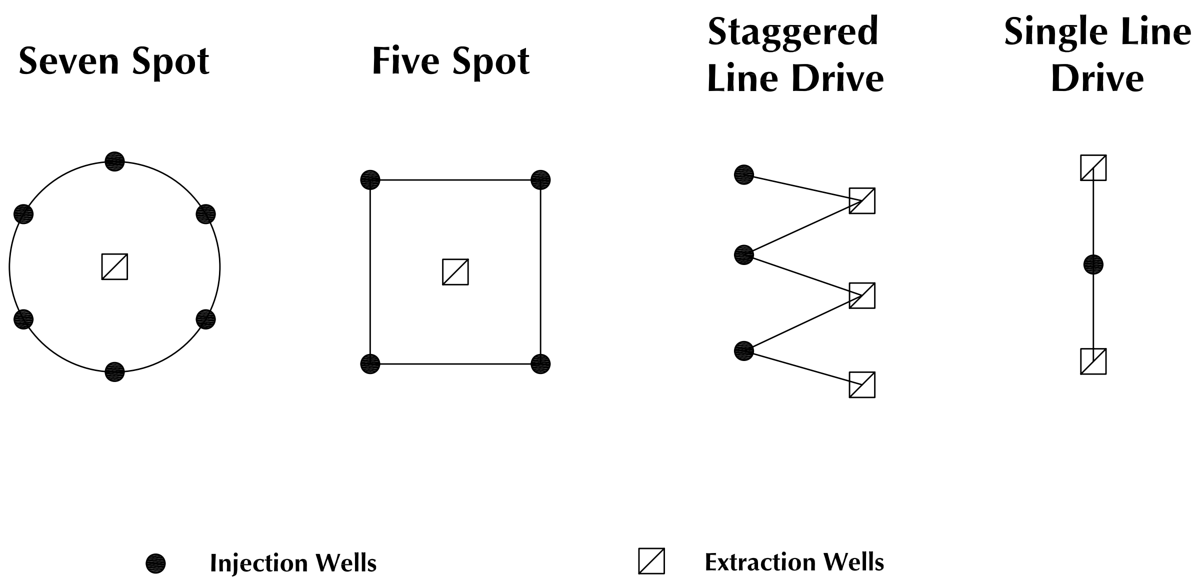


Figure 2.7 Compares 4 Different Wellfield Patterns

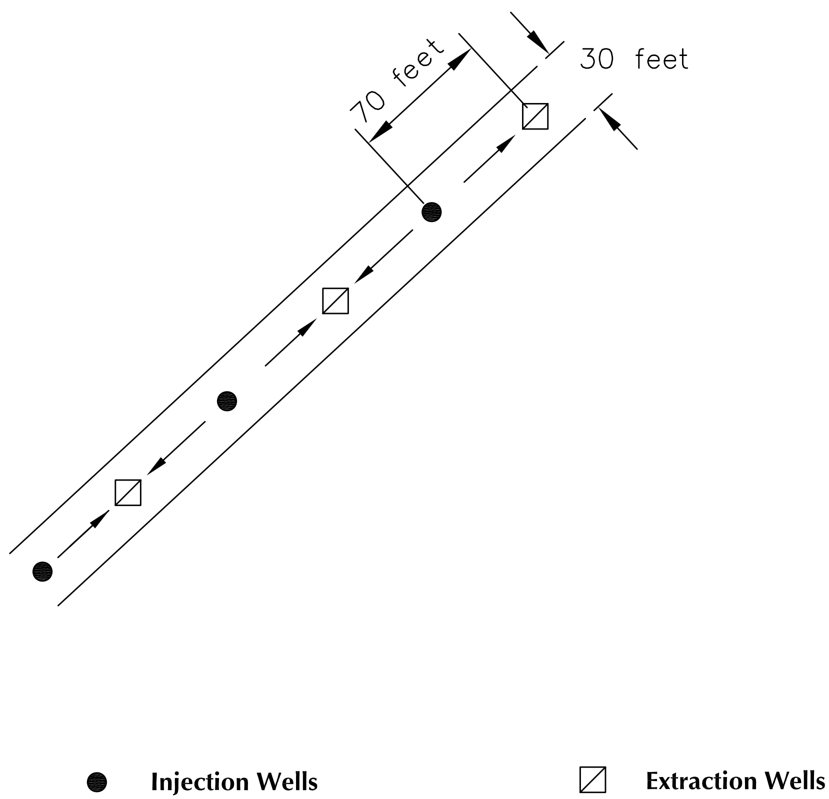


Figure 2.8 Single Line Drive Wellfield Pattern

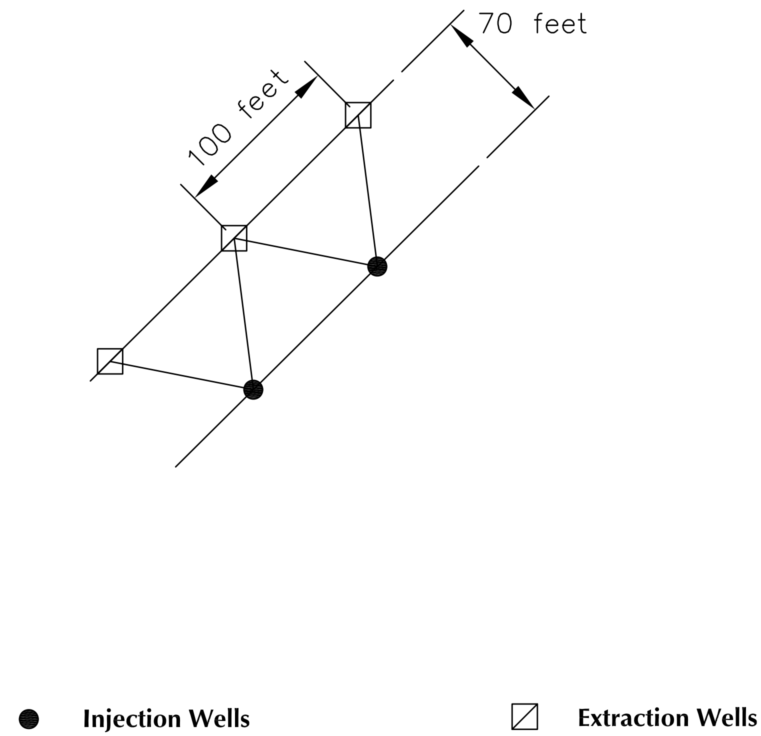


Figure 2.9 Staggered Line Drive Well-field Pattern

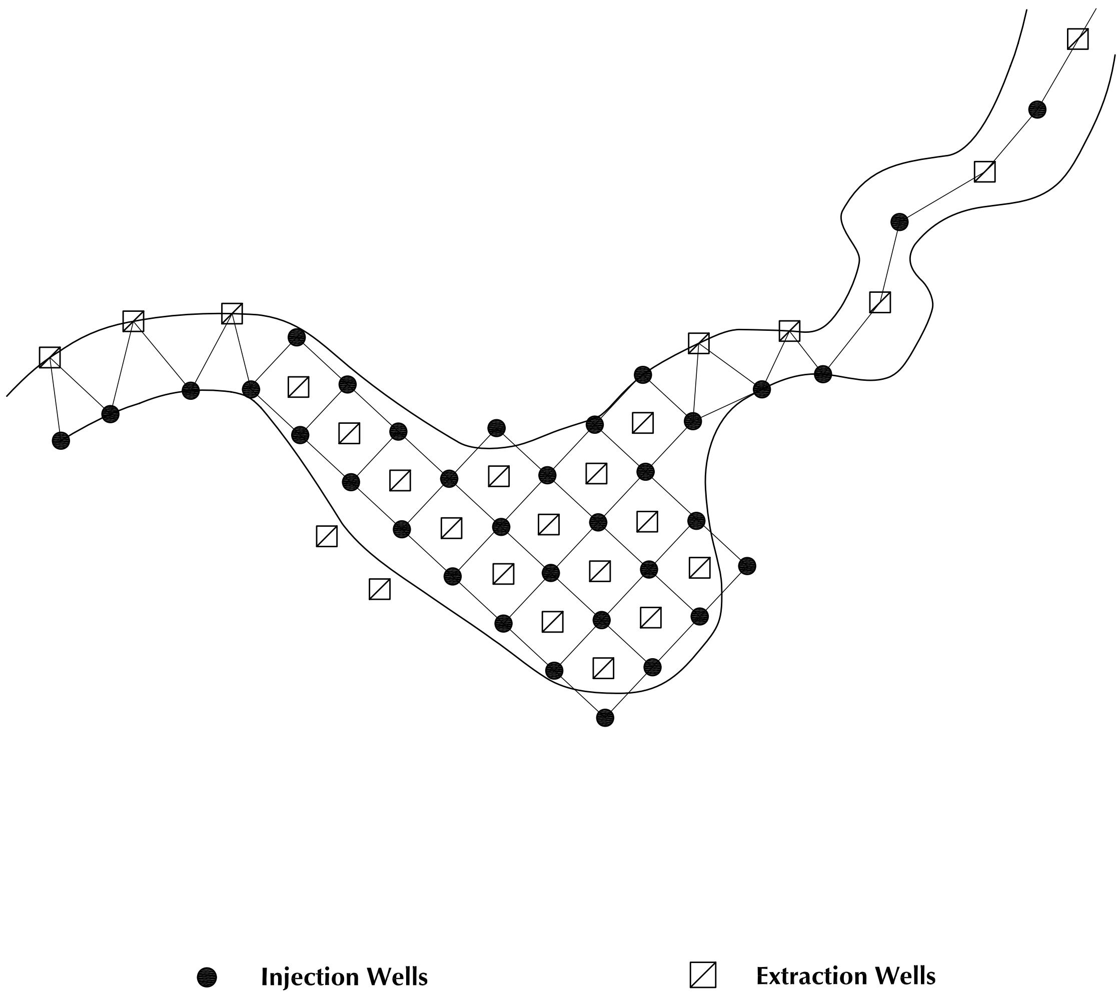


Figure 2.10 Ore Body Using Combination of Well-field Pattern

Individual recovery zones are sized and located based on final delineation of the ore body, performance of the area, and development requirements. Wells are constructed to serve as either injection or extraction wells, as needed, depending on site-specific conditions. This arrangement allows flow directions to be easily modified to optimize uranium recovery or groundwater restoration (IAEA, 1999; HRI, 1997a). Well field balance planning and implementation (including the "process" bleed) involves the day-to-day monitoring and manipulation, as necessary, of pumping rates of individual wells to assure maximum recovery, control excursions, and maximize efficient groundwater restoration efforts. Figure 2.11 shows injection and wells as they relate to the subsurface at a typical ISR site.

As noted above, monitor wells are placed in the recovery zone in a monitor well ring around the recovery zone(s), and, depending on site-specific conditions, in water-bearing zones directly overlying and underlying the production zone. Selected wells are monitored for water level and sampled for certain water quality parameters on a regular basis to ensure that the injected recovery solutions stay within the defined recovery zone (IAEA, 1999; HRI, 1997a).

In each recovery zone, more water is extracted than injected. This creates a localized hydrogeologic cone of depression or pressure sink. This pressure gradient provides containment of the recovery solutions by causing natural groundwater movement from the surrounding area toward the recovery unit. This natural groundwater movement also dilutes contaminant build-up that could adversely affect the efficiency of uranium recovery operations. The over-production or bleed rate ranges from 0.5 percent to 1.5 percent of the extraction flow rate from any given recovery zone (IAEA, 1999, HRI, 1997a, Crowe Butte Resources, Inc. [CBR], 2007).

2.2.6 Well field Procedures and Equipment

This section discusses well construction, well development, and well field operations.

2.2.6.1 Well Construction

Materials

The well casing material for injection, production, and monitor wells is typically PVC. However, well casings can be constructed using fiberglass, polyethylene, or steel. Well casing diameter typically ranges from 4 to 6 inches (in). Site-specific conditions determine the type of well casing material and diameter used (HRI, 1997a; CBR, 2007).

Well Construction Method

Injection, production, and monitor wells are installed using conventional drilling techniques such as mud-rotary drilling, but could be installed using reverse circulation techniques or drilling with foam. To control drilling fluid viscosity, native mud and a small amount of commercial drilling fluid additive are used. Although mud-rotary drilling is commonly used, other drilling methods can be used depending on site-specific conditions (e.g., hollow stem auger, cable tool, reverse circulation rotary, and air rotary drilling methods). Pilot holes are drilled to the top of the target completion interval. Each pilot hole is logged, reamed, casing set, and cemented to isolate the completion interval from other water bearing zones (HRI, 1997a; CBR, 2007).

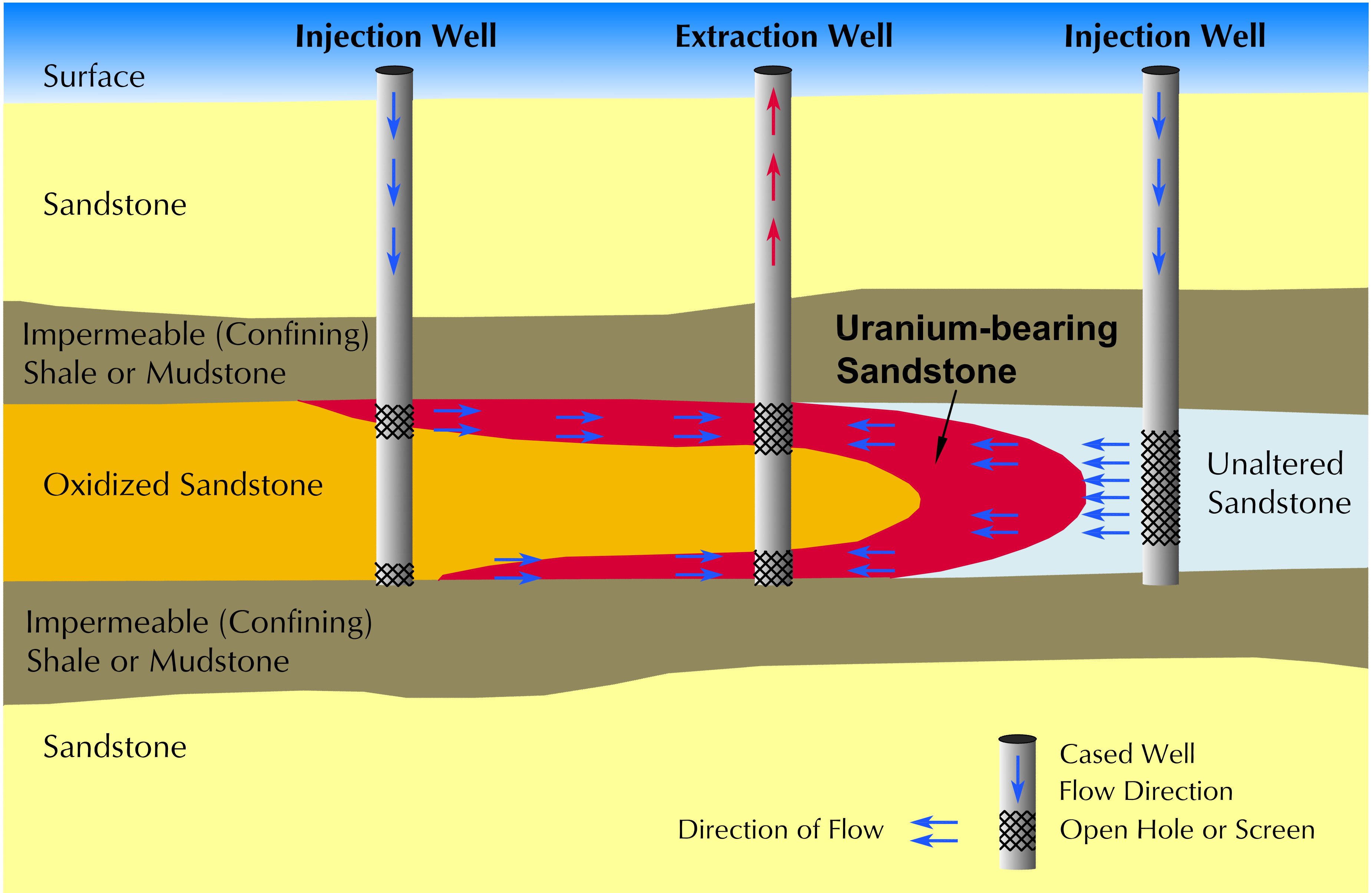


Figure 2.11 ISR - Injection and Extraction Wells

The production, injection, and monitor wells are cased using one of the following techniques (HRI, 1997a, CBR, 2007):

- Method 1: Single string of casing with cement basket, and plug assembly, and with integral screen across the completion interval as shown on Figure 2.12 (CBR 2007 Figure 3.1-1)

- Method 2: Single string set to the top of completion interval; below the casing, the hole will be drilled out (under-reaming is optional), and a retrievable screen assembly is set below the casing across the completion zone; a packer will be set inside the casing at the top of the screen and optional gravel pack sand outside of the screen as shown on Figure 2.13 (equivalent to CBR 2007 Figure 3.1-2)

- Method 3: Similar to the first two methods, the casing is cemented in along the entire length and the casing and grout are under-reamed across the completion interval with a retrievable screen assembly installed as shown on Figure 2.14 (CBR 2007 Figure 3.1-3)

Depending on site-specific conditions, dual size casing can be used. A shallow, larger casing is set at the pumping depth to accommodate large submersible pumps, and smaller diameter casing is set through the completion interval (to be under-reamed or perforated) (HRI, 1997a).

Perforations and under-reaming are used to open wells that have casing placed across the target completion interval. The perforated casing completion uses the same shaped charge explosives, as used in the oil industry, to place hole through the casing, cement, and into the formation. The under-reamed casing completion uses a mechanical downhole tool to cut away casing, cement, and the filter cake on the borehole wall. Both techniques open the well bore to the completion zone. This method provides good vertical isolation of the interval because cement remains above and below the production interval (HRI, 1997a).

Casing centralizers are used to center the casing inside the borehole to ensure an effective cement seal within the annulus. Centralizers are typically spaced no more than 100 feet (ft) apart. Actual spacing depends on site-specific conditions. For example, Wyoming regulations (Chapter 11, Section 6 e) state, “Casing shall be equipped with centralizers placed at a maximum spacing of one per forty feet to ensure even thickness of annular seal and gravel pack.” The annular space between the casing and the borehole is sealed with cement-bentonite grout in compliance with relevant requirements. Grout is injected into the annulus from the bottom up, to ensure a complete seal (CBR 2007).

Well Development

Wells are developed after completion using conventional methods such as jetting, swabbing, air-lifting, pumping, or other appropriate method. The goal is to remove drilling fluids and fines from the completion zone to provide good hydraulic communication and restore the natural geochemical conditions. Well development continues until produced water runs clear. Turbidity measurements or visual observation are typically used as indicators to determine when well development is completed. Baseline water quality samples are collected after each well is developed (CBR 2007).

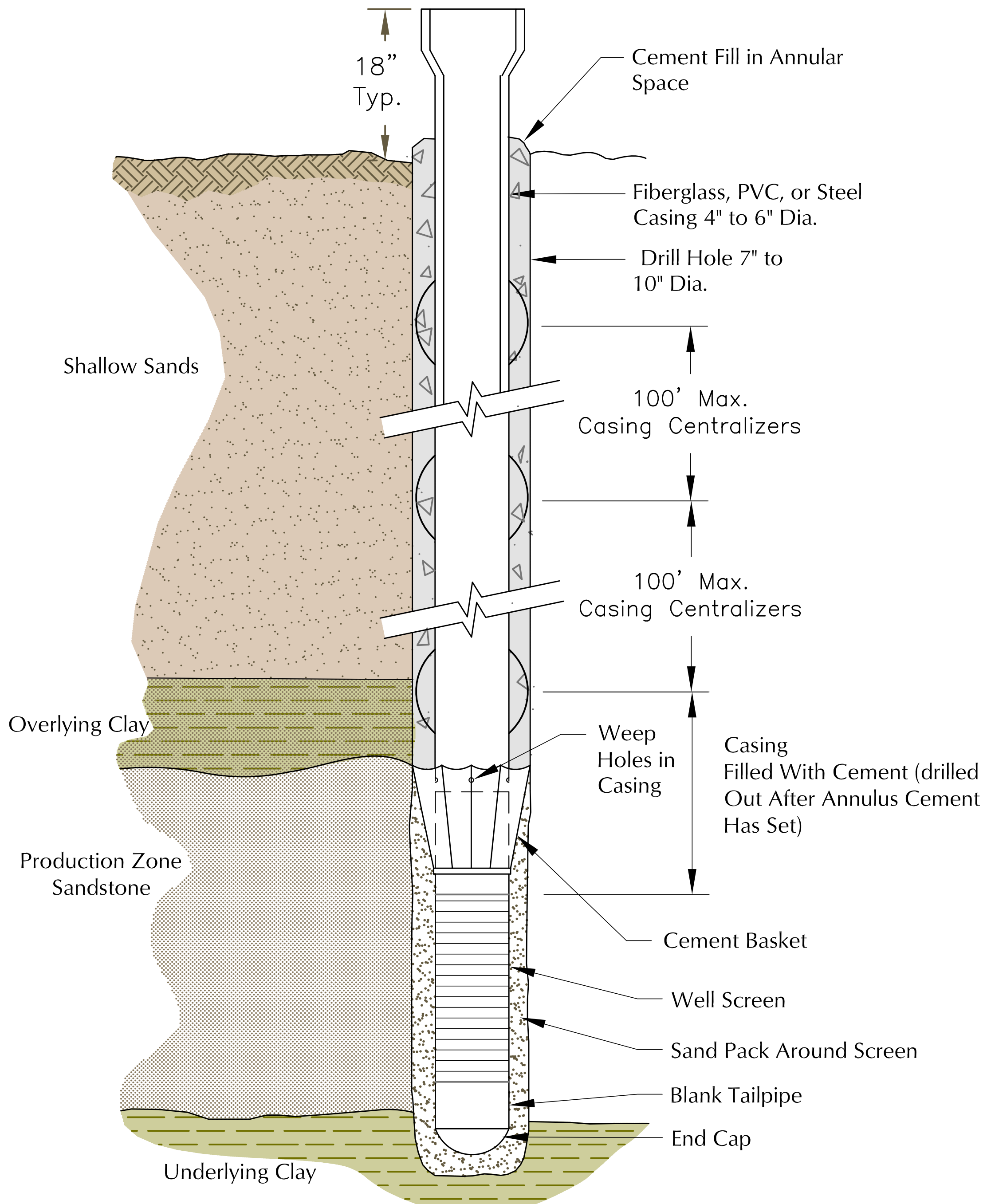


Figure 2.12 Conceptual Well Construction Method No. 1

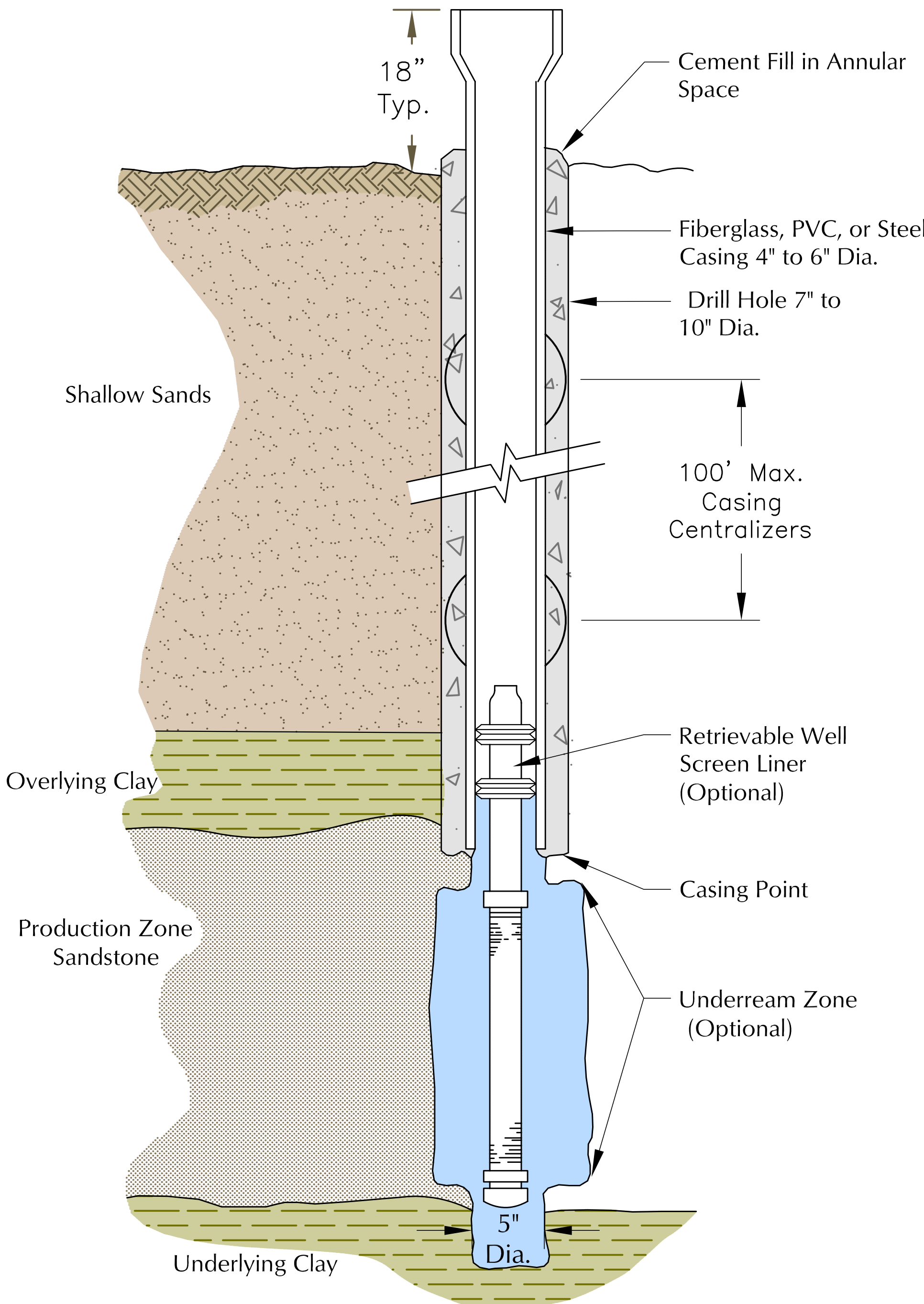


Figure 2.13 Conceptual Well Construction Method No. 2

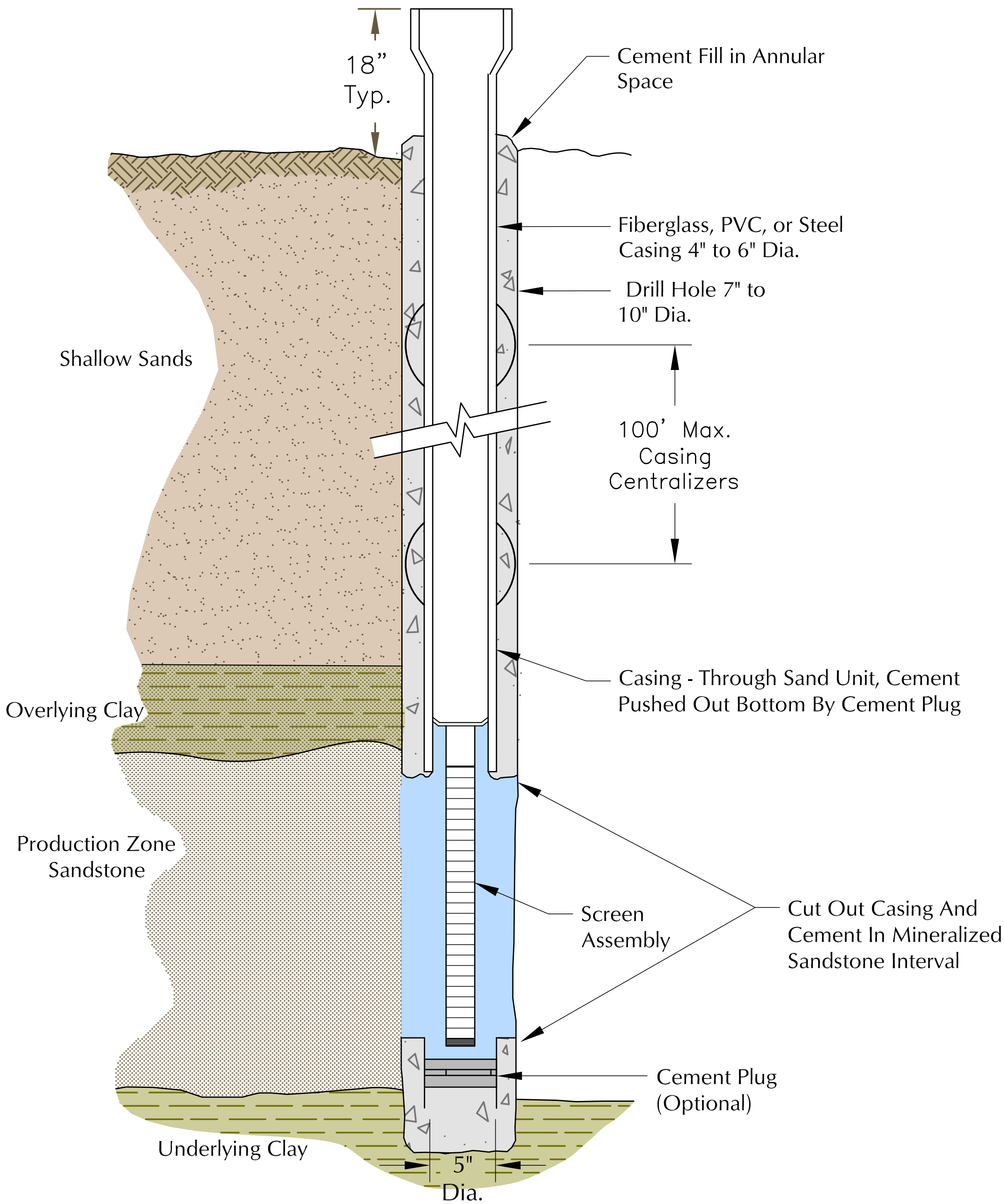


Figure 2.14 Conceptual Well Construction Method No. 3

Well Casing Mechanical Integrity Testing

Each well is tested for mechanical integrity before use in accordance with relevant EPA or state UIC regulatory requirements. The test is performed to ensure no hydraulic communication between the recovery zone in the aquifer and overlying or underlying water-bearing zones. In the test, the bottom of the casing adjacent to or below the confining layer is sealed with a down hole packer or other suitable device. The top of the casing is then sealed and a pressure gauge is installed to measure pressure inside the casing. The pressure in the sealed casing is increased to some pre-determined percentage above the maximum anticipated operating pressure, the well is closed, and all fittings are checked for leaks. After the pressure is stabilized, pressure readings are recorded at regular intervals for up 10 to 30 minutes. After the selected test duration, the well passes the test if less than 10 percent of the starting pressure is lost over the course of the test. If the pressure loss is greater than that percentage, the well fails the test (HRI, 1997a, CBR, 2007).

If a well fails the test, it is repaired as appropriate and tested again. A well that fails the test repeatedly is plugged and abandoned in accordance with the relevant requirements. Operating wells are tested for integrity prior to beginning operations, after repairs are made, and every 5 years (CBR 2007).

2.2.6.2 Well field Operations

During the production phase of a well field's life, the key objective is to maximize the rate of uranium production from each recovery well in service while, at the same time, preventing the migration (i.e., excursion) of recovery solutions into surrounding, non-exempt aquifers. Each injection and extraction well is operated at the maximum continuous flow rate achievable for that pattern area. Injection and production flow rates are monitored on a well-by-well basis, so that injection can be balanced with production across the entire well field, with the injection flow lower than the extraction flow by the amount of the process *bleed* rate.

Operating as a unit, multiple injection wells are paired with multiple extraction wells located within and around the uranium ore body, much like the well patterns in an oil or gas well field. The well field is operated effectively as a closed loop. Pumping water (extraction) out of the aquifer causes the injected waters to move toward the extraction wells, passing through the uranium ore body in the process. The water is drawn to the extraction wells, pumped to the surface and through the surface IX columns and re-injected. Injection is inextricably linked to extraction, i.e., without extracting at least as much water as is injected, the surface plant will run dry and re-circulation will stop. Injection cannot proceed without an equal or greater amount of extraction; so over-injection across the area cannot take place.

As stated above, overall injection flow rate into well fields is less than the total extraction flow rate by an amount known as "*process bleed,*" which results in a hydraulic pressure sink which causes native groundwater outside of the ore zone to migrate into the well field. This process bleed is used to help protect the monitor wells against lixiviant excursion and varies according to ore geometry, well pattern and magnitude and direction of the natural groundwater velocity. Details of the well field operations plan that relate to protecting against and responding to any potential excursion from the recovery zone in compliance with NRC license conditions and UIC program requirements will be detailed in a Site Operation Plan that is prepared prior to operations. The plan will detail the planned production flow rates, bleed, injection rates/ pressures, maintenance, instrumentation, and monitoring.

Pipelines

The fluids handling system involves various pumps, meters, pipelines, fittings, and connections. The pressure and temperature conditions in ISR operations are relatively low compared to many other industrial operations. As a result, readily available materials such as high-density polyethylene, PVC, fiberglass, steel, and stainless steel are suitable for well field and process piping, fittings, and vessels; special or exotic materials generally are not required. The components of the fluid handling system are rated to withstand ambient temperatures and pressures of the environment and the fluids. The materials are chemically resistant over their useful life to the fluids and solids conveyed. Specifications are determined to maintain structural integrity throughout the anticipated life of the component. All well field piping systems and equipment may be housed in containment buildings, placed on the surface, or buried depending on local climate conditions (HRI, 1997a).

Conveyance pipes in the well field are single wall and are commonly constructed of HDPE. HDPE offers high chemical resistance, resistance to sunlight (if installed on the surface as is done in South Texas) and possesses structural and thermal properties suited to the conditions (fluid pressure less than 265 pounds per square inch [psi]) and temperature less than 80 degrees Celcius (^{o}C) (176 degrees Fahrenheit [^{o}F]) under which it is expected to operate. Pipes must be capable of providing ultraviolet (UV) protection or be painted to provide protection. Where weather conditions permit, such as in Texas, the pipes are installed above ground in order to facilitate routine inspections, early leak detection, and repairs. Pipes at road crossings or other high-traffic areas may be encased in steel culverts and buried. The pipes are sized to safely operate under the maximum anticipated fluid pressure and maintain high fluid velocities below limits recommended by the manufacturer.

Fluid temperatures in ISR pipelines usually range from 13 ^{o}C to 38 °C (55 ^{o}F to 100 °F). The continuous flow of aqueous solutions at these temperatures prevents freezing in the surface pipelines during winter where freezing is only an intermittent possibility (HRI, 1997a). In locations where temperatures do not allow for this approach, pipelines are buried to prevent freezing.

Typically, polyethylene (e.g., HDPE) or PVC pipes and fittings connect injection and extraction wells to their respective manifolds. Polyethylene fittings are pressure welded. These manifolds may be located inside small containment buildings, where local climate conditions require, and are fitted with meters and valves to measure and regulate flow to and from each well. The manifolds are connected to the trunk lines that convey fluid to and from the processing plant. The trunk lines are metered at the processing plant to monitor flow. Well field piping is pressure-tested for mechanical integrity using procedures similar to those used for wells.

Instrumentation

Instrumentation includes:

- Sensors
    - Liquid pressure monitors
    - Flow meters
    - Leak detectors in sumps
    - Dryer unit differential pressure monitor

  - o Radiation monitors with alarms
  - o Radon monitors with alarms
  - o Video cameras
  - o Moisture detectors

- Flow control devices

  - o Valves

- Control system

  - o Equipment control panel
  - o Programmable logic controller
  - o Failsafe switches

<u>Meters and Monitors</u>

The production system is monitored in both the well fields and the processing plants. An operational metering system will permit continuous pressure monitoring on both the injection and extraction pipeline systems, and will provide audible alarms for plant operators in the event of leaks or ruptures. Formal visual inspections will be conducted and documented twice during each 12-hour shift. Pipelines and header houses also can be continuously monitored with video cameras. Additionally, personnel who will conduct construction and routine maintenance in the well field areas will provide supplemental well field surveillance.

The well field instrumentation includes the well head, valves, pressure gages, totalizing meters, and flow meters. Injection and extraction flow rates for each well are monitored to balance injection and extraction across the well field, with injection rates smaller than extraction flow by the amount of the bleed. A variety of meters are used in the well field and the plant, with differing accuracy depending on their use. ISR operates continuously and meters are monitored for repair or replacement as part of a larger operational maintenance program. System fault interrupts (fail-safe interlocks) can be installed to shut down the system in the event of an unwanted condition (e.g., pipe break detected by pressure transducer). These could include moisture detectors in header houses to provide early warning of a leak as well as video cameras in header houses.

Operators also will provide their ISR plants with sumps and pump equipment to prevent any potential spills from escaping processing pads.

Routine environmental monitoring will be conducted independently of operational monitoring. ISR environmental monitoring systems are based on an outline provided in NRC's Regulatory Guide 4.14, *Radiological Effluent and Environmental Monitoring at Uranium Mills* (NRC, 1980a) or current revisions thereof.

An applicant's proposed environmental and plant monitoring and documentation system (including associated routine and non-routine reporting procedures) will be included as conditions in the approved NRC license. In-plant radiation monitoring and occupational safety programs will be reviewed and approved by NRC.

2.2.7 Processing Plant Facilities

This section describes typical ISR processing plant facilities and details specifications that have been or are generally applied to such facilities. It is understood that specifications will be revised from time to time as improved materials or process equipment are developed. Therefore, in keeping with NRC performance-based licensing philosophy, it is suggested that licenses issued for ISR facilities only require operators to select equipment adequate to meet specific performance objectives, rather than limiting them to only particular equipment types or materials.

Processing plant facilities typically include the following major structures:

- Central processing plant and satellite processing facilities, in which uranium extraction, concentration, and precipitation equipment are located
- A dryer room or building that houses the yellowcake dryer and product packaging unit
- Waste retention/evaporation ponds
- Wastewater treatment and management facilities
- Administrative offices, laboratories, and workshops.

Central processing plants contain various vessels to hold and process liquid solutions. The principal vessels include IX columns (upflow, downflow, or Higgin's Loop™), elution columns, and yellowcake precipitation tanks, washing, and dewatering equipment. The central processing plant also can contain tanks for storage of various liquids including barren lixiviant, barren eluant, process chemicals, and yellowcake slurry.

Satellite processing facilities include IX columns (upflow or downflow), and may or may not include elution columns, and yellowcake precipitation vessels.

Drying and packaging equipment is housed in a separate building at a central processing plant.

2.2.7.1 Product and Reagent Storage

ISR operators prepare SOPs to be followed for management of potentially hazardous materials used or produced at the site.

Typical reagents stored on-site include HCl (or H_2SO_4), NaOH, $NaHCO_3$, liquid brine, H_2O_2, liquid CO_2, liquid O_2 and NaCl. Yellowcake product is securely stored inside the designated restricted area of the ISR recovery facility, in accordance with NRC/Agreement State regulations governing the security of licensed material, license conditions and the facility's standard operating procedures (SOPs).

Liquid oxygen tanks are located near where the oxygen will be used, typically in the well fields. Other chemical storage tanks typically are stored on curbed or bermed concrete pads that may be located near their point of use or in a designated chemical storage area.

Building and Containment Structures

Central processing plants typically are constructed on concrete pads of varying measurements and dimensions (e.g., 20 centimeters (cm) or 8 in thick) with curbs. Thicker footings can be provided where heavy processing equipment and vessels might be located. Specific plant design is based on engineering specifications.

Curbs surrounding process equipment are designed to confine and hold potential spills. The containment volume provided by each curb exceeds the capacity of the largest vessel inside the curbed area. Curbed areas also include sumps and drains to collect and retain potential spills. Contained spills are pumped either into storage tanks or evaporation ponds.

Piping

Process piping within ISR plant facilities typically consists of steel, PVC, fiberglass, and HDPE of varying diameters and wall thickness, that follow American Society for Testing and Materials (ASTM, 2003) standards. Wherever applicable, PVC and HDPE piping are used because of their superior rating for chemical resistance. All process piping is designed in accordance with generally accepted, current engineering standards according to the flow rate, required pressure, and the medium being processed. Process pumps are sized to minimize required discharge pressures to achieve transfer requirements as specified below.

PVC Pipe: Schedule 40 or Schedule 80 PVC (or equivalent) currently is used. Process fluids in ISR facilities typically are transferred at pressures under 150 pounds per square inch gauge (psig). According to PS 21-70 and ASTM 1785, the maximum working pressure at 73.4 ^{o}F for 8-in., schedule 40 PVC is 160 psig. Most PVC piping within ISR processing plants will be smaller than 8 in. or less in diameter. Schedule 80 PVC, which has a thicker pipe wall than schedule 40, allows higher maximum operating pressures. For example, 6-in diameter schedule 80 PVC pipe has a maximum operating pressure of 280 psig.

Steel Piping: Although used for oxygen service, use of steel pipe will generally be minimized in ISR facility applications. However, if steel pipe is used, it will be sized such that its rated operating pressure is above the maximum operating pressure of the fluid it will convey. For example, Grade A pipe of dimensions 8 in, 10 in, and 12 in have maximum operating pressures of 1,300, 1,200, and 1,400 psig, respectively. These safe operating pressures far exceed any that will be encountered at an ISR central processing facility. Steel conveyance pipe conforms to American Society of Metallurgical Engineers (ASME) A53 for standard plain end pipe.

Because process fluids within ISR operations are transferred at relatively low pressures, in some facilities, fiberglass or HDPE piping is used in lieu of or in addition to PVC piping. Selection of these alternate materials is based on their suitability for the operating conditions and compatibility with the material to be conveyed. As with PVC or steel piping, piping diameters and thicknesses are selected such that the ASTM maximum allowable operating pressure rating is substantially higher than the operating conditions encountered in the process.

Vessels

Steel Vessels: Sand filters (if used) and IX vessels are fabricated from steel using the ASME guide of Section VIII, Division 1, for the design and fabrication of pressure vessels. These vessels are usually rubber lined.

Fiberglass Vessels: Fiberglass vessels conform to PS 15-69. The vessels are constructed of a fiberglass resin that will be compatible with both acidic and caustic liquids.

IX Resin Loading

Uranium is recovered from the pregnant lixiviant solution using an IX process step. The concentration of uranium in pregnant lixiviant can exceed 100 mg/L. As the pregnant lixiviant passes through the IX resin, the uranyl carbonate complex displaces anionic ligands and becomes trapped on the resin. The resulting barren lixiviant is then re-amended with oxygen, carbon dioxide or carbonate (for pH control), as described above, and returned to the well field for re-injection. When the IX resin has been loaded to capacity (uranium breaks through), the vessel is taken off line for elution. Upflow ion exchange columns can be used as well as can Higgin's Loop™ columns.

Ion Exchange Columns

Uranium-laden recovery solution containing the uranyl carbonate complex is received at the processing plant through a network of well field piping and pumped through the IX columns. Uranium is exchanged, as in a conventional home water softener for chloride, on the reacting sites of the resin as follows where R is a reacting site of the ion exchange resin.

$$Na_2UO_2(CO_3)_2 + 2RCl \rightarrow R_2\,UO_2(CO_3)_2 + 2NaCl$$

The concentration of uranium in pregnant lixiviant can exceed 100 milligrams per liter (mg/L).When the ion exchange resin in a column has captured uranium to its optimum loading capacity, uranium breakthrough occurs. That is, uranium concentration in the barren leach water exiting the IX column begins to rise. At this point, the column is taken out of service and another column with fresh ion exchange resin is placed on-line.

After the uranium is removed by the ion exchange the process, bleed is removed from the lixiviant stream and is disposed of by an approved method. The process bleed insures that more water is withdrawn than is injected, thereby keeping recovery solutions laterally within the production zone.

After the bleed is removed from the stream exiting the IX columns, the uranium-depleted (barren) water can flow through sand filters to remove any particulates and then is re-fortified and piped back to the well field for reinjection. The entire injection, extraction, IX, and reinjection process effectively is a closed system.

Many uranium ore deposits may not be large enough to support the cost of a full service process facility or portions of the well field may become so distant from the central processing facility that piping water to and from is not practical or cost-effective. In these cases, IX can be employed. IX's include ion exchange columns that contain ion exchange resin for recovering the uranium from the recovery stream. The resin, once loaded with uranium is as described in §

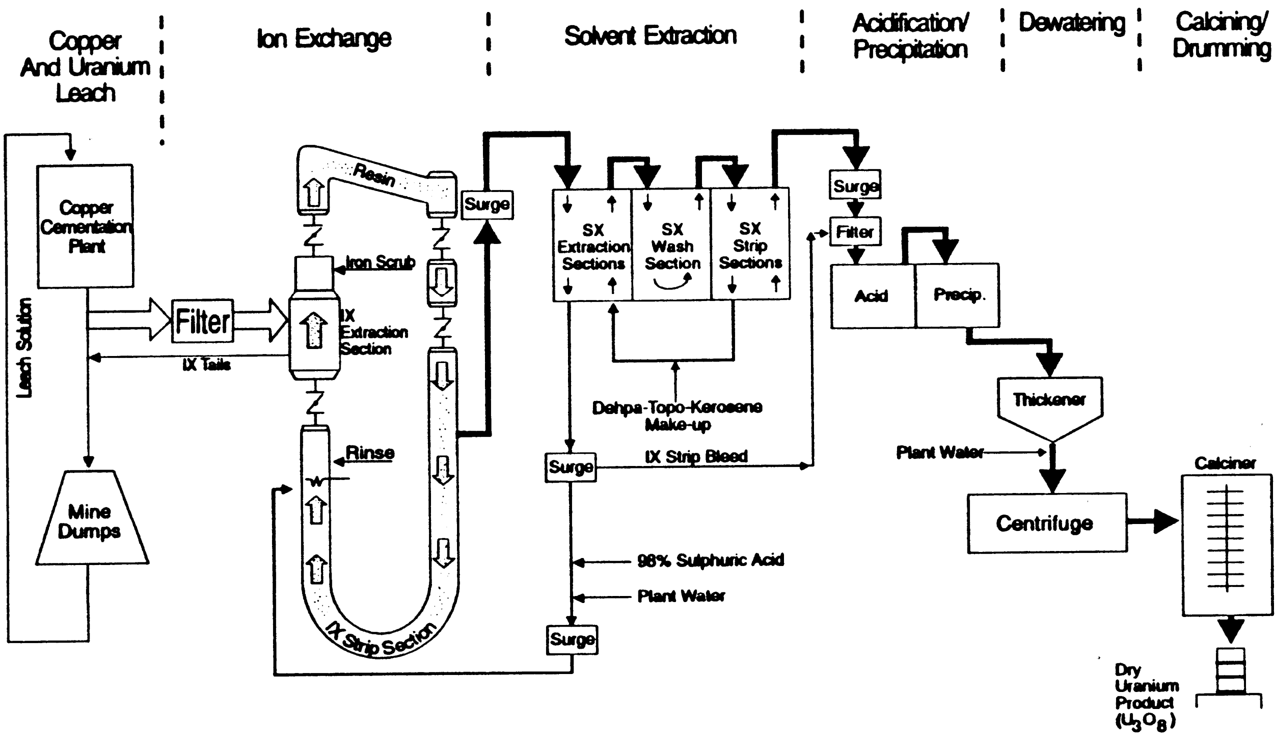
3.2 transferred out of the ion exchange columns, drained of free water and trucked to a central plant for removal of the captured uranium as described below. The clean ion exchange resin that has been stripped of all uranium at the central plant is transferred back to the RIX in the same way. The practice of RIX is not a new one and has been utilized to recover uranium in South Texas as early as 1980 and is currently being used by companies in Texas and Wyoming.

Higgin's Loop™ Columns

Higgin's Loop™ columns perform the processes of loading, elution and washing continuously. Uranium-bearing water flows through the resin in the left side of the U-tube. Loaded resin moves to the right side of the system. As the resin beads load, they become heavier and sink to the bottom of the column. A butterfly valve opens and lets a batch of heavy beads into the bottom of the U-tube (IX Strip Section on the diagram). The valve closes. Eluate enters the bottom of the U tube under pressure and the batch of resin in the bottom of the U-tube is eluted. Once eluted a second butterfly valve opens allowing the now eluted resin to flow into the bottom of the leftmost column. It is rinsed and ultimately cycles back to the rightmost column.

This process generates more concentrated pregnant eluates than are generated by either conventional upflow or downflow columns. Eluates of up to 65 grams per liter (g/L) uranium as opposed to 35 g/L uranium for eluates from normal columns can be generated.

The flow diagram for the Higgin's Loop™ uranium ion exchange recovery system constructed by Westinghouse Electric Corporation's (Wyoming Minerals Corporation) in Copperton, Utah near the Bingham Canyon Pit to recover uranium from copper dump leaching water is shown here (Image is courtesy of WMA's web site):



Bingham Canyon Uranium Extraction Plant Process Flow Diagram

Images of a Higgin's Loop™ system from the Severn Trent Services web site (http://www.severntrentservices.com/):

Such a system is currently operating in Sheridan, Wyoming. This system is not used for uranium recovery but rather for treatment of coal bed methane discharge water. A description of the Higgin's Loop™ system from the Severn Trent Services web site is included in italics below:

***Ion exchange system** resins are best known for their use in water demineralization, softening or other forms of water purification. In mining, resins have been commercially used for the extraction of valuable metals, specifically gold and uranium. There are much broader applications for ion exchange system than these relatively simple, low concentration separation processes, and advancements in resin quality, resin handling systems and process control have paved the way for commercialization of more complex processes.*

Severn Trent Services offers the Higgin's Loop™, a continuous countercurrent ion exchange system contactor for liquid phase separations of ionic components using solid ion exchange system resins.

The TETRA® Higgin's Loop™ (CCIX) is a Continuous Countercurrent Ion Exchange contactor for liquid phase separations of ionic components using solid exchange (I-X) resins. The Higgin's Loop™ contactor is a vertical cylindrical loop, containing a packed bed of I-X resin that is separated into four operating zones by butterfly, or "loop" valves. These operating zones - Adsorption, Regeneration, Backwashing and Pulsing - function like four separate vessels.

The Higgin's Loop™ treats liquids in the adsorption zone with resin while the ions are being removed from loaded resin in the regeneration zone simultaneously. Intermittently, a small portion of resin is removed from the respective zone and replaced with regenerated or loaded resin at the opposite end of that zone. This is accomplished hydraulically by pulsing the resin through the loop. The result is continuous and countercurrent contacting of liquid and resin.

Higgin's Loop™ technology is a great enhancement for ion exchange applications when compared with fixed bed and fluid bed systems. The Higgin's Loop™ will efficiently utilize the

resin capacity, uses less regenerant and fresh water, generates consistent product quality, and minimizes wastewater volumes. The technology offers greatly expanded ranges for the use of ion exchange resins and adsorbents in commercial separations.

Elution Facilities

Once loaded with complexed uranyl carbonate, resin is eluted. In this step, a concentrated salt brine solution, often amended with sodium carbonate, bicarbonate, or sesquicarbonate to elevate the pH is passed through the loaded resin, displacing uranium trapped on the resin bed. The following chemical reaction occurs:

$$R_2UO_2(CO_3)_2 + 2NaCl + Na_2CO_3 \rightarrow Na_4UO_2(CO_3)_3 + 2RCl$$

In the first elution step, partially enriched eluant (from the second step of the previous elution) is sent through the fully loaded IX bed to yield uranium-rich eluant and can be stored separately in a tank. In the second step of the process, barren eluant is passed through the partially eluted resin bed to remove the majority of the residual uranium present on the resin. The resulting partially enriched eluant can be stored in a recycle tank and used in the first step of the next elution cycle.

The process produces regenerated IX resin and production of a small amount of pregnant eluate bearing uranium at concentrations typically ranging from 10 to 42 g/L (with conventional downflow columns) and up to 65 g/L using a Higgin's Loop™ column. The eluate is transferred to a holding tank, and when a sufficient volume of eluate has accumulated, the next stage of uranium recovery (precipitation) commences. The barren resin produced by elution is either returned to the resin loading circuit for reuse, or appropriately disposed as 11e.(2) byproduct material, if unusable. In general resin is reused until it is spent. A resin bead is considered spent when it either loses physical integrity (beads break or become soft due to progressive weakening of the crosslinking in the beads) or becomes irreversibly fouled with recalcitrant ligands (polythionates or others) that the uranyl carbonate complex cannot displace.

Uranium Precipitation Facilities

Uranium-rich eluate from the elution circuit is transferred to a precipitation tank or system where uranium oxide is then precipitated from the uranium rich eluant. Uranium rich eluant, which contains uranyl di and tricarbonate, is acidified using hydrochloric acid (HCl) (or sulfuric acid) to destroy the uranyl carbonate complex as shown below.

$$Na_4UO_2(CO_3)_3 + 6HCl \rightarrow UO_2Cl_2 + 4NaCl + 3CO_2 + 3H_2O$$
$$Na_2UO_2(CO_3)_2 + 4HCl \rightarrow UO_2Cl_2 + 2NaCl + 2CO_2 + 2H_2O$$

In the next step hydrogen peroxide is added to the solution to oxidize the uranium even further and cause it to precipitate according to the following reaction:

$$UO_2Cl_2 + H_2O_2 + xH_2O \rightarrow UO_4\,xH_2O + 2HCl$$

The crystalline uranyl peroxide slurry (UO_4 or yellowcake) may require pH adjustment and then is allowed to settle. Where a thickener is used in the process, recycling some precipitate from the thickening step assists with precipitation by providing nucleation sites. Following settlement of solids, the barren eluant can be recycled, while the yellowcake slurry is transferred to the next stage at the same or a different processing plant.

Radium Precipitation Facilities (if used)

In the past, ISR plants used radium precipitation. Since even treated restoration water now is considered 11e.(2) byproduct material, and cannot be surface-discharged, there is no incentive for source material licensees to remove radium from plant effluents. As a result, operators may opt to omit radium precipitation from their water treatment circuits; however, radium precipitation remains a process option.

At facilities that choose to perform radium removal, supernatant from uranium precipitation is sent to a radium precipitation unit. A barium chloride solution (approximately 10 to 20 mg/L) is added to the supernatant. The barium chloride reacts with sulfate in the solution to form barium sulfate. The radium (Ra-226) is co-precipitated within the barium sulfate crystal structure. If the concentration of sulfate in the solution is too low to efficiently cause precipitation, sodium or ammonium sulfate may be introduced before barium chloride is added. Flocculant may also be added to enhance precipitation, and settling.

Yellowcake Washing Facilities

Yellowcake slurry is dewatered and washed with clean water using a commercially-available filter device, thickener, belt filter, or centrifuge, then dried. In addition to washing, thickeners, centrifuges, filter presses, or belt filters are used to dewater the yellowcake solids, or slurry, which will later be transferred to a drying operation in the restricted area for conversion to the product powder. Water removed from the filters typically is recycled. Water left over from dewatering and drying may either be reused in the elution process or sent to the wastewater disposal facilities.

Yellowcake Drying and Packaging Facilities

Dewatered yellowcake slurry is dried using a batch-type rotary vacuum dryer system or multiple hearth dryers. It is anticipated that most newer facilities will use a vacuum dryer system to dry de-watered yellowcake slurry for packaging as these systems represent the state-of-the-art technology. However, dewatered yellowcake slurry at older facilities has been dried using heated atmospheric dryers/multiple hearth dryers which still could be proposed for use in new ISR facilities. These dryers are generally propane or natural-gas-fired. In these systems, dewatered yellowcake slurry is fed to a chamber heated to approximately 650 to 800 ^{o}C. Gaseous emissions from the dryer are passed through dry and/or wet scrubbers and then vented to the atmosphere. The furnace, which usually consists of several tiers of hearths enclosed within a large cylinder, is generally contained in an isolated enclosed area on a concrete slab (NRC, 1980b). Dried yellowcake discharges into hoppers for transfer to the packaging system.

Newer facilities generally incorporate vacuum dryers. In these systems, the drying chamber is typically maintained at between 80 to100 ^{o}C in a vacuum of approximately 18 to 26 inches (in) of mercury. The drying chamber is heated with steam or hot oil. Drying progress is monitored

by the rise in level of condensed water in the condenser column. Drying time is typically 9 to 14 hours per batch. Total cycle time, including cooling, drum packaging, and refilling, ranges from approximately 16 to 24 hours. The manufacturer-recommended vacuum pressure is maintained in the drying chamber at all times, and operating parameters are continuously monitored. A high-efficiency particulate air (HEPA) bag filter is used to capture solid particles in water vapor prior to passing through the vacuum pump. Any solids escaping the bag filter are captured by the sealant water circulating in the vacuum pump. The sealant water is kept cool by passing it through a cooling tower. Water from the cooling tower can be periodically diverted to the recovery circuit to recover collected yellowcake particles; or alternately, this water can be diverted to the wastewater circuit. The vapor discharge line from the vacuum pump is then either passed through water for further particulate recovery or vented to the atmosphere. Yellowcake drying operations are immediately suspended if any emission control equipment is not operating within the recommended parameters.

The rotary vacuum drying system includes:

- A drying chamber: Dimensions of the chamber will vary according to the yellowcake production capacity of the plant. The chamber will be equipped with a mixing auger and a mechanism for directly discharging the dried product into drums (typically 55-gallon capacity).

- A heating system: The chamber will be heated using hot oil (at about 230 ^{o}C) in a recirculating closed-loop system. The oil will be heated using natural gas, propane, or grid power.

- A vacuum pump: The vacuum pump will maintain negative pressure inside the drying chamber. It will also remove water vapor produced in the chamber as the yellowcake slurry dries.

- Instrumentation for differential pressure: The monitoring system will produce an audible alarm if differential pressure falls below the manufacturer's recommended levels.

- A condenser: The condenser will operate inline with the vacuum pump and will remove water vapor from the vapor stream.

- A bag filter: The bag filter will be designed to recover 99.5 percent of the solids entrained in the water vapor, and will be sized to permit the required airflow. The type of bag filter used will permit return of captured solids to the drying chamber.

A multiple hearth roaster consists of:

- Storage tank for fuel if diesel-fired, or connections to a gas supply if gas-fired
- Multiple hearth roaster
- Emissions control system (scrubbers)
- Storage bin
- Lump breaker
- Barreling equipment

Drying and packaging will occur in the same area. The drying and packaging areas are restricted areas with negative pressure dust collection systems and bag filters, as described

above. In many cases, ISR facilities with vacuum dryers do not require a dryer room at negative pressure with filtered ventilation. Access to the drying and packaging area is limited to personnel appropriately trained and wearing suitable personnel protective equipment for activities in the area. Yellowcake drums awaiting shipment will be stored on a curbed concrete pad inside the restricted area.

Some ISR facilities may not have drying and packaging operations on site. These operators will either transport yellowcake slurry or dewatered yellowcake to other uranium recovery facilities operating under appropriate licenses, as noted above.

Transportation Equipment and Facilities

Because loaded IX resins, yellowcake slurry or yellowcake will be transported off-site from a satellite or main plant, transportation safety must be addressed. If the product is yellowcake, it will be transported to a truck trailer by front-end loader, which will be sealed as a dedicated shipment. If the product is yellowcake slurry or loaded IX resin, it will be pumped into a designated tanker truck. At a hypothetical production rate of 1 million pounds per year, up to 50 shipments of yellowcake or up to 1,000 shipments of resin could be transported off site each year. In most cases, after leaving the satellite well field or the central processing facility, transportation typically will be on unpaved roads initially in remote locations and on paved roads later in the shipment. In some cases, unpaved roads may be used for transport from a satellite to the central processing facility. By-pass routes are used to the extent practicable so that these shipments do not pass through population centers. All transport conveyances carrying resin, uranium slurry or yellowcake are required to carry the appropriate certifications and all drivers are required to hold appropriate licenses. Transport surveys are used to demonstrate that exposure levels are below regulatory limits and that truck surfaces are free of radioactive materials. In developing site-specific radiation survey programs relative to transportation surveys, licensees conform to DOT regulations, as well as their own operational SOPs for release of materials from restricted areas, as applicable. These SOPs are developed on the basis of NRC and DOT regulations guidance and radiological scanning standards. In addition, due to their low radioactivity and radiation levels, yellowcake shipments are characterized as LSA-1 (Low Specific Activity) shipments and meet the minimum packaging (Type IP-1 Industrial Packages) and labeling requirements for the transport of radioactive materials. Standard steel drums meet IP-1 requirements. Labeling requirements are as provided in NRC regulations 10 CFR Part 71 which are compatible with the internationally accepted IAEA TS-R-1 transport regulations.

The issues and potential risks associated with yellowcake packaging and transportation are assessed in the 1980 GEIS, NUREG-0170, and NUREG-0535 (NRC, 1980b). As a result, NRC should incorporate these assessments in its ISR GEIS.

Groundwater Restoration Facilities

Restoration Goals

After uranium has been recovered from one or more recovery zones, groundwater affected by recovery operations will be restored. The restoration goals are intended to assure that water quality outside the recovery zone will be protected adequately. Restoration goals are established initially on a parameter-by-parameter basis, with the primary goal of returning all parameters to levels *consistent with* average pre-operational baseline conditions. To the extent

that it is not reasonably achievable for each and every water quality parameter to be returned to its precise average pre-operational baseline levels, the secondary goal will be to return water quality to the MCLs as specified in EPA secondary, and primary drinking water regulations or relevant state standards. If it still is not reasonably achievable for a groundwater parameter to be restored to its secondary goal, the operator can demonstrate to NRC or an Agreement State that leaving the parameter at a higher concentration will not result in a significant hazard to public health and safety, and the environment. Upon such a showing, an ACL-equivalent can be granted, which is a site-specific, constituent-specific, risk-based concentration limit.

Some states, such as Wyoming, allow the goal of restoration consistent with prior class of use. A 2001 Memorandum of Understanding between the Wyoming Land Quality Division and Water Quality Division joint advisory board endorses "Class of Use" with regard to ISR groundwater restoration. Example projects include the Cogema Irigaray Restoration Project where the goal is to return groundwater quality to a condition “consistent with the pre-operational class of use (Cogema, 2004).

Restoration to class of use at ISR sites has been achieved. For example, Crow Butte Resources, Inc. obtained regulatory approval for restoration of Mine Unit 1 at the Chadron, Nebraska project (Nebraska Department of Environmental Quality 1999). Appendix B contains several examples of approvals from regulatory bodies for completed restoration projects. As noted in the Preamble, NRC has published its intention to propose new rules addressing restoration standards (as opposed to goals in guidance) in 2008.

In another Agreement State, Texas, according to Texas Regulations[103], in determining whether the approved restoration values can be amended, the Texas Commission on Environmental Quality will consider: the uses for which the groundwater was suitable at baseline water quality levels; the actual existing use of groundwater in the area prior to and during mining; the potential future use of groundwater of baseline quality and of proposed restoration quality; the effort made by the permittee to restore the groundwater to baseline; the technology available to restore groundwater for particular parameters; the ability of existing technology to restore groundwater to baseline quality in the area under consideration; the cost of further restoration efforts; the consumption of groundwater resources during further restoration; and the harmful effects of levels of particular parameter. Analysis using these criteria (which are substantially similar to the criteria in Appendix A. Criteria 5 for an ACL) assures that the potential for adverse impacts on adjacent, non-exempt USDWs after restoration is completed is extremely remote.

Baseline Sampling

Table 2.3 presents the list of typical baseline water quality parameters representative of preoperational groundwater conditions for which groundwater restoration goals will be developed on a site-by-site and parameter-by-parameter basis.

[103] 30TAC331.107.f

Table 2.3
Typical Baseline Water Quality Parameters

Common Constituents	
Cations	**Anions**
Ammonia	Bicarbonate
Calcium	Carbonate
Magnesium	Chloride
Potassium	Fluoride
Sodium	Sulfate
	Nitrate
Trace and Minor Elements	
Arsenic	Manganese
Barium	Mercury
Boron	Molybdenum
Cadmium	Nickel
Chromium	Selenium
Copper	Silver
Iron	Uranium
Lead	Vanadium
Radium-226	Zinc
General Parameters	
Total dissolved solids	
Alkalinity	
Specific conductivity	
pH	

Source: HRI, 1997a

To establish baseline conditions, groundwater from zones that could be impacted is sampled and analyzed pursuant to specific procedures set forth in license conditions. Using essentially mathematic formula-driven procedures, the license applicant will include in its application preliminary site characterization water quality values for groundwater in the recovery zone and in adjacent aquifers. After a license is granted, an intensive baseline sampling program will include a selection of wells in the monitor well ring, production zone(s), and the overlying and underlying aquifers. The procedures for evaluating baseline conditions will be specified in the license application submitted to NRC. The criteria for baseline evaluation are detailed in NRC's NUREG-1569 in Sections 2.7, and 5.7.8.

Specific recommended commitments for groundwater baseline sampling and operational monitoring, which represent good, standard ISR industry practices and which have been approved by NRC in the HRI Final Environmental Impact Statement (FEIS) (NUREG 1508) are presented below. In addition to these commitments, license applicants will ensure that their baseline, operational and post-operational groundwater sampling and analysis programs conform with current NRC regulatory guidance for groundwater sampling and monitoring at ISR facilities. At present, this guidance is contained in NRC staff Technical Position Paper No. WM-8102, titled *Groundwater Monitoring at Uranium In Situ Solution Mines*. In its SRP for ISR

facilities, NRC lists additional references which applicants may use in developing baseline and operational sampling and analysis programs:

- American Society for Testing and Materials. 1992. *Standard Guide for Sampling Groundwater Monitor Wells.* Designation D4448–85a. West Conshohocken, Pennsylvania.
- American Society for Testing and Materials. 1994. *Standard Practice for Dealing with Outlying Observations.* Designation E178. West Conshohocken, Pennsylvania.
- American Society for Testing and Materials. 1998. *Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring*. Designation D6312–98.
- Nuclear Regulatory Commission (NRC) Regulatory (Reg.) Guide 4.14., *Radiological Effluent and Environmental Monitoring at Uranium Mills (Rev. 1)*
- NRC. 1985. Deutsch, W.J., et al. NUREG/CR–3709, "Method of Minimizing Ground-Water Contamination From In Situ Leach Uranium Mining." Washington, DC.
- NRC. 1986. Staub, W.P., et al. NUREG/CR–3967, *An Analysis of Excursions at Selected In Situ Uranium Mines in Wyoming and Texas*" Washington, DC.
- NRC. 1988. NUREG/CR–4604, *Statistical Methods for Nuclear Material Management*. Washington, DC.
- NRC. 1994. NUREG–1475*, Applying Statistics*. Washington, DC.
- NRC. 2001. NUREG/CR–6733, *A Baseline Risk-Informed, Performance-Based Approach for In Situ Leach Uranium Extraction Licensees*. Washington, DC: NRC. 2001.
- United States Environmental Protection Agency (EPA). 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA (Resource Conservation and Recovery Act) Facilities, Interim Final Guidance." EPA/530–SW–89–026. Washington, DC:.
- United States Geological Survey. and Hem, J.D. 1985. *Study and Interpretation of the Chemical Characteristics of Natural Water*. USGS Water Supply Paper 2254. Third edition. Reston, Virginia: United States Geological Survey.

As NRC reported in the HRI FEIS, detailed well field water quality and hydraulic data are collected before uranium recovery operations begin. The water quality data objectives are that the data be sufficient to (1) set the concentrations of parameters that will be used to determine whether the well field is being operated safely (UCLs); (2) identify, control, and clean up excursions; and (3) establish the water quality standards to which the aquifer will be restored after uranium recovery.

Restoration Techniques

Restoration efforts are intended to remove or render immobile constituents added to the native groundwater for uranium recovery and those mobilized during the recovery process to re-

enhance the natural reductive capacity of the depleted recovery zone. In some cases, it may be useful to chemically treat the geologic formation to reverse or inhibit reactions initiated during the recovery phase. The optimum restoration technique depends on site-specific hydrogeologic and water quality conditions but, in general, combinations of two basic approaches have been used in the industry.

The same injection/extraction well field patterns, manifolds, piping, and surface facilities used for uranium recovery are used in restoration to continue maximizing the benefits of the engineered well field designs. Uranium recovery and restoration will occur sequentially through the recovery area as one or more units are depleted of uranium.

The first technique which was used often in the past is groundwater sweep. During this process, native connate water from the surrounding formation is drawn into the mined area by continuous pumping from the extraction wells. In the past, multiple pore volumes were pumped during groundwater sweep. Industry experience suggests, however, that approximately 1 pore volume (PV) of groundwater sweep is beneficial; but additional PV of sweep may have limited benefits. Thus, this technique often is the preliminary means of removing lixiviant from the aquifer and continues until site-specific conditions indicate it is no longer beneficial (NRC, 2007a). The recovered groundwater is conveyed to an evaporation pond or deep disposal well. The second restoration technique is conducted using an ion filtration process such as RO to treat groundwater pumped from the recovery zone (Figures 2.15 and 2.16). RO separates solute molecules from the wastewater and concentrates them into a smaller concentrated brine volume. The resulting product water typically meets, or exceeds pre-operational water quality. During restoration activities, RO treated water is circulated through the production zone utilizing the injection-extraction well field configuration that was employed during production operations. As noted above, by using the existing production well field pattern configuration, the efficient reservoir engineering design benefits that were employed during uranium production are available for restoration. RO technology has been widely utilized within the ISR industry and the resulting restoration history has been highly successful. Either deep well disposal or other approved method must dispose the concentrated brine, representing 25 to 35 percent of the feed volume.

These techniques are typically applied in series to achieve restoration goals. For example, at the Cogema Irigaray Restoration Site, the following restoration plan was developed (Cogema, 2004):

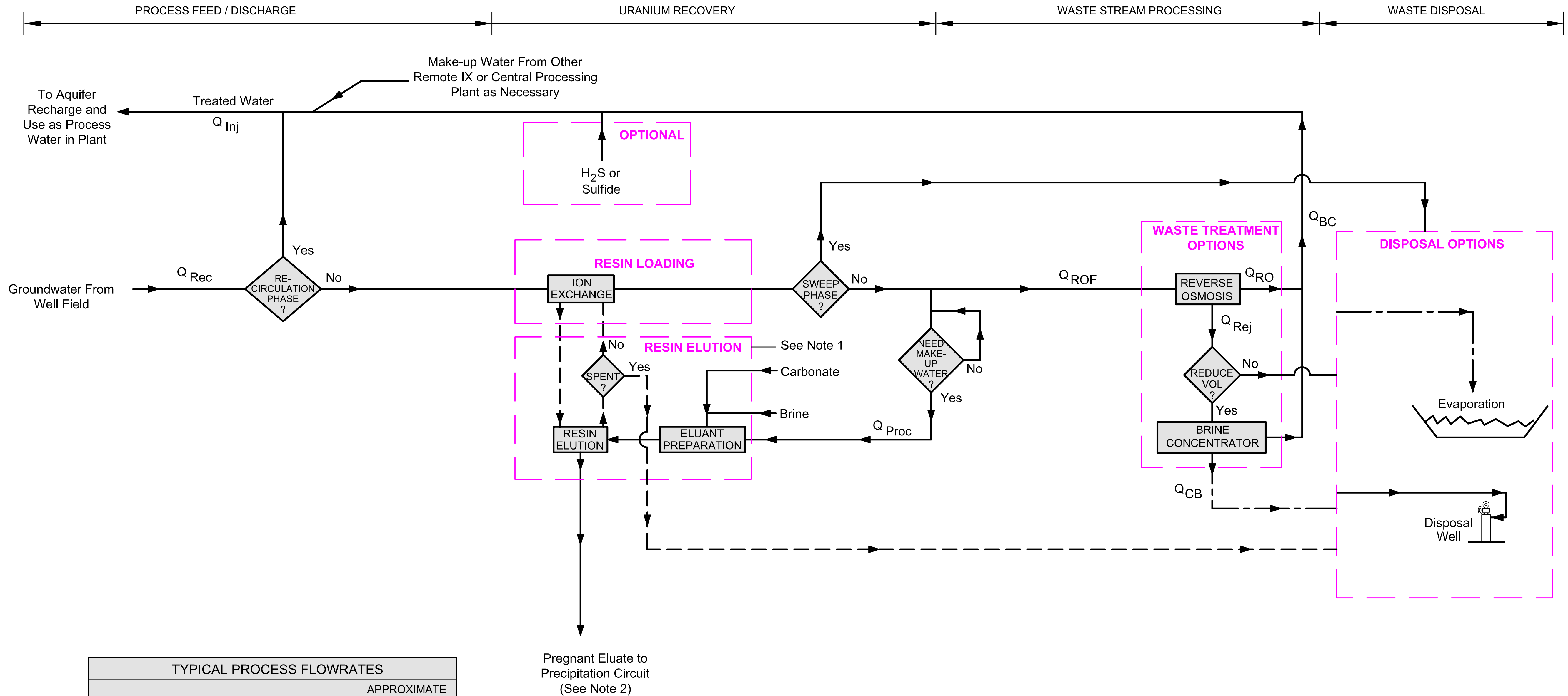
- Groundwater sweep – 3 PV
- RO permeate injections – 3 PV
- Aquifer recirculation – 1 PV

During aquifer recirculation, the last phase of active restoration at Irigaray, aquifer water was pumped and reinjected without treatment to provide a consistent water quality (Cogema, 2004). Use of this technique will depend on site-specific conditions.

Depending on site-specific conditions, chemical reductants can be used to attenuate trace metals. Dissolved metals solubilized by oxidizing conditions established during active recovery operations are precipitated by creating reducing conditions. Concentrations of oxygenated anions such as sulfate and nitrate also decrease. Reducing agents that have been used previously for post-recovery aquifer restoration include hydrogen sulfide gas, sodium bisulfate ($NaHS$) and sodium sulfide (Na_2S) (IAEA 2005). Safe handling procedures to reduce hazards associated with chemical reductants will be discussed in site-specific operation procedures and approved by NRC or other relevant agencies prior to use.

FIGURE 2.15

TYPICAL FLOWSHEET FOR GROUNDWATER RESTORATION PROCESS AT REMOTE IX FACILITY OR CENTRAL PROCESSING PLANT



TYPICAL PROCESS FLOWRATES		
PROCESS STREAM		APPROXIMATE FLOWRATE AS PERCENT OF PRODUCTION FLOW
Q_{Rec}	Recovery from production well field	100%
Q_{Proc}	Process make-up water	~0.125%
Q_{Rej}	RO reject steam	~25%
Q_{Rop}	RO-produced water	~75%
Q_{BC}	Brine concentrator - produced water	~23%
Q_{CB}	Concentrated brine	~2.5%
Q_{ROF}	RO feed	~99.9%
Q_{Inj}	Treated water	~99%

Note: Flowrates vary from one facility to another.

NOTES:

1. If a remote IX plant does not have an elution circuit, loaded resin is transferred to the central processing plant for elution.

2. Precipitation circuit is present only at the central processing plant.

LEGEND

- VAPOR
- SOLIDS STREAM
- LIQUID STREAM
- MIXED STREAM
- PROCESS OR OPERATION
- DECISION POINT

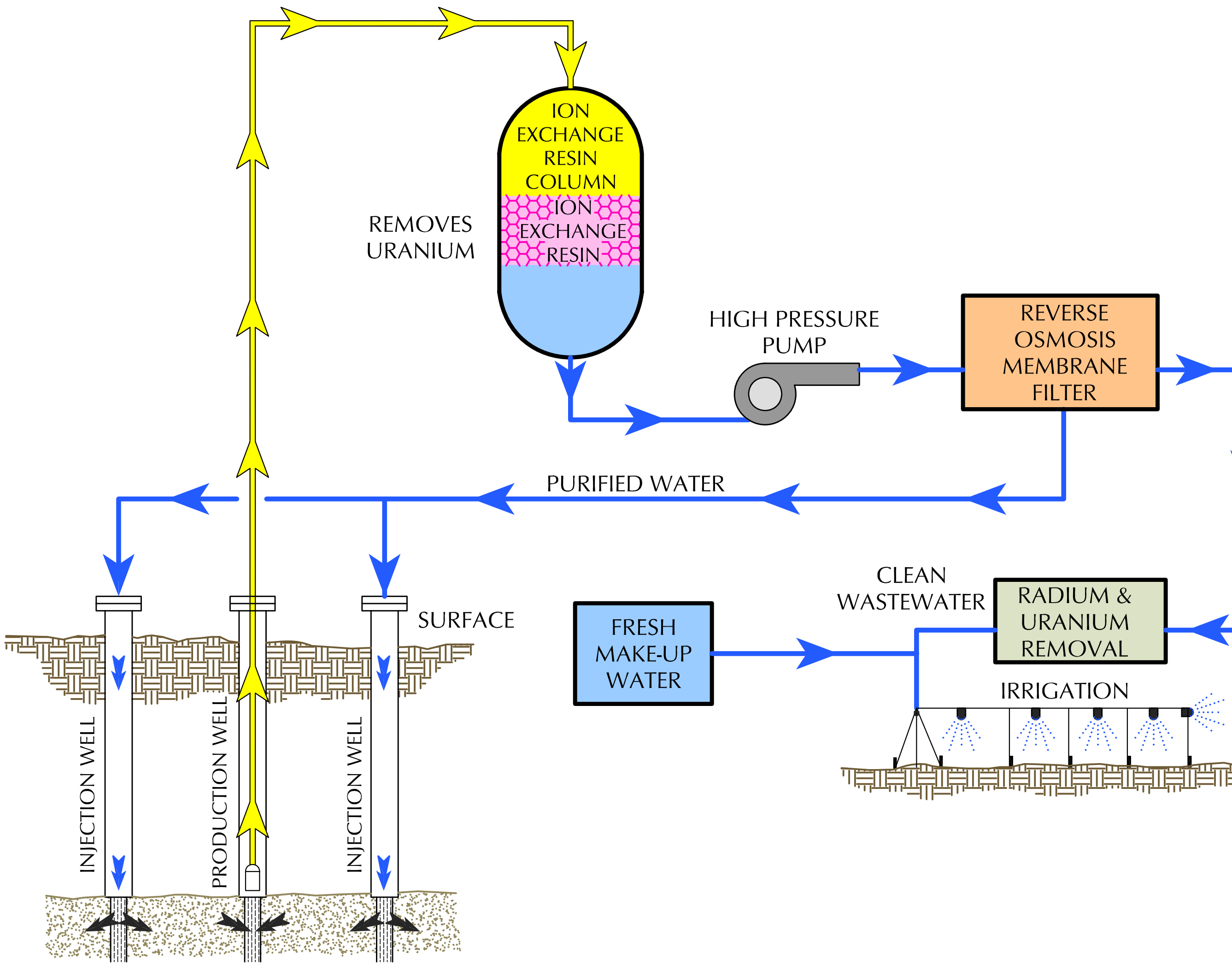


Figure 2.16 ISR Groundwater Restoration Flowsheet

Bioremediation is an additional method to achieve or enhance groundwater restoration is being considered by ISR operators. Bio-reductants are introduced to invigorate natural bacteria (already living in the sedimentary formations for thousands of years) to re-reduce metals to an insoluble state. The introduction of bio-reductants enables naturally-occurring bacteria to reduce the oxygen levels of the formation causing the precipitation of metals, including selenium, uranium, arsenic and vanadium, thus duplicating nature's process of mineral deposition. A variety of nutrients sources can be added to the clean water stream being injected into selected wells to achieve predetermined restoration targets. The nutrients used will be based on the chemical attributes of the site or region and submitted to NRC for approval on a case by case basis.

Bio-reduction has been used to treat a pit lake (Paulson 2004). In the case of the Sweetwater Pit, the lake had dissolved hexavalent selenium in concentrations of approximately 0.5 mg/L and dissolved uranium in concentrations of 8 to 10 mg/L. Following addition of 1 million pounds of nutrients into the pit lake which contained 1.2 billion gallons of water, selenium concentrations were reduced to 0.01 mg/L and uranium concentrations reduced to below 5 mg/L (a voluntary remediation goal). This technique that worked at the Sweetwater Pit Lake is now being considered for application to aquifers.

Power Resources, Inc. is currently evaluating the application of this technique to ISR aquifer restoration. Native bacteria with metal reduction properties in the system are nourished with externally provided nutrients (usually sugars, molasses, alcohols, fats and proteins). The bacterial will metabolize these nutrients and respire on dissolved metals in the system (uranium, selenium, iron etc.) converting them to a reduced form and precipitating them in place.

Historically, without bioremediation, multiple pore volumes have been displaced to achieve restoration of well fields. With the use of bio-reductants the number of pore volumes will be reduced, restoration will be achieved sooner. The reduction in pore volumes will minimize the consumption of groundwater pumped from well fields during restoration activities.

2.2.8 Emission Source Terms

Emission source terms are project parameters that can impact local and regional resources. The sources of potential impact can be radioactive or nonradioactive. In general, these potential impacts are caused during construction, operations or site D&D, including groundwater restoration. During construction of well fields, gaseous and particulate releases from drilling equipment can impact air quality. During operations, potential air quality impacts are primarily related to airborne effluents generated from processing and dust suspension due to transportation. During operations or restoration, leaks or spills from wells, pipelines or evaporation/retention ponds can have potential impacts on surface soils and surface or groundwater resources.

2.2.8.1 Airborne Emissions

Airborne emissions are discussed in contexts of normal operations and accidents.

2.2.8.2 Non-Radioactive Air Emissions

During well field construction, principal emissions to the air are suspended particulates and gaseous pollutants from vehicle, drill rig, and equipment exhausts; dust from vehicular traffic on

unpaved roads; and dust from disturbed and unprotected soil (HRI, 1997a). A summary of drill rigs and support vehicles that have been used at ISR sites is presented in Table 2.4, Estimated Vehicle Requirements for Well Field Construction, Operations, and Maintenance.

Non-stationary sources of air pollutants are diesel engines on the drill rigs and diesel-powered water trucks and other diesel-powered equipment. Drilling proceeds through the recovery zones, with each drilling location requiring one to two days of work. Most other equipment is used only sporadically, and its potential impact on air quality is therefore negligible. Other mobile vehicles and equipment used at ISR facilities are gasoline-powered, on-road cars and trucks, backhoes, forklifts, and other light construction equipment, which are equipped with required emission controls.

During well field construction, a typical site may average 100 vehicle-hours per day annually (HRI, 1997).

Table 2.4
Estimated Vehicle Requirements for Well Field Construction, Operations, and Maintenance

Equipment	**ISR Facility**				
	Church Rock	Moore Ranch	Alta Mesa	Crow Butte	Smith Ranch
Drilling rigs and support vehicles	7	14	20	6	48
Pick-up trucks	8	17	25	20	20
Forklift	1	2	2	1	4
Portable air compressor	3		4	1	1
Pump hoist trucks	2	4	3	3	3
Coil tubing trucks	2	3	2	0	3
Logging trucks	1	2	4	3	2
Back Hoe	3	2	3	2	2
Water trucks	2	3	3	5	3

Note: The estimated number of vehicle requirements is reflective of the varying size of operations.

2.2.8.3 Radioactive Air Emissions

HRI's Final Environmental Impact Statement (HRI, 1997a) identifies three major sources of radioactive air emissions from the ISR process. These sources are the releases that could occur in the form of air releases of particulate and gases during operation, disposal of waste material from the ISR process, and releases resulting from reclamation and restoration activities. These emission sources are discussed below.

For the Model ISR Site, airborne emissions are possible from the resin transfer/process circuit, the process circuit pressure vents, and the yellowcake drying process. Some facilities do or will utilize closed-loop pressurized down-flow IX columns. Uranium is recovered from uranium-rich lixiviant in the IX units, and loaded resin can be transferred out of the IX units, in a closed

system. Such transfers can be accomplished by switching valves as is generally the case with down-flow columns. Higgin's Loop™ do not involve resin transfer. Yellowcake drying can be done using multiple hearth dryers (roasters) or vacuum dryers, which reduce the resultant radioactive emissions. Using the multiple hearth dryers as a starting point for assessment, and assuming that the vacuum dryers will have a considerably lower rate of emissions, source term values can be presented for drying operations. The Texas Bureau of Radiation Control released a document entitled *Evaluation of Potential Environmental Impacts Related to a Yellowcake Drying and Packaging System at Everest Minerals Corporation's Hobson Facility, License No. 9-2663, Karnes County, Texas* in 1983. Some of the evaluation parameters and the resulting emission source terms appear in Table 2.5, below.

Table 2.5
Evaluation Parameters and the Resulting Emission Source Values

Parameter	Value
Ore Activity	617 picoCuries per gram (pCi/g)
Operating Days / Year	300 days/year (3-year plant life)
Dryer Stack Effluent (U_3O_8)	0.09 kg/day
Processing Rate (dryer)	41.7 pounds per hour (lb/hr)
Stack Height	8.43 meters (m)
Stack Gas Exit Velocity	12.67 meters per second (m/s)
Rate of U_3O_8 Recovery	99.976 percent
Process Recovery	99.976 percent
U-238	9.3 milliCuries per year (mCi/yr)
Th-230	0.465 mCi/yr
Ra-226	18 microCuries per year (μCi/yr)
Pb-210	18 μCi/yr

It is estimated that use of a rotary vacuum dryer, from which emissions are lower than open hearth/hot oil dryers, will allow for a doubling in yellowcake throughput per annum without any increase in emissions.

Analysis of data from other operating facilities suggests that the range of radon releases can be quite variable from facility to facility depending on factors such as the size of the operation, the concentration of radon in the groundwater and recovery solutions, the "tightness" of the system, and the type of columns used (downflow, upflow, or Higgin's Loop™). Brown (2007) suggests an annual average radon release of the order of 300 to 400 Ci/yr (10^{12} to 10^{13} Becqere/year [Bq/yr) at an average recovery flow rate of 3,000 L/min) noting that the release is likely site-specific depending on ore grade, formation characteristics and other factors. Brown also suggests that on the basis of Bq released per kg U_3O_8 produced, radon from ISR facilities is approximately 50 percent of that from the model mill case described in the 1980 GEIS [NRC, 1980]. Other facilities have reported annual releases of radon as high as 5,000 Ci/year.

NRC's SRP [NUREG 1569 at 7 to 9] suggests that on average, about 25 percent of the well field radon content is released in the ISR process plant operations. However, operating data indicates that the "tightness" of the process system and the types of columns used are important factors affecting radon releases, and releases from closed systems and pressurized IX columns are much lower than those from upflow or open systems.

2.2.9 Airborne Emission Controls

Airborne emissions of potentially significant concern at ISR operations can include particulate matter—dust from drilling and construction activities, diesel emissions from such equipment, exhaust gases from operation of standby electricity generators and from facility heating plants, and, most importantly, uranium (yellowcake) product and gaseous emissions, radon and radon daughters, and aerosols of contaminated liquids. Fugitive emission control strategies include containment and filtration and scrubbing of gaseous emissions.

2.2.9.1 Control of Fugitive Particulate Matter

Fugitive particulate matter from drilling and construction is controlled by good management practices (e.g., suppression by spraying) and scrubber/filters for equipment emissions. The sources of airborne particulate matter will have only minimal potential impacts in any event.

Yellowcake Drying and Packaging

Fugitive particulate matter can result from yellowcake drying and packing, and can appear in the form of aerosols resulting from mixing air and liquids.

Yellowcake is the generic term for uranium products, and color can vary from yellow to green to black depending on product chemistry and drying or calcining temperature. Yellowcake from ISR operations is typically yellow and is produced by precipitation of uranium from solution with peroxide to produce uranium oxide and or uranyl peroxide (U_3O_8 and UO_4).

The yellowcake dewatering and washing steps can vary, depending on the facility configuration. At some facilities, the yellowcake solid settles out in a conical tank called a thickener to become a thick slurry that is pumped to a liquid-solid pressure filter (filter press or belt filter). It can also be dewatered in a centrifuge. Plate and frame filters are used that permit the filter cake to be washed with clean water to remove soluble salts. However, the process can be configured where the yellowcake slurry from the precipitation process is directly pumped to a plate and frame filter press where the yellowcake is washed and de-watered simultaneously. The wet yellowcake is transferred to a conical holding tank prior to transfer to the yellowcake dryer.

The washed filter cake is transferred by conveyor or positive displacement pump to a vacuum dryer or multiple hearth roaster to remove the remaining water. The rotary vacuum dryer is operated on a batch basis and is maintained under a negative pressure by a liquid seal (water) vacuum pump. The multiple hearth roaster is operated continuously and uses an emissions control system (wet scrubbers).

There are no significant airborne particulate emissions from the precipitation and filtration process equipment, due to the wet condition of the yellowcake. The rotary vacuum is essentially emissions-free by design while the emissions control system removes most emissions from the multiple hearth roaster. Potential particulate emissions from the drying and packing processes can be controlled effectively. The off-gases generated during the drying cycle are cleaned of uranium product in the following 3-stage process for rotary vacuum dryers. The first stage is a dry filter that operates at a temperature above the dew point of the off-gases. A dry product is returned to the dryer. Filtration efficiencies of 99 percent can be expected. The filtered off-gases are passed through a wet condenser/scrubber that removes residual

particulate matter. The wet-ring vacuum pump itself provides additional gas scrubbing, and the discharge of the vacuum pump passes through a demister.

The gas cleaning and vacuum pump system is used to maintain a negative pressure during the unloading of the dryer and transfer to the 55-gallon (208-L) steel drums. The emissions control system reduces the particulate emissions from multiple hearth roasters. After appropriate cooling (to prevent yellowcake drum reactions), the drums are sealed and weighed in preparation for shipment.

Aerosols originate from vigorous mixing of air and liquids. Aerosols originating from ISR operations can contain uranium and radionuclide daughters of uranium and dissolved salts.

Minimization of aerosol dispersion will be achieved by containment of liquid transfer locations; elimination of splashing and vortexing in any chemical mixing areas and in the precipitation circuit; and the installation of mist eliminating mechanisms on wet gaseous exhausts.

2.2.9.2 Control of Radon Emissions

Radon is present in the recovery solution as it arrives at the uranium recovery plant. Radon can escape by diffusion and by degassing through from solutions through vents or leaks, or during transfer of resin from a satellite facility to a central processing plant.

Potential hazards from radon emanation are controlled in two ways: ventilation and containment. In locations where a processing plant may not need to be contained within a building, radon can rapidly dissipate into the outside air. Containment of radon may be practiced by operating the components of facilities that deal with pregnant and barren lixiviant and IX under pressure. Excess vapor pressure as result of CO_2 or O_2 is vented to the atmosphere through relief valves and monitored vents. In the case where an up-flow IX process is used, the entire system is open to the atmosphere and the radon is evacuated from the work area by either atmospheric or forced air draft.

Release of radon can occur when pressurized equipment is opened for inspection or maintenance. Dedicated ventilation equipment — e.g., pipes and hoods connected to the general building ventilation — is used to ensure that concentrations meet regulatory requirements (10 CFR Part 20).

<u>Liquid Emissions</u>

Liquid emissions, both radioactive and non-radioactive, can result from ISR operations from tanker trucks, process tanks, piping, and evaporation/retention pond leaks or spills.

Non-Radioactive Liquid Emissions

Non-radioactive liquid emissions source terms can be leaks or spills from tanker trucks or process tanks containing process chemicals. Good management practices, including worker training, inspection/monitoring, and facility configuration (e.g., bermed concrete pads with sumps) can minimize, if not eliminate, potentially significant potential impacts. Impacted soils can be treated or removed as necessary.

Radioactive Liquid Emissions

Radioactive emission source terms due to liquid releases can occur due to surface or near surface spills or leaks in the well fields and liner leaks from evaporation ponds. The potential impacts of leaks near the surface and at the surface are considered equal for the most part due to varying transport rates and modes of pipe failure. NUREG/CR-6733 identified four possible scenarios for the release of hazardous contaminants in fluid:

1. Surface ponding in place.
2. Runoff into surface water bodies.
3. Infiltration and adsorption in soil or on rock.
4. Infiltration and transport to groundwater.

The estimated dose rate for the first scenario is 3.05×10^{-3} millirem per hour (mrem/hr). This estimated dose rate includes the total of exposures from radon (Rn)-222, polonium (Po)-218, lead (Pb)-214, bismuth (Bi)-214), Po-214, Ra-226, and natural uranium. This is well below the 10 CFR Part 20 limit of 2 mrem/hr. However, release of pregnant lixiviant that infiltrates surface water bodies was identified as a potential hazard in the context of regulatory effluent limits.

The consequences of scenario 3 were determined to be a cause for concern, as the Total Estimated Dose Equivalent (TEDE) for someone living on top of the contaminated soil was calculated as 140 mrem at one year after closure, and 260 mrem at 25 years after closure. This dose could exceed regulatory limits over time due to the in growth of Pb-210, Bi-210, and Po-210, and the long-term contributions of Ra-226, Pb-210, and uranium (U)-234.

The resultant dose for scenario 4 was not available, but the probability of infiltration and transport to groundwater is minimized due to stringent requirements set out in 40 CFR Parts 144-146 for groundwater protection in ISR facilities. The conclusion drawn in NUREG 6733 was that the potential for dose to members of the public under normal and accident conditions indicates *minimal* expected risk; however, potential doses from *unmitigated* spills may not be negligible.

The potential adverse impacts of radioactive liquid emissions can be controlled by good management practices, as noted above, for non-radioactive liquid emissions. However, due to the potential radiation risk discussed above. All soils impacted by spills or leaks of radioactive fluids will be surveyed and removed to assure compliance with Appendix A Criterion 6(6). The contaminated soils will be transported to a licensed 11e.(2) disposal facility.

Site environmental and operational monitoring procedures define programs for monitoring and reporting:

- Contamination that could result from spills resulting from normal operations outside of concrete-bermed areas
- Valve or tank failures
- Pressure imbalances indicative of injection well upsets
- Leaks in impoundment liners

2.2.10 Waste Management

Management of wastes generated at ISR facilities is governed by an existing framework of federal and state regulations. Wastes from ISR recovery can be divided into two broad classifications, depending on whether they are process or restoration wastes subject to the AEA , or non-AEA wastes governed by other regulatory regimes. Pursuant to 10 CFR Part 40, Appendix A, Criterion 2 and NRC's *Interim Position on Disposal of In-Situ Wastes*, ISR operators are required to dispose of 11e.(2) byproduct material at a licensed 11e.(2) disposal facility or in a Class I UIC deep disposal well.

However, during the operational phase, ISR facilities also periodically generate small quantities of non-radioactive, solid and liquid wastes from offices, sanitary facilities, maintenance shops, storage areas, and other ancillary activities on the site. Wastes that are not associated with uranium recovery must be managed in compliance with existing regulations addressing hazardous, solid, and universal wastes, and recyclable materials. Table 2.6, below, identifies the typical AEA and non-AEA wastes generated throughout the life cycle of an ISR facility, the regulations applicable to their management, and the typical method of disposition for each.

Table 2.6
Waste Management Summary Table

Waste Type	Applicable Regulation(s)	Disposal Method(s)	Generated During Pre-Operation?	Generated During Operation?	Generated During Site D&D?
AEA Regulated Wastes (11e.[2])					
Solids					
Process solids, including pond sludge, RO solids.	10 CFR 40 Appendix A	Licensed 11e.(2) disposal facility (mill or other)	No	Yes	Yes
Soils contaminated by spills or leaks, spills of loaded or spent IX resin, filter sand or other process media	10 CFR 40 Appendix A	Licensed 11e.(2) disposal facility (mill or other)	No	Yes	Yes
Parts, equipment, debris, and personal protective equipment (PPE) that cannot be decontaminated for unrestricted release including, but not limited to, pipe, fittings, and hardware.	10 CFR 40 Appendix A	Licensed 11e.(2) disposal facility (mill or other)	No	Yes	Yes
Liquids (potentially containing dissolved or suspended solids)					
Wastewaters from decontamination showers, sinks, washing machines in the restricted area.	10 CFR 40 Appendix A	Evaporation system or Class I UIC deep well injection	No	Yes	Yes

Table 2.6
Waste Management Summary Table

Waste Type	Applicable Regulation(s)	Disposal Method(s)	Generated During Pre-Operation?	Generated During Operation?	Generated During Site D&D?
Production bleed	10 CFR 40 Appendix A	Evaporation system or Class I UIC deep well injection	No	Yes	No
Wastewater from production bleed treatment	10 CFR 40 Appendix A	Evaporation system or Class I UIC deep well injection	No	Yes	No
Treated water from RO and brine concentration	10 CFR 40 Appendix A	Evaporation system or Class I UIC deep well injection	No	Yes	Yes
Spent eluant	10 CFR 40 Appendix A	Evaporation system or Class I UIC deep well injection	No	Yes	Yes
Liquids from process drains	10 CFR 40 Appendix A	Licensed 11e.(2) disposal facility (mill or other)	No	Yes	Yes
Contaminated reagents, spilled process liquids	10 CFR 40 Appendix A	Evaporation system or Class I UIC deep well injection	No	Yes	Yes
Liquid wastes from groundwater restoration	10 CFR 40 Appendix A	Evaporation system or Class I UIC deep well injection	No	No	Yes
D&D solutions from surface facilities	10 CFR 40 Appendix A	Evaporation system or Class I UIC deep well injection	No	Yes	Yes
Non-AEA Wastes					
Solids					
TENORM (including, but not limited to drilling fluids, pre-existing mine wastes) not directly associated with uranium recovery	State-specific technically enhanced naturally occurring radioactive material (TENORM) regulations	On site management	Yes	No	No
Universal wastes including, but not limited to, fluorescent tubes and light ballasts, batteries not directly associated with uranium recovery	40 CFR 273 or state-specific regulations	Appropriately-permitted off-site disposal facility	No	Yes	Yes

Table 2.6
Waste Management Summary Table

Waste Type	Applicable Regulation(s)	Disposal Method(s)	Generated During Pre-Operation?	Generated During Operation?	Generated During Site D&D?
Miscellaneous trash including, but not limited to, office trash, boxes, packaging materials, and common solid waste not directly associated with uranium recovery	State-specific solid waste regulations	Off-site municipal or subtitle D landfills; on site in permitted facility	No	Yes	Yes
Asbestos-containing materials not directly associated with uranium recovery	40 CFR 61 or state-specific asbestos standards	Appropriately-permitted off-site disposal facility	No	Yes	Yes
Hardware, parts, and equipment not directly associated with uranium recovery or that can be decontaminated for free release	State-specific solid waste regulations	Disposal at off-site solid waste disposal facility or salvage/sale to others	Yes	Yes	Yes
Liquids					
Non-radiologic domestic sewage	State-specific solid waste regulations	Septic system, leach field, or publicly owned treatment works	Yes	Yes	Yes
Stormwater	40 CFR 122 or state-specific regulations	Evaporation system or permitted NPDES outfall	Yes	Yes	Yes
Used oil from vehicles, hydraulic equipment and other non-radioactive equipment sources	40 CFR 279 or state-specific regulations	Appropriately-permitted off-site used-oil recycler or disposal facility	Yes	Yes	Yes
Small quantities of paints, maintenance fluids, including, but not limited to cleaners, solvents, degreasers.	40 CFR 261 or state-specific waste regulations	Appropriately-permitted off-site disposal facility	Yes	Yes	Yes
Polychlorinated biphenyls in Transformer Fluids	40 CFR 761 et. Seq.	Appropriately-permitted off-site disposal facility	Yes	Yes	Yes

2.2.10.1 Waste Treatment and Disposal

Waste streams from uranium recovery such as production bleed, spent eluant, and supernatant from precipitation and liquid from the dewatering process can be processed further at some ISR facilities to reduce the volume of material to be disposed of. The treatment circuit for waste stream processing can be comprised of RO and/or brine concentration. The “clean” water produced by these processes is used beneficially for ISR or restoration operations. Some

facilities choose only to use RO and others dispose of their liquid wastes without any processing for volume reduction. It should be noted that all ISR facilities that propose to use clean water injection for aquifer restoration will need to have an RO treatment circuit.

Reverse Osmosis

RO systems work by forcing water through a semi-permeable membrane. The membrane acts as a molecular sieve and traps solute molecules. Water forced across the membrane is also termed permeate or “RO-produced water.” The remainder of the solution that does not pass through the membrane is termed the brine or “reject stream” and is either disposed of or further concentrated prior to disposal.

The RO feed stream may be pre-treated with a sodium bisulfate or other reducing agent, a pH adjusting agent (if required), an algicide/bactericide (if required), and an anti-scale agent. The solution can then be passed through sand filters to remove solids greater than 30 microns in size, then through bag or Cuno filters to remove residual solids greater than 3 microns in size. The filtered stream also can then be passed through a RO system at a high feed pressure. RO results in approximately 50 to 75 percent by volume, RO-produced water and a reject stream ranging from approximately 25 to 50 percent of the original feed volume. As noted above, the reject stream is then directly disposed of or further treated in a brine concentrator prior to disposal.

Most facilities will use RO units to reduce the volume of waste brines. The membranes in these units will have properties similar to spiral wound polyamide thin film composite membranes. The selected membranes do not plug easily. Salt precipitates and micron-size debris do not clog membrane pores. As such, these membranes are more conducive to backwashing and reuse than hollow filament membranes. These membranes will be able to withstand a wide pH range, thus avoiding the need for pH adjustment of the feed stream. However, one disadvantage of polyamide membranes is their low tolerance of strong oxidants such as dissolved oxygen or residual chlorine (used as a disinfectant). As a result, the RO feed stream will need to be pre-treated with a reducing agent such as sodium bisulfate, if polyamide membranes are used.

Brine Concentrators

Brine concentration is a process that separates a waste stream into deionized water and a solids slurry. Water in the waste stream is evaporated in a boiler and condensed. The condensate formed is essentially distilled water, and the residue in the boiler is hyper-concentrated brine. Common salts precipitate in the brine when their concentrations exceed their solubility in water. The resulting solids slurry is removed and disposed of. Typically, for each 100 gallons of waste brine treated, 99 gallons of distilled water and 1 gallon of solids slurry are formed.

Brine concentrators, if used, are of the type that exploits the ideal Carnot cycle: an initial fixed volume of concentrated brine is heated to boiling point. The steam generated is then mechanically compressed. Compression elevates the temperature of the steam by about 15 to 20 ^{o}C. This steam is then passed through heat exchangers to cool the steam and produce condensate. The heat lost during condensation is used to heat the brine in the boiler and maintain the temperature of brine at the boiling point. The cycle is mostly self-sustaining, with

an exception for the external energy used to heat the initial batch of brine and power the compressor.

Evaporation Ponds

Evaporation ponds are commonly used in the southern and western United States, to take advantage of high evaporation rates. In more northern climates, evaporation capacity may be limited due to climate conditions, so either enhanced evaporation or a combination of evaporation with Class I UIC deep well injection may have to be used. Certain arid regions have high evaporation rates (approximately 60 inches per year (for example the Pan-Central Red Desert in Wyoming). The physical process in ponds is similar to brine concentration, in that water evaporates from liquid wastes leaving behind a solid slurry; however, unlike brine concentrators, evaporation ponds do not capture evaporating water. The high concentration of nonvolatile solutes in liquid waste depresses vapor pressure and inhibits evaporation, thus, rates of evaporation are generally expected to be lower than those observed in fresh water ponds. Ponds are typically sized based on the rate of evaporation in the region, the rate at which waste water is produced during the restoration phase, the fraction of waste water that is processed via evaporation, and the required freeboard of the evaporation pond. As such, evaporation pond sizes vary from site to site. For example, in general, to dispose of the typical 150 to 250 gallons per minute (gpm) of liquid waste produced during a groundwater sweep phase of restoration, a facility would need a pond with an area of approximately 100 acres (HRI, 1997b).

NRC guidance provides recommendations for design, construction, operation, and monitoring of evaporation ponds at ISR facilities (NRC 2003a).

Most evaporation ponds have two liners that are constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure because of pressure gradients, physical contact with the waste or leachate, climatic conditions, and the stresses of installation and daily operation.

The subgrade is engineered to prevent failure of the liner because of settlement, compression, or uplift. Double liners with leak detection and collection systems between the liners and below the bottom liner, are installed to cover all surrounding earth likely to be in contact with the wastes or leachate. Liner materials for impoundments are selected based on their compatibility with the anticipated chemical environment and atmospheric conditions to which the liner may be exposed. Tests must show that the liner will not deteriorate when subjected to the waste products and expected atmospheric and temperature conditions at the site. Applicant test data and all available manufacturers test data will be submitted with the application.

Field seams of synthetic liners are tested along the entire length of the seam. Representative sampling will be used for factory seams. Testing is conducted using state-of-the-art methods recommended by the liner manufacturer. Compatibility tests are performed to test compatibility of the field seam material with the waste products and climatic conditions. Any liner repair is carried out under supervision of the manufacturer.

Proper preparation of the subgrade and slopes of an impoundment is very important to the integrity of the surface impoundment. The strength of the liner depends heavily on the stability of the slopes of the subgrade. The subgrade is treated with a soil sterilant. The subgrade surface for a synthetic liner is graded to a surface tolerance of less than 2.54 cm (1 in) across a

30.3 cm (1 foot [ft]) straightedge. NRC Reg. Guide 3.11, Section 2 (NRC, 1977) outlines acceptable methods for slope stability and settlement analyses, and is used in design.

If a surface impoundment with a synthetic liner is located in an area where the water table could rise above the bottom of the liner, under drains are provided. The impoundment is inspected in accordance with NRC Reg. Guide 3.11.1.

Quality control is established for the following factors: (i) clearing, grubbing, and stripping; (ii) excavation and backfill; (iii) rolling; (iv) compaction and moisture control; (v) finishing; (vi) subgrade sterilization; and (vii) liner sub-drainage and gas venting.

To prevent damage to liners, some form of protection is provided, including: (i) soil covers, (ii) venting systems, (iii) diversion ditches, (iv) side slope protection, or (v) game-proof fences. Maintenance for the liner features is developed, and repair techniques are planned in advance.

A leak detection system is installed at every site using synthetic liners. Ponds with two liners have leak detection systems between each liner, and water levels are monitored in the underdrain system to collect leakage from the primary liner. The system is designed to perform the following functions: (i) detect accidental leaks from the impoundment, (ii) identify the location of the leak so that liner repair can be implemented immediately, and (iii) isolate the leakage and control it (NRC 2003a). Additional protection is provided by the location of downgradient monitor wells in the first water–bearing formation.

2.2.10.2 Deep Disposal Wells

When subsurface geology at the site is conducive to injection of liquids, Class I UIC deep well injection is often the preferred method for disposal of ISR liquid waste due to its efficiency, less land use with no evaporation ponds, and no off-site transport. Class I disposal wells are drilled into zones below the lowermost formation containing an EPA-exempted USDW within 0.25 mile (mi) of the well bore. UIC regulations prohibit direct injection or migration of foreign fluids into aquifers that contain less than 10,000 mg/L total dissolved solids (TDS), unless an aquifer exemption for the disposal zone is approved.

Injection well operation is regulated by UIC permit, and the maximum pressure at which wastes can be injected is calculated based on injection zone properties. Federal and state Class I UIC regulations prohibit wells from injecting waste above the calculated fracture pressure of the injection interval. This requirement ensures that subsurface fracturing of the injection zone does not occur, which, in turn, ensures that waste does not migrate *vertically* from the intended injection zone. Additionally, continuous monitoring of injection and annulus pressure is performed, as well as mechanical integrity testing (MIT) of the well to ensure continued proper well operation. Automated alarms are required and a system shutdown is implemented if the monitored parameters are not in compliance with permit-specified ranges. Mechanical integrity testing is performed periodically, as defined in the appropriate permit.

Typically, Class I UIC deep-injection disposal wells are 3,000 to 10,000 ft deep, and inject into EPA-exempted porous, permeable aquifer horizons amenable to fluid injection. Operational injection rates typically range from 25 to 500 gpm. Rates vary based on disposal zone characteristics and the operator's disposal needs. Injected waste originating from ISR operations can have different chemical compositions based upon the mineralogy of the deposit and geologic materials, lixiviant chemistry, and process plant design and operations. Typically, injectant is saline brine with TDS ranging from about 10,000 to 50,000 mg/L. Sodium chloride

(NaCl) content can vary from about 65 to over 75 percent of the total TDS, with calcium, magnesium, bicarbonate, sulfate, and potassium also contributing to TDS. Minor quantities (less than 0.5 mg/L) of inorganics such as arsenic, barium, cadmium, chromium, lead, mercury, and selenium may be present. Uranium concentration within injectate can vary depending on process design, but may range from about 5 to 25 parts per million (ppm), sometimes averaging about 13 to 14 ppm. Radium also will be present in concentrations typically ranging from about 400 to 1400 pCi/L.

The target formation must have an overlying confining layer precluding hydraulic communication with overlying water-bearing zones. TDS in these formations typically exceed 10,000 mg/L. Calcium and iron scaling inhibitors, biocides (anti-algae and bacteria chemicals) and pH adjustment chemicals are often added to the liquid waste prior to injection. The process is continuously monitored for pressure, flow rate, and temperatures (HRI, 1997b). Failsafe switches trigger system shutdown when sensors detect a potential for system upset. The conditions triggering automatic shutdown vary from facility to facility, but can be based on lower or upper limits for parameters such as flow rate, pressure, or fluid level.

Regulatory provisions for deep-well injection are further discussed in Section 1.0 and Preamble, Sections B and I, above.

Site Decommissioning and Decontamination

Facility decommissioning will be performed in accordance with Regulatory Guide 3.65, as appropriate. Financial assurance for decommissioning will be provided per Regulatory Guide 3.66 and NUREG-1569. Typically, pursuant to 10 CFR Part 40, Appendix A, Criterion 9, ISR operators are required to submit detailed financial assurance cost estimates for site D&D in Commission-mandated restoration action plans (RAPs).

Materials remaining on site at the end of facility operations primarily will include buildings and process equipment. These materials can be disposed, or if properly decontaminated, recycled for off-site use or reused on-site. All materials are screened for radioactivity including surface contamination and gamma radiation. As recommended in the SRP (NRC 2003a), appropriate survey methods to determine the extent of contamination of equipment and structures will be devised before starting D&D. NRC Reg. Guide 8.30 provides guidance for conducting contamination surveys, instrument calibration and discussion of NRC decontamination criteria. Particular attention will be focused on those parts of the processing system that are likely to have accumulated contamination over long time periods such as pipes, ventilation equipment, effluent control systems, and facilities and equipment used in or near the yellowcake dryer area. The removal and disposal of byproduct material to an existing uranium mill or licensed disposal site will meet requirements of 10 CFR Part 40, Appendix A, Criterion 2. (NRC 2003a).

Contaminated materials not meeting release requirements are managed in the following ways:

- Equipment can be sold or transferred to another source material licensee after decontamination to satisfy relevant release criteria. Such equipment will be transported in accordance with applicable DOT regulations.

- Equipment can be decontaminated in accordance with NRC guidelines and sold for reuse, salvage, or scrap.

- Materials (such as building foundations) having no salvage value can be decontaminated in accordance with NRC guidelines and disposed of, or buried on site.

- Materials with no salvage value that cannot be decontaminated are disposed of as 11e.(2) byproduct material at a facility licensed to accept such waste. Applicants for a uranium recovery license and current licensees must maintain a current disposal agreement with an approved 11e.(2) disposal facility.

Upon decommissioning, wells are plugged and abandoned, process facilities removed, and any affected surface area(s) are reclaimed and revegetated in accordance with the reclamation plan and bond for the site. Decommissioning and plugging and abandonment of wells will comply with state regulations applicable to the site. In general, the land then readily reverts to its previous uses.

As noted previously, wastes generated after ISR operations cease include wastes generated during site D&D, and restoration of depleted well fields. Site D&D wastes, including restoration wastes, will be transported to a licensed 11e.(2) disposal facility for final disposal or disposed using a Class I UIC deep-injection well(s).

2.3 No-Action Alternative

No action means that “the proposed activity will not take place, and the resulting environmental impacts from taking no action will be compared with the impacts of permitting the proposed activity or an alternative activity to go forward” (Fed. Reg. 46 § 18026). Thus, the no-action alternative for NRC is to not issue the applicant a license to construct and operate an ISR facility for uranium recovery.

Under the no-action alternative, baseline conditions will be influenced by natural processes and by any other industrial, commercial, or residential development in the area. Groundwater in the ore-bearing aquifer will remain unsuitable for drinking because of high naturally occurring radionuclide levels and other heavy metal concentrations, as described in Section 1.2 and elsewhere in this GER.

2.4 Other Reasonable Alternatives Considered but not Carried Forward for Detailed Analysis

This section describes two reasonable alternatives to the proposed action that were considered but not carried forward for detailed analysis at this time: (1) conventional uranium mining/milling, including heap leaching, and (2) byproduct/side-stream recovery from other mineral recovery operations.

2.4.1 Conventional Uranium Mining/Milling (Including Heap Leaching)

Conventional methods of uranium mining/milling (including heap leaching) are alternatives or adjuncts to the ISR method of uranium recovery. These alternatives are considered but not carried forward for detailed analysis in this report because they have been assessed in the 1980 GEIS for conventional uranium mining/milling. Conventional uranium mining, milling, and heap leaching are summarized below; the Final GEIS on Uranium Milling (NUREG-0706) should be consulted for additional detail (NRC, 1980b).

2.4.1.1 Conventional Uranium Mining

Conventional mining generally refers to open-pit (surface) and underground mining. Open-pit mining is used for ore deposits that are located at or near the surface, while underground mining is used to extract ore from deeper deposits or where the size, shape, and orientation of the ore body may permit cost-effective underground mining.

Open-pit mining involves the surface removal of soil and rock overburden and extraction of ore. Typically, open-pit mines are broad, open excavations that narrow toward the bottom, and are generally used for shallow ore deposits. The maximum depth of open-pit mining in the United States is usually about 550 ft. Lower-grade ore can be recovered in open-pit mining, since costs are generally lower compared with underground mining costs. In more recent open-pit operations, topsoil is removed and stockpiled for later site reclamation. Overburden is removed using scrapers, mechanical shovels, trucks, and loaders. In some cases, the overburden may be ripped or blasted free for removal. Overburden forms the largest volume of waste and is generally lowest in naturally radioactive elements (i.e., it is not as enriched in uranium as primary ore or as protore (which is ore with mineral content higher than overburden but less than the primary ore). Protore is often stockpiled at the mine site, and is higher in radionuclide or heavy metal content than topsoil or overburden.

Deeper uranium ore deposits require underground mining by one of several excavation techniques, including longwall retreat, room and pillar, and panels. Larger, deeper deposits may require one or more vertical concrete-lined shafts or declines large enough for motorized vehicles to reach the ore. Stopes (an underground excavation from which ore has been removed in a series of steps) reaching out from the main shaft provide access to the ore. Ore and waste rock generated during mining are usually removed through shafts via hoists, or carried to the surface up declines in trucks. Because of the high costs of removing such materials, some waste rock may be used underground as backfill material in mined-out areas.

Conventional uranium mining is not regulated by NRC, but it is regulated by state mining agencies and other federal agencies such as the Mine Safety and Health Administration. Mining operations are subject to numerous environmental and safety requirements, including extensive site reclamation requirements.

2.4.1.2 Conventional Uranium Milling

Under the conventional mining/milling scenario, uranium ore extracted from a mine is transported from the mine to the mill by truck or conveyor from a pit, shaft or decline. Depending on the chemical characteristics of the ore, conventional uranium mills use either the acid-leach process coupled with solvent extraction (SX), IX, the alkaline-leach process, or all of the above. Since the acid leach process is most commonly used, it is the process considered in this alternative.

The initial step in conventional milling involves crushing, grinding, and classification of the crude ore to produce sand-sized particles. Wet and/or dry classification was used in older mills, but the only currently operating mill uses wet classification. Ore is fed from crushers to the grinding circuit or is fed directly into the grinding circuit following sizing via a grizzly where it is mechanically milled (via semi-autogenous grinding or other techniques) to reduce the size of the ore. Water is added to the system in the grinding circuit to aid the movement of solids and for dust control. Screening devices and/or cyclones are used to size the finely ground ore,

returning coarse materials for additional grinding. The slurry generated in the grinding circuit contains 50 to 65 percent solids. Fugitive dust generated during crushing and grinding is usually controlled by water sprays or, if collected by air pollution control devices, recirculated into the leaching circuit. After grinding, the slurry is pumped to a series of tanks for leaching. The pregnant lixiviant (the recovery solution) is separated from the residual solids (tails); typically the solids are washed with fresh lixiviant until the desired level of recovery is attained. The uranyl ions are recovered (stripped) from the pregnant lixiviant using an organic solvent in the SX circuit at the facility. The final steps consist of precipitation to produce yellowcake, followed by drying and packaging. The stripped lixiviant is replenished and recycled for use within the leaching circuit. Ultimately, the solids may be washed with water prior to being pumped to a tailings pond; this wash serves to recover any remaining lixiviant and reduce the quantity of chemicals being placed in the tailings impoundment.

2.4.1.3 Heap Leaching

The milling process described above is not generally used for low grade ores, although the Sweetwater Mill in Wyoming was specifically built to accommodate lower-grade ores, and successfully processed grades as low as 0.02 to 0.03 percent uranium. As an alternative, low-grade ore that is removed from open-pit or underground mining operations can undergo further processing to remove and concentrate the uranium by heap leaching. Heap leaching occurs at or very near the mine site. The low-grade ore is crushed to a fine size and mounded above grade on a prepared pad. The heap leaching pads must be constructed to the same standards as tailings impoundments per 10 CFR Part 40 Appendix A, including the requirement for a double liner. A sprinkler or drip system, positioned over the top, continually distributes leach solution over the mound. For ores with low lime content (less than 12 percent), an acid solution is used, while alkaline solutions are used when the lime content is above 12 percent. The leach solution trickles through the ore and mobilizes uranium, as well as other metals, into solution. The solution is collected at the base of the mound by a manifold and processed to extract the uranium. The uranium recovery from heap leaching is expected to range from 50 to 80 percent, resulting in a final tailings material of around 0.01 percent U_3O_8 content. Once heap leaching is complete, the depleted materials are 11e.(2) byproduct material that must be placed in a tailings impoundment unless NRC grants an exemption for disposal in place. Heap leaching was used mostly on an experimental basis in the 1970s and 1980s, but generally is not in use in the United States today, although it may be in the future. As a uranium extraction process, heap leaching is regulated as *milling* by NRC or its Agreement States and the depleted material is considered 11e.(2) byproduct material.

<u>Conventional Mining and Milling Wastes</u>

A number of radioactive and nonradioactive wastes are generated by processing uranium ore at a typical mill. However, tailings represent the overwhelming majority of both radioactive and nonradioactive wastes generated. With the exception of recovered uranium and some process losses, tailings account for practically all of the ore solids and the process additives, including water. All uranium milling wastes (including tailings) are regulated by NRC or Agreement States as 11e.(2) byproduct material.

Conventional mills can generate 2,000 to 4,000 tons per day of waste disposed of in the form of a slurry composed of tailings, dissolved minerals, spent process reagents, and process water-bearing carbonate complexes (alkaline leaching) and sulfuric acid (acid leaching), sodium, manganese, and iron. The characteristics of this waste vary greatly, depending on the ore, the

extraction procedure, and the source of the water (fresh or recycled). On average, 30 percent of the tailings liquid component is usually decanted and re-circulated to the crushing and grinding or leaching circuit. Tailings typically consist of two fractions, sands (>200 mesh, +75 microns) and slimes (<200 mesh, -75 microns).

The sand and slimes can be combined and deposited directly in the impoundment or can be distributed through a cyclone such that the sand fraction is directed toward the perimeter, while the slimes are directed to the interior of the pond. Radium-226 and thorium-230 are the principal constituents of concern and are associated primarily with the slime fraction of the tailings. Slimes typically constitute 35 percent of the tailings by weight and contain 85 percent of the radioactivity. Radon-222 (gas) is also a tailings constituent. The concentrations of radionuclides in the tails will vary depending on the leach method used (thorium is more soluble in acid than alkaline leaches). Typically, tailings will contain up to 95 percent of the original radioactivity of the ores depending on the proportion of radon lost during the operation. Other tailings constituents (including metals, sulfates, carbonates, nitrates, and organic solvents) will also be present in the tailings impoundment depending on the type of ore, beneficiation methods, and waste management technique

The following describes historic uranium tailings depositional practices, contrasting these with more recent uranium mill tailings cell construction practices.

Historically, the tailings pond initially was typically a square or rectangular basin formed by building low earthen embankments. More recently, in the case of one currently active mill, the evaporation pond and tailings cells were situated below-grade, on fairly flat terrain, with berms located downgradient.

In general, tailings slurry is discharged from the mill into the tailings impoundment via a peripheral discharge system. Because the location of the slurry discharge pipe was moved on occasion to keep the tailings area fairly level, it has been fairly common for areas of the tailings to dry out intermittently.

Historically, as the basin was filled, the coarse fraction of the tailings (sands) was used to raise and broaden the embankments. The embankments were compacted on the outer side to provide strength. However, current regulations (10 CFR Part 40 Appendix A) require embankments constructed using soils and clays rather than tailings sands. Clay and synthetic liners must be installed along with a tailings underdrain system to collect fluid from the tailings to promote dewatering. The design must include consideration and evaluation of tailings neutralization.

The total tailings disposal area at a uranium mill that is being constructed to meet the first of the two “work practice” standards in EPA’s 40 CFR Part 61, Subpart W regulations, is 40 acres with no more than two such 40 acre impoundments in use at any one time. In the past, some tailings impoundments have been as large as around 100 hectares (ha) (250 acres). At these historic sites, some 80 ha (200 acres) might contain tailings; 20 ha (50 acres) were covered by water and 10 ha (25 acres) were maintained "wet" during operation; hence, as much as 50 ha (125 acres) might be dry during operations. This tended to contribute to both higher radon emissions, as well as allowing significant wind-blown tailings—both of which are far less an issue with use of modern techniques (e.g., liners, below-grade impoundments, etc.). In historic operations, it was only after milling operations ceased that the tailings were allowed to dry sufficiently to accommodate heavy equipment. The depth of many of these tailings piles was calculated to be about 8 m (26 ft), so the tailings would take years to dry out, which as noted

above, allowed wind-blown tailings that became a significant source of radioactive particulate emissions without interim cover.

The second work practice standard in subpart W involves dewatering tailings before disposition and progressive tailings reclamation so that no more than 25 percent (10 acres) of tailings deported remain uncovered at any time to minimize radon emissions and wind blown tailings. 40 CFR § 61.252(b)(2). This standard does not limit the size of the impoundment. If the operator chooses to use the 40 acre cell or the continuous deposition of dewatered tailings approach, there is no requirement for the operator to actually measure radon emissions to assure that the 20 picoCuries per square meter per second (pCi/m^2/s) radon emission standard is not being exceeded. Additionally, in both cases, settlement will occur far more rapidly than has been observed in historic facilities, thereby accelerating the reclamation and closure timetable for these cells.

In summary, while more recent requirements with regard to radon emissions; tailing compaction; incremental reclamation of tailings cells; control of windblown material; and slimes management have resulted in significant improvements in tailings cell management and reduced potential impacts associated with future tailings cells, it is still true, however, that significant land area is required for deposition of tailings to be transferred to the United States Department of Energy (DOE) for management of the 11e.(2) byproducts in perpetuity.

Potential Impacts of Conventional Uranium Mining/Milling

Alternative ore extraction processes including traditional open-pit or underground mining and conventional milling were considered but eliminated from further analysis in this GER. This alternative is eliminated from further analysis, because it does not meet the purpose and need of the proposed action. Also, the decision to eliminate this alternative from further analysis was based on numerous, documented environmental impacts from conventional mining/milling associated with either the physical extraction of ore or mill tailings impoundments that are not associated with the ISR method of uranium recovery. While current regulatory requirements and recovery technology have further mitigated the already manageable potential adverse impacts from conventional mining/milling, compared to ISR operations, these have numerous environmental, safety, and economic disadvantages, which include the following:

- **Potential Radiological Impacts.** The potential worker exposures in underground uranium mines were a significant potential health hazard prior to 1970. Currently, regulatory controls have reduced that risk to acceptable levels (Sec. 4.4). In addition, public health is protected by 40 CFR § 61.22 which requires that dose to any member of the public from radon from underground uranium mines be no more than 10 mrem/yr. NRC assumes that the most significant potential impact from mill operations will be from persistent radon releases from tailings impoundments. By comparison, radiological risks from ISR are small to negligible because soils and ore-bearing formations are not physically disturbed, and there are no surface tailings impoundments. Moreover, the relatively larger workforce required for conventional mining/milling introduces more on-site receptors to radiological exposures. While such exposures are maintained as low as reasonably achievable (ALARA), the 1980 GEIS estimated an occupational risk to millworkers to be at the high end of the range of exposures due to natural background (i.e. 380 mrem/yr vs. 300 mrem/yr). Improved radiological monitoring and protection likely has reduced that risk since it was estimated in the early 1980s; nevertheless, it is a disadvantage of conventional uranium mining/milling compared with ISR operations.

- **Air Quality.** The potential impact of mining/milling activities on air quality results from dust generated from tailing cells, mining activities, and traffic on dry, unpaved roads. Apart from the potential radiological risks associated with airborne tailings or yellowcake dust, particulate matter releases (less that 10 micrometers in aerodynamic diameter [PM_{10}]) present limited potential public health risks and potential risks of environmental degradation that are, to a large extent, not as significant at an ISR facility.
- **Land Use.** Potential land use impacts from conventional mining/milling operations, and tailings disposal can be significant. Absent subsidence associated with underground mines, potential land use impacts from both underground and surface mining generally are temporary, pending completion of final reclamation requirements. The most significant long-term impact is the permanent commitment of land to mill tailings disposal and perpetual stewardship of the reclaimed disposal facilities (to date, as much as 250 acres). Deposition of windblown tailings also may restrict use of land near tailings impoundments during operations, but must be recovered to satisfy this 5/15 radiation in soil standard. Compliance with that standard for radium (or the radium benchmark for other radionuclides) releases the land for unrestricted use. As noted above, potential land use impacts at ISR sites are temporary and minimal at best.
- **Groundwater.** Both surface and underground mines can have profound potential impacts on local groundwater conditions, particularly with respect to water consumption. Tailings, which can be located above "pristine" USDWs, frequently contain a wide range of trace metal, radioactive, and chemical contaminants in concentrations significantly above existing state and federal water quality limits. Seepage of such solutions can adversely affect groundwater aquifers and drinking water supplies, although EPA and NRC regulatory requirements have mitigated the potential impacts of such seepage and modern tailings impoundments are designed so that seepage into groundwater largely is eliminated. ISR operations take place in exempted aquifer(s), which can never be USDWs, and restoration requirements minimize, if not eliminate, the potential for adverse impacts on adjacent, non-exempt USDWs.
- **Safety.** Conventional mining inherently creates a physically hazardous work environment. The use of heavy construction equipment, haulage trucks, other large motorized devices, and explosives increases the risks for on-site personnel. Underground mining adds an entire other potential set of safety concerns that are not relevant to either surface mining or ISR processes.
- **Economic.** Longer lead times for mine development, higher capital and operating costs, larger work force, and costly, time and material-intensive reclamation requirements for conventional mining/milling facilities are significant economic disadvantages.

2.5 Preliminary Recommendations

Per 10 CFR § 51.71(e), this section presents a preliminary recommendation by NMA on the proposed action, based on the information and analyses contained herein and reached after consideration of the potential impacts of the proposed action. NMA recommends adoption of the proposed action, which is the review and issuance of source material licenses by NRC for the construction and operation of facilities for ISR and processing. As the data and analyses presented in this document demonstrate, no significant potential adverse impacts will result from the proposed action and any impacts that do occur will be minimized or eliminated by mitigation measures in a manner that assures adequate protection of public health, safety, and the environment.

NMA further recommends that NRC use its scoping comments and this GER to assist in the development of an ISR GEIS that will serve as a programmatic document off of which site-specific studies, investigations, and compliance documentation can be tiered. Specifically, documentation to ensure compliance with NEPA will be tiered to the ISR GEIS in accordance with applicable regulations. "Tiering" (defined in 40 CFR § 1508.28 and presented in 40 CFR § 1502.20) is a procedure by which more specific or more narrowly focused environmental documents can be prepared without duplicating relevant parts of previously prepared, more general, or broader documents. In this case, NEPA documents (either EAs or EISs) for site-specific ISR operations can be tiered off the ISR GEIS, once complete. The site-specific environmental documents incorporate by reference the analyses and conclusions in the ISR GEIS and concentrate on the issues and potential impacts of the project that are not specifically covered in the GEIS, or which fall outside of the scope and conclusions of the GEIS. Also, the decision made as a result of the more specific documents cannot change or modify the decision(s) of the GEIS. The new environmental document must identify the GEIS as the document from which it is tiered and both documents must be available for public review (NRC 2003b).

3.0 DESCRIPTION OF MODEL REGION FOR ISR

The model region is composed of average site conditions in regions where ISR is likely to be technically and economically achievable, generally throughout the western United States, in states such as Texas, Wyoming, Nebraska, New Mexico, Colorado, South Dakota, Arizona, and Oklahoma. Areas within these states that typically are suitable for ISR have similar land, surface water, and groundwater characteristics. For example, due to naturally-occurring mineralization (including uranium and radium), groundwater quality in the proposed uranium recovery zones do not meet federal or state drinking water standards; see Section 3.4 for a description of water resources and hydrology.

Most of the land within the model region consists of rangeland (typically 50 to 60 percent), with the majority of rangeland in the public domain with some Native American reservations and some scattered private ranch holdings. Typically, prime farmland is not located in areas suitable for ISR, although generally, 10 percent of adjacent land is mixed use, which can include some agricultural use. Other land uses in the model region include forest and open woodland (20 to 30 percent), and these areas typically have openings that also are used for grazing. No industrial forest operations are within or adjacent to the model region because tree species in the eco-regions where ISR can be utilized typically are not economically desirable. However, forest thinning and other land management operations are possible. Extractive land uses, primarily coal mining, oil and gas development, sand and gravel operations, and uranium recovery, typically account for less than 1 percent of the total land area, in part, because many of the mining operations are underground activities and have limited effects on surface land areas. Urban land uses also typically account for less than 1 percent of the total land area, with most of the surrounding population concentrated in small urban areas (HRI, 1997b).

Thus, lands adjacent to the Model ISR Site typically include primarily rangeland and, to a lesser extent, agricultural, industrial, forested, and residential land. Due to the conditions of the model region, land use is not expected to change significantly in the near future.

Site-specific information will include actual percentages of each land use category within and adjacent to the site within 2 miles of the site boundary, as well as the distance to the nearest town(s) and any other nuclear fuel cycle facilities (NRC 2003a). Previous and present industrial activities, with their potential negative impacts on the environment (such as air and water contamination, noise, and visual impact) will be documented, with emphasis placed on information regarding potential contaminants from these industries that also could be expected from ISR site effluents. An inventory of existing and abandoned wells and boreholes will be made, including those used for agricultural purposes, and plugging of each abandoned well or borehole will be verified. Documentation of previous and present agricultural activities in the vicinity of the proposed project helps to identify domestic animals and other meat animals, and crops that may be part of the food chain delivering potential radiation exposure to man (IAEA 2005).

Regional and local maps will be included that indicate the project location, as well as any nearby towns, schools, hospitals, farming areas, and other land uses important to assessment of potential impacts (NRC 2003b). In some cases, BLM may be the federal landlord for surface access at sites proposed for ISR. In those instances, environmental clearances for surface disturbances and approval for temporary occupancy must be obtained from BLM. State and local agencies also may have regulations to be considered. For example, the state of

Wyoming's State Land Use Planning Act establishes a State Land Use Commission that is responsible for leases, easements, and temporary uses of state lands. In addition, the state regulates drilling and well spacing and requires an approved application for permit to drill for wells drilled in the State of Wyoming regardless of land ownership (BLM 2002).

3.1 Land Use

During ISR project construction and operation, land will be required primarily for (1) well fields, (2) processing facilities, and (3) waste storage and management. Each of these requirements is described below.

3.1.1 Use of Land for Well Fields

Depending on the selected method of wastewater management (see Section 3.1.3), the majority of land requirements for ISR facilities typically are for well fields. Since well fields are specifically tailored to the configuration of the identified and defined ore body, there is no discretion available to the ISR operator in sighting and installing well fields (i.e., the well field provides the means by which the fortified native groundwater is circulated through the ore body to recover uranium). Therefore, well field design, and associated land disturbance, is crucial in maximizing the effective use and confinement of recovery solutions.

Well spacing and orientation is influenced by the hydrologic characteristics of the formation, which limit the rate and efficiency of circulation. Well completion techniques contribute to vertical confinement and vertical sweep efficiency of the recovery solution through the mineralized zone. The ultimate number of injection and extraction wells comprising a well field, and therefore the amount of land required, is established by the dimensions of the ore-body.

Generally, land for well fields is required for the following uses:

- Surface drilling to fully define the aquifer system and ore zone.
- Well fields are laid out to maximize the fit to the ore body and the natural hydrogeological conditions.
- Location of injection and extraction wells are planned to maximize uranium recovery. The layout typically consists of a grid with alternating extraction and injection wells. Wells in a well field are typically spaced approximately 20 to 30 meters apart; but this may vary on a site-specific and well field-specific basis.
- Wells are connected by pipelines to trunk lines, manifold and monitoring equipment, and then to an IX facility.
- Monitor wells are completed in overlying and underlying aquifers within the well field. Another series of wells are situated around the well field in the monitor well ring.

For each site, the applicant will document any pre-recovery wells or drill holes in the area and endeavor to verify that each abandoned well or hole is properly plugged. The applicant will include specific wells and drill hole descriptions for UIC Class III injection wells and Class I UIC deep wells in site-specific applications and/or operational documentation and analyses.

3.1.2 Use of Land for Processing Facilities

Land is required for processing facility buildings, plant areas, and parking lots, as well as associated access roads. The following structures generally are required for ISR (HRI, 1997b):

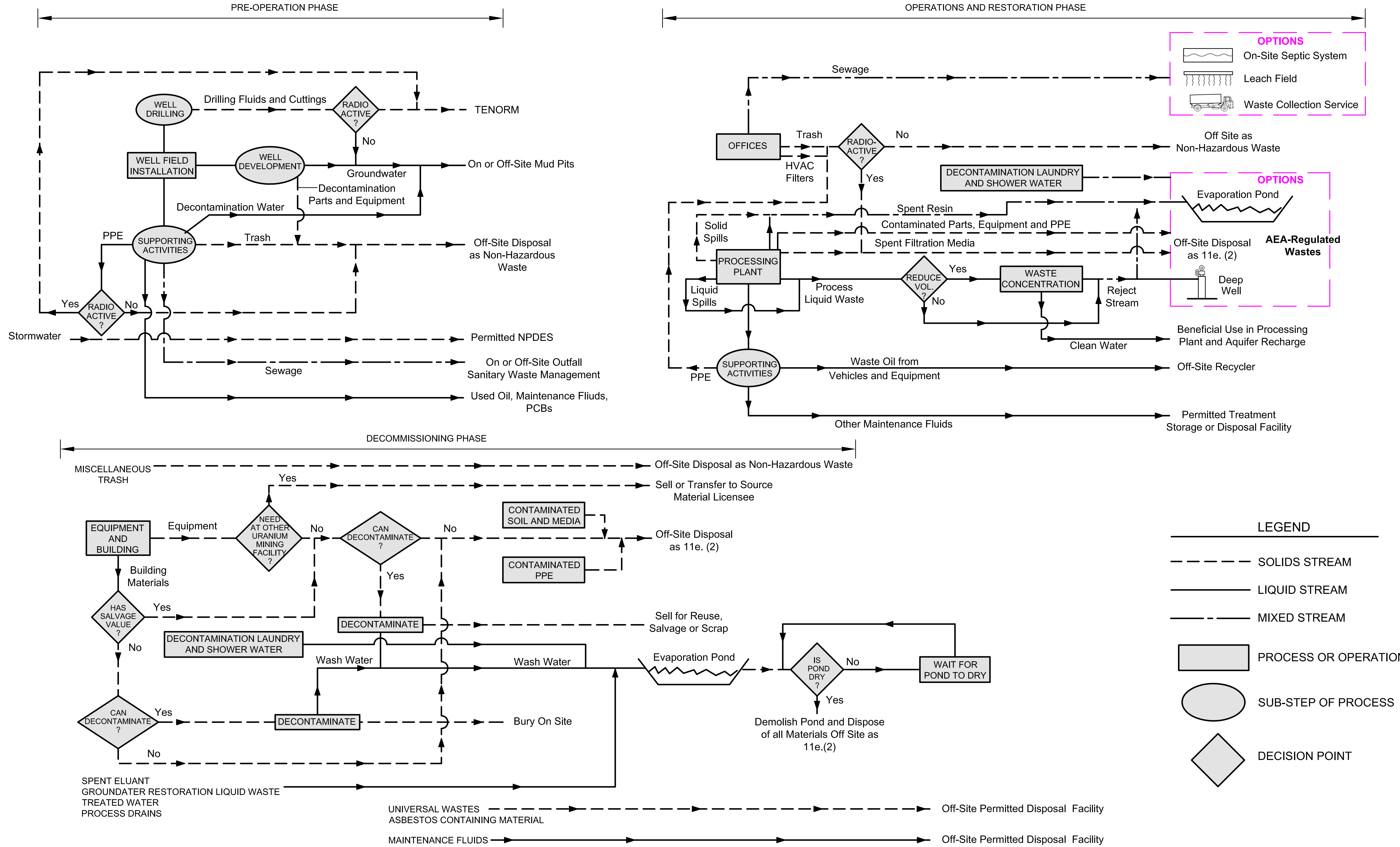
- Site surface preparation, which includes grading for placement of temporary structures, construction of access roads to well sites, laying of pipelines, and construction of well pads (EPA 2007a)
- Process pad, on which IX equipment will be located (size may vary depending on planned production capacity and whether the project has a direct connection to a central processing facility or if the project is a satellite or remote-IX)
- Waste retention/evaporation ponds (discussed in Section 3.1.3)
- Restoration treatment equipment which can be housed in a separate building or located in the processing plant
- Office and service building(s) (laboratory control room, workshops, and so forth)
- Production chemical storage pad
- Brine concentrator pad (if used)
- Sheds or other building structures to house well field manifold and monitoring equipment

3.1.3 Use of Land for Waste Storage and Management

Land use at an ISR site for holding and disposing of both liquid and solid wastes that are produced during site development, uranium extraction, processing, and decommissioning is minimal relative to conventional milling. The characteristics of the wastes produced are used to model and assess potential effects to public health and the environment, and although ISR operations produce relatively small amounts of waste, such wastes must be managed and controlled safely and disposed of in appropriately licensed disposal facilities (EPA 2006). The primary wastes of concern at an ISR facility are 11e.(2) byproduct material, which is defined by NRC as, "…the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content."

The manner of disposal of the "discreet surface wastes" from ISR operations, (i.e. 11e.(2) byproduct material) is determined by their character – liquid wastes can be evaporated in evaporation ponds or disposed of down deep disposal wells, and solid wastes typically are transported to a licensed disposal facility (HRI, 1997b). The methods by which liquid and solid wastes generated from drilling, production "bleed," process waste, aquifer restoration, and decommissioning are disposed of, depends on their classification as AEA or non-AEA wastes. Each of these methods is described below. Figure 3.1 presents the typical waste management process flow.

FIGURE 3.1
TYPICAL FLOWSHEET FOR WASTE MANAGEMENT PROCESS



R:\Clients\NMA\ Process Flow Diagrams.dwg 11/21/2007 deborah.ford DN

<u>Liquid Waste Disposal</u>

Mud Pits

Pre-operational liquids produced by drilling typically have slightly elevated concentrations of radionuclides (EPA 2007a), and are disposed of in mud pits along with the solid wastes produced during drilling, and are defined as TENORM, which is not within NRC's AEA jurisdiction (HRI, 1997b).

Deep-Well Injection

UIC Class I deep injection wells can be used to dispose of waste water and brines. Wells are drilled into deep geological formations, typically thousands of feet deep, extending below any usable aquifer, much less one in which the groundwater is of drinking water quality (NRC 2001).

Process Pad

The process pad is a concrete slab typically with a surrounding curb designed to serve as secondary containment. The purpose of the slab is to hold heavy equipment and contain any contaminated runoff for the equipment. Any spilled material may be transferred to retention ponds or storage tanks (HRI, 1997b).

Evaporation and Retention Ponds

Before transport or final disposal, wastes are normally held in lined ponds. These ponds serve several purposes, including (HRI, 1997b):

- Storing wastes
- Storing restoration water if to be treated
- Providing an area to evaporate of water that cannot be returned to the environment
- Containing and concentrating source and byproduct materials found in effluents

These ponds typically have two impermeable synthetic liners with a leak detection system between the liners and an underground leak collection capacity. The primary types of wastewater in holding ponds are bleed solutions, recovery solutions, and restoration fluids (EPA 2007a). These wastewaters typically have elevated radium and other contaminant (metals) concentrations, and are commonly either allowed to evaporate, are sent back to the IX process for further processing or are disposed of down a deep disposal well (EPA 2007a).

Evaporation ponds are most commonly used for disposal of brines. The purpose of the evaporation pond is to allow the liquid waste to evaporate leaving a solid waste (discussed further below).

Surface Discharge and Land Application

In the past, some ISR operators land-applied wastewater over a relatively large area of land via agricultural irrigation equipment (HRI, 1997b). Given regulatory uncertainties associated with land application, liquid wastes typically are disposed of using Class I deep-well injection wells or evaporation ponds.

Solid Waste Disposal

The solids entrained in pre-operational drilling muds, as well as other solid wastes or debris with elevated radionuclide concentrations produced during exploration drilling, are categorized as TENORM and are not subject to NRC's AEA jurisdiction (HRI, 1997b). Thus, TENORM is disposed of in drilling mud pits designated for management of TENORM.

Solid wastes produced from ISR operations and D&D activities include spent resin, empty chemical containers, tank sediments, domestic waste, contaminated equipment, and slurry left in evaporation and retention ponds (i.e., the "discrete" surface wastes resulting from uranium solution recovery processes per 10 CFR § 40.4). Non-contaminated and non-11e.(2) wastes, such as solvents, degreasers, oils, and paints not associated with uranium recovery, are disposed of in accordance with the regulations for the specific material type (NRC 2001). Disposal of 11e.(2) byproduct material generally is determined by its status as a liquid or solid. As noted above, most liquids are treated to reduce liquid content (e.g., evaporation or brine concentration) or disposed of in deep disposal wells. Evaporation pond solids are dredged, removed, packaged, and disposed of via transportation to an off-site facility licensed to receive 11e.(2) byproduct material (NRC 2001). Spent resin and tank sediments also are collected and transported to a licensed facility. Not all equipment, however, is destined for off-site disposal. Typically, all equipment is surveyed to assess radiological contamination and, if deemed decontaminated in accordance with free release standards, it can be sold or transferred to another ISR uranium or other mineral recovery operation. If it cannot be recycled, then it becomes 11e.(2) waste and is disposed of at a licensed 11e.(2) disposal site.

Disposal at such sites is required by 10 CFR Part 40, Appendix A, Criterion 2 which states:

Criterion 2--*To avoid proliferation of small waste disposal sites and thereby reduce perpetual surveillance obligations, byproduct material from in situ extraction operations, such as residues from solution evaporation or contaminated control processes, and wastes from small remote above ground extraction operations must be disposed of at existing large mill tailings disposal sites; unless, considering the nature of the wastes, such as their volume and specific activity, and the costs and potential environmental impacts of transporting the wastes to a large disposal site, such offsite disposal is demonstrated to be impracticable or the advantages of onsite burial clearly outweigh the benefits of reducing the perpetual surveillance obligations.*

To further interpret Criterion 2's provisions, NRC issued Interim Guidance to ISR operators mandating that 11e.(2) byproduct material generated as a result of ISR operations be disposed of at existing 11e.(2) disposal facilities, including conventional uranium mills with licensed uranium mill tailings impoundments, unless a licensee demonstrates that no option other than individual onsite disposal is currently available for ISR-generated 11e.(2) wastes. Thus, in the event that 11e.(2) byproduct material cannot be disposed of using Class I UIC deep-injections wells must be disposed of at existing 11e.(2) disposal sites.

It is possible that, in the future, one or more ISR operators will propose to construct and manage a licensed 11(e).2 byproduct material disposal site at their facility. Approval of any such proposal will require NRC to reconsider the underlying assumptions for Criterion 2 and its associated Interim Guidance.

3.2 Transportation

The generic model region that will contain the model ISR facility exhibits characteristics of eight Midwestern, Rocky Mountain, and Gulf Coast states. While the exact location of individual site-specific operations will vary, it is anticipated that most sites will be located near existing highway infrastructure. The product to be shipped (typically, yellowcake, yellowcake slurry, or loaded IX resin) is generally produced in small amounts and shipped in manageable secure containers or tanker trucks. Likewise, materials for construction and process chemicals used in operation are typically shipped by highway. Therefore, it is not anticipated that bulk shipping methods (such as rail tankers, rail cars, or barges) will be used. Accordingly, neither freight rail line connections nor access to navigable waterways will be required to transport product or wastes from the model region facility to a processing or disposal facility (i.e., all materials are anticipated to be transported by truck). If site-specific conditions differ from this GER (e.g., if rail, water, or air transport are involved) and/or if extension of a highway or other transportation infrastructure is required, then the individual site-specific environmental assessment will address other modes of product and process chemical transport.

The transportation system associated with the proposed model facility will include local collector roads, which can be used to access the major state-owned highway system (United States and state routes). There are no anticipated weight restrictions on such local roads and bridges that will restrict anticipated truck traffic; and if there are, improvements can be made to remove such restrictions in advance of construction and operations. Site-specific analysis can contain a schematic diagram illustrating the important local routes to the closest intraregional highway. No new major roadways, rail spurs, or canals are proposed to improve transportation to and from the model region facility. If transportation infrastructure is needed, various federal transportation agencies will use their own NEPA process. These agencies include the Federal Highway Administration, Surface Transportation Board, Federal Aviation Administration, and others. It is anticipated that parking facilities, driveways, and access and internal roadways will be constructed within the boundaries of the model ISR site for operation and maintenance. Most of these internal site improvements will be removed upon decommissioning, depending on proposed reuse options for the site.

All access for machinery for construction and reclamation will be expected to occur via the roadway network. All access for commuting workers and materials transportation during operation will be via the roadway network. Pedestrian and/or mass transit access is not anticipated because, typically, ISR facilities have been remotely located, although there are no technical or environmental reasons mandating remote location. The ore body mandates the location.

3.2.1 Generic Transportation Conditions and Infrastructure

NRC’s 1980 GEIS and other generic assessments (e.g., NUREG-0535) have addressed conditions and infrastructure for the transportation of yellowcake from uranium recovery facilities. In the event that site-specific conditions fall outside the boundaries of the analyses and conclusions addressed in these assessments, site-specific studies will be prepared and submitted.

From a site-specific facility to an interstate highway, the analysis will include anticipated travel routes, including the number of miles of unimproved (unpaved) two-lane roads, the number of miles of paved local roads, and the miles of intrastate collector highways. The approximate

number of miles of paved driveways and roadways that will be installed for commuters to access the processing plant will be documented. In addition, an approximation of the number of miles of unimproved roads that will be used to maintain extraction wells, evaporation ponds, and other satellite facilities will be developed.

Within the model region, outside of major metropolitan areas, traffic congestion and travel routes are not problematic. Shipping of hazardous materials typically is conducted to avoid peak traffic periods and congested areas, but will be addressed by individual transport companies. If warranted, a separate site-specific traffic study report describing current traffic conditions in the region can be created for a detailed description of traffic and related issues. Where warranted, site-specific information summarizing existing and anticipated average daily traffic, and levels of service for the alternatives can be considered. A traffic study report could also predict modeled increased traffic conditions during operations, including predicted regional traffic conditions. A traffic study report, where appropriate, could also describe recommended measures to abate traffic congestion where warranted based on projected increases in traffic. It is not anticipated that minor transportation improvements will contribute to any secondary or cumulative potential impacts to subregions.

Peak commuting traffic to and from each individual facility is expected to be a manageable number of vehicles per hour. Average truck trips are expected to account for a small number of trips per day.

3.2.2 Potential Truck Accident Assessment

Transportation of hazardous materials is governed by the Hazardous Materials Transportation Safety Act of 1974 as amended (Hazardous Materials Transportation Uniform Safety Act of 1990, amended 1994 and the Safe, Accountable, Flexible, Efficient Transportation Equity Act of 2005), and by state laws under RCRA. ISR products are considered Class 7 (radioactive materials) according to 49 CFR Parts 171-173. Federal laws and regulations apply to transport of hazardous materials across Native American lands. State laws also may apply to non-tribal members transporting hazardous materials through Native American lands, and to public road rights-of-way and easements. Tribal requirements will be subject to review by DOT, but RCRA cannot be delegated to tribes to implement. Measures (such as timing the shipment departure times to coincide with off-peak traffic hours) to minimize the possibility of an incident are assumed in accordance with 49 CFR § 177 and 49 CFR § 173.403, and will be the responsibility of the motor carrier transporter.

ISR facilities produce uranium for transport in the form of loaded resins, yellowcake slurry, and, when dried, as yellowcake. These products are shipped in tanker trucks or appropriate containers to the next step in uranium recovery. If the shipped product is in the form of slurry or loaded resins, the product is shipped to a properly licensed ISR central processing facility or to a conventional uranium mill for uranium recovery and/or drying. If the shipped product is yellowcake, the product goes to a licensed conversion facility located in Metropolis, Illinois or is exported for conversion overseas pursuant to an NRC export license. However, conversion could occur at other locations in the future, depending upon market factors and possible construction of additional licensed conversion facilities. The possibility of transport truck accidents is presented in Section 3.2.2.1.

In addition to the transport of loaded resins, yellowcake slurry, and yellowcake from the Model ISR Site, truck transport also will be required to ship process chemicals to the site to support the ISR process. This issue is discussed in detail in Section 3.2.2.2.

3.2.2.1 Radioactive Truck Accident Scenario

ISR facilities (i.e., remote IX, satellite, and central processing plants) produce uranium products as loaded resin, yellowcake slurry or dried yellowcake. Loaded resin and yellowcake slurry are shipped in bulk to processing facilities for recovery and/or drying to produce dried yellowcake. Dried yellowcake is containerized and then shipped to and processed at specialized processing facilities for conversion. As noted above, the next stage in the fuel cycle involves conversion facilities located in Port Hope in Ontario, Canada and Metropolis, Illinois. The model region facility will ship the partially processed product to one or both of these locations. Transport distances from Arizona, Texas, and Wyoming range between approximately 1500 and 2000 miles to Ontario, and1000 to 1200 miles to Illinois from the model region facility. Transport distances from the other five states in the model region will be comparable but less.

The model facility will have resin stripping facilities and, therefore, it is anticipated that such facility will ship yellowcake product only; not resin or yellowcake slurry. Some ISR facilities may ship yellowcake slurry in the event that they do not have drying and packaging facilities. Product is shipped in drums that meet applicable DOT hazardous materials requirements for non-enriched nuclear materials. All shipping will be done in conventional van-type tractor-trailer transports. The transport is classified as an exclusive use container where the drums are secured inside a sealed trailer. NRC specifies the use of strong, tight packages in accordance with DOT regulations for this purpose. The materials transporter is required to provide all of the necessary spill control measures and to conduct any necessary cleanup in the event of a spill while the material is in transport. DOT requires materials transporters to have a security plan and an emergency plan. After the transporter accepts the shipment, it has responsibility for and will have detailed plans and response capabilities in place to respond to any incidents. Measures such as route selection and timing the shipment departure times to coincide with off-peak traffic hours to minimize the possibility of an incident are assumed and will be the responsibility of the transporter.

The incidence and impact of potential transport accidents have been assessed previously in the 1980 GEIS (NRC, 1980b). Since the yellowcake to be shipped from the facility is exactly the same as the yellowcake shipped from a conventional milling facility, the assessment of accidents from the model ISR site is considered to be the same as previously assessed in 1980. Additionally, NUREG-1508 considers two models of truck accident in its effects evaluation (HRI, 1997a): Model I is the loss of all drums being carried and all of the related contents, while Model II is a partial loss of contents. Immediately following the truck accident event, there is a release of airborne particulates that can be inhaled by surrounding populations. The impact of this release is determined through assessment of wind speeds and population density at the site of the accident.

The loss of yellowcake drums into a body of water could result in the spread of particulates throughout a water supply. Depending on water flow rate and the quantity of yellowcake that is released into the water, it is possible that dilution will occur and reduce the concentration of radioactivity to below the maximum permissible concentration. However, it should be noted that yellowcake is only sparingly soluble and the major route of dispersion is expected to be transport of yellowcake particles by flowing water.

The chance of a transportation incident depends on a number of factors, including transport distance, class of road, traffic density and traffic mix, potential for inclement weather, and other factors. Although airborne releases are possible, accidents involving the transport of yellowcake to date have been responded to quickly and the spread of contamination has been controlled.

3.2.2.2 Non-Radioactive Truck Accident Scenario

In addition to the transport of yellowcake from the Model ISR Site, truck transport also will be required to ship process chemicals to the site to support the ISR process. Truck accidents involving the shipment of process chemicals to the ISR facility, such as lixiviant components and salt, also can have potential local environmental impacts. Table 3.1 lists the major chemicals that typically are used at ISR facilities. Depending on the chemical properties and the magnitude of the spill, the potential impacts of a truck accident carrying process chemicals can vary greatly.

Table 3.1
Chemicals Typically Used in ISR Facilities

Chemical	Form
Salt (NaCl)	Dry Solid
Sodium bicarbonate (NaHCO)	Dry Solid
Sodium carbonate (NaCO)	Dry Solid
Sodium sesquicarbonate	Dry Solid
Sodium sulfide	Dry Solid
Barium chloride	Dry Solid
Sodium hydroxide (NaOH)	Liquid
Hydrochloric acid (HCl)	Liquid or gas
Sulfuric acid	Liquid
Oxygen (O_2)	Liquid or gas
Diesel fuel	Liquid
Bottled gases	Liquid or gas
Liquefied petroleum gas (LPG)	Liquid
Carbon dioxide (CO_2)	Liquid or gas
Hydrogen peroxide (H_2O_2)	Liquid
Ammonia	Liquid or gas
Hydrogen sulfide	Gas
Welding gases	Gas

Sources:

(1) "Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico, Docket No. 40-8968." NUREG-1508. February (HRI, 1997a).
(2) "Final Generic Environmental Impact Statement on Uranium Milling, Project M-25, Volume 1." NUREG-0706. September (NRC, 1980b).

3.2.2.3 Considerations for Assessment of Truck Accident Impact

A variety of information is needed to assess the potential for a truck accident and the potential impacts of such an accident. Four major categories of factors must be considered in this assessment: (1) the location of the accident, (2) the quantity of material that has been released, (3) the severity of the accident, and (4) the nature of the material, which may be the most crucial

factor. The location of the accident determines the affected environment in an accident scenario. A truck accident that occurs over or near a body of water can result in widespread contaminant transport because of water flow and, although mixing factors can lead to significant dilution, an assessment of specific transport routes to the proposed model ISR site will be conducted to minimize the possible water impacts of transportation accidents. Additionally, the release of material during an accident can result in the dispersal of particulates in air, so environmental characteristics such as wind speed, humidity, and soil permeability will be considered in determining the potential impacts of a possible accident. Concentrations in the region around the accident site will depend on these factors as a function of the magnitude of the release and the duration of the release (which will be combined to indicate the total mass and volume of contaminants released to the environment in the accident scenario). The severity of the accident and the number of vehicles involved in the event will have a significant effect on the final impact of the accident. The possible involvement of fire or collision will be less probable, but will complicate the evaluation of any release. The nature of the material is critical to any assessment of potential impacts from truck accidents. Potential truck accidents can involve materials associated with the ISR process such as chemicals or uranium-bearing materials (i.e., yellowcake, yellowcake slurry, and loaded IX resins), and the potential exposure pathways and impacts must be evaluated on a material-specific basis.

Potential truck accident impacts will be defined on the basis of short- and long-term potential environmental impacts and potential socioeconomic impacts. Population density on the proposed transportation route will be a factor in determining the scope of the potential impact on human populations and the potential economic consequences. A densely populated area might also have a higher vehicular density, so the time of the accident will be a factor in assessing potential impacts due to both increased exposure and loss of efficiency in movement of people and goods. Most importantly, the severity of the accident also will be a function of the material that has been spilled. Accidents involving the release of radioactivity or chemicals that are known to be harmful to the environment will be considered more severe than accidents involving chemicals that are deemed to be relatively benign or easily contained. The physical form of the released material will be critical in the determination of severity because the release of a dry solid likely will result in a much less significant environmental impact than a liquid or gas. RADTRAN is a computer code used and endorsed by NRC to help in the modeling and prediction of potential truck accident impacts according to Sandia National Laboratories, which developed RADTRAN. For over 30 years RADTRAN has been the national and international (INTERTRAN) computer code standard for transportation risk assessment and consequence analysis for radioactive materials. This program is supplied by the DOE at no cost to approved users, and incorporates demographic, material and health physics data in the modeling process.

3.3 Geology and Soils: General Conditions for Uranium Deposits Amenable to ISR Method of Uranium Recovery

This section describes the regional geology based on referenced information and helps establish a geologic context for the model facility. The geology in the recovery area can be described using geologic cross sections based on geophysical logs and field investigations. The production zone and confining zones need to be identified on the cross sections. When applicable, the depositional environment of the host aquifer can be discussed, including the physical characteristics (for example, grain size, sorting, and so forth) and mineralogical composition of the ore-bearing units, especially the finer fractions of the ore.

United States Uranium Deposits and Primary ISR Regions

In the United States, the geologic conditions and soil types in which uranium-bearing deposits are found are concentrated in the western states. ISR facilities (pending license approval, licensed, and active) are located in three primary areas in the western United States, as depicted in Figure 3.2. Each of the three primary ISR areas are described below and a significant ISR site is provided as a Model ISR Site for considering the geology and soils in the region:

(1) The “Four Corners” Area: A region of high desert plateau surrounding the intersection of Colorado, Utah, New Mexico, and Arizona. Model ISR Site – Crownpoint

(2) Powder River Basin: Region spanning the southwestern Wyoming and northeastern South Dakota border. Model ISR Site - Irigaray

(3) South Texas: Narrow region along the Gulf of Mexico, including the area around Hebbronville, Brownsville, and Corpus Christie. Model ISR- Site – La Palangana

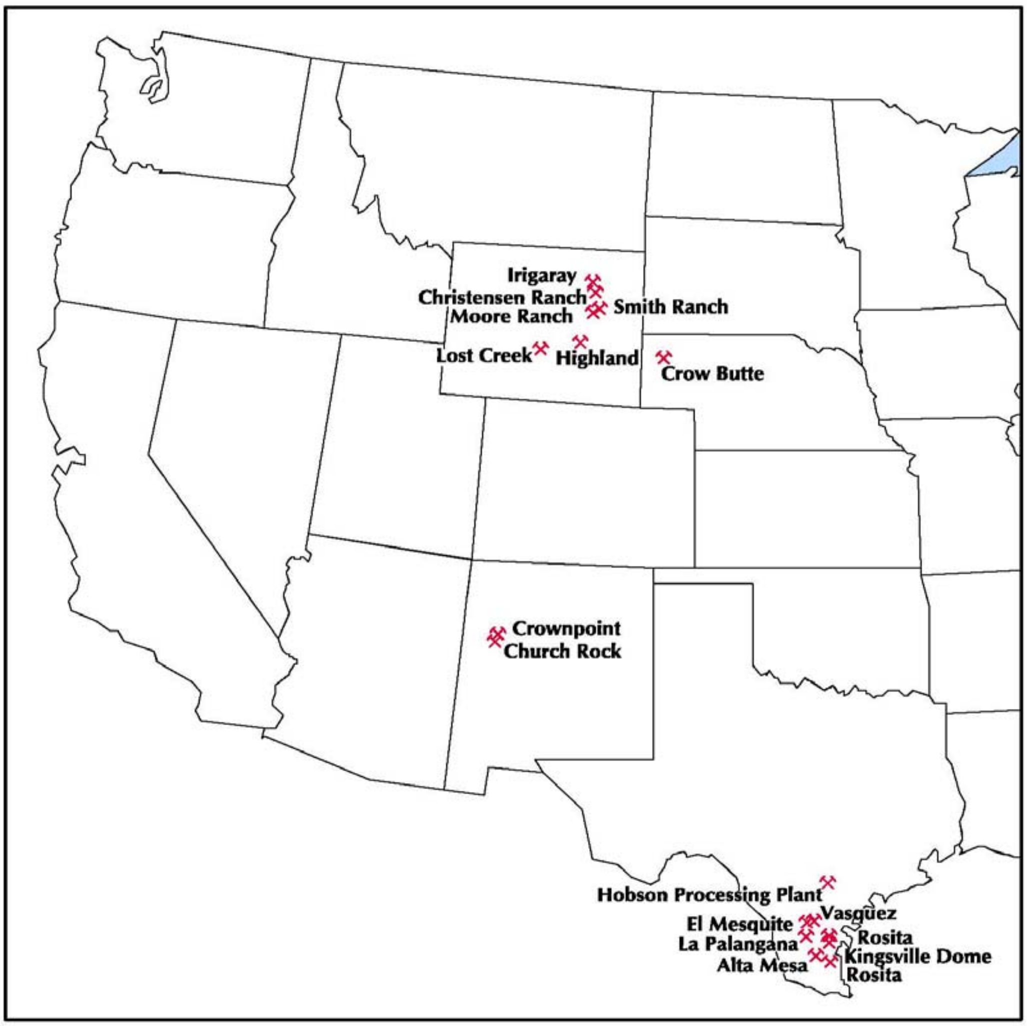


Figure 3.2 - Pending, Licensed, and Active ISR Operations

Table 3.2 shows United States Uranium ISR information on plant ownership, plant name, uranium production capacity, and 2006 operating status.

Table 3.2
United States Uranium In Situ Leach Plants by Owner, Capacity, and Operating Status at End of the Years 2003-2006 (http://www.eia.doe.gov/cneaf/nuclear/dupr/qupd.html; EIA, 2007)

ISR Plant Owner	ISR Plant Name	Production Capacity[a] (lbs yellowcake per year)	2006 Operating Status
Cogema Mining, Inc.	Christensen Ranch	- -	Reclamation
Crow Butte Resources, Inc.	Crowe Butte	1,000,000	Operating
HRI	Church Rock	1,000,000	Partially permitted and licensed
HRI	Crownpoint	1,000,000	Partially permitted and licensed
Mestena Uranium LLC	Alta Mesa	1,000,000	Operating
Power Resources, Inc.	Smith Ranch-Highland	5,500,000	Operating
South Texas Mining Venture, LLP	Hobson	1,000,000	Standby
Uranium One/Energy Metals	La Palangana	1,000,000	Permitting
Uranium Resources Inc. (URI)	Kingsville Dome	1,000,000	Operating
URI, Inc.	Rosita	1,000,000	Standby
URI, Inc.	Vasquez	800,000	Operating
	Total Production Capacity:	**14,300,000**	

Notes:

Data based on most recent Form EIA-851A or Form EIA-851Q survey. An operating status of "operating" and "operational" usually indicates the ISR plant was producing uranium concentrate at the end of the period.

Sources: Energy Information Administration: Form EIA-851A and Form EIA-851Q, "Domestic Uranium Production Report."

Geologic Processes Resulting in Uranium-Containing Ore (from URI 2006)

Because of its molecular structure and properties, uranium is most commonly found in specific rock formations. Uranium roll-front deposits typically form in relatively near-surface sandstone aquifers of fluvial or lacustrine origin. As noted above, deposition of uranium and other metals occurs in these deposits at redox interfaces where the change from oxidizing to reducing

conditions causes uranium deposit formation. Groundwater travels from oxidizing conditions near the surface, where it solubilizes low concentrations of uranium and other metals from soils and rock into the deeper portions of the aquifer, where chemically reducing conditions are present. These reducing conditions are commonly attributed to the increased abundance of organic carbon from woody debris and plant material (kerogen), pyrite (FeS_2) or hydrogen sulfide (H_2S) gas. As oxidized groundwater moves into the reduced zone, the dissolved uranium is precipitated in its reduced mineral form and removed from solution. In addition to uranium, elements such as arsenic, molybdenum, iron, manganese, selenium, and vanadium, which generally are mobile in oxidized conditions, also are precipitated in the vicinity of uranium roll-front deposits because of the low solubility of their reduced forms. Ore-related minerals reported in uranium roll-fronts include the uranium minerals uraninite [UO_2(s)] and coffinite [$U(SiO_4)_{1-x}(OH)_{4x}$], the iron sulfides FeS_2 and marcasite, hematite (Fe_2O_3), iron silicates, calcite ($CaCO_3$), gypsum ($CaSO_4 \cdot 2H_2O$), ferroselite ($FeSe_2$), native selenium (Se), molybdenite [MoS_2(c)], and jordisite [MoS_2(am)].

Figure 3.3 shows the distribution of minerals in a roll-front deposit.

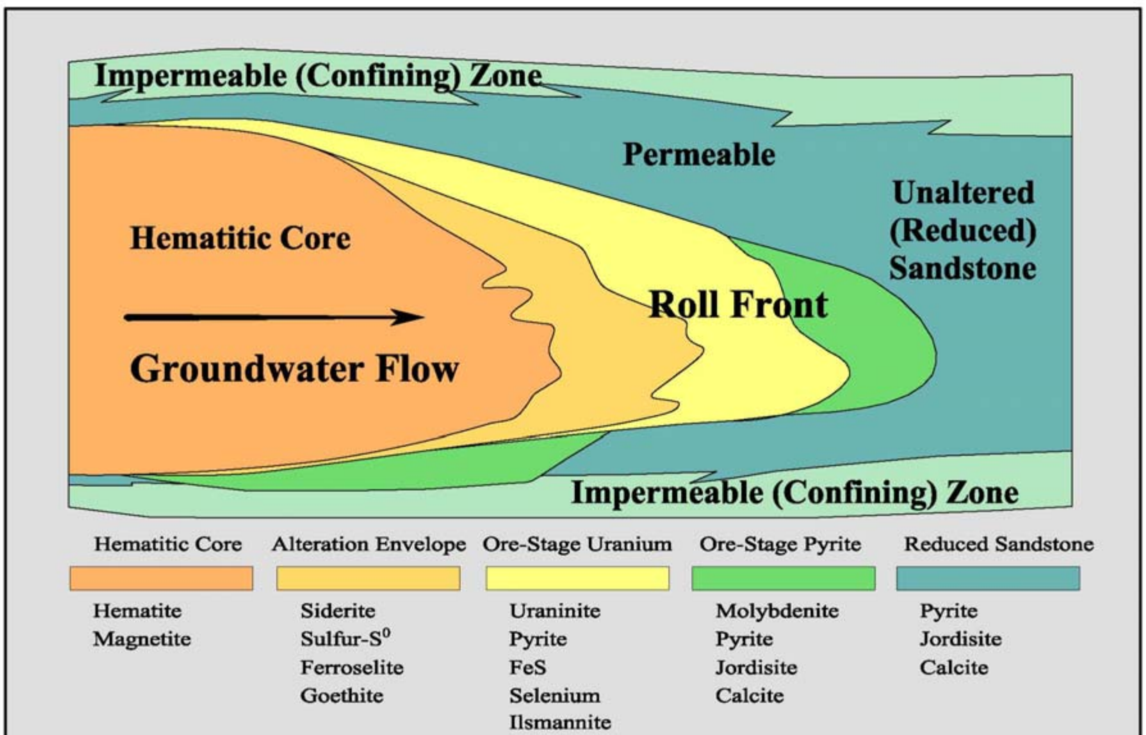


Figure 3.3 Conceptual Model of Uranium Front Deposit
(After Devoto, 1978)

The boundary between oxidized and reduced conditions in the aquifer represents a redox interface at which metals become concentrated. Over time, the redox interface will migrate in the direction of groundwater flow, creating a *redistributed* ore body that can extend laterally across the groundwater gradient for hundreds or thousands of feet but only tens of feet in the downgradient direction. The characteristic "roll" shape of the redox interface (Figure 3.4) is formed over time as groundwater moves more rapidly through the central, more permeable portion of the sandstone. Within the host aquifer, the oxidized and reduced zones can be distinguished by color and mineralogy. The oxidized portion of the aquifer is frequently yellow to

red, containing iron oxides and ferric iron clay minerals that have replaced FeS_2. In some cases, the oxidized portion of the aquifer has been reduced after ore zone formation by the influx of strongly reducing fluids containing H_2S. A range of permeabilities commonly is observed within the host sedimentary unit because of spatial differences in depositional environments.

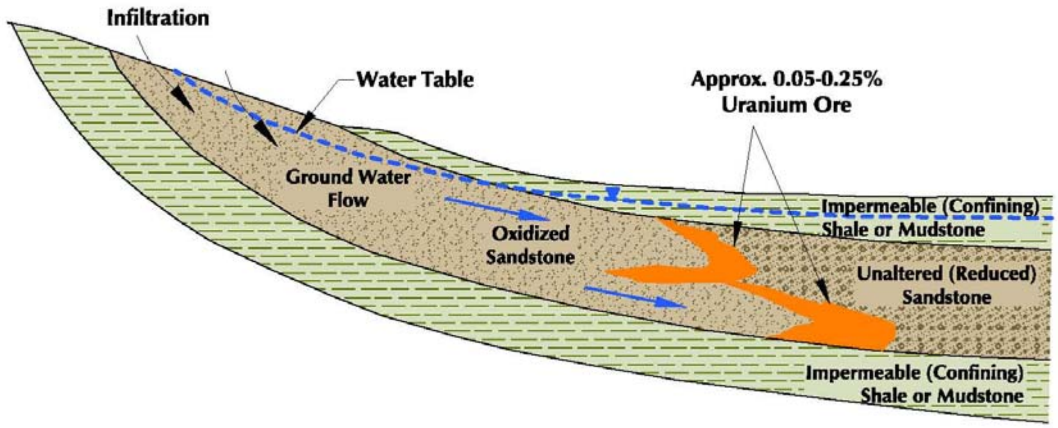


Figure 3.4 - Crownpoint Geology and Soils - Simplified Cross-Section of Roll-front Uranium Deposits Formed by Groundwater Migration

<u>Geologic Characteristics of Model ISR Site</u>

Data from ISR facilities in Nebraska, New Mexico, Texas and Wyoming show the general geology is nearly identical. As examples, all south Texas operations are within fluvial deposits with multiple stacked ore sands. Detailed pump testing has confirmed that the formation is functionally a single hydrological unit for monitoring purposes. Successful operations have been conducted in Texas for 30 years. In Wyoming ISR is generally conducted in the Fort Union aquifer. The Fort Union aquifer is fluvial. Successful operations have been conducted in Wyoming for 30 years. In Nebraska ISR is generally conducted in the Chadron aquifer. The Chadron aquifer is fluvial. Successful operations have been conducted in Nebraska for 15 years. There is no known evidence to demonstrate that a fluvial deposit in Nebraska, Texas or Wyoming results in subsurface channels which cause problems during recovery or restoration operations.

The typical depositional environment for all these ISR host formations is moderate energy, braided streams. The sands are moderately sorted, with numerous clay clasts intermixed throughout the section. Typically individual uranium mineral roll-fronts will form along the redox interface confined by the subsidiary clays clasts or horizons above and below. The paleostreams were noted by repeated cycles of flood events where banks were cut, followed by periods of quiescence where low energy water deposited sediments. The cycle of cut and fill repeated itself – in human terms – perpetually. There are no simple channels in this mode of deposition – rather the remnants of deposition cycles from various energy levels (sand size) after many “cuts” and “fills” become hydrologically interconnected at the scale of a recovery unit or production area. This results in a sheet shaped deposit of interconnected and interbedded lenses. In the case of an artesian aquifer, which is the case with those associated with uranium deposits, this mass of smaller cut and fill channels acts hydrologically as one homogeneous

sheet-like unit on a larger scale but may actually permit ISR recovery patterns in individual zones between the individual subsidiary clays clasts or horizons within a given recovery unit or production area.

Pump testing in a new recovery zone for ISR determines the degree of communication between the recovery zone, and (1) the overlying conforming zones, and (2), the production zone monitor wells. Properly designed pump tests will reflect the effects of hydraulic pathways, such as unplugged holes, and other pathways, to the overlying or underlying zones. Pump tests also prove that, in fluvial systems, the potential for channels is not relevant and the monitor well spacing is adequate. A dysfunctional monitor well in a impermeable zone (say outside a channel) will not draw down during the pump test. The pump tests that are required to demonstrate the adequacy of monitor wells are a key environmental protection provision of NRC's regulatory program.

For the purposes of this document, the model geology characteristics are as follows:

- Roll-front or tabular deposits with low concentrations of uranium.
- Sandstone with aquitards (impermeable beds) above and below the host sandstone; aquitards are comprised of clay-rich sediments or other fine-grained, low-porosity materials.
- Ore-bearing regions are isolated below local groundwater.
- Other mineral resources (such as uranium, oil and gas, coal, sulfur salt, and so forth) also can be present depending on the nature of the specific site.

<u>Soil Characteristics of Model ISR Site</u>

For the purposes of this document, the model soil characteristics are as follows:

- Shallow sands or sandy loams with low uranium content.
- High erodibility and medium chance of mass failure depending on site-specific rainfall patterns and topography

The characteristics described above are widely applicable to the site geology and soils amenable to ISR in many geographic locations. Each ISR site subject to an environmental review will have site-specific characteristics, including the geologic formations and specific soil types present, and to satisfy the requirements of the review, those site-specific conditions will be delineated in detail to the extent that they are not consistent with the conditions evaluated and conclusions reached in the ISR GEIS. To provide concrete examples in this GER for ISR sites, Table 3.3 provides descriptions of the geologic characteristics of the three primary ISR regions:

(1) The "Four Corners" Area: Model ISR Site – Crownpoint (Figure 3.5)

(2) Powder River Basin: Model ISR Site - Irigaray

(3) South Texas: Narrow region along the Gulf of Mexico including the area around Hebbronville, Brownsville and Corpus Christie. Model ISR Site – La Palangana

Maps, figures, and data are included at the end of this section from one ISR site (the Unit One ISR site) as examples to indicate the appropriate types and level of detail required.

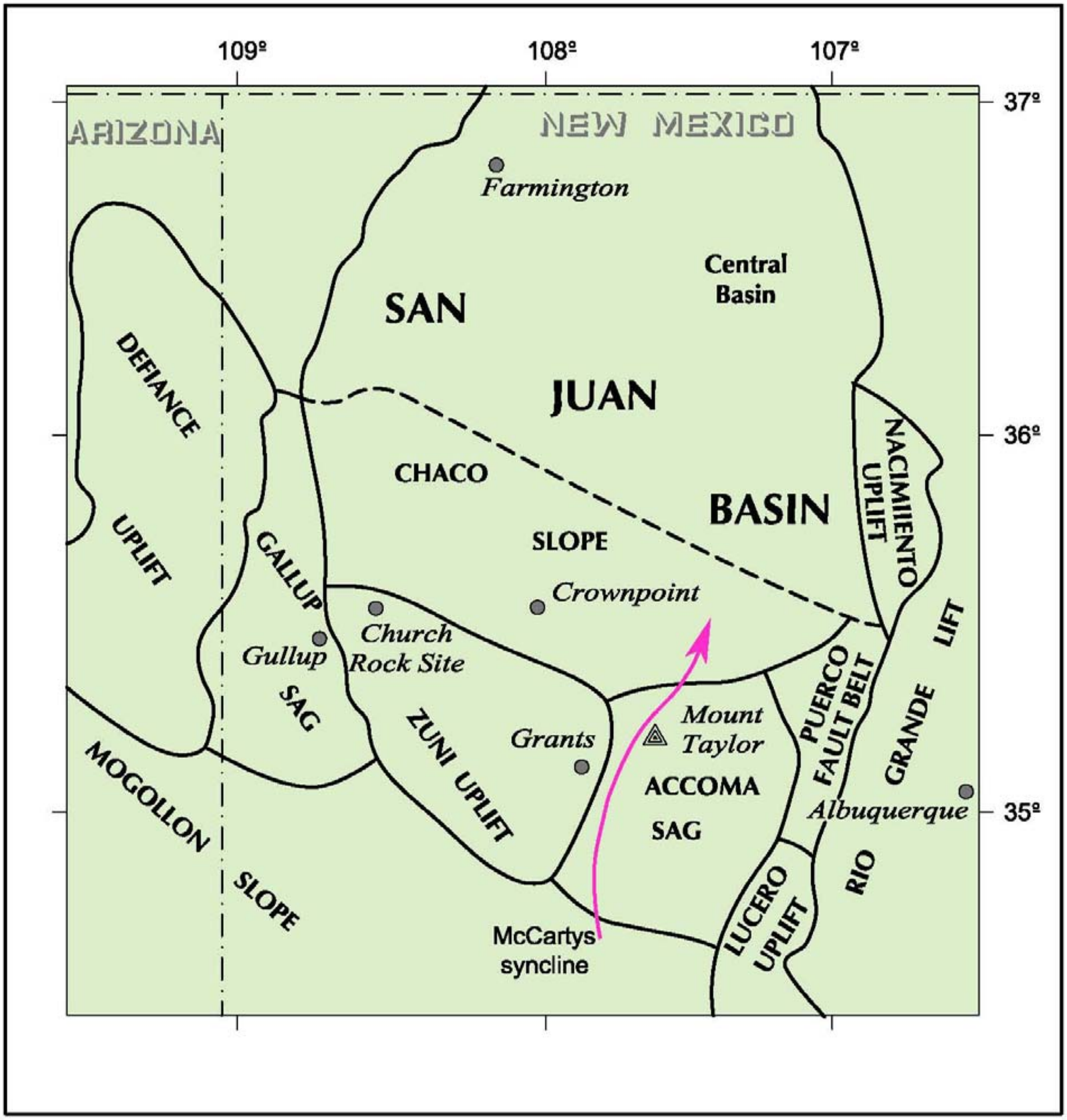


Figure 3.5 - Crownpoint Geology - Structural Setting of the San Jaun Basin (source: Kelly 1963; Kelly and Clinton 1960)

Table 3.3
Regional Geology of Three Primary United States ISR Regions and Example Sites

ISR Region 1: San Juan Basin - "Four Corners Area": Region of high desert plateau surrounding the intersection of Colorado, Utah, New Mexico, and Arizona (McLemore, 1997).

The San Juan Basin is a structural depression occupying a major portion of the southeastern Colorado Plateau physiographic province underlain by up to 10,000 ft of sedimentary strata, which generally dip gently from the margins toward the center of the basin. The margins of the basin are characterized by relatively small elongate domes, uplifts, and synclinal depressions. The stratigraphic sequence in the San Juan Basin is composed of units ranging from Precambrian to the Holocene age.

The Paleozoic and Mesozoic rocks in the San Juan Basin were deposited on a relatively stable continental platform and are products of sedimentary depositional systems that covered the entire Colorado Plateau and beyond (Green and others 1991; Baars 2000). Formerly an active seaway connecting the central New Mexico Sea with the Paradox Basin in Utah during most of pre-Permian time (Baars 2000). During Jurassic time, a desert environment covered much of the San Juan Basin, and sediments were deposited in dune fields, playas, saline lakes, fluvial systems, and alluvial aprons. A large lake formed in the center of what is now the San Juan Basin, and the Todilto Limestone was deposited. Gypsum, limestone, and uranium were produced from the Todilto in the southern San Juan Basin, and uranium was produced from sandstones of the Jurassic Morrison Formation. During the Late Cretaceous, approximately 100 million years ago, the predominant depositional environment was a vast but shallow sea covering much of New Mexico, including the San Juan Basin area. Marine and coastal nonmarine environments shifted through time across the San Juan Basin, depositing coal (Hoffman 1996, 1997), sandstones, siltstones, and shales. By Tertiary time (65 million years ago), the sea had retreated and the structural San Juan Basin had begun to form.

ISR Region 1 Representative Site: Crownpoint (from HRI, 1997b)

Local Stratigraphy/Petrology or Lithology of Rock Units:
The Morrison Formation is composed of the Recapture, Westwater Canyon, and Brushy Basin Members and is the host formation for major uranium deposits in the area, as described below in ascending order.

- The Recapture Member is as thick as 500 ft northwest of Gallup, but thins considerably and in outcrops near Gallup and eastward is only 150 to 300 ft thick. It occurs in the Gallup mining district as a sequence of interbedded siltstone, mudstone, and sandstone strata. Individual strata range from centimeters to meters in thickness. Sandstone beds are generally less than 15 ft thick (Hilpert, 1969). No significant uranium deposits occur in the Recapture Member.
- The Westwater Canyon Member consists of interbedded fluvial red, tan, and light gray arkosic sandstone, claystone, and mudstone and is the major water-bearing member of the Morrison formation. The unit's thickness in outcrop from Gallup to the continental divide ranges between 175 and 275 ft (Hilpert, 1969) and is considerably thicker locally. In most places, the Westwater displays one or more mudstone units that range from thin partings to units up to 20 ft thick. This member is host for the major uranium deposits in the region occurring in coarse-grained, poorly sorted sandstone units and is closely associated with the carbonaceous material that coats the sand grains.
- The Brushy Basin Member ranges from 40 to 125 ft thick in the Gallup region and is mainly composed of light greenish-gray and varicolored claystone, interbedded with

Table 3.3
Regional Geology of Three Primary United States ISR Regions and Example Sites

sandstone lenses with similar lithology and appearance to sandstones found in the Westwater Canyon Member (Ristorcelli, 1980). The mudstones are largely derived from volcanic ash falls (Peterson, 1980) and contain considerable amounts of bentonite.

- The Dakota Sandstone is the basal formation of the Cretaceous System and uncomfortably overlies the Morrison Formation. The Dakota is a gray-brown quartz sandstone with some interbedded conglomerate, shale, carbonaceous shale, and coal. It is a marine sandstone and is considered to represent the earliest transgression of late Cretaceous seas. The Dakota crops out around the margins of the San Juan Basin and thickens toward the center of the basin to about 200 ft regionally.
- The Mancos Shale is thick, mostly uniform gray marine shale containing thin lenses of fine-grained sandstone varying in thickness up to 2,000 ft regionally.
- The Mesaverde Group overlies the Mancos Shale and is composed of several formations; provided below in ascending order.
    - The Gallup Sandstone - a grayish-white or pink-to-tan, medium- to fine-grained, moderately well-sorted, calcareous, cross-bedded sandstone; varies regionally from 0 to more than 230 ft thick and is about 80 ft thick near Crownpoint.
    - The Crevasse Canyon Formation consisting of an upper and lower member composed of interbedded lenticular sandstones, claystones, and thin discontinuous coal beds separated by a sheet-like body of fine-grained, well-sorted calcareous marine sandstone; varies from 490 to 750 ft thick.
    - The Point Lookout Sandstone is a fine- to medium-grained, grayish-brown to white sandstone. The Satan Tongue of the Mancos Shale consists of interbedded shale, mudstone, and thin calcarious sandstone beds.

Tectonic Features (Faulting, Folding, Fracturing):

- Rocks in the Crownpoint area dip approximately 1 to 2 degrees north-northeast. Wentworth and others (1980) report that northeast-trending faults are known in the Crownpoint area but have limited displacement. Robertson (1986) maps two east-trending faults crossing the town (Figure 3.6). Field observations indicated one of the faults is well exposed on the mesa slopes in the southwest quarter of Section 19. The fault was observed in outcrops where sandstone and coal strata in the northern block are offset relatively downward by approximately 23 ft. Robertson's (1986) interpretation reveals that the fault steepens in the subsurface, passing through the ore zone. Associated cross-sections indicate that the offset of this fault is minor compared with strata thickness and that differing sandstone units are not juxtaposed.

Soil Type:

- Major soil associations in the Crownpoint area are the Lohmiller-San Mateo, Hagerman-Travessilla, and Rock Land-Travessilla (TVA, 1979). The Lohmiller-San Mateo association occupies the lowest topographic position in the area. It occurs on flood plains, terraces, and gently sloping plains along ephemeral streams. Because the association is formed on alluvium derived from sandstone and shale, the soils are 6 to 10 inches thick, light brownish-gray to pale brown, calcareous clay loam to loam. They form a surface layer overlying 5 ft or more of stratified, fine-textured alluvium.

Continuity of Geologic Strata:

- In the Crownpoint area, the top of the Westwater Canyon is found at an average approximate elevation of 5,000 ft or a depth of 1,840 ft. Log data indicated the Westwater Canyon Member ranges from about 236 ft to over 345 ft.

Table 3.3
Regional Geology of Three Primary United States ISR Regions and Example Sites

o Uranium deposits at the Crownpoint site average nearly 11 ft thick in each zone. The stacked ore zones have a combined thickness of about 120 ft. The combined dimensions of the Unit 1 and Crownpoint ore bodies exceed 5 miles long, and their width varies from 950 to 2,500 ft.
ISR Region 2: The PRB: Region spanning northeastern Wyoming, northwestern South Dakota, and southeastern Montana (Cogema, 2004).
The PRB is a large, asymmetrical structure bounded on the west by the Big Horn Mountains, on the east by the Black Hills, and on the south by the Laramie Range and Hartville Uplift. The Basin orientation and plunge generally are south to north. The Basin is open to the north and encloses approximately 13,000 square miles of northeastern Wyoming. Most of the structural expression of the Basin is from subsidence and sedimentation, rather than uplifting. Approximately 16,000 to 18,000 ft of sediments overly the Precambrian basement in the basin. Lower to Upper Cretaceous-age rocks (Frontier to Lance Formations) outcrop on the west side of the PRB, whereas predominately Upper Cretaceous (Lance) and Pliocene (Fort Union) deposits are present on the south and east sides. In the central portion of the basin, marine and fluvial deposits are approximately 8,000 ft below the outcrop elevations. Eocene Wasatch Formation is present at the surface across most of the PRB. ▪ The southern part of the PRB appears to have been relatively stable during and after Eocene time (Sharp and Gibbons, 1964). Dips of beds within the Wasatch section range from less than 1 degree to 2.5 degrees. At the fringes of the PRB, the Fort Union dips to the center of the PRB from 2 to 20 degrees. ▪ Structural and stratigraphic development in the area was associated with tectonic events during Late Cretaceous times extending through the Eocene Epoch. ▪ Surrounding uplifts (such as the Central Rocky Mountain Region) created a basin in which up to 8,000 ft of non-marine clastic sediments were deposited. ▪ Four distinct stratigraphic units are recognized in the PRB as a result of surrounding tectonic activities: the Cretaceous Lance Formation, Paleocene Fort Union Formation, Eocene Wasatch Formation, and Oligocene White River Formation.

ISR Region 2 Representative Site: Irigaray – PRB, Wyoming
(from Cogema, 2004)
Local Stratigraphy/Petrology or Lithology of Rock Units:
▪ Located in the west-central portion of the PRB, a broad north-south aligned asymmetrical syncline whose axis lies west of its center.
▪ A broad northward-plunging anticline has its axis parallel to and slightly east of the Pumpkin Buttes alignment and is intersected by a broad westward-plunging arch.
▪ Strata dips northwesterly at 1 to 2 degrees, consistent with the position on the northwest flank of the anticline.
▪ The specific stratigraphy of the Irigaray section from the Oligocene White River Formation to the Paleocene Fort Union Formation are presented below in descending order.
  ▪ Surficial deposits consisting mainly of weathered sediments of the Wasatch Formation, alluvium in small drainages, and alluvium/terrace deposits in the immediate vicinity of the Powder River
  ▪ Alluvial deposits in descending order, as follows: (1) the Kaycee terrace (sandy silt, gravel, and coarse-grained sand with cobbles); and (2) the Moorcroft terrace, consisting of silty, fine-grained alluvium, and the Lightning terrace (silty, fine- or medium-grained sand with lenses of coarse-grained sand or fine-grained gravel).

Table 3.3
Regional Geology of Three Primary United States ISR Regions and Example Sites

- The Oligocene White River Formation commonly found on the surface in the fringes of the PRB has been eroded away in the Irigaray area; occasional surficial deposits are encountered in the vicinity of Pumpkin Buttes.
- The White River is composed of tuffaceous sandstone, conglomerate, and claystone.

Tectonic Features (Faulting, Folding, and Fracturing):

- Numerous cross sections through the Irigaray area give no indication that detectable faulting has occurred in Tertiary sediments of the area.

Soil Type:

- The Eocene-age Wasatch Formation unconformably overlies the Fort Union Formation and is present on the surface throughout the Irigaray area.
- The Wasatch Formation is composed of claystone, lenticular sandstone, and minor coal deposits from fluvial origin.
- Approximately 3,500 ft of the Wasatch Formation is present in the northern portion of the PRB and due to erosion progressively thinner Wasatch deposits are found to the south. Sediments on the edges of the PRB typically are characterized by broad sheet-like sandstones deposited by braided streams that have not been confined within a single channel and commonly are coarse-grained, poorly sorted, and contain low concentrations of carbonaceous materials.
- Toward the interior of the PRB, channel sand deposits from meandering streams are more common. Between the channels, siltstones and mudstones containing high carbon content have been deposited by flood events. The channel sandstones typically are crossbedded, grade upward from coarse- to fine-grained, and contain carbonaceous debris.

Continuity of Geologic Strata:

- The Irigaray area has several subparallel systems consisting of multi-storied channels superimposed on top of one another, with the channel deposits averaging about 100 ft thick, 2 to 7 miles in width, and more than 20 miles long. The width in the specific Irigaray area is generally reported as 2 to 3 miles.
- For the Irigaray area, Morris and Bahr identified two superposed channel systems that are ore-bearing: Upper Irigaray Sandstone (UISS) and the Lower Irigaray Sandstone (LISS). Because of greater ore grades and sand quality, all mining operations to date have been conducted in the UISS. The UISS and LISS generally are separated by 10 to 30 ft of clay, and are underlain by sandstone, silt, and shale. Within the Irigaray area, the mineralized deposits typically are encountered at depths from 100 to 300 ft below ground surface.
- The UISS consists of feldspathic to arkosic sandstone, with grain sizes ranging from very fine to coarse, and sorting from good to poor. Interbedded siltstone, mudstone, and coal are common. Carbon is present but erratically distributed, and pyrite is usually less than 0.5 percent.
- A thin lignite bed (referred to as the overlying coal unit) is present above the UISS throughout the Irigaray area, and has been shown to be continuous over a large area (that is more than 6 miles east to west).

Table 3.3
Regional Geology of Three Primary United States ISR Regions and Example Sites

ISR Region 3 - South Texas: Narrow region along the Gulf of Mexico including the area around Hebbronville, Brownsville and Corpus Christie. Model ISR Site – La Palagana (from Well Field Restoration Report, Irigaray Restoration Plan, June 2004)
South Texas geology is characterized by an arcuate belt of Tertiary fluvial clastic units deposited along the passive North American plate margin, paralleling the Gulf Coast from the Mexican border to Louisiana. These sedimentary units are primarily of fluvial origin and were deposited by southeasterly flowing streams and rivers. The stratigraphic sequences consist of packages of permeable sandstone units separated by and interbedded with impermeable intervals of siltstone and mudstone. The key units of the region, which also constitute the South Texas Uranium Belt, are presented below from oldest to youngest. o The Late Eocene Whitsett Formation: The Whitsett, a minor uranium-producing unit, is part of the Jackson Group and consists primarily of coastal barrier-bar, channel-fill and lagoonal deposits of fine- to medium-grained, tuffacious, and feldspathic sandstones. The Jackson Group grades southeasterly into a barrier-bar complex. o The Oligocene Catahoula Formation: The Catahoula, a major uranium-producing unit, is separated from the underlying Whitsett by the Oligocene Frio Clay. It consists of a series of highly tuffacious, fluvial, channel-fill, and crevasse splay sandstones accompanied by flood plain and lacustrine muds. They are thought to represent a volcanic sedimentary source in Trans-Pecos Texas or northern Mexico. The Catahoula grades down-dip into a deltaic and barrier-bar complex. o The Miocene Oakville Sandstone: The Oakville, also a major uranium-producing unit, unconformably overlies the Catahoula Formation and consists of medium- to coarse-grained channel deposits of calcilithic fluvial sand, gravel, and mud, grading laterally into fine-to medium-grained sheet splay sands. The coarser deposits are at the base of the unit. Interfluvial floodplain and playa muds and silts bound this unit. The Oakville was deposited in response to uplift along the Balcones Fault Zone. Cretaceous limestones and volcanic material from west Texas are the principal source rocks. Down-dip, these sediments grade into strike-oriented barrier-bar sandstones. o The Miocene Fleming Formation: The Fleming conformably overlies the Oakville and is generally similar except for a greater proportion of the mud. It contains only minor uranium mineralization. o The Pliocene Goliad Formation, host of many uranium deposits, unconformably overlies the Fleming and is composed of three units: a basal fine- to coarse-grained to conglomeratic cross-bedded unit with calcareous clay; a middle member of calcareous clay; and an upper unit of sandstone and calcareous clay. Caliche is common, especially in the muddy sediments. The conglomerates contain a variety of lithic fragments from the Fleming and older formations. The Goliad Formation is interpreted to be a braided meander belt fluvial deposit with muds as flood plain or overbank deposits. The sands and gravels composed mostly of quartz and chert are very clean and associated with channels and point bars. o Passive margin growth faulting along the South Texas Uranium Belt is common with "down-to-the-coast" normal faults predominating.
ISR Region 3 Representative Site: Palangana – South Texas (from Standard Uranium, Inc. 2005) **Local Stratigraphy/Petrology or Lithology of Rock Units:** o The local geology is characterized by the occurrence of a Gulf Coast piercement salt dome approximately 2 miles in diameter and overlain by Pliocene sediments of the Goliad Formation. The Palangana dome is marked at the surface by a shallow circular basin surrounded by low hills rising 50 to 80 ft above the basin floor.

Table 3.3
Regional Geology of Three Primary United States ISR Regions and Example Sites

o The salt dome is an almost perfectly circular salt core with a remarkably flat top that is approximately 10,000 ft across and occurs from 800 to 850 ft below the topographic surface. The rocks covering the dome are essentially flat lying, but data from historic oil well drilling indicated the beds dip from 30 to 58 degrees at depths of 3,500 to 4,200 ft. The dome's caprock consists of 400-foot-thick sequence of anhydrite with some gypsum and calcareous material and sulfur. No structural details of the lateral beds around the salt core have been worked out as currently known from the available information.
Tectonic Features (Faulting, Folding, Fracturing):
o There are faults across the top of diaper and associated radial faulting. The Palangana stratigraphy is horizontal to sub-horizontal, with at most a 2 to 3 degree southeasterly dip.
Soil Type:
o The Goliad at Palangana is composed of fine- to medium-grained, often silty, channel sands interbedded with lenses of mudstone and siltstone. For the most part, the sand is very sparsely cemented although it varies from friable to indurated. A generalized lithologic section from youngest to oldest consists of (1) 20 to 30 ft of sand, clay and Caliche; (2) 160 to 200 ft of reddish-brown sandy clay with occasional sand lenses; (3) a 10- to 20-foot bluish-gray clay marker bed; (4) an 80- to 100-foot-thick sequence of sandstones and claystones that mark the uranium mineralized horizon; and (5) a bluish-green clay horizon that extends to the anhydrite cap.

Geologic Characteristics of Model ISR Site

Based on the general and specific information presented above, the following are geologic characteristics of the Model ISR Site:

- Shallow sandstone aquifers of fluvial or lacustrine origin 10 to 200 feet thick which are sufficiently permeable to allow groundwater flow
- Deposits are hosted in permeable sandstones bounded above and below by units of poorer permeability, such as clays or mudstones, that limit the vertical movement of groundwater
- Sediments are shallowly dipping (i.e., 2 to 20 percent)
- Redox conditions within the sediments that concentrate uranium
- Little to no faulting within the sediments so that groundwater is not directed away from the roll-front and tat the redox conditions are maintained

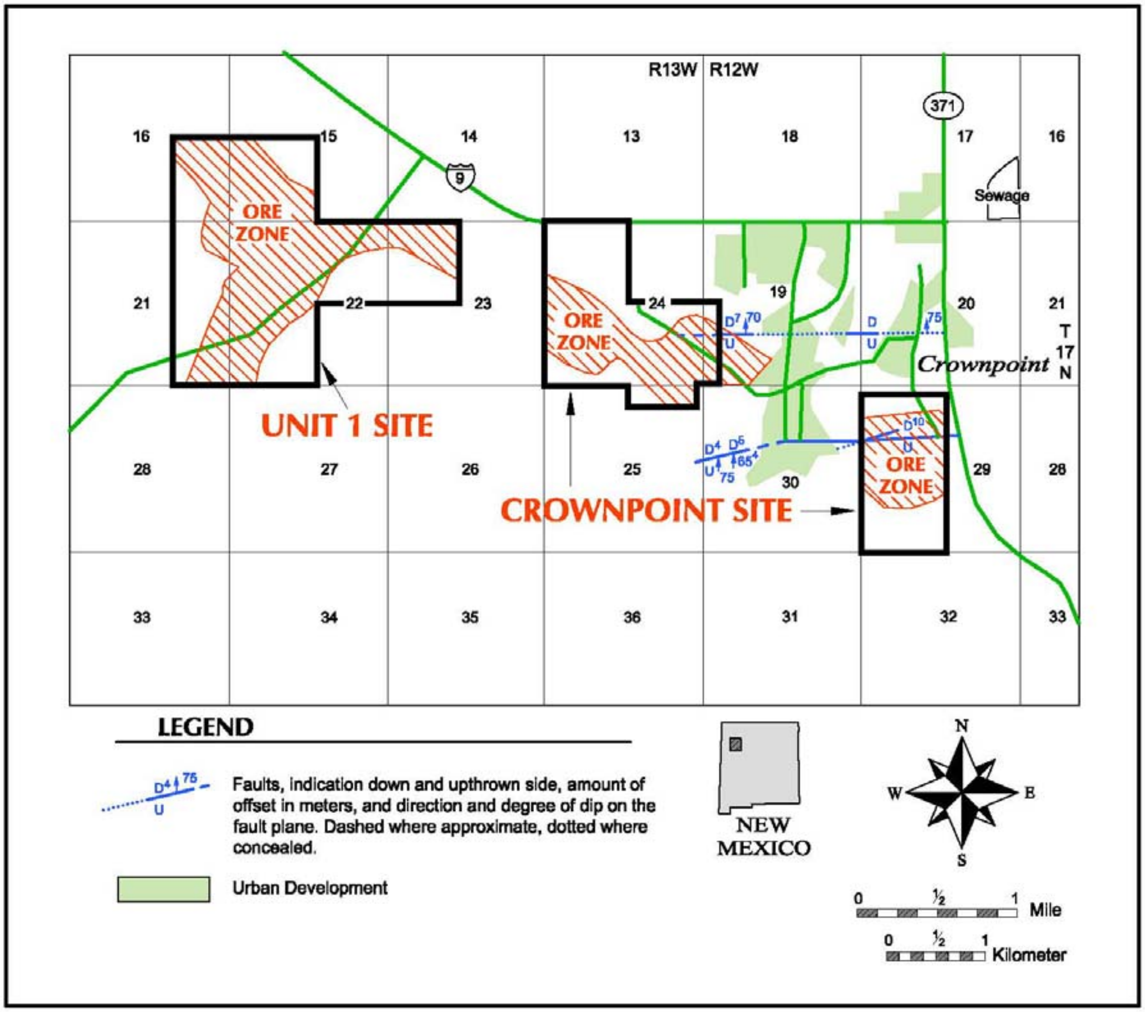


Figure 3.6 - Crownpoint Geology and Soils - Surface Locations of Faults and Ore Zones in the Crownpoint Area

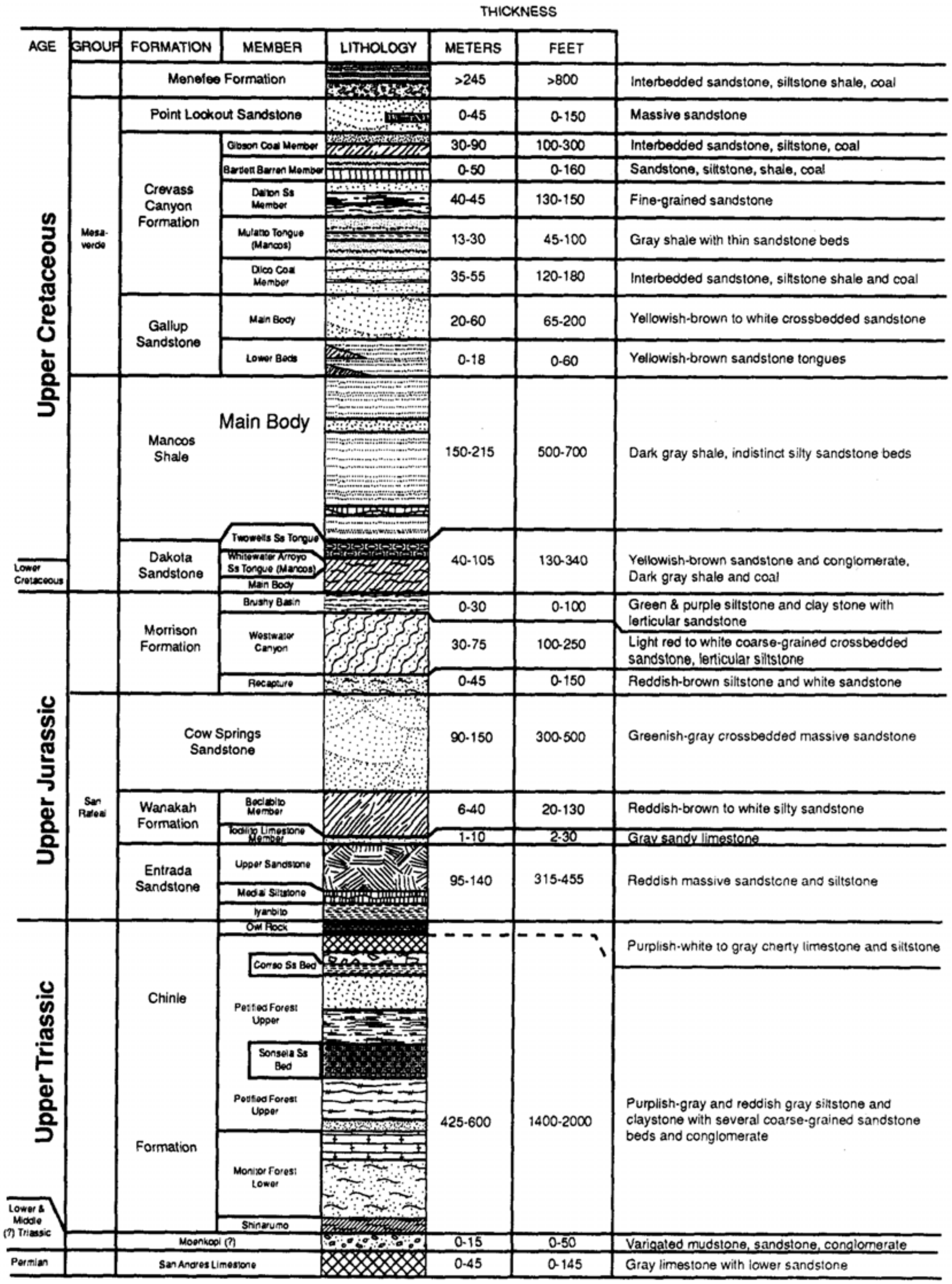


Figure 3.7 - Crownpoint Geology and Soils – Stratigraphic Column of the Church Rock, New Mexico Area (adapted from Chenoweth and Learned 1980.

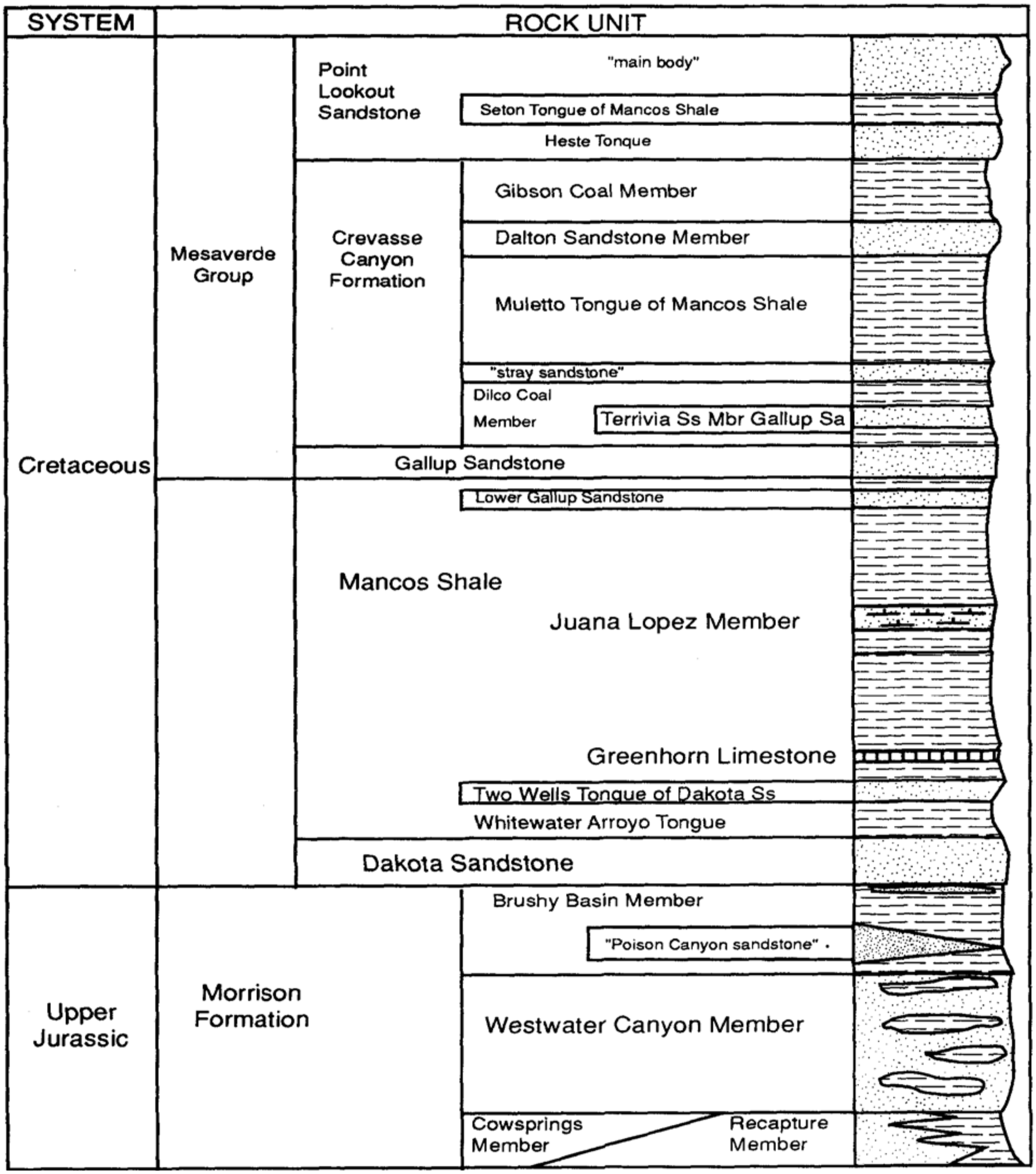


Figure 3.8 - Crownpoint Geology and Soils – Stratigraphic Column of the Unit 1 and Crownpoint Sites

3.4 Water Resources and Hydrology

Water resources related to ISR operations are groundwater and surface water. Groundwater can consist of the subsurface hydrologic resources that can and cannot be used for potable water consumption, agricultural irrigation, livestock watering, and industrial applications. Industrial applications near ISR operations may include mining, oil and gas, and power generation plants. Surface water resources consist of lakes, rivers, and streams. Surface water can be important for its contributions to the economic, ecological, recreational, and human health of a community or locale. Surface water in ISR areas typically supports agricultural uses and wildlife.

3.4.1 Groundwater

All current ISR sites, including the Model ISR Site, recover uranium from roll-front deposits in shallow fluvial sandstones. However, some future deposits that may be mined could be considered tabular. Refer to Table 3.3 for Model ISR Site geologic, hydrologic, geochemical, and soil characteristics.

Each extraction well is operated at the maximum continuous flow rate achievable for its pattern area. Injection and extraction flow rates are monitored in order that injection can be balanced with extraction across the entire well field, with the injection flow smaller than the production flow by the amount of the *bleed* rate.

Operating as a unit of EPA Class III wells in a UIC permit *area*, multiple injection wells are paired with multiple extraction wells located within and around the uranium ore body. The balance of the entire well field is built upon the individual balance of paired injectors and extractors. The individual injection and extraction wells within well field are operated effectively as a closed loop. Pumping water (extraction) out of the aquifer causes the injected waters to move toward the extraction wells, passing through the uranium ore body in the process. The water is drawn to the extraction wells, pumped to the surface and through the surface ion exchange (IX) facility and is re-injected. Injection is inextricably linked to extraction, i.e., without extracting at least as much water as is injected, the surface plant will run dry and re-circulation will stop. Injection cannot proceed without an equal or greater amount of extraction; so over-injection across the area cannot take place.

As stated above, the overall injection flow rates into the well fields are less than the total extraction flow rates by an amount known as "*process bleed*", resulting in a hydraulic pressure sink which causes native groundwater outside of the ore zone to migrate into the well field. This process bleed is used to help protect the monitor wells against lixiviant excursion and varies according to ore geometry, well pattern and magnitude and direction of the natural groundwater velocity.

The water quality within recovery zones at ISR sites typically does not meet drinking water standards even prior to ISR operations due to naturally occurring concentrations of radionuclides (e.g., uranium, radium) and other heavy metals. As such, the assumption is made that the Model ISR Site will meet the requirements for an aquifer exemption under the SDWA, which is necessary for ISR to proceed. Baseline water quality in recovery zones will be characterized after licensing but prior to the start of active recovery activities and will continue to be characterized on a well field by well field basis as the project proceeds. Groundwater in the monitor well ring (i.e., outside the recovery zone) also will be characterized to enable the

operator to identify readily if an excursion has taken place. Baseline water quality values from the recovery zones and monitor well ring will not be averaged, since it would make the identification of excursions extremely problematic. Water quality data will be used to determine NRC-approved upper control limits (UCLs) for purposes of identifying excursions and determining that corrective action has succeeded. This process of developing an adequate water quality "database" for ISR operations over the course of the development of a given project is consistent with NRC's statement in NUREG-1569 that initially, "*in situ* leach facilit[ies] [are] not based on comprehensive information. This is because *in situ* leach facilities obtain enough information to generally locate the ore body and to understand the natural systems involved. *More detailed information is developed as each area is brought into production*." NUREG-1569 at 1-1.

3.4.1.1 Generic Description of Regional Aquifer Conditions for ISR Projects

There is some degree of uranium mineralization in most Tertiary and older sedimentary rocks of the western and southwestern United States. However, the principal regions of potential uranium recovery by the ISR method currently are in, but are not limited to, the Wyoming Basins, the Colorado Plateau, and the Gulf Coastal Plain of Texas as shown on Figure 3.2. The southern Black Hills and northeastern Colorado/northwestern Nebraska, within the Great Plains region, also contain sedimentary uranium deposits that may be amenable to ISR mining. The Model ISR Site is relevant to each of these areas.

Based on the Model ISR Site stratigraphy presented in Section 3.3, ISR projects generally are located within sandstone formations of lacustrine or fluvial origin and of arkosic/volcanic origin. The Model ISR Site aquifer within these formations may contain a number of water-bearing units separated by confining units, that are distinct hydrostratigraphic units which impact ore occurrence and distribution as well as vertical and lateral water movement from the recovery zone.

It is widely acknowledged that groundwater conditions amenable to ISR are bounded by many *common* characteristics. That is, ISR deposits are consistently found in relatively porous units which are bounded by very low-permeability units; ISR deposits also exhibit poor water quality in the zones of uranium mineralization. The generic parameters in this GER include assumptions regarding:

(1) thickness and characteristics of aquitards and mineral-bearing sequences;
(2) thickness, location and production of aquifers;
(3) generic pre-mining water quality data;
(4) hydraulic properties such as porosity, permeability, transmissivity, storage coefficients,
(5) generic range of natural flow velocities and flowpaths; and
(6) aquifer interconnections (natural and through poorly plugged boreholes).

<u>Hydrologic Characteristics of ISR Deposits</u>

Groundwater generally occurs under unconfined or water table conditions in the recharge areas and transitions to confined conditions further downgradient within the areas were ISR occurs. At the ISR locations, groundwater will flow under confined conditions through the portion of the saturated zone containing the more porous media. The flow can be described or modeled using a classical theory of flow through porous media. Flow does not occur through highly permeable discrete pipes over short or long distances.

Groundwater recharge to the regional aquifer system is mainly from infiltration of oxygen-rich water in the form of rainfall or snow melt. The recharge generally occurs in the higher elevations where outcrop areas exist along basin margins. The oxygenated water percolates downward through the surface and through uranium-bearing sediments. Uranium is dissolved by the water and carried in solution deeper into the aquifer in a down-dip or downgradient direction. At some point away from the recharge area, reducing conditions are encountered, causing the uranium to drop out of solution, forming the ore body, as discussed Section 3.4.1.1. Beyond the ore body, regional discharge from the aquifer system occurs through springs, seeps, evapotranspiration, rivers and streams, or wells.

Characteristics of water-bearing intervals will vary depending upon the specific lithologic and hydrostratigraphic characteristics of the system. Typically, and as discussed in Section 3.3, sandstone intervals hosting roll-front uranium deposits are of varying thickness, ranging from less than 50 to over several hundred feet thick. Water-bearing zones containing roll-front ore bodies are capped and floored by aquitard units both intraformational and/or as thick shales or other low permeability units. For example, at Crownpoint the mineral-bearing Westwater Canyon interval, is underlain by up to 500 feet of interbedded mudstone, siltstone, and thin sandstones, and is overlain by 40 to125 ft of Brushy Basin claystones.

Porosity of zones hosting ISR deposits must be sufficient to allow oxygenated groundwater movement through the system. Overlying and underlying confining units, typically are of significantly lower permeability typical of shales, siltstones or clays. Porosities within the Model ISR Site ISR intervals vary from 10 to over 30 percent with hydraulic conductivities of less than 1 to 20 ft/d. Confining aquitards typically exhibit hydraulic conductivities less than 0.01 ft/d. Hydraulic conductivity, porosity and hydraulic gradient, are aquifer parameters that are considered in both mineral extraction and restoration. Average groundwater velocity can be calculated from these parameters using the following equation

$$V = k\, i/\phi$$

Where v = average groundwater velocity
K = hydraulic conductivity
I = hydraulic gradient
ϕ = porosity

As an example, a typical sandstone aquifer hosting a roll-front uranium deposit might have a natural hydraulic gradient of 0.0025 ft/ft (13.2 feet per mile), a porosity of 25 percent (0.25) and a hydraulic gradient of 5 ft/d. Using these values, average groundwater velocity for this aquifer under natural conditions can be calculated as 18.25 feet per year (ft/yr). For an aquifer with the same porosity and hydraulic gradient but a hydraulic conductivity of 1 ft/d, the groundwater velocity will be 3.65 ft/yr and at a hydraulic conductivity of 10 ft/d, the groundwater velocity will be 36.5 ft/yr. Thus, groundwater flow velocities for a typical uranium roll-front deposit could range from approximately a few feet to several tens of feet per year under natural conditions. Over time, the aquifer will return to natural conditions after restoration is complete. In most ISR environments, the hydraulic conductivity values are at the lower end of the range used for the example calculations (typically, 1 to 4 ft/day), but site-specific system characteristics may vary.

Generic Discussion of Nature of Uranium Deposits in Relation to Groundwater Conditions

The Model ISR Site uranium roll-front deposits typically form in relatively near-surface sandstone aquifers of fluvial or lacustrine origin as shown on Figure 3.4. The uranium is thought to have been derived from granite, which supplied the parent material to form the arkosic sandstones, or from volcanic material that was deposited with or later than the sandstone, or perhaps from both. Granitic bodies containing uranium are found in many of the mountains that provided the host sandstones.

Groundwater flows from oxidizing conditions near recharge areas, where uranium is mobilized and travels into deeper portions of the aquifer. Further downgradient, the groundwater with dissolved uranium comes into contact with a reducing environment. The reducing environment is typically a result of anaerobic decomposition attributed to the increased abundance of organic carbon from woody debris and plant material, pyrite, or hydrogen sulfide gas. As the oxidized groundwater moves into the reducing zone, precipitation of uraninite and accessory minerals (such as arsenic, molybdenum, selenium, and vanadium) occurs at the reduction-oxidation interface. A mineralized zone likely will be present in these deposits: typically, pyrite and calcite are found at the leading edge of the interface; pyrite and uraninite in the ore zone; and siderite, goethite, and hematite on the trailing edge. The water quality within the mineralized zone reflects these geochemical characteristics, containing excessive amounts of uranium and other minerals so that the groundwater quality within the ISR deposit is poor (i.e. highly mineralized).

Over time, the redox interface will migrate in the direction of groundwater flow, creating a redistributed ore body that may extend laterally for hundreds of feet across the gradient but only tens of feet in the downgradient direction. The characteristic roll shape of the redox interface is formed over time as groundwater moves more rapidly through the central portions of the sandstone.

Uranium and Uranium Progeny Values in Groundwater at ISR Facilities

The water used for ISR is not suitable for drinking and can be reclaimed to constituent levels that are consistent with baseline to minimize or eliminate the potential for post mining migration of constituents into adjacent USDWs. Specifically, uranium and uranium-related elements such as radium and ^{222}Rn and gross alpha radiation that are uranium's natural decay products are found in water in uranium deposits in New Mexico, Nebraska, Texas and Wyoming. When the mineralization is in sufficient concentrations, uranium and its progeny cause the natural groundwater in the ore zone to exceed federal and state drinking water limits for uranium and/or gross alpha (α) radiation, radium (^{222}Rn) and radon (^{226}Ra) rendering it potentially toxic for human and livestock consumption.

The EPA National Primary Drinking Water Regulations (NPDWRs) are legally enforceable standards that public water systems are required to satisfy. NPDWR MCLs for uranium and uranium progeny are listed below.

EPA has proposed a ^{222}Rn MCL at 300 pCi/L. [Federal Register: November 2, 1999 (Volume 64, Number 211)]. The potential health hazards associated with ^{222}Rn are described at length therein. Given the estimates of the potential hazards of ^{222}Rn exposure as described by EPA, the 300 pCi/l proposed ^{222}Rn MCL is included along with uranium and radium MCLs as a criteria to screen groundwater for suitability as a source of drinking water.

Contaminant	MCL†	Potential Health Effects from Ingestion of Water	Sources of Contaminant
Alpha particles	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
^{226}Ra and ^{228}Radium	5 pCi/L	Increased risk of cancer	Erosion of natural deposits
Uranium	30 µg/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits

† **Maximum Contaminant Level (MCL)** - The highest level of a contaminant that is allowed in drinking water. MCLs are enforceable standards.

The presence of uranium and uranium progeny in groundwater is a positive indicator of uranium in the rock and vice versa. As clearly stated by EPA, these contaminants are caused from the erosion of natural deposits. Those with experience in the uranium industry know that one common exploration technique is to measure uranium and its progeny from water sources such as springs to screen for the presence of economic uranium mineralization. Those with experience in the uranium recovery industry also know that considerable treatment is required to remove uranium and its progeny from water generated during conventional mining operations to meet surface discharge requirements. Also considerable ventilation is required in underground mine workings to mitigate the potential impacts of radon that is emitted from the rock and water in the mine. All of these traits are indicative of a radiochemical footprint that is associated with groundwater resources that are commingled with uranium ore.

It is this understanding of the uranium radiochemical footprint in groundwater water that EPA uses as the basis for Aquifer Exemptions for ISR facilities and therefore it is not reasonable to consider water in a uranium ore zone as being pristine or suitable for human consumption.

As a result of the unique geochemical conditions associated with ISR deposit formation, groundwater within the ISR deposit is highly mineralized and typically unpotable, particularly with respect to radionuclides. Concentration of uranium and radium in groundwater at ISR sites in Nebraska, New Mexico, Texas, and Wyoming were obtained and are shown in Table 3.4a. For each ISR site, the highest and average groundwater radium and uranium concentrations were tabulated to show the average range of concentrations typical of ISR deposits within example states, as well as typical high concentrations values (also presented as a range). Table 3.4a provides the ranges in these values for each state.

3.4.1.2 Examples of ISR Site Hydrology in the Three Primary ISR Regions

The principal regions of potential uranium recovery by the ISR method are the Wyoming Basins, the Colorado Plateau, and the Gulf Coastal Plain of Texas. This section describes a representative site from each of these regions with regard to water quality and geologic and hydrogeologic characteristics. The following case studies are not meant to provide all inclusive information about each example site, but are instead to demonstrate that common hydrogeologic data can be obtained at sites and that there are significant similarities in site conditions between each region. NRC also should review water quality data from recently submitted license applications from ISR companies for Powder River and Great Divide Basin projects.

Table 3.4a
Maximum Contaminant Levels versus Ranges of Uranium, Radium, and Radon in Groundwater at ISR Sites

State	Uranium MCL (µg/L)	Range in ***High*** Uranium Values (µg/L)	Range in ***Average*** Uranium Values (µg/L)	Radium MCL (µg/L)	Range in ***High*** Radium Values (µg/L)	Range in ***Average*** Radium Values (µg/L)	Radon MCL* (µg/L)	Range in ***High*** Radon Values (µg/L)	Range in ***Average*** Radon Values (µg/L)
Nebraska	**30**	132-1,131	46-133	**15**	519-1,477	81-235	**300**	ND	ND
New Mexico	**30**	21-6,627	6-1,795	**30**	15-391	3-61	**300**	1,100,000	140,677
Texas	**30**	2-102,000	1-3080	**5**	7-1,510	3-758	**300**	341,000	98,231
Wyoming	**30 – 1,400****	28-28,100	1-2,110	**5**	43-2,032	15-734	**300**	525,000-1,250,000	106,000-533,053
EPA	**30**	--	--	**5**	--	--	**300**	--	--

Notes:

There is newer data being collected that will be available to NRC when they will be developing the GEIS.

*Proposed EPA regulation
**Depending on hardness
ND No data

Four Corners Area – Unit 1

Unit 1 is located in northwestern New Mexico within the San Juan Basin of the southeastern Colorado Plateau physiographic province. The plateau encompasses much of western Colorado, eastern Utah, northeastern Arizona, and northwestern New Mexico.

Regional aquifers in northwestern New Mexico are grouped into multiple aquifer systems or hydrostratigraphic units based on hydrogeolgic relationships. At Unit 1, the Dakota Sandstone and Morrison Formation, with additional shallower aquifers found in the Mesaverde Group, are the zones for ISR.

The Westwater Canyon Member of the Morrison Formation is the principal host for roll-front uranium deposits in the Grants Mineral belt. The Dakota Sandstone is a quartz fluvial sandstone with some interbedded conglomerate, shale, carbonaceous shale, and coal serving as aquitards. The Westwater Canyon Member consists of interbedded fluvial arkosic sandstone, claystone, and mudstone. Shale aquitards (Recapture Member and Brushy Basin Member) occur above and below the Westwater Canyon Member mine zone. Beds dip approximately 1 to 2 degrees north-northeast. Uranium deposits average nearly 11 feet thick in individual ore zones that are stacked for a combined thickness of about 120 feet.

Groundwater in these locations occurs under artesian or confined aquifer conditions. Recharge occurs from infiltration of precipitation or infiltration of streamflow in the higher elevation uplift areas and moves in a down-dip direction toward the deeper parts of the basin.

Groundwater flow velocities range from 12.9 feet per year in the east to 8 feet per year at the west side of the site. Aquifer transmissivity ranges from 2,256 to 2,698 gallons per day per foot (gal/day/ft) based on aquifer testing. Storage coefficients range from 1.19E-4 to 4.5E-5. Groundwater quality of the Westwater Canyon Member is shown in Table 3.4b.

Table 3.4b
Unit 1 Site Water Quality Data [a]
Westwater Canyon Member Aquifer (HRI, 1997a)

Parameter	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)
Calcium	3.75	18.0	1.1
Magnesium	0.145	9.2	0.0
Sodium	113.0	1100.0	82.0
Potassium	1.95	12.0	0.7
Carbonate	12.0	120.0	0.0
Bicarbonate	206.0	270.0	89.0
Sulfate	35.5	220.0	20.0
Chloride	5.5	41.0	<3.0
Nitrate	0.03	1.8	<0.05
Fluoride	0.1	0.4	<0.5
Silica	18.5	23.0	11.0
TDS	285.0	590.0	0.0
Conductivity[b]	402.5	820.0	0.0
pH[c]	8.75	9.1	7.5
Arsenic	<0.005	<0.005	<0.005
Barium	<0.2	0.4	<0.2
Cadmium	<0.005	<0.005	<0.005
Chromium	0.003	0.008	<0.005
Copper	0.0405	0.980	<0.005
Iron	0.04	1.0	<0.01
Lead	0.0095	0.170	<0.005
Manganese	0.0035	0.034	<0.005
Mercury	<0.0001	<0.0001	<0.0001
Molybdenum	0.0035	0.016	<0.005
Nickel	<0.02	0.02	<0.02
Selenium	<0.005	<0.006	<0.005
Silver	<0.005	<0.005	<0.005
Uranium	2.0	2.7	0.68
Zinc	0.023	0.800	<0.005
Boron	0.01	0.5	<0.1
Radium-226[d]	10.3	200.0	0.0
Gross alpha [d]	42.0	610.0	0.0
Gross beta [d]	43.0	510.0	0.0
Radon (pCi/L) [d]	81699.0	1100000.0	22.0

Notes:

[a] Source: HRI, 1997a
[b] µmhos/cm
[c] Units
[d] pCi/L

Powder River Basin – Irigaray

The Irigaray permit area is located within the west central portion of the Powder River Basin in Wyoming. Shallow subsurface geology consists of fluvial deposits of the Wasatch Formation, Fort Union Formation, and the Lance Formation.

Uranium deposits are found in the Wasatch sediments, which are a complex, interrelated sequence of shales, mudstone, siltstones, sandstones, and thin lignite coal seams. Roll-type uranium mineralization is present in fluvial channel sands of the Wasatch formation. This host environment consists of arkosic sands of fluvial depositional environment. This mine zone is confined by aquitards above and below that consist of layers of shale, mudstones, and claystones. Mineralized zones are typically 18 feet thick. Beds dip from 1 to 3 degrees northward.

Groundwater occurs under artesian or confined aquifer conditions. Recharge occurs predominately from infiltration of precipitation or streamflow along the edges of the basin where the Wasatch crops out. Groundwater moves in a down-dip direction toward the center of the basin. Locally, at Irigaray groundwater flows in a north-northwest direction under a regional gradient of 0.004 to 0.006 feet per foot (ft/ft).

Aquifer hydraulic conductivity ranges from 0.46 to 0.55 feet per day (ft/d). The average storage coefficient is approximately 2.0E-4.

Initial groundwater quality for the Irigaray area is shown in Table 3.4c.

Table 3.4
Irigaray Area Initial Groundwater Quality Data (NRC, 1978)

Parameter	Initial (mg/L)
Calcium	58.5
Magnesium	
Sodium	308
Potassium	8.14
Carbonate	4.2
Calcium Carbonate	616
Sulfate	270
Chloride	531
Nitrate	4.91
Nitrite	2.76
Fluoride	2.75
Silica	5.3
TDS	1302
Conductivity[a]	3.30E-03
pH[b]	7.94
Arsenic	0.033
Barium	0.09
Cadmium	0.3
Chromium	< 0.002
Copper	0.215

Table 3.4
Irigaray Area Initial Groundwater Quality Data (NRC, 1978)

Parameter	Initial (mg/L)
Iron	2.15
Lead	0.32
Magnesium	19.5
Manganese	0.784
Mercury	0.0002
Molybdenum	< 0.02
Nickel	1.79
Selenium	1.02
Silver	< 0.002
Uranium	18
Vanadium	< 0.05
Zinc	0.218
Boron	8.3
Ammonia	180
Ra-226[c]	478 ± 9
Gross Alpha [c]	12,317 ± 288
Gross Beta [c]	5,374 ± 115
Th-230	640 ± 21

Notes:

(a) Concentrations are in μmhos/cm
(b) Units
(c) Concentrations are in pCi/L

South Texas – Palangana

The Palangana site is located in the Gulf Coastal Plain Province of Texas. The Gulf Coast Aquifer underlies most of the area consisting of alternating clay, silt, sand, and gravel beds of fluvial origin.

Uranium deposits at the Palangana site are found in the Goliad Formation, which is composed of channel sands interbedded with lenses of mudstone and siltstone. A salt dome lies beneath this formation at the Palangana site. Beds dip from approximately 0 to 3 degrees south to southeast.

Groundwater in the mine zone occurs under confined aquifer conditions. Recharge occurs from infiltration of precipitation or infiltration of streamflow in the higher elevation outcrop areas and moves in a down-dip direction. Groundwater flows in a southeasterly direction.

Groundwater flow velocities average approximately a few hundred feet per year. The average discharge of wells in this aquifer is about 300 gpm. Specific capacity ranges from 4 to 17 gpm per foot. Aquifer transmissivity ranges from 990 to 6,700 gal/day/ft. The storage coefficient ranges from 2.4E-04 to 6.2E-4.

Groundwater quality of the Goliad Formation is shown in Table 3.4d

Table 3.4
Groundwater Quality in the Goliad Formation (NRC, 1977)

Parameter	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)
Calcium	21	21	21
Magnesium	6.65	7.5	5.8
Sodium	453.5	599	308
Potassium	8.6	12	5.2
Bicarbonate	291.5	315	268
Sulfate	243	324	162
Chloride	417.5	600	235
TDS	1330.5	1710	951
pH[a]	7.8	7.9	7.7

Notes:

a Units

3.4.1.3 Groundwater Characteristics of Model ISR Site

Based on the general and specific information presented above, the following are groundwater characteristics of the Model ISR Site:

- Mineral bearing sequences occur in shallow sandstones that can be from 10 to over several hundred feet thick, with zones present in regional aquifer systems that facilitate downgradient movement of oxidized groundwater
- Water-bearing zones that contain deposits are bounded above and below by aquitards of varying thickness that limit vertical movement of groundwater between aquifers.
- In addition to overlying and underlying confinement by low permeability aquitards, reducing conditions in the aquifer downgradient from the mineralized zones typically inhibits further migration of uranium and associated constituents in groundwater.
- Generic pre-mining water quality in the ISR interval is poor, containing elevated radionuclides and other heavy metals levels that make groundwater unsuitable as a USDW.
- Hydraulic properties such as porosity, hydraulic gradient and hydraulic conductivity, exhibit characteristic ranges, so natural groundwater flow velocities (pre mining and post restoration) are typically on the order of tens of feet per year.
- Systems are not characterized by thin “pipeline” zones that allow rapid groundwater flow. If they were, such systems will be tube-like and perpendicular to the roll-front.

3.4.1.4 Ongoing Characterization of the Groundwater System

While many years of operational experience has demonstrated that ISR can be performed that is protective of groundwater resources both during and subsequent to operations, it is crucial that groundwater conditions be well-understood in order to ensure such performance and meet all regulatory requirements for protection of public health and safety and the environment. As a

result, even though a model ISR site can be generically defined, it remains crucial for applicants to gather all necessary site specific data are gathered both prior to and during operations.

Baseline water quality in recovery zones will be characterized in detail after licensing but prior to the start of recovery activities and will continue to be characterized on a well-by-well and well field by well field basis as the project proceeds. Groundwater in the monitor well ring (i.e., outside the recovery zone) also will be characterized to enable the operator to readily identify if and when an excursion has taken place. Water quality data will be used to determine NRC-approved upper control limits (UCLs) for purposes of excursion identification and control. Water quality data will also be used to develop targets and goals for post-operational groundwater restoration. This process of developing an adequate water quality "database" for ISR operations over the course of the development of a given project is consistent with NRC's statement in NUREG-1569 that, initially, "*in situ* leach facilit[ies] [are] not based on comprehensive information. This is because *in situ* leach facilities obtain enough information to generally locate the ore body and to understand the natural systems involved. *More detailed information is developed as each area is brought into production*." NUREG-1569 at 1-1.

Accordingly, in addition to the generic descriptions presented above, license applicants are encouraged to ensure that site-specific details, specifically those which may vary from the ranges described, as well as preliminary site-specific characterization data and plans for obtaining further well field specific data, are presented in the ISR facility application submitted to NRC.

NRC provides the following guidance (NUREG-1748) concerning the details to be included in license applications for ISR facilities:

- Site-specific data on physical and hydrological characteristics of ground and surface water in sufficient detail to provide the basic data for the evaluation of potential impacts on water bodies, aquifers, aquatic ecosystems, and social and economic structures of the specific area.
- Site-specific maps showing:
    - Spatial and temporal relationship of the site to the major surface and subsurface features
    - hydrological systems such as aquifer systems and drainage basins;
    - Surface and subsurface systems that could be affected by facility withdrawals and/or discharges (cross sections where feasible);
    - Mean, range, and temporal and spatial variations of the subsurface and surface water quality characteristics including water temperature, chemical, ecological, and physical characteristics (i.e., temperature, conductivity) that are typically monitored;

These data will enable NRC to assess and compare ISR GEIS analyses and conclusions with any site-specific components in a "tiered" EA document to accompany the issuance of the Source Material License for the site. For examples of additional guidance about how these data can be presented in an application, it is recommended that licensees refer to the HRI FEIS, NUREG 1748, and the SRP.

3.4.1.5 Additional Permitting Safeguards

ISR recovery operations are regulated by both federal and state agencies under different regulatory programs. NRC issues a uranium recovery license and EPA, or the state or tribal agency if the state or tribe has UIC primacy, issues a Class III UIC Permit for ISL uranium facilities. ISR deposits often occur at shallow depths, where TDS concentrations are below 10,000 mg/L); as such, technically, the aquifer is considered an USDW under the SDWA unless and until an aquifer exemption is granted. However, as noted above, in the uranium recovery zone, the water contains elevated concentrations of radionuclides (most commonly radon-222, radium-226 and uranium), as well as other constituents. Although a portion of the aquifer is exempted from protection for the purposes of ISR, groundwater in the aquifer(s) outside of the exempted area still must be protected so the potential for future use of the USDW outside the exemption area is not impaired (NRC 2003a).

The Model ISR Site will have a license with performance-based license conditions. Performance-based license conditions are consistent with and endorsed in Commission policy and have been used for many years to provide for efficient use of both the licensee's and NRC's resources. Performance-based licensing allows operators to make certain changes to their operations including changes to facilities, changes to processes, alterations to standard operating procedures (SOPs) and the conduct of tests without the need for prior approval by NRC. This only applies provided the changes do not conflict with mandatory license conditions, the changes do not adversely affect safety or the environment and, the changes are consistent with the facility EIS/EA and SER. Before making such changes, however, any such changes must be evaluated and approved by the licensee's Safety and Environmental Review Panel (SERP). All such decisions must be documented and made available to NRC. Inspection of ISL facilities which have been issued performance-based licenses includes an evaluation of the effectiveness of any SERP decisions and can result in post-decision enforcement action. Thus, it is important for the licensee to ensure its SERP is properly selected and trained and that all appropriate documentation relating to the SERP program is maintained on file for review by NRC inspectors.

3.4.2 Surface Water

Surface water at the model ISR site is typical of semiarid regions of the western United States; however, one of the model regions, coastal Texas, has more precipitation. The average annual precipitation of the model ISR site can range from approximately 5 to 60 inches (National Atlas 2007). Surface waters near the model ISR site typically are intermittent streams and small ranch impoundments used for livestock watering. These ephemeral streams have their maximum flows in June and July and typically are dry from September to February. Rivers and reservoirs are typically several miles away from the model ISR site. Accordingly, most ISR sites will be located in high steppe or rangeland areas and not in floodplains or near large bodies of water.

In most cases, nearby surface water is not pristine (not of drinking water quality) and may contain relatively high concentrations of dissolved solids making it unsuitable for many purposes.

Site-specific assessments of the surface water near an ISR facility will be conducted prior to operation. At a minimum, such assessments will include the following:

(1) Survey and document surface water resources in the Study Area, including rivers, reservoirs, wetlands, seeps, and streams.
(2) Establish general use of surface waters, such as for recreation, irrigation, and so forth.
(3) Establish water quality baseline defined by "Class of Use."
(4) Document stream flow regimes and stream densities.
(5) Research of applicable data from sources such as United States Geological Survey and National Wetland Inventory.

3.5 Ecology

For purposes of this GER, the ecological environment considered is based on a composite of current and potential ISR locations in the United States, including Texas, Wyoming, Nebraska, New Mexico, Colorado (Weld County), South Dakota (west of the Black Hills), Arizona, and Oklahoma.

A description of the flora and fauna in the vicinity and their habitats is necessary to help identify potential impacts on each species. Species that are critical to the structure and function of the ecological system or a biological indicator of radionuclides or chemical pollutants in the environment will be identified. Inventories will be made of the terrestrial and aquatic organisms on or near the ISR facility, their relative abundance, and species that migrate through the area or use it for breeding grounds. Documentation of populations and distributions of domestic fauna, in particular cattle, sheep, and other meat and game animals that may be exposed to radionuclides, will be used to estimate potential impacts on the food chain. The occurrence of rare, threatened, or endangered species on and within the licensed area at a distance based on species identified will be noted, along with information on surveys and literature searches conducted for the presence or absence of species determination.

Descriptions of the division, province, fauna, and vegetation for the above-mentioned areas are provided in Table 3.5, Flora and Fauna Descriptions for the Model ISR Site (Bailey, 1995). In Table 3.5, the above-mentioned areas are grouped into three geographically similar areas: Wyoming/Northern States; Texas; and the San Juan Basin or "Four Corners Area."

Site specific assessments for ISR projects will be conducted and will include the following objectives at a minimum:

(1) Survey and document vegetation communities in the Study Area
(2) Document occurrences of any threatened, endangered, or sensitive species in the Study Area
(3) Document occurrences of any noxious weeds and invasive species in the Study Area
(4) Document occurrences of any hydrophytic plant species in the Study Area
(5) Establish vegetation reference areas

Table 3.5
Flora and Fauna Descriptions for the Model ISR Site

Region	Division		Province		
				Fauna	**Flora**
ISR Region 1: San Juan Basin - "Four Corners Area": Region of high desert plateau surrounding the intersection of Colorado, Utah, New Mexico, and Arizona	Temperate Desert (340)*****	Temperate deserts of continental regions have low rainfall and strong temperature contrasts between summer and winter. In the intermountain region of the western United States between the Pacific coast and Rocky Mountains, the temperate desert has characteristics of a sagebrush (Artemisia) semidesert, with a very pronounced drought season and a short humid season. Even at intermediate elevations, winters are long and cold, with temperatures falling below 32 ºF (0 ºC). These deserts differ from those at lower latitudes chiefly in their far greater annual temperature range and much lower winter temperatures. Unlike the dry climates of the tropics, dry climates in the middle latitudes receive part	Intermountain Semidesert and Desert (341)	Few large mammals live in this province, but mule deer, mountain lion, bobcat, and badger occasionally venture into it. Sagebrush provides ideal habitat for pronghorn antelope and whitetail prairie dog. The most common species are such small mammals such as ground squirrels, jackrabbits, kangaroo mice, wood rats, and kit foxes. In the lower life belts, some ground squirrels—especially the Belding and Townsend ground squirrels—become dormant during the hot, dry summer. Bird species range from the burrowing owl to such specialized species such as sage sparrow and sage thrasher, both found only in sagebrush habitat. Raptors include the American kestrel and golden eagle, along with the ferruginous hawk and various other species of western hawks. In early spring, groups of sage grouse engage in elaborate courtship displays.	Sagebrush dominates at lower elevations. Other important plants in the sagebrush belt are antelope bitterbrush, shadscale, fourwing saltbush, rubber rabbitbrush, spiny hopsage, horsebrush, and short-statured Gambel oak. All these shrubs tolerate alkali to varying degrees, essential to their survival on the poorly drained soils widespread in the region. On soils with the highest concentrations of salt, even these shrubs are unable to grow; they are replaced by plant communities dominated by greasewood or saltgrass. Although sagebrush now dominates this zone, it may not represent climax growth, but rather a disclimax produced by overgrazing. In plots protected from fire, grasses typical of the Palouse grassland or mixed-grass steppe gradually become dominant. Above the sagebrush belt lies a woodland zone dominated by pinyon pine and juniper, similar to the pinyon-juniper woodland of the Colorado Plateau. In the montane belt above the woodland zone, ponderosa pine generally occupies the lower and more exposed slopes and Douglas fir the higher and more sheltered ones. In the subalpine belt, the characteristic trees are subalpine fir

Table 3.5
Flora and Fauna Descriptions for the Model ISR Site

Region	Division		Province		
				Fauna	**Flora**
		of their precipitation as snow.			and Engelmann spruce. Only a few mountains rise high enough to support an alpine belt.
			Colorado Plateau Semidesert (313)	Major mammals are the mule deer, mountain lion, coyote, and bobcat; elk are locally important. Pronghorn antelope are the primary large mammal in the arid grasslands. Smaller species include the blacktail jackrabbit, Colorado chipmunk, rock squirrel, wood rat, white-footed mouse, cliff chipmunk, cottontail, porcupine, and gray fox. The ringtail cat and spotted skunk occur rarely. The most abundant resident birds are the bushtit, pinyon jay, plain titmouse, black-chinned hummingbird, Woodhouse's jay, red-tailed hawk, golden eagle, red-shafted flicker, and rock wren. Summer residents include the chipping sparrow, nighthawk, black-throated gray warbler, northern cliff swallow, lark sparrow, and mourning dove. Common winter residents are the pink-sided junco, Shufeldt's junco, gray-headed junco, red-backed junco, Rocky Mountain nuthatch, mountain bluebird, robin, and	Vegetational zones are conspicuous but lack uniformity. In the lowest zone, there are arid grasslands, but the shortgrass sod seldom covers the ground completely, leaving many bare areas. Xeric shrubs often grow in open stands among the grasses, and sagebrush is dominant over extensive areas. A profusion of annuals and perennials blooms during the summer rainy season. At low elevations in the south, several kinds of cactus and yucca are common. Cottonwoods and more rarely other trees grow along some of the permanent streams. The woodland zone is the most extensive, dominated by open stands of two-needle pinyon pine and several species of juniper, often termed a pygmy forest. Between the trees, the ground is sparsely covered by grama, other grasses, herbs, and various shrubs, such as big sagebrush and alderleaf cercocarpus. The montane zone extends over considerable areas on the high plateaus and mountains, but it is much smaller in area than the pinyon-juniper zone. Vegetation in the montane zone varies considerably from area to area. In the south, especially in Arizona, ponderosa pine

Table 3.5
Flora and Fauna Descriptions for the Model ISR Site

Region	Division		Province		
				Fauna	**Flora**
				Steller's jay. Turkeys are locally abundant during winter. Reptiles include the horned lizard, collared lizard, and rattlesnake.	is the dominant forest tree. Douglas fir is associated with ponderosa pine or grows in more sheltered locations or at higher elevations. In Utah, by contrast, lodgepole pine and aspen are dominant. The subalpine zone is characterized by abundance of Engelmann spruce and subalpine fir. On San Francisco Mountain in northern Arizona, the spruce is often associated with bristlecone pine. Because only a few isolated mountains rise above the timberline, the alpine zone is not extensive. South of the Mogollon Rim in Arizona, toward the American Desert, lies a foothill forest. The principal trees are Mexican pinyon, alligator juniper, and various species of oak. Forests of ponderosa pine and common Douglas fir carpet moist canyons and northfacing slopes. Pointleaf manzanita is a common evergreen shrub.

Table 3.5
Flora and Fauna Descriptions for the Model ISR Site

Region	Division		Province		
				Fauna	**Flora**
ISR Region 2: Powder River Basin: Region spanning northeastern Wyoming, northwestern South Dakota, and southeastern Montana.	Temperate Steppe (330)	Temperate steppes are areas with a semiarid continental climatic regime in which, despite maximum summer rainfall, evaporation usually exceeds precipitation.	Great Plains-Palouse Dry Steppe (331)	Common large mammals include elk, deer, bighorn sheep, mountain lion, bobcat, beaver, porcupine, and black bear. Grizzly bear and moose inhabit the province's northern portions. Small mammals include mice, squirrels, martens, chipmunks, mountain cottontails, and bushytail woodrats. Common birds include the mountain bluebird, chestnut-backed chickadee, red-breasted nuthatch, ruby-crowned kinglet, pygmy nuthatch, gray jay, Steller's jay, and Clark's nutcracker. Rosy finches are found in the high snowfields. Blue and ruffed grouse are the most common upland game birds. Hawks and owls inhabit most of the region.	The vegetation is steppe, sometimes called shortgrass prairie, and semidesert. Typical steppe vegetation consists of numerous species of short grasses that usually grow in sparsely distributed bunches. Scattered shrubs and low trees sometimes grow in the steppe; all gradations of cover are present, from semidesert to woodland. Because ground cover is generally sparse, much soil is exposed. Many species of grasses and other herbs occur. Buffalo grass is typical of the American steppe; other typical plants are the sunflower and locoweed. The semidesert cover is a xerophytic shrub vegetation accompanied by a poorly developed herbaceous layer. Trees are generally absent. An example of semidesert cover is the sagebrush vegetation of the middle and southern Rocky Mountain region and the Colorado Plateau. A striking feature of the region is its pronounced vegetational zonation, controlled by a combination of altitude, latitude, direction of prevailing winds, and slope exposure. Generally, the various zones are at higher altitudes in the southern part of the province than in the northern, and they extend downward on east facing and northfacing slopes and in narrow

Table 3.5
Flora and Fauna Descriptions for the Model ISR Site

Region	Division		Province		
				Fauna	**Flora**
					ravines and valleys subject to cold air drainage. Grass, often mixed with sagebrush, regularly covers the ground in open ponderosa pine forests and some treeless areas. These treeless openings are usually small, and they often alternate (depending on slope exposure) with ponderosa pine forest. At the lower edge of the montane zone, they may open onto the adjacent grass and sagebrush belt. Below the montane belt is the foothill (woodland) zone. Dry rocky slopes in this zone often have a growth of shrubs in which mountain-mahogany and several kinds of scrub oak are conspicuous. Many unforested parks are dominated by grasses, but some are covered largely by sagebrush and other shrubs, such as antelope bitterbrush.
	Prairie (250)	Prairies are typically associated with continental, mid-latitude climates that are designated as subhumid. In summer, air and soil temperatures are high; soil moisture in the uplands is inadequate for tree	Great Plains Steppe (332)	Bison once grazed the western margin of the mixed-grass steppe. Pronghorn antelope and coyotes are still present. Jackrabbits are numerous on the steppe, and cottontails are present where there are streams and cover. Burrowing rodents include ground squirrels, prairie dogs, pocket gophers, and many	This region, called mixed-grass steppe, reaches from the tallgrass prairie parkland to the shortgrass steppe. As its name suggests, it contains a mixture of shortgrass and tallgrass species. The tall grasses grow to a height of about 48 inches; the shorter grasses reach 18 inches. Shorter dominants include blue grama, hairy grama, and buffalo grass. Taller grasses include little

Table 3.5
Flora and Fauna Descriptions for the Model ISR Site

Region	Division		Province		
				Fauna	**Flora**
		growth, and deeper sources of water are beyond the reach of tree roots.		smaller species. Burrowing predators include the badger and the black-footed ferret. The northern portion of this region is an important breeding area for migrating waterfowl. Mourning doves have become abundant in shelterbelt plantings. The sharp-tailed grouse, greater prairie chicken, and bobwhite are present in fair numbers; however, the northern greater prairie chicken is classified as threatened.	bluestem and needle-and-thread grass. Woody vegetation is rare, except on the cottonwood floodplains. In mixed-grass steppe, additional species include green needlegrass, sand dropseed, slender wheatgrass, galleta, and purple three-awn. There are numerous species of forbs throughout the region. Match weed or broomweed, scurf-pea, sunflowers, goldenrods, and ragweed occur from Oklahoma into Canada. The eastern and western boundaries of this region continually shift with changes in precipitation. A series of dry years results in an increased dominance of short grasses (better adapted to a dry climate), moving the region's boundaries to the east. Westward shifts occur after periods of relatively high precipitation, which favor the taller grasses.

Table 3.5
Flora and Fauna Descriptions for the Model ISR Site

Region	Division		Province		
				Fauna	**Flora**
ISR Region 3 - South Texas: Narrow region along the Gulf of Mexico including the area around Hebbronville, Brownsville and Corpus Christi.	Tropical / Subtropical Steppe (310)	The climate of tropical/subtropical steppes is a hot semiarid climate where potential evaporation exceeds precipitation, and where all months have temperatures above 32 ºF.	Tropical/Subtropical Desert Division, Chihuahuan Desert Province (321).	Pronghorn antelope and mule deer are the most widely distributed large game animals. Whitetail deer inhabit parts of Texas. The armadillo, badger, feral hogs, possums, and collared peccary or javelina is common in the southern part of the region. The blacktail jackrabbit, desert cottontail, kangaroo rat, wood rat, and numerous smaller rodents compete with domestic and wild herbivores for available forage. Mammalian predators include the coyote, mountain lion, and bobcat. The black-throated sparrow is one of the most abundant birds of the province. Greater roadrunner, curve-billed thrasher, mourning dove, and Chihuahuan raven are also common. Scaled quail and Gambel's quail occupy most of the area, and bobwhite populations reach into its eastern portion. Raptors include the golden eagle, great horned owl, red-tailed hawk, ferruginous hawk, and the rare zone-tailed hawk. The many reptiles include the common chuckwalla, Texas horned lizard, desert spiny	A number of shrubs, most of them thorny, are typical of the Chihuahuan Desert. They frequently grow in open stands, but sometimes form low, closed thickets. In many places, they are associated with short grass, such as grama. Extensive arid grasslands cover most of the high plains of the province. On deep soils, honey mesquite is often the dominant plant. Cacti are also abundant, particularly prickly pears, but they are smaller in size and fewer in number of species than in the Sonoran Desert. The desert is characterized by yuccas, so much so that one has been adopted as the state flower of New Mexico. A few cottonwoods and other trees grow beside the widely separated rivers. Creosote bush, which covers great areas in characteristic open stands, is especially common on gravel fans. Although creosote bush is the most abundant plant cover of the province, other species like lechuguilla are also abundant. Another distinctive plant is candelilla, or wax plant. On rocky slopes, the ocotillo is conspicuous. Juniper and pinyons, limited to rocky outcrops, are prominent around the Stockton Plateau in western Texas. Some isolated mountains in the Chihuahuan Province rise high enough to carry a belt of oak and juniper woodland. On a few of the

Table 3.5
Flora and Fauna Descriptions for the Model ISR Site

Region	Division		Province		
				Fauna	**Flora**
				lizard, cottonmouth (water moccasin), copperhead, coral snake, bull snake, and various species of rattlesnakes.	highest mountains, there are pines among the oaks, in some places forming nearly pure stands. Douglas fir and white fir occupy a few sheltered upper slopes in the Santa Catalina Mountains.
	Tropical/ Subtropical Desert (320)	South of the Arizona-New Mexico Mountains are the continental desert climates, which have not only extreme aridity, but also extremely high air and soil temperatures. Direct sun radiation is very strong, as is outgoing radiation at night, causing extreme variations between day and night temperatures and a rare nocturnal frost.	Tropical/Subtropical Steppe Division, Southwest Plateau and Plains Dry Steppe and Shrub Province (315)	The northern limit of distribution of several mammals coincides generally with the northern boundary of this province. The Mexican ground squirrel and gray fox live to the south of this boundary, but not to the north. Whitetail deer are abundant, and armadillo are present. The fox squirrel is hunted in wooded areas along streams. Chief furbearers are the ringtail and raccoon. The Edwards Plateau contains several scattered limestone caverns that support huge populations of Mexican freetail bats. The threatened golden-cheeked warbler and black-capped vireo inhabit northwestern areas where the Ashe juniper is present. Wild turkey, mourning dove, scaled quail, and bobwhite are common game birds, and several species of hawks and owls are present.	This province is characterized by arid grasslands in which shrubs and low trees grow singly or in bunches. On the plains of northwestern Texas and eastern New Mexico, xerophytic grasses (blue grama and buffalo grass) are the characteristic vegetation. However, in much of this area, mesquite (*Prosopis*) grows in open stands among the grasses. On the Edwards Plateau, oak and juniper are often mixed with grasses and mesquite, and on steep rocky slopes these trees may form closed stands. Due to low rainfall, they rarely grow higher than 20 feet. The most characteristic tree is Ashe juniper. Over much of the plateau, the characteristic vegetation is grass, especially prairie three-awn (needlegrass); trees and shrubs are present only in very open stands. On slopes leading down to the Rio Grande, the ceniza shrub dominates. Live oak forest is found along the Gulf Coast. A unique semiarid forest consisting of small trees and shrubs with Mexican affinities occupies the Rio Grande delta. The endangered sabal palm is native here.

3.6 Meteorology and Climatology, Air Quality, and Noise Levels

This section describes the meteorology and climatology, air quality, and noise levels that are typical for the model regions. The location of probable uranium resources is shown and described in Section 3.0. Potential ISR operations likely will occur in the western United States and along the gulf coast region of Texas.

The meteorology, climatology, and air quality vary considerably between the uranium producing regions of the United States. Averaging meteorology, climatology and air quality data is not attempted because the differences between regions will yield results that are not representative of typical uranium-producing regions. Since potential impacts of ISR operations are largely site-specific, general site descriptions of three representative locations are reviewed and discussed in this document and provide a general level of detail in regions where development of ISR likely will occur. The representative locations selected for regional analysis are a location near the coast of Texas; a location near northwestern New Mexico, northeastern Arizona, southeastern Utah, and southwestern Colorado referred to as the Four Corners region; and a location near the Wyoming and South Dakota border. The regions are representative of locations where uranium reserves are present.

Because each region is mostly rural and has similar geographic features, the climatological and air quality characteristics are similar for most ISR sites.

3.6.1 Meteorology and Climatology

The model environments for ISR projects are described below.

3.6.1.1 South Texas

The uranium-producing areas in Texas are primarily located in a warm temperate zone. Temperatures in the south Texas model region are represented by data collected in Corpus Christi, Texas (see Table 3.5). This model region has a subtropical humid climate noted for warm summers. The climate varies between the humid subtropical region to the northeast and the semi-arid region to the west and southwest. Normal rainfall is just over 32 inches a year. Peak rainfall months are May and September. Temperatures range from highs in the low 90s during summer and the mid- and upper 60s in winter. Lows range from the mid-70s during the summer to the mid- and upper 40s in winter. Based on the proximity of the Gulf of Mexico, humidity is high throughout the year and fog is common in fall, winter, and early spring. Snow and other forms of frozen precipitation are rare, with trace amounts every 2 years on average. Temperatures below freezing seldom occur along the immediate coast, but normally occur several times a year west of the city and further inland. Hurricanes and tropical depressions can occur from June through November (NWS 2007). Typically these storms lose intensity as the pass over land areas. A summary of the model region precipitation, humidity, and wind data is presented in Table 3.6.

Table 3.6
Corpus Christi, Texas Temperature, Precipitation, Relative Humidity, Pan Evaporation, Wind Speed and Wind Direction

Month	Temperature (ºF)	Precipitation (inches)	Relative Humidity (percent)	Pan Evaporation (inches)	Average Wind Speed (mph)	Average Wind Direction
January	56.1	1.62	76.8	2.54	12.0	SSE
February	59.5	1.84	75.8	3.00	13.0	SSE
March	66.0	1.74	74.8	4.44	13.7	SSE
April	71.5	2.05	76.2	5.15	14.1	SE
May	77.5	3.48	80.2	5.83	12.8	SE
June	81.9	3.53	78.6	6.83	11.3	SE
July	83.8	2.00	75.4	7.69	11.5	SE
August	83.9	3.54	75.2	7.36	11.0	SE
September	80.8	5.03	76.0	5.83	10.3	SE
October	73.8	3.94	76.0	5.04	10.6	SE
November	65.1	1.74	77.8	3.50	11.8	SSE
December	58.1	1.75	76.0	2.85	11.7	N
Annual	71.5 (average)	32.26 (annual total)	76.6 (average)	60.19 (annual total)	12.0 (average)	SE (average)

Notes:
N North
SE Southeast
SSE South-southeast

Source:
SRCC 2007

3.6.1.2 Four Corners Region

The uranium-producing areas in the Four Corners region are primarily located in a semi-arid zone. The warmest days often occur in June before the thunderstorm season begins during July and August. The average range between daily high and low temperatures is from 25 ºF to 35 ºF, with the average annual high temperature in Farmington of 67 ºF and the average annual low temperature of 38 ºF. Summer rains fall almost entirely during brief, but frequently intense, thunderstorms. The general southeasterly flow from the Gulf of Mexico brings the gulf moisture, which combined with strong surface heating and orographic lifting over higher terrain, produces summer thunderstorms. July and August are the rainiest months over most of the region, with from 30 to 40 percent of the year's total moisture falling in that timeframe.

Winter precipitation is caused mainly by frontal activity associated with the general movement of Pacific Ocean storms across the country from west to east. As these storms move inland, much of the moisture is precipitated out over the coastal and inland mountains ranges of California, Nevada, Arizona, and Utah. Much of the remaining moisture falls on the western slope of the Continental Divide (WRCC 2007a). A summary of the model region precipitation, humidity and wind data is presented in Table 3.7.

Table 3.7
Farmington, New Mexico Average Temperature Precipitation, Relative Humidity, Pan Evaporation, Wind Speed and Wind Direction

Month	Temperature (˚ F)	Precipitation (inches)	Relative Humidity (percent)	Pan Evaporation (inches)	Average Wind Speed (mph)	Average Wind Direction
January	28.7	0.57	55.3	0.00	7.3	E
February	35.1	0.48	48.5	0.00	8.3	E
March	41.3	0.53	40.0	0.00	9.0	W
April	51.1	0.57	32.3	7.97	9.8	W
May	60.3	0.49	32.3	10.06	9.4	W
June	69.3	0.34	30.3	12.00	9.4	E
July	75.9	0.84	41.5	12.52	8.7	E
August	73.6	1.17	47.5	10.70	8.2	E
September	65.7	0.78	46.3	8.15	8.0	E
October	53.9	1.15	43.8	5.41	7.8	E
November	39.7	0.48	49.3	0.00	7.6	E
December	30.3	0.79	56.0	0.00	7.3	E
Annual	52.1 (average)	8.19 (annual total)	43.6 (average)	66.81 (annual total)	8.4 (average)	E (average)

Notes:

Relative humidity data for Albuquerque (WRCC 2007b)
E East
W West

3.6.1.3 Wyoming-South Dakota

The potential uranium producing area in the Wyoming-South Dakota region is generally open terrain that permits free movement of winds and weather systems through the area, which can result in rapid and extreme weather changes. The Big Horn Mountains, about 60 miles to the west, greatly influence climatic conditions in the region. The climate in this model region is semiarid with long, cold winters; short, hot summers; and wide variations in daily and seasonal temperatures and seasonal precipitation. In nearby Gillette, precipitation averages approximately 16 inches per year and can vary from about 10 to 23 inches per year.

Approximately half of the precipitation occurs in April, May, and June. Winter blizzards bring high winds and very cold temperatures to the region. Snowdrifts several feet deep are common. Temperatures in the area average approximately 52 °F annually, but record lows and highs vary from about -40 °F to 107 °F. Average monthly temperatures range from 20 °F in January to 71 °F in July. Severe weather in the region includes blizzards, thunderstorms, and extended dry spells. Annually, five or more blizzards, lasting several hours to several days, may occur in Gillette. Strong winds can cause extensive drifting of snow and limited visibility (GPR, Inc. 1982). A summary of the model region precipitation, humidity and wind data is presented in Table 3.8.

Table 3.8
Gillette, Wyoming Average Temperature Precipitation, Relative Humidity, Wind Speed and Wind Direction

Month	Temperature (° F)	Precipitation (inches)	Relative Humidity (percent)	Pan Evaporation (inches)	Average Wind Speed (mph)	Average Wind Direction
January	20.7	0.55	64.5	0.00	11.0	SW
February	26.2	0.63	63.8	0.00	11.4	SW
March	31.4	1.05	60.3	0.00	11.2	S
April	41.5	1.91	58.0	4.52	11.5	S
May	51.5	2.79	52.5	6.40	11.1	S
June	60.9	2.93	46.0	7.50	10.3	S
July	69.2	1.30	44.0	9.88	9.4	S
August	67.9	1.63	47.8	9.44	10.0	S
September	57.2	1.10	51.78	6.18	9.4	S
October	46.6	1.09	67.8	4.36	10.3	S
November	32.7	0.71	61.8	2.39	10.9	SW
December	24.3	0.61	63.8	0.00	11.8	S
Annual	52.4 (average)	16.3 (annual total)	56.8 (average)	50.67 (annual total)	10.7 (average)	S (average)

Notes: Relative humidity data for nearby Sheridan, Wyoming (WRCC 2007c)
S South
SW Southwest

3.6.2 Air Quality

National Ambient Air Quality Standards (NAAQS) exist for sulfur dioxide (SO_2) nitrogen dioxide (NO_2), carbon monoxide (CO), lead (Pb), and particulate matter smaller enough to move easily into the lower respiratory tract (PM_{10}). The NAAQS are expressed as pollutant concentrations that are not to be exceeded in the ambient air; that is, in the outdoor air to which the general public is exposed (40 CFR Part 50). Primary NAAQS are designated to protect human health, while secondary NAAQS were developed to protect public welfare, including protection for animals, vegetation, visibility, and buildings.

Table 3.9 lists the applicable NAAQS that must be maintained throughout construction and operation of the project (Title 40 CFR Part 50).

Table 3.9
National Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS ($\mu g/m^3$)
PM_{10}	24-hour[1]	150
	Annual[2]	50
NO_2	Annual[2]	100
SO_2	3-hour[1]	1300
	24-hour[1]	365
	Annual[2]	80
CO	1-hour[1]	40,000
	8-hour[1]	10,000

Table 3.9
National Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS (µg/m^3)
Ozone	1-hour[3]	235
	8-hour[4]	157
Lead	Quarterly	1.5

Notes:

1 This standard is not to be exceeded more than once per year.
2 Arithmetic mean.
3 The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 235 µg/m^3 (0.12 part per million) is <= 1. (b) The 1-hour standard is applicable to all areas notwithstanding the promulgation of 8-hour ozone standards under Sec. 50.10. On June 2, 2003 (68 Fed. Reg. 32802), EPA proposed several options for when the 1-hour standard would no longer apply to an area.
4 The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 157 µg/m^3 (0.08 parts per million).

µg/m^3 Micrograms per cubic meter
PM_{10} Particulate matter with an aerodynamic diameter of 10 microns or less
NO_2 Nitrogen dioxide
SO_2 Sulfur dioxide
CO Carbon monoxide

Source: EPA. 2007b. "National Ambient Air Quality Standards." Available Online at: http://epa.gov/air/criteria.html

The air quality in the model region(s) generally is good. The areas are sparsely populated and not heavily developed with industrial sources of air pollution. Table 3.10 presents air quality monitoring data in the model regions compared with the NAAQS.

Table 3.10
Monitored Air Quality Values

Pollutant	Averaging Time	Monitored Concentration (µg/m^3)	NAAQS (µg/m^3)
Corpus Christi, TX			
PM_{10}	24-hour[1]	65.0	150
	Annual[2]	32.9	50
NO_2	Annual[2]	9.6	100
SO_2	3-hour[1]	399.0	1300
	24-hour[1]	13.3	365
	Annual[2]	3.2	80
CO	1-hour[1]	4,176	40,000
	8-hour[1]	2,784	10,000
Ozone	1-hour[3]	176.0	235
	8-hour[4, A]	71.0	157
Lead	Quarterly	0.01	1.5
Gillette, WY			
PM_{10}	24-hour[1]	136	150
	Annual[2]	10.1	50
NO_2	Annual[2]	4.1	100
SO_2	3-hour[1]	133.0	1300
	24-hour[1]	74.5	365

Table 3.10
Monitored Air Quality Values

Pollutant	Averaging Time	Monitored Concentration (µg/m^3)	NAAQS (µg/m^3)
	Annual[2]	8.0	80
CO	1-hour[1]	1,276	40,000
	8-hour[1]	464	10,000
Ozone	1-hour[3]	156.0	235
	8-hour[4, A]	101.8	157
Lead	Quarterly		1.5
Farmington, NM			
PM_{10}	24-hour[1]	29.0	150
	Annual[2]	16.0	50
NO_2	Annual[2]	26.5	100
SO_2	3-hour[1]	31.9	1300
	24-hour[1]	8.0	365
	Annual[2]	2.9	80
CO	1-hour[1]	4,292	40,000
	8-hour[1]	3,132	10,000
Ozone	1-hour[3]	152.0	235
	8-hour[4, A]	81.2	157
Lead	Quarterly	0.03	1.5

Notes:
1 This standard is not to be exceeded more than once per year.
2 Arithmetic mean.
3 The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 235 µg/m^3 (0.12 part per million) is <= 1. (b) The 1-hour standard is applicable to all areas notwithstanding the promulgation of 8-hour ozone standards under Sec. 50.10. On June 2, 2003 (68 FR 32802), EPA proposed several options for when the 1-hour standard would no longer apply to an area.
4 The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 157 µg/m^3 (0.08 parts per million). These values were not available for this document.

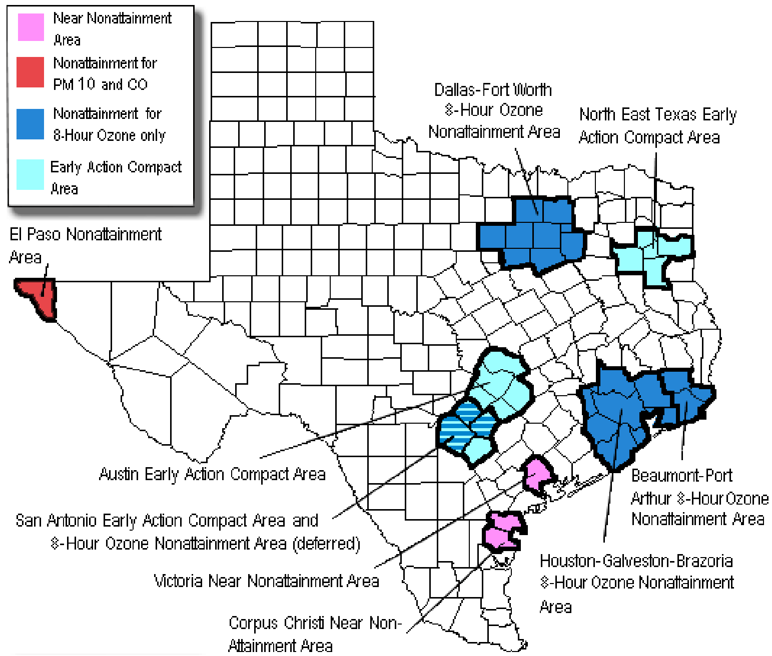
µg/m^3 Micrograms per cubic meter
PM_{10} Particulate matter with an aerodynamic diameter of 10 microns or less
NO_2 Nitrogen dioxide
SO_2 Sulfur dioxide
CO Carbon monoxide

Source: http://air.state.nm.us/http://deq.state.wy.us/aqd/Monitoring%20Data.asp

3.6.2.1 Attainment Status

Areas of the country where air pollution levels persistently exceed the NAAQS may be designated "nonattainment" areas. A nonattainment designation carries certain significant regulatory consequences. In nonattainment areas, any "stationary source" (i.e., an industrial source that produces air emissions and requires an air quality permit) wishing to expand or to newly locate within the nonattainment area faces strict new source review (NSR). NSR requirements apply to major stationary sources. Major stationary sources locating or expanding in attainment areas are required to install strict emission controls following Best Available Control Technology guidelines and in accordance with Lowest Achievable Emission Rate rules.

The Four Corners and Wyoming-South Dakota regions are located in attainment areas. Potential ISR locations in the South Texas region may be located in nonattainment areas. Figure 3.9 presents the nonattainment areas in Texas.



Source: TCEQ 2007

Figure 3.9 - Texas Nonattainment and Near Nonattainment Areas

There are also national standards for the prevention of significant deterioration (PSD) of air quality (40 CFR Part 51). PSD standards differ from NAAQS in that the NAAQS provide maximum allowable concentrations of pollutants, while PSD standards provide for maximum allowable increases in concentrations of pollutants. PSD standards are calculated using increases in concentrations, termed increments. PSD increments are the maximum permissible level of increased air quality impacts that may occur beyond a baseline air quality level. Allowable PSD increments have been established for SO_2, NO_2, and PM_{10} but do not exist for other pollutants. Regulations do not allow total air quality impacts beyond the applicable NAAQS limits, even if all the PSD increment is not consumed (EPA, 1990). One set of allowable increments exists for Class II areas, which cover most of the United States. Different sets of increments exists for Class I areas. Class I areas include certain national parks and monuments, wilderness areas, and other areas as defined in 40 CFR Part 51. Maximum allowable PSD increments are presented in Table 3.11.

Table 3.11
Maximum Allowable PSD Increments

Pollutant	Averaging Time	Class I Increment (μg/m^3)	Class II Increment (μg/m^3)
PM_{10}	24-hour	8	30
	Annual	4	17
NO_2	Annual	2.5	25
SO_2	3-hour	25	512
	24-hour	5	91
	Annual	2	20

Notes:

μg/m^3 Micrograms per cubic meter
NO_2 Nitrogen dioxide
PM_{10} Particulate matter with an aerodynamic diameter of 10 microns or less
PSD Prevention of significant deterioration
SO_2 Sulfur dioxide

Source: EPA. 2007c. "Prevention of Significant Deterioration New Source Review: Refinement of Increment Modeling Procedures; Proposes Rule." Available Online at: >http://www.epa.gov/fedrgstr/EPA-AIR/2007/June/Day-06/a10459.pdf>.

3.6.3 Noise

Noise or "unwanted sound" can be intermittent or continuous, steady or impulsive, and stationary or transient. Humans or wildlife can be affected by noise either interfering with normal activities or diminishing the quality of the environment. Perception of noise is affected by the intensity, frequency, pitch and duration, as well as the auditory system and physiology of a particular human or animal. Noise levels experienced by humans or wildlife are dependent on variables such as distance, percentage and type of ground cover, and objects or barriers between the noise source and the receiver, as well as the atmospheric conditions.

A logarithmic unit known as the decibel (dB) is typically used to represent the intensity of a sound. Humans typically have reduced hearing sensitivity at low frequencies compared with their response at high frequencies, and the "A-weighting" of noise levels, or A-weighted decibels (dBA), closely correlate to the frequency response of normal human hearing.

Noise evaluations use standards from EPA, ASTM International, and Occupational Safety and Health Administration (OSHA). Noise is not regulated by EPA or ASTM International standards, but is instead regulated by state and local government. Exposure of workers to noise within the model facility will be governed by applicable OSHA standards (OSHA, 1991).

Based on certain land uses or types of facilities, some receptors (human and wildlife) are more sensitive to a given level of noise than other receptors that may have less exposure to a given noise. These "sensitive receptors" may include schools, churches, hospitals, retirement homes, campgrounds, wilderness areas, hiking trails, and some species of threatened and endangered wildlife.

The acoustical environment of the model regions can be characterized as rural, with background noise levels typically controlled by natural sources, such as vegetation rustle, wildlife and insects. Current ambient noise within the model region is limited to naturally occurring sources, nearby light roadway traffic and off-road motorized sources, and noise from

any nearby population centers. Noise generated by the proposed facility will include exploration (primarily isolated drilling equipment) and construction machinery prior to operation and during active operations (i.e., additional well field construction occurs while operations are ongoing), and machinery during demolition activities for plant decommissioning. Outside noise during operation of the extraction and processing plant will include that generated by material shipments and commuting traffic. It is not anticipated that the plant itself will produce measurable off-site noise, because noise-generating processing equipment is largely contained within buildings.

3.7 Historic and Cultural Resources

The following sections relate to preservation of cultural resources, which include historic architectural structures and landscapes, archeological sites, and traditional tribal cultural areas. The related study processes are also discussed.

3.7.1 Generic Overview of Historic and Cultural Resource Preservation

Applicable regulations in addition to NEPA include: (1) NHPA of 1966; (2) Archaeological and Historic Preservation Act of 1974, as amended; (3) Archaeological Resources Protection Act of 1979, as amended; and (4)) Native American Graves Protection and Repatriation Act (NAGPRA); (5) Religious Freedom Protection Act (RFPA); and (6) state, local, and tribal laws (*site-specific*). Historic properties eligible for or listed on the National Register for Historic Places (NRHP) are protected by Section 106 of the NHPA. Under the Act, NRC is required to consult with the SHPO, the ACHP, the THPO, if relevant, and other interested parties on the effects that NRC and/or Agreement State agencies' licensing action(s) could have on historic and cultural properties listed or eligible for listing on the NRHP.

Simplistically stated, cultural resources can be of several types: (1) significant archaeological resources; (2) significant historic architectural resources – structures, districts, and landscapes; and (3) traditional cultural areas.

The model region was inhabited by Native Americans during the Paleo-Indian and Archaic periods (10,000 BC to c. 1,500 AD) and post-contact period. Portions of the model region were historically settled by Eurasian and African American populations in the late 19th and early 20th Centuries. Research, including review of SHPO archaeological site survey files, NRHP files, and historic survey files, will indicate whether known archaeological sites are present in the model region. There are recorded archaeological and historic resources within the model region, but more site-specific studies will be conducted as part of the tiered process to determine the significance, impacts, and measures to avoid or mitigate potential impacts to cultural resources. Consultation with the Bureau of Indian Affairs and local tribes will occur on a site-specific basis to identify previously defined traditional cultural areas in the vicinity of the specific proposed ISR extraction site and in accordance with specific license conditions. In addition, as detailed in Section 3.7.2, additional cultural resources surveys are part of the ongoing environmental study process.

3.7.2 Nature of Historic and Cultural Resource Preservation Process

Section 106 of the NHPA requires NRC and agreement states to consider the potential impacts of their undertakings on cultural resources eligible for or listed on the NRHP. The first step in this process is the identification of previously documented cultural resources in the potentially

affected area. In addition, archaeological surveys of areas within the proposed project sites that have not previously been surveyed will be conducted. A detailed traditional culture property survey also will be conducted by professional archaeologists and ethnographers, with input from local Native American practitioners and residents.

The results of these surveys will be reviewed by the State Historic Preservation Office and the tribal National Historic Preservation Department pursuant to the tribal National Cultural Resources Protection Act *(as applicable)*. Other parties invited to participate in the review could include the occupying tribes throughout various time periods.

Once the survey work is complete, a determination of the potential for impacts or adverse impacts to properties listed on or eligible for listing on the NRHP will occur. The determination will incorporate the model region site plan for avoidance of all sites, as described in Section 5.0, and the nature of the sites identified. Mitigation measures to minimize potential adverse effects may include those identified in Section 5.0 and others designed specifically for the particular cultural properties. Historic resources surveys and determinations of eligibility and impact will be conducted if necessary. Testing for archaeological resources will be conducted if warranted in areas of probable prehistoric occupation or where historic archaeology of significance could be encountered. Monitoring for these resources will be ongoing through construction activities, which will be halted, pending SHPO and tribal consultation, if unaccounted for archaeological sites are discovered during ISR facility development, operation, and D&D activities. In accordance with the Section 106 process, these mitigation measures will be developed in consultation with the parties named previously.

Section 3.7.1 discusses the occurrence of cultural resources at the model region site that can be determined without additional surveys being conducted under the Section 106 process. Site-specific research will be conducted, and will continue during the project development process. Table 3.12 lists the SHPOs.

Table 3.12
Respective State Historic Preservation Officers

State	State Historic Preservation Office
Arizona	Arizona State Parks, State Historic Preservation Office
Colorado	Colorado Historical Society
Nebraska	Nebraska State Historical Society
New Mexico	New Mexico Historic Preservation Division
Oklahoma	Oklahoma Historical Society
South Dakota	South Dakota State Historical Society/Office of History
Texas	Texas Historical Commission
Wyoming	Wyoming State Historic Preservation Office

Table 3.13 lists the major extant Native American entities (such as tribes, nations, communities, and bands) by region.

Table 3.13
Native American Entities (Tribes, Nations, Communities, and Bands)

State	
Arizona	(1) Navajo Nation, (2) Colorado River Tribes, (3) Fort Mojave Tribe of Arizona, (4) White Mountain Apache Tribe, (5) Cocopah Tribe of Arizona, (6) Quechan Tribe of Fort Yuma Reservation, (7) Hopi Tribe of Arizona, (8) Tohono O'odham Nation of Arizona, (9) Ak Chin Indian Community of the Maricopa

Table 3.13
Native American Entities (Tribes, Nations, Communities, and Bands)

State	
	Reservation, (10) Gila River Community, (11) Fort McDowell Yavapai Nation, (12) Pascua Yaqui Tribe of Arizona, (13) Salt River Pima-Maricopa, (14) San Carlos Apache Tribe, (15) Kaibab Band of Paiute, (16) San Juan Southern Paiute, (17) Havasupai Tribe, (18) Haulapai Tribe, (19) Tonto Apache Tribe of Arizona, (20) Yavapai-Apache Nation of Camp Verde, and (21) Yavapai-Prescott Tribe
Colorado	(1) Southern Ute Tribe and (2) Ute Mountain Tribe
Nebraska	(1) Omaha Tribe of Nebraska, (2) Santee Sioux Nation, (3) Winnebago Tribe of Nebraska Iowa, (4) Ponca Tribe of Nebraska, (5) Iowa Tribe of Kansas and Nebraska, and (6) Sac and Fox Nation of Missouri in Kansas and Nebraska
New Mexico	(1) Navajo Nation of Arizona, New Mexico and Utah, (2) Jicarilla Apache Nation, (3) Pueblo of Laguna, (4) Mescalero Apache Tribe, (5) Ohkay Owingeh, (6) Pueblo of Nambe, (7) Pueblo of Picuris, (8) Pueblo of Pojoaque, (9) Pueblo of San Ildefonso, (10) Pueblo of Santa Clara, (11) Pueblo of Taos, (12) Pueblo of Tesuque, (13) Pueblo of Acoma, (14) Pueblo of Cochiti, (15) Pueblo of Isleta, (16) Pueblo of Jemez, (17) Pueblo of San Felipe, (18) Pueblo of Sandia, (19) Pueblo of Santa Ana, (20) Pueblo of Santo Domingo, (21) Pueblo of Zia, (22) Ute Mountain Tribe, 23) Zuni Tribe
Oklahoma	(1) Chickasaw Nation, (2) Cherokee Nation, (3) United Keetoowah Band of Cherokee in Oklahoma, (4) Eastern Shawnee Tribe of Oklahoma, (5) Miami Tribe of Oklahoma, (6) Modoc Tribe of Oklahoma, (7) Ottawa Tribe of Oklahoma, (8) Peoria Tribe of Oklahoma, (9) Quapaw Tribe, (10) Seneca-Cayuga Tribe of Oklahoma, (11) Shawnee Tribe, (12) Wyandotte Nation, (13) Alabama-Quassarte Tribal Town, (14) Kialegee Tribal Town, (15) Muscogee Creek Nation, (16) Thlopthlocco Tribal Town, (17) Osage Tribe, (18) Choctaw Nation of Oklahoma, (19) Seminole Nation of Oklahoma, (20) Iowa Tribe of Oklahoma, (21) Apache Tribe of Oklahoma, (22) Caddo Nation of Oklahoma, (23) Comanche Nation, (24) Delaware Nation, (25) Fort Sill Apache Tribe of Oklahoma, (26) Kiowa Tribe of Oklahoma, (27) Wichita and Affiliated Tribes (Wichita, Keechi, Waco, and Tawakonie), 28) Cheyenne-Arapaho Tribes of Oklahoma, (29) Kaw Nation, (30) Otoe-Missouria Tribe, (31) Pawnee Nation of Oklahoma, (32) Ponca Tribe of Oklahoma, (33) Tonkawa Tribe of Oklahoma, (34) Absentee-Shawnee Tribe of Oklahoma, (35) Citizen Potawatomi Nation, (36) Sac and Fox Nation of Oklahoma, and (37) Kickapoo Tribe of Oklahoma
South Dakota	(1) Cheyenne River Sioux Tribe, (2) Crow Creek Sioux Tribe, (3) Flandreau Santee Sioux Tribe of South Dakota, (4) Lower Brule Sioux Tribe, (5) Oglala Sioux Tribe of the Pine Ridge Reservation, (6) Rosebud Sioux Tribe, (7) Sisseton-Wahpeton Oyate of the Lake Traverse Reservation North and South Dakota, (8) Standing Rock Sioux Tribe of North and South Dakota, (9) Ponca Tribe of Nebraska, and (10) Yankton Sioux Tribe of South Dakota
Texas	(1) Alabama-Coushatta Tribes of Texas, (2) Kickapoo Traditional Tribe of Texas, and (3) Ysleta Del Sur Pueblo of Texas
Wyoming	(1) Arapahoe Tribe of the Wind River Reservation, and (2) Shoshone Tribe of Wind River Reservation

Note that other, in absentia, tribes will also be consulted on archaeological resources that could pertain to the tribes' periods of occupation.

3.8 Visual and Scenic Resources

Aesthetic areas of visual and scenic resources are protected from potential adverse impacts due to industrial development activities. If the proposed activity could impact nationally or state-designated landscapes or waterways, additional coordination with applicable agencies will be conducted.

3.8.1 Wilderness Areas

Federal agencies have designated areas of the United States as wilderness areas. Wilderness areas are found in National Parks, Wildlife Refuges, National Forests, National Grasslands, Prairie Reserves, and the public domain, and may include land in several different units managed by different agencies. These areas are considered visual and scenic resources and are therefore examined in NEPA evaluations. Most United States wilderness areas are found in National Forests and National Parks. The National Wilderness Preservation System coordinates the wilderness activities of four federal agencies: the BLM, the USDA-FS, the NPS, and the USFWS.

In addition to the National Wilderness Preservation System, land in the Great Lakes Region (Great Lakes Indian Fish and Wildlife Commission) and Montana (Flathead Indian Reservation) has been designated as Tribal Wilderness Areas. None of the eight model region states contain Tribal Wilderness Areas. Additionally, 13 states contain state wilderness areas, including 1 state in the model region, Colorado, which contains the Mitani-Tokuyasu State Wilderness Area. The other seven states in the model region do not have designated state wilderness areas.

3.8.2 Wild and Scenic Rivers

The NPS and individual states have designated select rivers as Wild and Scenic Rivers. These rivers possess remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. These rivers or designated sections of rivers are preserved in their free-flowing condition. Wild and Scenic Rivers are not considered National Parks or Wilderness Areas; therefore, they maintain their own standards of protection. These standards do not halt the development of facilities near the rivers or the use of the rivers, but seek to preserve the character of the rivers. National Wild and Scenic Rivers are managed by one or more agencies of the federal or state government.

3.8.3 Designated Areas in Model Regions States

Table 3.14 identifies designated scenic resources (Wilderness Areas or Wild and Scenic Rivers) within the model region. The scenic resources are areas the BLM, NPS, and USDA-FS have established for preserving the landscape (Class I), maintaining the existing character of the landscape (Class II), or partially maintaining the existing character of the landscape (Class III).

Table 3.14
Designated Scenic Resources

State	Wilderness Area or Wild and Scenic River
Arizona	**Wilderness Areas** Apache Creek Wilderness Hells Canyon Wilderness Aravaipa Canyon Wilderness Arrastra Mountain Wilderness Aubrey Peak Wilderness Baboquivari Peak Wilderness Bear Wallow Wilderness Beaver Dam Mountains Wilderness Big Horn Mountains Wilderness Cabeza Prieta Wilderness Castle Creek Wilderness Cedar Bench Wilderness Chiricahua National Monument Wilderness Chiricahua Wilderness Cottonwood Point Wilderness Coyote Mountains Wilderness Dos Cabezas Mountains Wilderness Eagletail Mountains Wilderness East Cactus Plain Wilderness Escudilla Wilderness Fishhooks Wilderness Fossil Springs Wilderness Four Peaks Wilderness Galiuro Wilderness Gibraltar Mountain Wilderness Grand Wash Cliffs Wilderness Granite Mountain Wilderness Harcuvar Mountains Wilderness Harquahala Mountains Wilderness Hassayampa River Canyon Wilderness Havasu Wilderness Hells Canyon Wilderness Hellsgate Wilderness Hummingbird Springs Wilderness Imperial Refuge Hummingbird Springs Wilderness Imperial Refuge Wilderness Juniper Mesa Wilderness Kachina Peaks Wilderness Kanab Creek Wilderness Kendrick Mountain Wilderness Kofa Wilderness Mazatzal Wilderness Miller Peak Wilderness Mount Baldy Wilderness Mount Logan Wilderness Mount Nutt Wilderness Mount Tipton Wilderness Mount Trumbull Wilderness Mount Wilson Wilderness Mt. Wrightson Wilderness

Table 3.14
Designated Scenic Resources

State	Wilderness Area or Wild and Scenic River
Arizona	Muggins Mountain Wilderness Munds Mountain Wilderness Needle's Eye Wilderness New Water Mountains Wilderness North Maricopa Mountains Wilderness North Santa Teresa Wilderness Organ Pipe Cactus Wilderness Paiute Wilderness Pajarita Wilderness Paria Canyon-Vermilion Cliffs Wilderness Peloncillo Mountains Wilderness Petrified Forest National Wilderness Area Pine Mountain Wilderness Pusch Ridge Wilderness Rawhide Mountains Wilderness Red Rock-Secret Mountain Wilderness Redfield Canyon Wilderness Rincon Mountain Wilderness Saddle Mountain Wilderness Saguaro Wilderness Salome Wilderness Salt River Canyon Wilderness Santa Teresa Wilderness Sierra Ancha Wilderness Sierra Estrella Wilderness Signal Mountain Wilderness South Maricopa Mountains Wilderness Strawberry Crater Wilderness Superstition Wilderness Swansea Wilderness Sycamore Canyon Wilderness Table Top Wilderness Tres Alamos Wilderness Trigo Mountain Wilderness Upper Burro Creek Wilderness Wabayuma Peak Wilderness Warm Springs Wilderness West Clear Creek Wilderness Wet Beaver Wilderness White Canyon Wilderness Woodchute Wilderness Woolsey Peak Wilderness **Wild and Scenic Rivers** Verde River, USDA-FS
Colorado	**Wilderness Areas** Black Canyon of the Gunnison Wilderness Black Ridge Canyons Wilderness Buffalo Peaks Wilderness Byers Peak Wilderness Cache La Poudre Wilderness Collegiate Peaks Wilderness

Table 3.14
Designated Scenic Resources

State	Wilderness Area or Wild and Scenic River
Colorado	Comanche Peak Wilderness Eagles Nest Wilderness Flat Tops Wilderness Fossil Ridge Wilderness Great Sand Dunes Wilderness Greenhorn Mountain Wilderness Gunnison Gorge Wilderness Holy Cross Wilderness Hunter-Fryingpan Wilderness Indian Peaks Wilderness James Peak Wilderness La Garita Wilderness Lizard Head Wilderness Lost Creek Wilderness Maroon Bells-Snowmass Wilderness Mesa Verde Wilderness Mount Evans Wilderness Mount Massive Wilderness Mount Sneffels Wilderness Mount Zirkel Wilderness Neota Wilderness Never Summer Wilderness Platte River Wilderness Powderhorn Wilderness Ptarmigan Peak Wilderness Raggeds Wilderness Rawah Wilderness Sangre de Cristo Wilderness Sarvis Creek Wilderness South San Juan Wilderness Spanish Peaks Wilderness Uncompahgre Wilderness Vasquez Peak Wilderness Weminuche Wilderness West Elk Wilderness **Wild and Scenic Rivers** Cache La Poudre River, NPS/USDA-FS
Nebraska	**Wilderness Areas** Fort Niobrara Wilderness Soldier Creek Wilderness **Wild and Scenic Rivers** Missouri River, NPS Niobrara River, NPS/USDA-FWS
New Mexico	**Wilderness Areas** Aldo Leopold Wilderness Apache Kid Wilderness Bandelier Wilderness Bisti/De-Na-Zin Wilderness Blue Range Wilderness Bosque del Apache Wilderness Capitan Mountains Wilderness

Table 3.14
Designated Scenic Resources

State	Wilderness Area or Wild and Scenic River
New Mexico	Carlsbad Caverns Wilderness Cebolla Wilderness Chama River Canyon Wilderness Cruces Basin Wilderness Dome Wilderness Gila Wilderness Latir Peak Wilderness Manzano Mountain Wilderness Ojito Wilderness Pecos Wilderness Salt Creek Wilderness San Pedro Parks Wilderness Sandia Mountain Wilderness West Malpais Wilderness Wheeler Peak Wilderness White Mountain Wilderness Withington Wilderness **Wild and Scenic Rivers** Jemez River (East Fork), USDA-FS Pecos River, USDA-FS Rio Chama, BLM/USDA-FS Rio Grande, BLM/USDA-FS
Oklahoma	**Wilderness Areas** Black Fork Mountain Wilderness Upper Kiamichi River Wilderness Wichita Mountains Wilderness **No Wild and Scenic Rivers**
South Dakota	**Wilderness Areas** Badlands Wilderness Black Elk Wilderness **Wild and Scenic Rivers** Missouri River, NPS
Texas	**Wilderness Areas** Big Slough Wilderness Guadalupe Mountains Wilderness Indian Mounds Wilderness Little Lake Creek Wilderness Turkey Hill Wilderness Upland Island Wilderness **Wild and Scenic Rivers** Rio Grande National Wild and Scenic River, NPS
Wyoming	**Wilderness Areas** Absaroka-Beartooth Wilderness Bridger Wilderness Cloud Peak Wilderness Encampment River Wilderness Fitzpatrick Wilderness Gros Ventre Wilderness Huston Park Wilderness Jedediah Smith Wilderness North Absaroka Wilderness

Table 3.14
Designated Scenic Resources

State	Wilderness Area or Wild and Scenic River
Wyoming	Platte River Wilderness Popo Agie Wilderness Savage Run Wilderness Teton Wilderness Washakie Wilderness Winegar Hole Wilderness **Wild and Scenic Rivers** Clarks Fork of the Yellowstone River, USDA-FS

Sources:

National Wilderness Preservation System Map, available at: http://www.nationalatlas.gov/wallmaps.html#wildp
Wild and Scenic River list, available at: http://www.rivers.gov/publications/rivers-table.pdf
State-by-State Wild and Scenic Rivers list, available at: http://www.rivers.gov/wildriverslist.html

Site-specific qualitative and quantitative ratings of visual quality are determined using one or more applicable ratings systems, including ratings used by the BLM, NPS, or USDA-FS. The BLM Visual Resource Management (VRM) rating system includes VRM inventory techniques and VRM analysis (contrast rating).

3.8.4 Generic Regional Aesthetic Conditions

Aesthetic scenery affects how viewers perceive the environment. The model region exhibits diverse landscape elements, which contribute to its aesthetic appeal. The model region contains mountains with rugged terrain, coniferous forests, and valley bottoms. In other areas, the topography contains a transition area where forested mountain terrain flattens and changes into open plains. The landscape of the open plains further transitions into rugged plateau. It is not anticipated that lands designated as part of the National Wilderness Preservation System, including state or tribal wilderness areas and federal- or state-designated Wild and Scenic Rivers, in the model region will be in close proximity to ISR sites; however, this will be confirmed on a site-specific basis. The landscape within the viewshed of the model region site is largely undeveloped rolling rangeland consisting of shortgrass prairie, mixed-grass steppe (with short grasses sparsely bunched around tallgrass species), scattered shrubs and trees, and grassland-forest transition areas. The potential for recreational use and development in the model region is high. On a site-specific basis, there may be organized recreational use in these areas.

Using an applicable recognized visual rating assessment method, or methods, overall site-specific assessment of the viewshed will be determined. The BLM method will be conducted using distance and visibility zones, as follows:

(1) Foreground-Middleground Zones
(2) Background Zones
(3) Seldom-Seen Zones

Foreground-Middleground Zones are those areas highly visible from travel routes. Background Zones are those areas behind Foreground-Middleground Zones that are visible to about 15 miles. Seldom-Seen Zones are those beyond Background Zones, which are screened based

on distance or topography. Sensitive areas will be identified on a site-specific basis and include areas of public interest and areas adjacent to residential land use that will be mapped for comparison with the distance and visibility zones. Representative site-specific digital images (pre-operation, during operation, and post-operation) are an effective tool that can be used on a site-specific basis as warranted to illustrate potential visual impacts.

Potential impacts are discussed in Section 4.0. Possible mitigation measures are discussed in Section 5.0.

3.9 Socioeconomic Conditions

Socioeconomic considerations are important, including consideration of the positive effects the proposed ISR facility will have on local employment and the regional tax base.
On average, ISR operations will be a short-term use of the land (an average of approximately 12 years, with reclamation efforts anticipated for several years afterwards). On a regional long-term basis, ISR operations do not preclude other types of development and land use following the use of the site for ISR operations. After reclamation of ISR project sites, reuse options for the land could include agricultural/forestry, industrial, commercial, recreational, and other uses as defined by state, regional, or local land use plans and ordinances. Because a site's topography is largely unchanged as a result of ISR operations, the interim use of the land for ISR operations will not interfere with other long-term land use plans. ISR operations will partially alter the deep aquifer containing the ore bodies, but the water in the recovery zone can never be a USDW and NRC-mandated restoration activities will restore the affected portion of the aquifer (the exempted aquifer) consistent with baseline or other relevant federal or state standards (e.g., MCLs, class of prior use) to minimize or eliminate the potential for post-restoration impacts on adjacent, non-exempt USDWs. Therefore, ISR operations also will not have a noticeable or measurable impact upon water-dependent uses such as certain types of agriculture (for example, livestock watering or irrigated crops) and residential development.

Local and regional economic development councils and planning officials will be consulted about site-specific conditions and development regulations for individual ISR proposals. Site-specific conditions, including an analysis of population demographics and income are considerations for assessing the relative degree of positive potential impacts that the proposed actions will provide to the community. Respective data, including United States Census information, will be compiled and combined for comparison to measure the impacts on the local economy. Specific demographics and income statistics are necessary to compare the localized area with the surrounding region and state as a whole to determine the character of the community and the potential for impacts.

ISR operations will have minimal potential impacts especially when compared to the potential impacts of oil, gas and coal bed methane development in the same areas. This is especially true in Wyoming.

3.9.1 Generic Demographics

In general terms the areas appropriate for ISR operations are located a distance away from large population centers, but may be near smaller communities and settlements. Rural minority and/or low income populations may be present and will be accounted for on a site-specific basis. Within the model region, urban population centers are the primary locations for services such as public water supplies, public sewer systems, social services, and emergency services

providers (fire/rescue and ambulance service stations and police protection). Therefore, the demographic data set tends to be small in comparison with more highly developed areas where ISR operations typically are not anticipated. Recreation is one of the more common uses for most of the undeveloped land areas in the model area.

Site-specific data, such as presented in Table 3.15, will be presented in tiered NEPA documents for individual sites to allow comparison of demographic statistics of the site compared with those of region and state. Table 3.15 is a blank template that can be used as a “go-by” example for site-specific environmental assessment studies. Numerical data and percentages are available from the decennial United States Census and other sources.

Table 3.15
Demographics Template

	Site Census Block Groups	Site County	Site State
Total population	#	#	#
Native Americans	#/ percent	#/ percent	#/ percent
White	#/ percent	#/ percent	#/ percent
Other Race	#/ percent	#/ percent	#/ percent
Hispanic	#/ percent	#/ percent	#/ percent
Non-Hispanic	#/ percent	#/ percent	#/ percent

Site-specific trends in the demographic data will include the percentage of minority races, including Native Americans and minority ethnic group (such as Hispanic) populations, in the census block compared with the county and statewide average statistics.

3.9.2 Generic Income Statistics

Typically, the general areas of ISR mining in the model region will be located outside of urban population centers, in either sparsely settled areas or areas with small communities with fewer economic opportunities than urban centers in the region. Some of the sub-regions of the model region contain large populations of Native Americans within reservations and small communities.

Site-specific data, such as presented in Table 3.16, will be presented in tiered NEPA documents for individual sites to allow comparison of the housing and income statistics of the specific site compared with United States Census block groups, as well as those of the county and state. Table 3.16 is a blank template that can be used as an example for site-specific environmental assessment studies. Data are available from the United States Bureau of Labor Statistics.

Table 3.16
Income Statistics Template

	Site Census Block Groups	Site County	Site State
Native American			
Population	#	#	#
Median Household Income	$	$	$
Unemployment Average 2006 -	percent	percent	percent

Table 3.16
Income Statistics Template

	Site Census Block Groups	Site County	Site State
June 2007			
Percent Below Poverty Level	percent	percent	percent
White			
Population	#	#	#
Median Household Income	$	$	$
Unemployment Average 2006 - June 2007	percent	percent	percent
Percent Below Poverty Level	percent	percent	percent
Other Race			
Population	#	#	#
Median Household Income	$	$	$
Unemployment Average 2006 - June 2007	percent	percent	percent
Percent Below Poverty Level	percent	percent	percent

Site-specific trends in income statistics will be studied (such as lower median household incomes and higher unemployment rates than the national average). Earnings and employment trends are discussed further in Section 3.9.3.

States such as Wyoming recently have experienced significant increases in income due to expanded development of oil, gas, and coal bed methane resources. As a result, income levels likely have increased in these areas.

3.9.3 Generic Earnings and Employment Structures

Table 3.17 presents the comparison of United States Census unemployment and earnings for the states in the model region and United States over the past 30 years. Site-specific data will be supplied to allow comparisons with state and county unemployment and earnings statistics in tiered NEPA documents for individual sites. The last row of Table 3.17 is incomplete, so that applicable national/state data can be supplemented with regional and site-specific data for any site-specific environmental assessment studies. Site-specific county and census block group data are available from the decennial United States Census.

Table 3.17
Annual Average Unemployment Percentage and Income Template
(Partially Completed)

Unemployment (percentage of working-age population)				
	1980	1990	2000	2006
United States	7.1 percent	5.6 percent	4.0 percent	4.6 percent
Arizona	7.5 percent	5.4 percent	4.1 percent	4.1 percent
Colorado	6.8 percent	5.1 percent	2.9 percent	4.4 percent
Nebraska	4.3 percent	2.4 percent	2.9 percent	3.1 percent
New Mexico	7.8 percent	6.8 percent	4.9 percent	4.2 percent
Oklahoma	5.6 percent	5.4 percent	3.2 percent	4.0 percent
South Dakota	5.1 percent	3.8 percent	2.7 percent	3.2 percent
Texas	5.3 percent	6.3 percent	4.3 percent	4.9 percent
Wyoming	4.3 percent	4.9 percent	3.8 percent	3.3 percent

2005/2006 Median Household Income			
	State Rank	Dollarsx1000	# Workers x 1000
United States	--	$48.0,	132,605
Arizona	27	$46.7	2,574
Colorado	12	$53.9	107
Nebraska	20	$48.8	901
New Mexico	43	$40.1	789
Oklahoma	45	$38.9	1,503
South Dakota	34	$45.0	381
Texas	38	$43.0	9,761
Wyoming	28	$46.6	292

Source: United States Bureau of Census. *American Factfinder*. Online address: http://factfinder.census.gov/home/saff/main.html Accessed September 18, 2007
Source: United States Bureau of Census. *Income 2006 (Two-Year Median)*. Online address: http://www.census.gov/hhes/www/income/income06/statemhi2.html Accessed November 20, 2007
Source: United States Bureau of Labor Statistics. Unemployment. Online address: http://www.bls.gov/data/home.htm Accessed September 18, 2007

It is evident that the model region states (with the exception of Colorado and Nebraska) are generally behind the United States median for earnings, and certain states such as New Mexico and Texas exhibit a trend of higher unemployment rates than the United States average.

3.9.4 Generic Housing and Public Infrastructure

Residential and other development in the immediate vicinity of the model region site is expected to be scattered. No anticipated major infrastructure or public facilities and services (including public water and sewer service) exist at the Model ISR Site likely to be used for ISR operations, with the possible exception of electric utilities.

3.9.4.1 Housing

Based on generally low available housing in the model region, it is anticipated that available housing in the specific site vicinity will be sparse. The infrastructure, public facilities and services necessary to support population and housing growth are also generally not present in the model region. Site-specific information, such as presented in Table 3.18 will be used in tiered NEPA documents for individual sites to compare available housing and housing costs in the area with the statewide averages for those factors. Table 3.18 is a blank template that can be used as an example for site-specific studies. Data are available from the decennial United States Census and other state/regional sources.

Table 3.18
Housing Comparison Data Template

	State	**County**	**Site Census Blocks**
Total Housing Units			
Occupied (households)			
Seasonal/Occasional/ Recreational Use			
Vacant			
Owner/Renter Occupied (percent / percent)			
Median Value			
Average Value			
Persons Per Household			
Conclusions:			

These site-specific data will be used to demonstrate trends in available housing in the specific site vicinity compared with the larger region and state statistics, as well as housing affordability compared with larger regional and statewide statistics.

Rawlins, Rock Springs, and other communities in Wyoming are experiencing a severe housing shortage due to the oil, gas, and coal bed methane development occurring in the state.

3.9.4.2 Water and Wastewater Systems

Water and wastewater systems are located in population centers; the nearest of which is expected to be distant from most potential Model ISR Sites. Domestic water supplies are provided by groundwater aquifers perched above the geologic formations containing the uranium deposits proposed for recovery. Sewage treatment and disposal are primarily via in-ground septic treatment tank systems, with in-ground drainfields or other on-site disposal methods and technologies, although trucking of sewage can be an alternative at a specific site. Groundwater also supplies farm livestock in certain areas.

3.9.4.3 Police, Fire, and Emergency Protection and Response

Police, fire, and emergency protection and response facilities are located in population centers in the model region; the nearest of which is expected to be a reasonable distance from the potential sites to provide adequate response times in case of situations requiring the services of police, fire, and emergency service providers. Some ISR sites likely will provide security and emergency response capabilities on site for first response and/or fund specialized equipment and training for local responders.

3.9.4.4 Education Resources

Elementary, secondary, and higher education facilities are located in population centers in the model region; the nearest of which is expected to be distant from the potential Model ISR Site.

3.10 Environmental Justice

Although NRC policy states that Environmental Justice (EJ) related issues normally are not considered during preparation of generic or programmatic EISs (69 Fed. Reg. § 52040, p. 52048), this GER briefly discuss EJ issues as they relate to the general background and approach to the issue, suggested initial screening tools to identify low income and minority communities for site-specific NEPA analyses. The following sections also include guidance related to the issues of subsistence food consumption, and the sensitivity of Native Americans to potential impacts of ISR operations based on their culture and religious beliefs.

3.10.1 Generic Background and Approach

EJ is, "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no groups of people, including racial, ethnic, or socioeconomic groups, will bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations of the execution of federal, state, local, and tribal programs and policies…" (EPA, 2004).

EJ is considered by NRC in accordance with NEPA. NRC Office of Nuclear Material Safety and Safeguards (NMSS) published final policy for addressing EJ in regulatory and licensing actions (69 Fed. Reg. § 52040). The CEQ also issued guidance in December 1997. The approach outlined in Sections 3.10.2, 3.10.3, and 3.11.4 is in keeping with the NMSS guidance and the general provisions of CEQ's guidance. Note that NRC is not directly governed by Executive Order 12898 (February, 1994), but NRC considers EJ to be an issue evaluated as part of the NEPA process in accordance with civil liberties considerations.

Resources that may have EJ implications are health, ecological (including water quality and water availability), social, cultural, economic, and aesthetic. NMSS guidance identifies a significant EJ impact as one that is:

- High and adverse (for example, significant, unacceptable, or above generally accepted norms); and
- Disproportionately borne by minority or low-income populations.

CEQ indicates that the identification of potential impacts borne by a minority or low-income population will heighten agency attention to mitigation strategies and consideration of alternatives and preferences expressed by the affected population.

The following sections discuss the composition of the potentially affected community, the population's subsistence consumption of natural resources, and the sensitivity of the community to the potential for impacts from the proposed project. In general terms, the Model ISR Site is not located near settlements or large population centers. The analysis looks at the demographic make-up of the residents in the potentially affected United States Census block groups, in comparison with the overall study area, county, region, and state populations.

3.10.2 Generic Discussion of Minority and Low-Income or Native American Populations in the Area of Effect

Given the general statewide demographic data presented in Section 3.9, it appears that it can be expected that rural populations within the model region will contain concentrations of low-income communities. Given current settlement patterns, it is also expected that there are places in the model region where minority ethnic and racial groups make up higher percentages of the total population compared to the state or region as a whole.

Example Table 3.19 below is a template. This table or a similar one can be used for site-specific analysis to present for comparison, the racial and income statistics of the specific site compared to surrounding block groups as well as those of county and state. Site-specific United States decennial Census or other census data will allow comparisons with state and county minority population percentages and percentages below the poverty threshold, in tiered NEPA documents for specific sites. These tiered analyses will include assessment of transient populations in addition to resident communities. Table 3.19 is a template that can be used to organize information for analysis and present it in the specific site study. These data will be used to develop conclusions and demonstrate initial findings related to EJ populations.

Table 3.19
Analytical Data Template for Identification of Minority and Low Income Population Concerns for Site-Specific Analysis

	Site–Specific Census Block Groups	County	State
White, non-Hispanic Population	# and percent	# and percent	# and percent
Total Racial Minority Population*	# and percent	# and percent	# and percent
White, Hispanic Population	# and percent	# and percent	# and percent
Native American Population	# and percent	# and percent	# and percent
Median Household Income	$	$	$
Percent Below Poverty Level	percent	percent	percent
Summary	EJ populations include:		

Table 3.19
Analytical Data Template for Identification of Minority and Low Income Population Concerns for Site-Specific Analysis

	Site–Specific Census Block Groups	County	State

Notes:
* minority persons are (1) Black (having origins in any of the black racial groups of Africa); (2) Hispanic (of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race); (3) Asian (having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands); or (4) Native American and Alaskan Native (having origins in any of the original people of North America and who maintains cultural identification through tribal affiliation or community recognition). Minority Population: any readily identifiable groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed NRC program, policy, or activity.

Additional precision screening tools that can be used to further identify low income populations include determining locations of federally subsidized community housing, in addition to analyzing subsidized school meal program participation percentages within the census block groups. Where those data are available, rows to supplement the basic collection of information presented in template Table 3.16 will be added to further refine the understanding of the potential for EJ populations.

In general, the model region contains reservations of Native American populations and also contains areas of concentrated racial and ethnic minority groups. There is also the potential for concentrations of low-income populations, due to the rural nature of many areas suitable for ISR facilities. However, site-specific analysis is required to develop conclusions for individual facilities. If populations are identified, NRC has policies requiring the requisite hard look at the potential for disproportional adverse disparate impacts upon those populations. However, if as is the case with ISR development, operations, and site D&D (including groundwater restoration), the potential adverse impacts are “vanishingly” small to non-existent, by definition, there can be no disproportionate adverse environmental consequences.

3.10.3 Natural Resource Consumption by Populations

Subsistence is a regular pattern of eating fish or wildlife caught or hunted, or eating vegetation or livestock raised for oneself or one’s family. Subsistence activities are relevant in EJ analyses because the proposed activities could introduce exposure pathways or pathway scenarios that potentially affect a population’s exposure to and health consequences of contamination.

Although no detailed examination of the subsistence activities of the model region Native American population exists, some Native Americans still practice traditional ways of life. Some Native Americans supplement their diets using their livestock and gardens. These ways of life include herding sheep, goats, and cattle that graze on the land and that are watered from shallow wells. Diets of some Native Americans include subsistence consumption of domestic plants (for example, squash, corn, beans, and chiles) and also harvest of indigenous plants to eat and use for medicinal purposes.

As discussed in Section 3.1, abandoned wells and boreholes will be sealed to prevent discharges of recovery solution or harmful gases to the food chain. Also, site-specific surveys and documentation of previous and existing domestic and wild animal and plant consumption at

or near a given ISR facility site will be conducted where warranted, in accordance with IAEA (2001). It is worth noting that where well field piping is buried because of winter temperatures as in Wyoming, wildlife (e.g., deer and antelope) routinely continue to graze in ISR well fields with no adverse impacts. NRC license conditions likely will include notification signs around the perimeter of the ISR facility, so that persons will be informed of the fact that radiological materials could be encountered anywhere on site, and will take appropriate precautions related to subsistence consumption. Although once the site is developed, it will be fenced and controlled thereby preventing members of the public from accessing the project site without permission of the licensee.

3.10.4 Sensitivity of Native American Communities to Potential Impacts of Proposed Action

Solicitation of public comments includes Native American communities that are present in the vicinity and the model region. As with all communities, there are those who support and those who object to resource extraction activities such as ISR operations. Comments from the community are addressed in Appendix A of this GER.

4.0 POTENTIAL ENVIRONMENTAL IMPACTS

The following section describes potential impacts to the social and physical environment of areas where ISR operations will take place. The potential impacts from ISR operations are described in detail, followed by a discussion of potential impacts under the no-action alternative. This section and its analyses are based on the best available information about the affected environment; however, since this report is intended to be a GER, each ISR site can have potential site-specific impacts to the social and physical environment.

4.1 Potential Impacts of Proposed Action

The sections that follow describe and analyze key potential impacts of the proposed alternative for ISR operations (see Section 2.2). These include potential impacts associated with land use; transportation; geology and soils; water resources; ecology; air quality; noise; historic and cultural resources; visual/scenic; socioeconomic; environmental justice; public and occupational health; and waste management; as well as cumulative impacts.

It should be noted that the potential impacts associated with ISR operations are orders of magnitude lower than those associated with conventional mining/milling. This is supported by the fact that prior to the Commission's ruling in 2000 that restoration fluids from ISR groundwater restoration activities constitute 11e.(2) byproduct material and, by implication, that the subsurface activities during ISR operations effectively constitute "milling underground" or "processing" thereby making the provisions of 10 CFR § 51.20(b)(8) applicable to ISR operations, NRC typically analyzed the potential impacts from proposed ISR projects using a site-specific EA rather than an site-specific EIS.

At the beginning of its experience with the ISR process, NRC performed site-specific EISs for proposed ISR projects. However, sometime around the mid-1980s, NRC determined that proposed ISR projects, absent any site-specific issue (e.g., land ownership status), merely required site-specific EAs due to their low level of risk. To the best of NMA's knowledge, in the last 15 to 20 years, the only site-specific EIS performed by NRC for a proposed ISR project is HRI's Crownpoint Uranium Project (CUP). However, in the case of the CUP, one of the four proposed project sites (Unit One) was located on Bureau of Indian Affairs (BIA)-administered lands and, pursuant to BIA procedures; a site-specific EIS would be required for that particular project site. However, NRC informed HRI that all of the project sites could be merged into one site-specific EIS rather than performing EAs for certain project sites and an EIS for the Unit One site. As a result, HRI agreed to have one site-specific EIS for the entire CUP. Therefore, the only site-specific EIS performed for a proposed ISR project in the past 15 to 20 years was performed due to the land ownership status of a project site and not due to its potential impacts.

4.1.1 Potential Land Use Impacts

As noted previously conventional (underground/surface) uranium mining /milling was the primary source of domestic uranium production until the decline in uranium prices that began in the early 1980s. Although conventional uranium mining/milling has been and can be managed effectively to minimize potential impacts to lands, ISR operations result in significantly less potential impacts. Mine pits, waste dumps, haul roads, ore pads, and tailings impoundments are not needed, the surrounding land areas will remain available for grazing or raising crops, and the site will be returned to its pre-operational use after the completion of site D&D.

While construction and operation of an ISR facility has some potential impacts on existing land uses, these impacts are temporary because, after completion of final site reclamation, there is little, if any, evidence that an ISR operation ever existed at the site.

Potential temporary land use impacts include on-site disturbance and restrictions during project construction and operations (HRI, 1997a). Surface disturbances occur during the construction phase due to drilling, pipeline installation, road construction, and pumping station construction (IAEA 2005). ISR project sites typically require few buildings, and they can be temporary and easily demolished upon site closure. During construction of each well field, drilling activities will occur only on a small percentage of an ISR site at any one time (HRI, 1997a). The amount of land disturbed at any time typically will range from 100 to 400 acres (EPA 2007a); however, some ISR sites may be larger or smaller.

Generally, the total surface area required for ISR facilities and associated well fields ranges from less than 1,500 to over 15,000 acres (EPA 2007a). Under the proposed action, this land temporarily will be converted from typical previous uses as rangeland or forested land to ISR use on a progressive, “phased” basis. Land will be further disturbed by a likely increase in human activity at the site. Disturbance associated with drilling and pipeline and facility installation normally will be limited, as the affected area can be reclaimed and reseeded in the same season. Vegetation normally will be re-established over these areas within 2 years. Disturbance for access roads also will be minimized (IAEA 2005). See Section 5.0 for mitigation measures.

Additional potential land use impacts could include disruption of livestock grazing and potential relocation of any residents within the project boundaries. These potential impacts will be temporary: for the duration of recovery operations in the area and until the area is released for unrestricted use. Additionally, because much of the waste will be transported to facilities licensed to accept these wastes, there will be only indirect impacts associated with the transfer of waste to other locations. Surface soils can be impacted by radioactive contamination from leaks or spills in well fields or from pipelines, but site reclamation requirements assure that any such impacts are eliminated prior to site closure and license termination, as approved by NRC or an Agreement State.

4.1.1.1 Potential Liquid Waste Disposal Impacts

<u>Mud Pits</u>

The potential impacts associated with mud pits will be relatively minimal. Solid and liquid wastes will be produced on-site when wells are drilled and soils and liquids are displaced. Subsequently, they will be relocated into pits, buried, and the surface will be reclaimed via revegetation or other methods. Mud pits used for drilling operations generally are reclaimed upon completion of the given drill hole. The muds are allowed to dry and the pit filled with previously excavated material, covered with topsoil and reseeded. There still can be potential long-term impacts, including the following:

- As equipment is brought into the pit location, soils will be compacted in all areas where the equipment travels. Soil compaction could alter the soil-water interface by reducing the soil pore space and reducing the ability of the soil to absorb water, thereby creating the potential for increased runoff and, subsequently, soil erosion. Additionally, soil compaction could affect the ability of vegetation to prosper due to the reduced pore space and the ability for burrowing animals to penetrate the soils, thus possibly altering

the animal ecology. Although there is the potential for these impacts, in actuality, any such impacts likely will be negligible.

- The disposal of drilling wastes, including solids and liquids originating from deeper strata, into these pits could alter soil composition and liquid saturation in the area. Due to this change in composition and saturation, vegetation native to the mud pit area might be unable to re-emerge. Additionally, the soils deposited in these pits originate from areas in and around uranium-rich ores and, therefore, could exhibit slightly elevated levels of radioactivity, which will result in possible human exposure (discussed further in Section 4.1.12). However, mud pits contain cuttings from a relatively narrow ore intercept compared to the amount of overburden and uranium barren rock that is drilled overall; therefore, the activity of the mixed cuttings in a given mud pit typically is very low.

Deep-Well Injection

Deep-well injection requires drilling wells that are typically thousands of feet deep through which wastewater is injected into geologic media for final disposition. Such deep injection wells require an EPA-approved aquifer exemption and a Class I UIC permit pursuant to EPA UIC regulations. The potential impacts from deep-well drilling could include the following:

- As equipment is brought into the well location for drilling, soils could be compacted in all areas where the equipment travels or is stationed during drilling and injection. The compaction of soil is discussed above in the section on potential mud pit impacts and, as noted above, likely will be negligible.

- As deep wells are drilled, there could be disruption of soil formation, rock formation, and water flow processes. Although significant testing and modeling will be completed prior to drilling, there could be a minor possibility of land subsidence during or after drilling. While unlikely, this type of disruption could alter the geology and hydrogeology. Additionally, changes caused by thermal (heat caused by drilling), chemical (possible reaction caused by displaced chemicals during drilling), and mechanical alterations could change permeability and hydrogeology, although such impacts most likely will be negligible.

- The injection of a solution, usually a saline solution, could cause changes in the underground environment. Although ISR-related solutions for deep-well injection disposal are relatively benign, there could be the potential for physical and chemical reactions during and after injection. Typically, if chemical reactions occur, they affect subsurface porosity, either enhancing it through dissolution of matrices or decreasing it through precipitation of minerals or clogging of pore space via fines. The effects, if any, could lead to changes in the local hydrologic parameters affecting local fluid flow, but typically there will not be regional impacts.

Process Pad

The process pad, a concrete slab with a surrounding curb adequately sized for the equipment involved, could produce minimal impacts, including the following:

- As equipment is brought into the process pad location for construction, minor soil compaction could occur in all areas where equipment travels. Additional soil compaction could result from the weight of the slab resting on the soil for an extended period of time. The compaction of soil is discussed above in the section on potential mud pit impacts and, as noted above, such impacts likely will be negligible.

- The existence of the impermeable layer of concrete could cause reduced permeability in the slab area and could have potential impacts on the soils below. Below the slab, the soils could change in composition due to the lack of natural water flow, sun exposure, and mineral deposition; however, any such potential impacts likely will be negligible.

- The slab, which could have a surrounding concrete curb to enclose any contamination, naturally will collect rainfall. The rainfall could then be treated as contaminated wastewater, thus adding to the amount of contaminated material for disposal.

Evaporation and Retention Ponds

The evaporation/retention ponds likely will have the greatest potential impact on the land surface due to their potential size and the potential for release of the contaminated liquids placed in them. The land area covered could be 100 acres or more. The surface will be disturbed and will take some effort to return to a useable status. *Although these ponds will be lined with multiple liners*, the potential impacts could include the following:

- Equipment brought into the pond area for construction will cause soil compaction. The compaction of soil is discussed above in the section on potential mud pit impacts and, as noted above, such impacts likely will be negligible.

- If the overlying vegetation and root systems are removed to create the ponds, the action could alter the habitat and contribute to soil erosion. Initially, there will be a substantial amount of soil displaced from the pond location. The displacement of this soil obviously will change the surface lands, and could promote erosion from the displaced soil. Potential impacts of any erosion could include increased dust and dirt carried by wind, change in mineral composition due to stripped vegetation, and a change in the soil-water interface causing increased runoff and further erosion. However, proper management practices will minimize, if not eliminate, any such potential impacts.

- Disposal of processing wastes, including solids and liquids, into the ponds potentially could alter the habitat, specifically by causing evaporative changes in the environment and subsequently changing vegetation ecology. Additionally, the wastes deposited in these ponds originate from uranium-rich ores and will exhibit slightly elevated radioactivity, resulting in potential human exposure (discussed further in 4.1.12). However, proper management practices could minimize any such potential impacts.

The most significant potential impact from evaporation and retention ponds are associated with the potential for liner leakage. Liner leakage could potentially allow radioactive or non-radioactive contaminants to escape from the pond system and spread to surface or subsurface soils. Potential impacts to the soils could include changes in the chemical composition and radioactivity of these media. However, proper operation, inspection, and maintenance procedures developed in the operating plan and required as conditions of an ISR license, are designed to minimize the likelihood of material escape from evaporation/retention ponds.

Surface Discharge/Land Application

The potential impacts from discharging treated wastewater over large portion of land will be relatively minor. The associated potential impacts could include the following:

- Bringing spraying equipment into the area of dispersal could have an impact on the land, including minor soil compaction and vegetation disruption, as discussed above in the section on potential mud pits impacts and, as noted above, such impacts likely will be negligible.

- Although the wastewater sprayed onto the land can be treated so that contaminant levels are at or below relevant regulatory standards or license condition limits, there potentially could be the possibility of introducing radioactive constituents into the sprayed surface environment. Good management practices likely will minimize any potential adverse impacts by keeping concentrations of radionuclides below regulatory levels for *free release* of lands

4.1.1.2 Potential Solid Waste Disposal Impacts

All solid waste either will be buried on-site or exported off-site. The burial of non-AEA wastes (TENORM or other) on-site potentially could impact the land by creating a change in soil composition. Since much of this buried waste will be in the form of concrete or metal, it could create an unnatural subsurface environment. This change in composition potentially could cause impacts on the area's permeability and ability to support vegetation, although any such potential impacts likely will be negligible.

The transportation of materials off-site could have potential direct and indirect impacts, including the following:

- The compaction of soils from transport vehicles will be more substantial in areas such as roads or parking areas. The potential impacts from soil compaction are described above in the section on potential mud pit impacts and, as noted above, such impacts are likely to be negligible.

- At some facilities, the creation of new roads will be necessary to accommodate the export of wastes from the ISR facilities for off-site disposal. Depending on the road's location, potential impacts include habitat fragmentation, vegetation disruption, and soils erosion, although good management practices likely will minimize any such potential impacts.

4.1.2 Potential Transportation Impacts

The proposed action will have minor potential impacts from transportation, including the following:

- Physical disturbance to local roadways can be expected during construction and demolition activities associated with the proposed action (ISR operations), but will be confined to the specific site entrance and will be temporary in nature. Onsite and offsite disturbance of local unimproved roads could occur in the form of compaction and erosion due to heavy machinery and truck traffic. Paved local roadways potentially

could be impacted by exploratory drilling activities, by construction activities for site preparation (e.g., re-grading to provide adequate site distances at entrances for operations), or by wear from heavier truck traffic than the roads otherwise will have to accommodate. The roadways will be restored to their pre-operational condition following construction and site D&D activities. Temporary closure of one lane of traffic potentially could occur during site construction and decommissioning, but traffic will return to normal following those activities. Rill and gully erosion on unimproved roads can mitigated with suitable engineering grade clean fill material and grading/piping to provide runoff of stormwater. Any reduction in the life of paved surfaces due to traffic or load increases can mitigated by repaving.

- Potential transportation impacts can result if uranium products and wastes are transported by means other than vehicular traffic on roadways, although transport by other means is not expected. NRC already has assessed potential uranium product transportation impacts in a variety of documents including the 1980 GEIS, NUREG-0535, and NUREG-0170, Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes (NRC, 1977a) and such assessments, to the extent relevant, should be included in the ISR GEIS.

- A range of potential impacts could result from a potential truck accident. Process chemicals being delivered to ISR facilities include hazardous materials that could result in hazardous materials spills during a traffic accident. Product (including yellowcake, yellowcake slurry, and uranium-loaded IX resins) shipped from the ISR facilities to refineries will be considered Class 7 LSA material, and will be packaged in strong, tight packages. Analysis of documented accidents involving product shipment shows that the secure containers have prevented spills.

- Detailed assessments for truck accident probabilities have been documented in NUREG 0706 (NRC, 1980b) and NUREG-0535 for yellowcake and NUREG-1508 (HRI, 1997a) for yellowcake and process chemicals. The chemicals typically used in ISR facilities are listed in 3.2.2.2, and the varying potential impacts of an accident involving these chemicals are dependent on location (e.g., population, traffic, environmental conditions such as wind speed and ground surface porosity) quantity of material released, severity of the accident, and the properties of the material. A spill of liquid acid can be more difficult to contain and, thus, more critical than a spill of solid NaCl, which can be easily contained and cleaned. Additionally, chemicals being transported that present a risk of explosion, such as the bottled gases and oils, present a concern for their potential impact on public safety in the case of an accident. Typically, transporters and local emergency authorities (e.g., fire, police, and emergency response) will be appropriately trained and licensed to reduce the likelihood of traffic accidents.

An assessment of the specific impact of truck accident scenarios was conducted by The Center for Nuclear Waste Regulatory Analysis for NRC (NUREG-6733) (NRC, 2001). In addressing the risk of transporting yellowcake to an off-site processing facility, determinations of the risk of radioactive exposure to the surrounding population were made using two models, one being a very conservative model (Model I) and one being more realistic (Model II). The expected fractional release from an accident was determined to be 0.45 (45 percent of the mass transported in the truck) for the bounding case (Model I) and 0.03 (3 percent of the mass transported in the truck) for the more realistic case (Model II). Combining dose commitments with the International Commission on Radiological Protection (ICRP) nominal probability coefficient for the whole population, an expected 0.1 and 0.007 cancer deaths per accident was

determined for Models I and II, respectively. Using the 0.11 probability of an accident per year per facility leads to an estimated expected 0.01 (Model I) or 0.0008 (Model II) cancer deaths per year as a result of yellowcake transport accidents associated with one facility.

Two examples of yellowcake spills can be used for comparative reference. In 1977, a spill of 12,000 lbs (5443 kg) of yellowcake occurred in Colorado. A 1.2 man-rem consequence was calculated from this event, which was lower than the estimated consequence from the realistic Model II case (which was estimated to be 14 man-rem) (NRC, 1980b). A spill in Kansas resulted in only 4 percent of yellowcake being released, and no dose commitments were calculated. The two examples of yellowcake spills are also assessed in NUREG-6733 (NRC, 2001)

With respect to the transportation of loaded IX resins from satellite or remote-IX well fields, NRC and its Agreement States (e.g., Texas) have assessed the potential impact associated with the transportation of such resins and have determined that it does not pose any significant potential impacts. As stated in NUREG-6733, “resin will be transported in tank trucks within the ISL [ISR] facility from satellite plants to the main [central] processing plant. The hazards associated with these activities were analyzed previously by NRC for both a generic uranium mill…and the proposed ISL [ISR] facility at Crownpoint…which was based directly on the earlier generic analysis.” NUREG-6733 at 4-53. Most recently, NRC issued a performance-based, multi-site license to R.M.D. Operations, LLC (RMD) for treatment of drinking water sources to remove uranium in compliance with EPA’s SDWA and its new uranium in drinking water MCL. In its evaluation, NRC concluded, “some treatment media [IX resins] and residual water could spill on the ground. However, the treatment media will retain the uranium and prevent contamination of soils at the accident site. Such a spill also will only spread a limited distance and will be easily recovered….All disturbed areas would then be reclaimed in accordance with applicable state and NRC regulations. *Thus, the risk of potential impacts on the environment from such accidents is negligible*.” (RMD EA 7). In addition, NRC found that, “any health and safety consequences are expected to be mitigated by the primary level of response, which will be from the transportation contractor’s established response team and procedures.” (RMD EA 7).

With respect to the transportation of yellowcake slurry, the potential transportation risks are likely to be between those associated with dried yellowcake and loaded IX resins. Yellowcake slurry does not pose a significant risk of airborne dispersion due to its moisture content. Further, as stated in NUREG-6733, “yellowcake slurry is routinely transported by tank truck from satellite plants to the main [central] processing plant…Quantitative analysis of the consequences of such an [truck] accident have not been reported, but NRC…has concluded that consequences are likely to be lower than for trucks carrying dry [yellowcake] concentrate, because airborne releases from wet material are minimal if the spill is quickly cleaned up.” (NUREG-6733 at 4-55).

In summary, NUREG-6733 concluded that, “[c]alculated expected radiological outcomes from transport accidents are relatively small, particularly for the more realistic analyses.” (NUREG-6733 at 4-55).

4.1.3 Potential Geology and Soils Impacts

The geology and soils at an ISR site potentially will be impacted during each phase of the project, including construction, operations and decommissioning, which includes recovery zone groundwater restoration. Potential impacts to the subsurface soils could occur due to construction of the wells and the recovery process during operations. Potential impacts to the

surface soils could result from the construction of buildings and other facilities for accessing well fields and processing uranium into yellowcake.

Examples of potential impacts to site geology could include subsidence, landslides, and disruption of natural drainage patterns. However, it is more likely that geological forces could exert an impact on the proposed action (e.g., seismic or volcanic hazards).

Examples of potential soil impacts could include removal and disturbance of topsoil, compaction, and altering of natural drainage paths that could affect soil erosion. Overall, the potential environmental impacts to the soil will be low and typically will not result from the ISR process itself, but rather from ancillary activities such as waste disposal and construction. In the past, ISR facilities have been operated to minimize erosion and surface disturbance and then assiduously restored, including removal of buildings and structures, leaving little, if any, impact on the soils.

4.1.3.1 Construction Activities

Well Field and Associated Piping:

- Subsurface soils will be excavated and removed from their native location. Excavated soils (drill cuttings) are returned to mud pits as TENORM.
- Movement of drilling and construction equipment and installation of wellheads, piping systems, and other facilities will disturb small areas of surface soil. Vehicle movement could cause compaction, rutting, and other disturbances to the surface soil and rocks. Depending on the intensity and duration of construction activities, compaction and erosion of surface soil could alter drainage and cause accelerated erosion and degradation of surrounding surface water resources. However, good management practices likely will minimize, if not eliminate, any such potential impacts.

Uranium Processing Facilities:

- Only very shallow surface soils will be disturbed during construction of ISR processing facilities, and will then be compacted in place for building foundations or used for site grading.
- Movement of construction equipment could disturb small areas of surface soil. Vehicle movement to and within the construction site could cause compaction, rutting, and other disturbances to the surface soil and rocks. Depending on the intensity and duration of construction activities, compaction and erosion of surface soil could alter drainage and cause accelerated erosion and degradation of surrounding surface water resources. However, good management practices likely will minimize any such potential impacts.
- Structures that cover existing surfaces (buildings, sheds, etc.) will include conveyance systems to handle precipitation that, if not properly designed or installed, could cause erosion of surrounding areas. However, good management practices likely will minimize any such potential impacts.

Wastewater Evaporation/Retention Ponds:

- Only very shallow surface soils in the immediate area will be disturbed during construction of the waste retention ponds, though excavated soils from other parts of the site typically will be imported and used to construct the foundation and walls of the ponds. Surface soils in the area will be compacted from the overlying weight of the pond.

- Movement of construction equipment could disturb small adjacent areas of surface soil, and vehicle movement to and within the construction site could cause compaction, rutting, and other disturbances to the surface soil and rocks. Depending on the intensity and duration of construction activities, compaction and erosion of surface soil could alter drainage and cause accelerated erosion and degradation of surrounding surface water resources. However, good management practices likely will minimize any such potential impacts.

4.1.3.2 ISR Operations

Active ISR operations generally will only affect the geology of the site. Occasionally, the soil can be affected if there is a spill or leak, but the operator will take necessary steps to correct any such potential impacts in accordance with relevant license conditions. If additional processing equipment is needed, there can be additional construction. (The potential impacts from construction activities are described above.)

ISR operations will not remove rock matrix or structure and will not cause subsidence or collapse of overbearing rock in the recovery zone, though it could exacerbate existing weaknesses caused by collocated former conventional mining shafts and pits.

Initial well field testing and shakedown periods prior to full-scale operation will begin the recovery process in the recovery zone of the aquifer. The introduced recovery solution likely will also solubilize other minerals of some or no value that will then be processed along with the uranium and used or removed for final disposition. A detailed discussion of potential water impacts is presented in Section 4.1.4.

Wastewater produced during ISR operations typically will be handled in one or a combination of ways: (a) reinjection of treated water (RO permeate) into other well fields; (b) injection of RO reject water into a deep-injection disposal well or (c) disposal to evaporation ponds. No evaporation ponds are needed if deep-injection well disposal capacity is adequate or if ISR operator treats the wastewater. Where such wells are not available, evaporation ponds will be the most practical option. Reinjection of the treated wastewater will have the following potential impacts on geology and soils:

- Reinjection could introduce minerals and other constituents of the treated wastewater into aquifers in the surrounding area; no evaporation ponds are needed.

- As deep-injection wells are drilled, there will be disruption of soil formation, rock formation, and water flow processes; however, these potential impacts are minor and are similar to common drilling for water, oil and gas or a disposal well. EPA/state UIC regulations and permitting guidance require an evaluation of the seismic risk of a

potential disposal well site, including evaluation of the potential pressure impacts to the injection zone. As such, current regulations are in place to ensure the seismic stability of the selected injection site. Changes caused by thermal (heat caused by drilling), chemical (possible reaction caused displaced chemicals during drilling), and mechanical alterations will be negligible and similar to most drilling projects. As the Class I UIC deep-injection well permitting process is intended to ensure protection of USDWs, ISR solutions destined for deep-injection well disposal will require compliance with EPA/state UIC regulations and, as such, the potential impacts will be negligible.

- In addition, the re-injection of treated groundwater as part of uranium recovery or as part of restoration of the recovery zone is unlikely to cause changes in the underground environment except to restore the water quality consistent with baseline or other NRC-approved limits and to reduce mobility of any residual radionuclides. Further, industry standard operating procedures, which are accepted by NRC and other regulating agencies for ISR operations, include a regional pump test prior to licensing, followed by more detailed pump tests after licensing for each individual area where uranium will be recovered prior to its production. Any potential variations in hydrogeology, due to disruption of soil or rock formation will be assessed and taken into account prior to commencing operations to ensure that operations will not impact adjacent, non-exempt drinking water resources in the region (Bartels, 1999).

4.1.3.3 Uranium Processing

In the Model ISR Site used for this GER, processing pregnant lixiviant into yellowcake will take place using processing equipment in on-site facilities. Normal ISR operations will not impact geology and soils at the site after the construction of the facilities. An impact will occur only if there is an accident or a malfunction that spills or emits processing chemicals, recovery solutions, loaded IX resins or yellowcake products (i.e., slurry or dried concentrate) onto site surface soils.

Spills and leaks from piping or evaporation/retention pond failures could introduce pregnant lixiviant to the surface soils or to an area beyond the limits of the ISR site resulting in potential impacts on surface and near-surface soils. In the event of a spill or leak, potential impacts on geology and soils from pregnant lixiviant could include contamination plumes, resulting in necessary remediation actions. Remediation will include removal and disposal of soil with other 11e.(2) byproduct materials at a licensed off-site disposal area in compliance with applicable regulations.

Transportation accidents can result in yellowcake, yellowcake slurry or loaded IX resin spills that could contaminate soils. The potential local impacts of such spills (contamination of the soil) can be mitigated readily. The impact of a loaded IX resin spill will depend on whether the resin is loaded with uranium or not. If a spill of a loaded IX resin occurs during a rain event, there is a minimal potential for some uranium to be contained into the surrounding soil. As stated above, a calculation of the impact of a spill of loaded IX resin was completed in NUREG-6733 (NRC, 2001) and also was discussed in EPA's TENORM report on uranium mining (EPA, 2007a). The most significant resultant indoor exposure to workers will be to radon, but this will not be an issue outdoors during a transport accident. External dose calculations using conservative values show very low doses (a maximum of 2.7×10^{-3} mrem/yr to someone standing directly on the spill). As affirmed by the EPA, since this spill is likely to be cleaned up within hours, the

external exposure to any one person is expected to be low and well within regulatory dose limits for both members of the public and site workers.

In the case of such an incident, the radiation levels and uranium concentrations in soil and water at the location will first be determined to assess exposure levels (resins may contain gamma-emitting radioactivity) and the need for any shielding or exposure limitations during cleanup. The loaded IX resin and surrounding soil will be removed to appropriate containers, such as standard steel drums. Sampling and analysis of the remnant soil in the spill area will then be used to confirm that all contamination has been removed. However, potential adverse impacts are anticipated to be minimal.

Stripped IX resin (having had uranium removed from it in the central processing plant) will have little potential to release uranium, even during a rain event. However, to be conservative, the same diagnostic procedure for the loaded IX resin will be used. A similar procedure will be used for yellowcake or yellowcake slurry spills. In both cases, standard best practices to minimize worker contamination/exposures will be followed. As noted in NUREG/CR-6733 (Section 4.2.1), the only radiological consequence of a yellowcake spill relates to potential inhalation of any dry yellowcake that might become airborne before and during site reclamation.

The shipment of loaded IX resin, yellowcake slurry, and yellowcake will include on-board spill containment equipment, and testing procedures for spill response.

4.1.4 Potential Water Resource Impacts

The following sections describe the potential impacts on surface and groundwater resources.

4.1.4.1 Potential Surface Water Impacts

Direct impacts on surface water resources from ISR operations potentially could result from physical intrusion of proposed actions into streams, seeps, springs, and wetlands. For example, if groundwater restoration versus consumptive use of groundwater is not properly balanced, potential direct impacts could occur to nearby seeps or springs. Careful attention to well field balance and drawdown can mitigate any such potential impacts.

Potential impacts could also occur from construction of access roads, which will increase the sedimentation and erosion potential. Thus, potential surface water quality impacts could include sediment delivery to water features and impacts on aquatic ecosystems. Analysis of potential site specific impacts will be conducted for each ISR site and will include, at a minimum, the number of stream crossings by drainage, potential impacts of the access roads and other actions on riparian areas and filter strips, and relative sediment delivery to streams.

Potential indirect impacts of ISR operations could include increased sediment deposition in streams, which could alter stream morphology and degrade the suitability of channel substrate for aquatic organisms. However, as stated previously, this issue is addressed by NPDES storm water requirements, and good management practices likely will minimize, if not eliminate, any such potential impacts.

4.1.4.2 Potential Groundwater Impacts

The potential groundwater impacts of ISR operations include the impacts from groundwater consumption and impacts to groundwater quality. During ISR operations, potential water quality impacts typically will be of greater concern than water consumption because water consumption, during recovery operations will be small relative to the amount of water circulated depending on the size and duration of recovery operations. Water consumption will become a larger potential impact during groundwater restoration activities (HRI, 1997a).

Groundwater Consumption

Groundwater consumption during ISR operations at the Model ISR Site is expected to be 0.5 to 1.5 percent of the total production rate. Assuming an average of 1.0 percent bleed, this equates to a range of 30 to 60 gpm for common plant design (3,000 to 6,000 gpm). Additional and more significant groundwater consumption (300 to 800 gpm) occurs during a groundwater sweep phase of restoration, all of which requires disposal (commonly to deep injection wells or evaporation ponds). If groundwater sweep is used, it likely will be followed by RO treatment and injection of de-ionized water. The RO brine that requires disposal (consumptive use) during RO treatment can range from 100 to 250 gpm. For this reason, overly aggressive, ongoing restoration (e.g., past the point of diminishing returns with regard to groundwater quality improvement over time) can result in significant consumptive use for little or no public health benefit since the recovery zone can never be a USDW.

Actual net consumption during the recovery and restoration processes will vary by site, especially with regard to design recovery and restoration flows. For example, at the Crow Butte North Trend Expansion Area, groundwater consumption during production was estimated to be at 23 to 68 gpm. For the entire operation (approximately 14 years including both mining and restoration), the annual estimated consumptive use would be approximately 50 to 100 gpm (approximately 80 to 160 acre-ft per year). (CBR 2007)

For the Mestena Alta Mesa facility in Texas, total consumptive use is projected to range from approximately 160 to 430 gpm (258 to 698 acre-feet per year). Some projects currently in the permitting stage in Wyoming likely will consume on the order of 100 to 200 gpm (160 to 320 acre-feet per year) for the average project life (approximately 10 to 12 years).

For perspective, growing small spring grain on one circle sprinkler (assumed to be 140 acres) in northwest Nebraska will require approximately 82 acre-feet of water (after accounting for water supplied by precipitation). Using the same assumption, the water use for one circle of active pasture or corn will be approximately 200 to 240 acre-feet per year (University of Nebraska-Lincoln Extension, Institute of Agriculture and Natural Resources, NebGuide G1465). Thus, in this regard, the potential drawdown impacts from ISR operations and restoration are similar to those from a small farm.

Potential impacts of consumptive use on local water users and systems can include water level drawdown that could extend beyond the recovery zone causing water levels in nearby wells to drop and requiring installation of deeper and/or more distant wells by users. The timing, magnitude and impact of such drawdown depend on the recovery/restoration rate, aquifer properties, and proximity of local water users. Groundwater modeling is used to assess the potential impact of consumptive use on local water users and systems. Factors that must be

considered to assess the potential impacts of groundwater consumption in a general framework include but are not limited to:

- Recovery/restoration life
- Average net consumptive use
- Location of pumping centroid
- Distance to nearby water users
- Formation transmissivity
- Formation thickness
- Formation hydraulic conductivity
- Formation storativity

Significant potential groundwater consumption impacts are possible in the event that restoration activities continue in an effort to achieve primary or secondary restoration goals beyond what is "reasonably achievable," after the asymptotic curve has been achieved.

Groundwater Quality

Another potential environmental impact to groundwater as a result of ISR is the degradation of water quality in the recovery zone within the well field pattern areas. While this impact is real, in and of itself, it is of limited importance, because the water quality is very poor prior to uranium recovery operations, due to the presence of highly elevated naturally occurring radionuclide levels that far exceed EPA or state drinking water limits that are the bases for UIC aquifer exemptions and which can never serve as a USDW (HRI, 1997a).

The ISR process causes an increase in trace elements and salinity in groundwater during the recovery process because of oxidation reactions, decreases in pH and IX. These processes do not introduce new chemical species to the ground-water system but do elevate levels of certain species that are native to the pre-operational groundwater and host aquifer. The most notable ISR impact that is a direct result of oxidation is the increase in solubilized uranium which is mostly present in the host ore in a reduced insoluble form. During the ISR process, the uranium is oxidized and complexed with bicarbonate anions in the groundwater and becomes mobile according to the following chemical reaction:

$$2UO_2 + O_2 \rightarrow 2UO_3$$
$$UO_3 + 2NaHCO_3 \rightarrow NA_2UO_2(CO_3)_2 + H_2O$$

The oxidation of the host rock also mobilizes other trace elements and increases their concentrations in the connate groundwater indirectly affecting pH. Depending on the mineralogy of a given uranium deposit, oxidation of: (1) iron sulfides will result in an increase in sulfate ions; (2) ferroselite will result in an increase in selenium values; and (3) molydebdenum sulfide will result in an increase in soluble molybdenum and perhaps elemental sulfur according to the following chemical reactions:

$$(1)\ FeS_2 + 15/4\ O_2 + 7/2\ H_2O \rightarrow Fe(OH)_3\ [ppt] + 4\ H^+ + 2\ SO_4^=$$

$$(2)\ FeSe_2 + 11/4\ O_2 + 7/2\ H_2O \rightarrow Fe(OH)_3\ [ppt] + 4\ H^+ + 2\ SeO_3^=$$

$$(3)\ 2\ MoS_2 + 9/2\ O_2 + 2\ H_2O \rightarrow Mo_2O_5 + 4\ H^+ + 2\ S_2O_3^=$$

All three of these reactions generate small amounts of sulfuric acid which results in a pH decrease from the slightly alkaline range to a more neutral range. This pH drop causes dissolution of calcium carbonate which results in increases of calcium, chloride and carbonate and a readjustment of pH upward according to the following chemical reaction:

$$2\ H_2SO_4 + 4\ CaCO_3 + 4NaCl \rightarrow 4NaHCO_3 + 2\ CaSO_4\ [ppt] + 2\ Ca^{++} + 2\ Cl^{-}$$

Finally, groundwater is affected during the surface IX process when the uranium-laden recovery solution containing the uranyl carbonate complex is treated at the central processing plant. Uranium on the reacting sites of the loaded IX resin is exchanged for chloride which is released to form NaCl in the barren lixiviant according to the following reaction where R is a reacting site of the IX resin:

$$Na_2UO_2(CO_3)_2 + 2RCl \rightarrow R_2\ UO_2(CO_3)_2 + 2NaCl$$

As a result of the processes of oxidation, pH adjustment and IX, the fortified native groundwater lixiviant registers an increase in trace elements and salinity that is higher than native groundwater as illustrated in the parameter concentrations below.

Calcium (mg/L)	100 - 350
Sodium(mg/L)	500 - 1600
Carbonate (mg/L)	0 - 500
Bicarbonate (mg/L)	800 - 1500
Sulfate (mg/L)	100 - 1200
Chloride (mg/L)	250 - 1800
Total Dissolved Solids (mg/L)	1500 - 5500
Uranium (mg/L)	50 – 250
Molydebdenum	0 -100
Selenium	0 -10
pH	7 – 9

Since the groundwater chemistry has been altered after uranium recovery is complete, groundwater restoration is conducted. The objective of groundwater restoration is to return, on a parameter-by-parameter basis, all parameters *consistent with (baseline) conditions*. Restoration is often conducted using reverse osmosis treatment (“RO”) of groundwater. RO treated water is circulated through the production zone utilizing the injection-extraction well field configuration that was employed during production operations. By using the existing production well field pattern configuration, the benefits from efficient reservoir engineering design that was employed during uranium recovery operations similarly are available for restoration.

Restoration to precise pre-operational concentrations on a parameter-by-parameter basis is not typically reasonably achievable, and continued efforts may not be desirable, because they will consume ever more quantities of groundwater without significant changes to quality of use as compared to pre-operational conditions. Indeed, in NUREG-1569, NRC has stated, “restoration activities are not likely to return ground-water quality to exact water quality that existed at every location prior to *in situ* leach [recovery] operations.” (NRC, 2003a). In determining whether to pursue an ACL-equivalent that amends one or more restoration parameters, an ISR operator must address certain criteria to the satisfaction of regulatory agencies, including the uses for which the ground water was suitable before recovery operations; the potential future use of ground water of pre-operational quality versus proposed restoration quality; the effort made to restore the groundwater consistent with pre-operational quality; the technology available to

restore groundwater for particular parameters; the cost of further restoration efforts; the consumption of groundwater resources to achieve further increments of restoration; and most importantly, the potential adverse impacts on public health of the proposed amended levels of particular parameter. This analysis must demonstrate that potable water outside of the recovery zone is protected after restoration is complete. Rather, in reality, the primary goal of these efforts is to minimize or eliminate the major potential impact of ISR operations—that is, migration of solubilized constituents to adjacent, non-exempt USDWs. Thus, restoration efforts to reverse the changes in water quality in the recovery zone that ISR operations cause are not directed primarily at improving water quality of water that is already so contaminated that it can never be a USDW.

The Model ISR Site is required to have an aquifer exemption approved by EPA in accordance with its UIC regulations, which allows injection of lixiviant into the exempted aquifer, or portion thereof, and demonstrates that it cannot now nor ever in the future serve as a USDW. Non-exempted groundwater zones, either horizontally or vertically adjacent to the exempted aquifer or portion thereof may fall into other classes of use, including drinking water, and must be protected.

Potential impacts to groundwater quality can be caused by excursions, accidents, and restoration activities. Potential impacts from these events are described below.

Excursions

An excursion can occur when recovery solutions are detected outside of the well field area in a well located in the exterior monitor well ring. Excursions can and have occurred at historic and active ISR sites. However, those excursions have not resulted in any significant adverse impacts to USDWs. The fact that such excursions have been detected and controlled demonstrates that the protective capabilities inherent in the ISR process, where exterior monitor wells are required to identify excursions of recovery solutions and license/permit requirements mandate proactive protection of adjacent, non-exempt aquifers. In this regard, it is important to understand that NRC licenses and a Class III UIC permit are written to protect USDWs, and well field balancing, including process bleed from ISR operations, monitor well systems, and pump tests are in-process safeguards directed towards that objective.

The causes for excursions include (CBR 2007):

- Improper balance between injection and recovery rates
- Undetected high-permeability strata or fault zones
- Improperly abandoned exploratory drill holes
- Vertical migration of recovery solutions through unsuitable aquitards
- Poor well integrity
- Hydrofracturing of recovery zone or nearby zones from excessive injection pressures
- Natural conditions

The most common cause of an excursion is improper well field balance (e.g., the amount of water injected into a certain pattern exceeds the water removed). Such an imbalance can result in migration of recovery solutions outside of the pattern area, toward the monitor well ring. To assess pre-operational water quality wells in a well field and the monitor well ring are sampled before ISR operations begin. The water quality data are used to set the concentrations of parameters (i.e., UCLs) that will be used to determine whether the well field is operating

properly. The UCL parameters are selected based on general well field water quality and the increased *mobility* of certain constituents. The latter is important because it provides the earliest possible indication of a potential excursion. Common UCL parameters are chloride, conductivity and bicarbonate, because they are persistent in a groundwater environment, are easily detected, and are excellent indicators of a potential excursion (e.g., many United States operations use a bicarbonate leach).

Excursions are declared based on excursion indicators in monitor wells when compared to site-specific UCLs. For example, at the Crownpoint site, an excursion is declared if any two excursion indicators in any monitor well exceed their respective UCLs, or a single excursion indicator exceeds its UCL by 20 percent (HRI, 1997b). Impacts of excursions include the potential to contaminate groundwater outside of the well field or in aquifers above or below the recovery zone. However, it is noted that, in spite of excursions at virtually every operating ISR site, no significant, adverse impacts to USDWs have been documented throughout the history of ISR operations in the United States, which indicates that operators have the capability to recover errant solutions.

During routine sampling, if two of the three UCL values are exceeded in a monitor well, or if one UCL value is exceeded by 20 percent, the well will be re-sampled within 48 hours and analyzed for the excursion indicators. If the second sample does not exceed the UCLs, a third sample will be taken within 48 hours. If neither the second or third sample results exceeded the UCLs, the first sample will be considered in error.

If the second or third sample verifies an exceedance, the well in question is placed on excursion status. Upon verification of the excursion, NRC Project Manager is notified by telephone or email within 48 hours and notified in writing within thirty (30) days.

If an excursion is verified, the following methods of corrective action will be instituted (not necessarily in the order given) dependent upon the circumstances:

- A preliminary investigation will be completed to determine the probable cause.

- Extraction and/or injection rates in the vicinity of the monitor well will be adjusted as necessary to generate an effective net over-recovery, thus forming a hydraulic gradient toward the recovery zone.

- Individual wells will be pumped to enhance recovery of recovery solutions.

- Injection into the recovery zone area adjacent to the monitor well may be suspended, while extraction continues, thus increasing the overall bleed rate and the recovery of recovery zone solutions.

In addition to the above corrective actions, sampling frequency of the monitor well on excursion status is increased to weekly. An excursion will be considered resolved when the concentrations of excursion indicators do not exceed the criteria defining an excursion for three consecutive one-week samples. Accordingly, while a real potential short-term impact, excursions during uranium recovery operations can be identified and controlled such that impacts are expected to be minimal.

Accidents

Groundwater quality also could be impacted during ISR operations due to an accident, such as:

- Storage pond leakage
- Uncontrolled release of process liquids due to a recovery zone accident
- Release of injection or production solutions from a recovery zone building or associated piping
- Spills
- Well rupture

An uncontrolled pond leak, spill, or recovery zone accident, could cause potential contamination of the shallow aquifer as well as the surrounding soils. This could occur as a result of a slow leak or a catastrophic failure, a shallow excursion, an overflow due to excess production or restoration flow or the addition of excessive rainwater or runoff. Injection pressures must be maintained below casing and formation rupture pressures to prevent casing rupture or vertical excursions. Well field operating pressures must be monitored at the wellhead or manifold house using instrumentation with alarms/interlocks to notify the operator in case of excessive pressures, so that corrective measures can be taken promptly. Well ruptures due to casing failure or excessive injection pressures could potentially to contaminate both shallow and deep aquifers. Constant attention to proper operating pressures will minimize the potential for such impacts. In addition, as will be shown below in Section 5.4, MIT testing procedures essentially have eliminated potential risk from excursions to shallow aquifers.

Restoration

ISR operations alter the geochemical conditions and water quality within the recovery zone horizon of the aquifer. The goal of restoration is to return the water quality in the recovery zone to a condition consistent with pre-operational (baseline) quality. This in turn will protect the quality of adjacent groundwater and preserve the potential uses of groundwater outside the aquifer exemption area.

Restoration typically involves: (1) groundwater sweep, in which groundwater is pumped from extraction and injection wells, drawing native water from the surrounding aquifer through the recovery zone; and (2) groundwater recirculation, during which groundwater is extracted, cleaned through RO treatment, and then re-injected to facilitate aquifer restoration. In some cases, near the end of the groundwater recirculation process, a reductant such as hydrogen sulfide (H_2S) may be added to the re-injected groundwater to assist in re-establishing reducing conditions. At the end of the groundwater restoration process, stabilization monitoring is generally conducted on a quarterly basis for a year or more. This monitoring is used to demonstrate that NRC/Agreement State-approved conditions are maintained as natural hydrologic conditions are re-established.

The re-establishment of long-term reducing conditions in the restored aquifer is a potentially important factor that can serve to limit the migration of constituents affected by ISR operations, because reducing conditions have a major effect on the mobility of many constituents associated with uranium roll-front deposits, including uranium, selenium, arsenic, molybdenum, and sulfur. These constituents likely will be relatively immobile under more reducing conditions, although adsorption onto clay and iron oxyhydroxide minerals in the aquifer is likely to cause some attenuation of uranium, selenium, arsenic, and molybdenum, even under oxidizing

conditions. Radium-226 attenuation is not directly dependent on redox conditions, and its mobility is instead limited by the formation of solid solutions with other constituents such as barium to form barite [$BaSO_4$] and by adsorption onto clay minerals in the aquifer.

In some cases, relatively low concentrations of ISR-related constituents may remain in the groundwater after restoration, or may reappear during groundwater stabilization. However, the offsite migration of these constituents is likely to be limited by the effects of dispersion and geochemical attenuation. Deutsch et al. (NRC, 1985) reported experimental results indicating that depleted recovery zone materials obtained from a Texas in-situ leach site retained significant reducing capacity even after being subjected to lixiviants. In addition, most sites will retain their original groundwater flow directions and the downgradient reduced sediments in the rock matrix have been shown to strongly attenuate these constituents. At sites where groundwater flow directions have been reversed, the influx of reducing groundwater from the unaltered, reduced sandstone will limit mobilization of constituents from the leached ore zone and would be expected to re-establish reducing conditions in the relatively small volume of rock matrix affected by ISL operations.

Attenuation and dispersion likely will mitigate any potential impact to obscurity even if there is incomplete restoration.[104] The uranium ore deposit will be millions of years old with billions of gallons of groundwater having moved through the area, but water analysis shows that because of attenuation and dispersion the constituents still are confined to the uranium mineralization zone.[105] The area affected by mineral recovery is extremely small compared to the size of the regional aquifer, so it is logical that the regional reducing capacity of the aquifer will prevail over any small pockets of residual oxidation that may persist. Even if there were no restoration, which will not be the case under NRC licenses, in the case of redistributed uranium ore (which is a prerequisite ore body for ISR operations as described in this GER) the aquifer has shown the regional capacity to reduce and precipitate uranium and other metals over a frontal length extending miles, an area that is orders of magnitude larger than an ISR site. Roll-fronts require broad areas of up gradient meteoric oxidation to keep uranium mobile until that oxidized water moves downgrade far enough to encounter a zone of abundant reductant. It is at this regional redox interface where the oxygenated water is reduced and uranium is deposited. *This process is not merely historic, it is active today*. It is unreasonable to conclude that a regional geologic formation maintains the capacity to absorb meteoric oxygen from expanses of slow moving ground water on a grand scale with resulting regional precipitation of metals, yet this same redox interface will be unable to absorb a far smaller amount of manually injected oxygen from an ISR operation from equally slow moving post-restoration groundwater and precipitate the very same metals. For example, the South Texas uranium trend in the gulf coast aquifer system encompasses tens of thousands of square miles, or hundreds of millions of acres. By comparison, ISR well field patterns, when fully developed, will encompass 100 to 400 acres. These well fields will be completed in a small fraction of the regional aquifer and will be restored so that uranium and other radionuclides are consistent with pre-operational values to minimize or eliminate the *potential* for post-restoration migration to adjacent USDW's.

Numerical modeling has been performed for two mines in Wyoming to assess the potential concentrations of certain constituents downgradient of well fields following the completion of restoration activities. The purpose of those assessments was to determine potential impacts, if

[104] *Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico*. NUREG-1508. Washington, D.C. February 1997. p 4-39, 4-57.
[105] Also see Deutsch, W.J., et al. 1983. *Aquifer Restoration at In-Situ Leach Uranium Mines: Evidence for Natural Restoration Processes*. NUREG/CR-3136.

any, on water quality at the exterior monitor well rings, which roughly approximate the aquifer exemption boundaries. The results of both studies indicate that residual concentrations in the well field following restoration will be reduced to levels below MCLs at the monitor well ring for key constituents of concern (e.g., radium-226, uranium, and selenium). A brief summary of both studies follows.

Groundwater flow and solute transport modeling was performed for the Highland (Power Resources, Inc.) Mine A-Well field in Wyoming using MODFLOW to assess site hydraulics and PHREEQC to evaluate geochemical interactions and transport (Lewis Water Consultants, 2001). Model parameters included a hydraulic conductivity ranging from 0.6 to 2.8 ft/d, hydraulic gradient of 0.004 ft/ft (21.1 ft/mi) and porosity of 20 percent. The results of that effort indicate that concentrations of key constituents (e.g., uranium and radium-226) will be reduced by several orders of magnitude by the time groundwater migrates from the well field to the exterior monitor well ring, and that those concentrations will be below MCLs. The modeling predicts that it will take over 50 years for water from the well field to reach the monitor well ring under natural hydraulic gradient.

Groundwater flow and transport modeling also was performed to assess restoration success for the Irigaray Mine (Cogema) in Wyoming using MODFLOW and MT3D (Petrotek Engineering Corporation, 2004). The approach taken for this site was to develop a model that was predominately dependent on advective transport, minimizing reliance on geochemical reactions. For Irigaray, the modeling focused on the potential impacts of advective mixing on constituent concentrations migrating from the site. The Irigaray modeling specifically did not address the effects of geochemical processes along the flowpath even though it is acknowledged that attenuation due to geochemical factors is significant. Minimizing reliance on geochemical processes is extremely conservative and results in overprediction of constituent concentrations downgradient of the site. The parameters required to simulate steady-state groundwater flow and advective transport include hydraulic conductivity, hydraulic gradient and effective porosity. Each of these parameters were quantified for the Irigaray site and are within the range of typical values for most ISR facilities. Representative values were incorporated into the model. Model parameters included a hydraulic conductivity ranging from 0.5 to 1.0 ft/d, hydraulic gradient of 0.005 ft/ft (26.4 ft/mi) and porosity from 25 to 29 percent. The results of the model indicated the maximum concentration resulting from migration of post-restoration constituents at a distance of 400 feet (approximately the exterior monitor well ring) from the well field was approximately 7 times lower than the post-restoration average well field concentration, after subtracting out the average background concentration. Further, the minimum time for the peak concentration to arrive at the exterior monitor well ring (400 feet from the well field) was on the order of 170 years after mining and restoration ended. The concentrations of all key constituents of concern were predicted to be below MCLs at the monitor well ring.

In summary, it is logical to conclude that the naturally occurring regional geochemistry that has existed for millions of years will not be disrupted by limited and localized operations at a typical ISR project site. When combined with active groundwater restoration, it is highly unlikely that any recovery solutions will migrate from the recovery zone to adjacent, non-exempt USDWs. Further, the studies noted above and previous ISR operating experience provide further evidence that this conclusion is correct.

4.1.5 Potential Ecological Impacts

Species listed as threatened or endangered under the ESA are provided protection from actions that could affect their livelihood and survival. An analysis of federal and state lists of animal and plant species that occur in the ISR site will be conducted. Direct impacts will be quantified by measuring acres lost of potentially suitable habitat for threatened or endangered species and other sensitive species, and acres lost of moderate- or high-quality habitat and sensitive habitats within the footprint of the ISR site. Potential indirect impacts will be described in qualitative terms. Where applicable, duration of impact (whether short-term or long-term) will be detailed. In addition, all required consultations will be conducted (please refer to Section 1.5 for more information regarding consultations).

The degree and duration of any potential impacts will vary depending upon the location, duration of operations, remediation methods and goals, transportation modes, and the potential presence of species and habitats. Potential impacts to ecology that could result from implementation of ISR operations include physical, chemical, and/or radiological impacts, such as the following:

- ISR operations could result in the loss of habitat through access roads, development of a central facility, and development of exploration and production wells. This loss of habitat could lead to a regional decline in biodiversity with regard to terrestrial ecology. Construction activity is likely to only temporarily displace wildlife due to noise, human presence, and heavy equipment.

- Traffic will be increased, including truck transportation of equipment and employee transportation to and from the ISR site. The increase in traffic could lead to a marginal increase in traffic-related wildlife mortalities.

- ISR facilities have the potential to contaminate groundwater manifesting itself in surface water, which could have potential adverse impacts on wildlife (NRC 2001).

- ISR sites likely will be located in remote, rural, areas. Increased noise from site construction and operations and from increased truck or rail transport could have potential adverse impacts on faunal communities.

- Other potential impacts could result from increased lighting that is could be employed for operations beyond normal daylight hours.

4.1.6 Potential Meteorology, Climatology, and Air Quality Impacts

The potential environmental impacts of ISR operations on air quality in the local and regional areas can be divided into those caused by construction and those caused by operations. During construction of the well fields, the gaseous and particulate releases from drilling equipment will have a minor impact on nearby air quality. Any potential air quality impacts from operations will be associated with any particulates generated during processing, drying, and transportation.

4.1.6.1 Construction Activities

During well field construction, potential air quality impacts will include pollutants from vehicle and drill rig exhausts, dust from traffic, and dust from disturbing soil. Mobile sources of air pollutants will be diesel engines on the drill rigs and diesel water trucks. Most other mobile vehicles will be gasoline powered and equipped with pollution control systems.

The potential for dust from wind erosion will be minimized by reclaiming soil and establishing vegetation covers. Well field construction will be completed with stationary equipment. Dust releases from vehicular traffic will be minimal because of the lack of traffic in the region.

4.1.6.2 Operation Activities

ISR operations will result in a range of atmospheric emissions, including carbon dioxide, diesel generator exhaust gases, and road dust. These emissions will have a negligible impact on the surrounding area because of the low overall amount of emissions and natural atmospheric dispersion.

Yellowcake dryers, if a component of a given ISR facility, will dry wet yellowcake continuously by indirect heating before packaging in steel drums. The low-temperature vacuum dryer operates under a negative pressure to remove moisture from the yellowcake. Moisture will be condensed and collected by a scrubber. Any particulate matter in the vapor from the dryer will be collected in the scrubber water and returned to the product thickener. The exhaust gas from the scrubber will be saturated in water vapor and devoid of solids. Thus, potential impacts from yellowcake particulate emissions will be minimal at best.

Open hearth dryers also have air emissions controls, including scrubbers, to remove particulates from the dryer. Although open hearth dryers do not operate under a continuous vacuum, residual risk associated with such equipment can be mitigated, if not eliminated, using sound work practices and testing procedures. Any potential emissions from yellowcake drying or packaging will be calculated according to NRC Regulatory Guide 3.59 (NRC, 1987).

The main source of carbon dioxide production will be from the combustion of LPG as a heat source for the yellowcake dryer (if necessary) and from diesel combustion for power generation. Emissions produced from small LPG combustion sources for drying and from diesel combustion will be nominal and likely fall under local permitting thresholds. Another source of carbon dioxide is from the process of adding it to groundwater for uranium recovery and during precipitation.

Carbon dioxide gas also will be produced during the precipitation of yellowcake. The gas will be generated by the reaction of acid with the sodium carbonate strip solution and will be vented from the precipitation tanks via a stack to the outside of the plant building.

Radioactive airborne discharges will be produced as a result of ISR operations, with radon and radon decay products accounting for the majority of these discharges. If the plant process tanks are not pressurized, they will be vented by means of a stack to the outside of the plant building to minimize personnel exposures in the plant. If the plant process tanks are pressurized, the radon will remain in solution in the injection/extraction circuit.

Well fields emit low levels of radon gas present in processing solutions. Radon can escape into the atmosphere at well field locations during maintenance, sampling, and venting operations. Ventilation systems will be installed in process buildings to avoid radon daughter buildup and will meet all applicable requirements. Average radon releases will be calculated according to methods outlined in NRC Regulatory Guide 3.59 (NRC, 1987).

No significant sources of pollutants resulting from ISR operations are expected. Operations likely will meet NAAQS and local requirements. Federal or state air quality standards likely will not be exceeded during construction and operation, so no significant impacts to air quality are expected from implementing ISR. Vehicular emissions from the maximum vehicle requirements will not be significant and typically are not regulated by federal, state or local agencies.

Preconstruction and operational air quality monitoring will identify any exceedances of air quality standards. In addition, an on-site meteorological monitoring program in accordance with NRC Regulatory Guide 3.63 will be required (NRC, 1988a). NRC also is beginning to accept pre-operational data from nearby NWS stations.

Because construction and ISR operations will not measurably increase background contaminant concentrations in air, the direct, indirect, and cumulative potential impacts on air quality will be negligible.

4.1.7 Potential Noise Impacts

Noise associated with ISR will originate from (1) construction of the well field and installation of wells, and (2) operation of the ISR facility(ies).

Noise levels could increase as a result of construction vehicles, trucks, and facility operations. EPA identifies a 24-hour exposure level of 70 decibels as the level of environmental noise beyond which a measurable hearing loss could result over a lifetime. Likewise, EPA defines 24-hour exposure levels of 55 decibels outdoors or 45 decibels indoors as levels that could prevent or interfere with activity and cause annoyance (EPA, 1974). Noise levels below these average daily decibel limits are considered to be levels that will permit “daily human condition” activities (spoken conversation, sleeping, working, and recreation). Noise in areas with human activity is not expected to increase beyond ambient levels due to plant operations. Likewise, no detrimental off-site noise impacts are anticipated due to the increases in commuter and truck traffic volumes.

4.1.7.1 Construction

In general, it is anticipated that construction noise levels associated with the proposed action will be comparable to current ambient noise levels (L_{EQ}). While construction noise could occasionally be discernible, it will not be expected to increase ambient noise levels significantly for any appreciable period. The average individual likely will tolerate noise associated with construction, given its temporary nature and the fact that most of the construction will take place during daytime hours. Any nighttime or weekend construction activities likely will be similar to the “finishing phase” of construction, which is typically 10 decibels quieter than for other phases. Also, the size of a nighttime workforce will be significantly smaller than a typical daytime workforce, which also reduces noise levels.

During construction of the ISR facility(ies), drill rigs, construction vehicles, and heavy trucks will generate noise that could be audible above background, at levels of 50 to 60 decibels. Because well field construction will occur primarily during daytime hours, construction noise likely will not cause exceedance of the 24-hour sound energy guidelines (EPA, 1978) to protect hearing. Residential receptors are not likely to be present near ISR facilities. If any receptors are present, they likely will be at a distance where potential noise level impacts from construction could be annoying but not likely harmful. Sensitive receptors likely will not exist in the model region (Section 3.5).

4.1.7.2 Operations

Operations at ISR sites typically do not create significant sources of noise to off-site receptors. Noise primarily is generated by drilling and construction activities in the well fields and, to a much lesser degree, by operations. In general, the operational noise sources will be pumps and occasional truck traffic.

Noise in areas with human activity will not be expected to increase beyond ambient levels due to the proposed action plant operations. Likewise, no detrimental off-site noise impacts will be anticipated due to the increases in commuter and truck traffic volumes associated with the proposed action.

Within the extraction and processing facility, OSHA requirements include a hearing conservation program that must be implemented when employees are exposed to 85 dB or more in an 8-hour day. The hearing conservation program includes annual audiometric testing and requires hearing protection devices, such as earplugs. OSHA requirements also include engineering or administrative noise controls when exposure exceeds 90 dB. Engineering controls will include redesigning the space to reduce machinery noise, replacing machinery with quieter equipment, enclosing the noise source, or enclosing the noise receiver. Administrative controls could include mandating the length of time an employee can be exposed to a particular noise source. Worker noise exposure in the model region facility is not expected to be significant.

New facilities are anticipated to use line power and will not have on-site continuously operated generators, which will create noise. In the past the Bison Basin Mine, located southeast of Lander, Wyoming in the Great Divide Basin, used on site generators for electrical power. Applicable measures to abate adverse potential noise impacts will be adhered to, with regard to state and local noise regulations, OSHA requirements, and National Institute for Occupational Safety and Health (NIOSH) standards. These are discussed in additional detail in Section 5.8, Noise Mitigation.

Noise levels generated during operation of the ISR facilities are not expected to result in any significant impacts or to violate any noise standards.

4.1.8 Potential Historic and Cultural Impacts

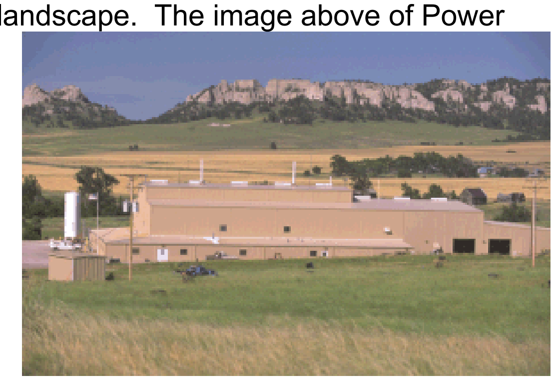
The proposed action will require site-specific background research, investigation, and/or coordination to avoid potential impacts to historic and cultural resources. Based on various inhabitation factors and the size of the model region, it is estimated that pre-contact archaeology sites could be present, and, therefore site-specific evaluation will be performed prior to exploration and development activities. General consultation with the SHPO will have to be coordinated by the applicant and NRC. It is expected that phased archaeological investigations

will be performed, where warranted, during site layout and operations plan preparation and approval. The flexibility of ISR operations permits the location of main and satellite facilities in areas where there are no archaeological resources. Accordingly, it is likely that avoidance measures can be undertaken if archaeological testing uncovers artifacts or archaeological sites.

There are 19th and early 20th century settlements in the model region, and historic resources eligible for listing in the National Registry could be present at specific sites. However, no potential direct impacts to historic architectural resources are anticipated, nor are secondary or cumulative impacts anticipated. If such resources are identified, avoidance measures will be investigated, and if avoidance were not possible, potential impacts will be mitigated in consultation with the SHPO and other responsible officials (as discussed in Section 5.9, Historic and Cultural Mitigation).

4.1.9 Potential Visual and Scenic Impacts

The proposed action will require construction of a processing plant facility, which could be reused or demolished during site D&D. In general, ISR operations are not visually intrusive and will not generate significant potential impacts to the landscape. The image above of Power Resources, Inc.'s Crow Butte Mine shows that these operations are not visually intrusive. (Image courtesy of WMA's website



The NEPA analysis of Wilderness Areas and Wild and Scenic Rivers includes evaluating the proximity of the project site to the area so designated (see Table 3.14), and the assessment of indirect or cumulative impacts. Because impacts to designated Wilderness Areas and Wild and Scenic Rivers are not anticipated, no associated coordination with federal agencies or state agencies is anticipated. No indirect or cumulative impacts to resources beyond the model region are anticipated as a result of the proposed ISR operation.

4.1.10 Potential Socioeconomic Impacts

It is anticipated that the proposed action will draw some workers to the specific project region, leading to unspecified but relatively minor changes in demographics. It is anticipated that a given facility will provide in the range of 50 to100 jobs, making it a major employer in the specific project area. This will improve overall income levels and contribute to the tax base (although it is not anticipated to affect the median income), reduce unemployment, and reduce housing vacancy rates. The increased tax base will accommodate slight increases in demand for public facilities and services and educational facility attendance. Existing infrastructure (water and sewer) service areas in the model region have the capacity to accommodate the increased demand in population centers for such services.

4.1.11 Potential Environmental Justice Impacts

The proposed action will be evaluated on a site-specific basis, as warranted, should environmental justice (EJ) populations be identified. The analysis of EJ considers potential direct impacts as well as potential proximity impacts to surrounding lands, including possible

potential indirect and cumulative effects. NRC takes into account the input from these populations as part of the licensing/permitting process, including “tiered” site-specific NEPA analyses.

The model region contains Native American reservations and Native American lands. Individual ISR sites could be located on lands where the surface is held in trust for Native Americans by the federal government or Native American allotments (former tribal land parcels created under the Dawes Act). The model region contains areas of concentrated Native American populations, including the national and tribal entities listed in Table 3.9.

The American Indian Religious Freedom Act was passed as a joint resolution of Congress in 1978 as a declaration of federal policy "to protect and preserve for American Indians their inherent right of freedom to believe, express and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians." It has no implementing regulations but it is tied to Executive Order 13007 regarding administrative policy and procedure relating to Indian Sacred sites.

The American Indian Religious Freedom Act (1978) requires federal agencies to consider the effects of their programs on places and practices of religious importance to Native Americans, Eskimos, and Native Hawaiians. In many cases, these places can be eligible to the National Register and are thus considered under Section 106 of the National Historic Preservation Act (NHPA). Executive Order 13007 states that for managing federal lands, federal agencies shall, to the extent practicable, accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites. The Advisory Council has posted guidance on the relationship of EO 13007 and Section 106 of the NHPA and how to integrate the requirements of the EO into tribal consultations under Section 106 at http://www.achp.gov/eo13007-106.html. NRC officials will consult and coordinate with the appropriate Tribe or NHO if they believe property of religious importance to Native Americans may be affected.

Programmatically, it is not anticipated that permitting or operation of an ISR site will disproportionately and adversely affect a disadvantaged, low income, or minority population; either directly or indirectly through secondary and cumulative impacts. Thus, it is not anticipated that an individual ISR site will contain a large population of Native Americans, nor is it anticipated that most facilities will be located near a Native American population center. However, on a site-specific basis, where it is determined that Native American populations live in relatively close proximity, an impact assessment will be performed as part of the tiered NEPA evaluation process. With regard to subsistence consumption of plants and animals, reviews will be conducted in accordance with 10 CFR Part 51 and NUREG-1569.

Likewise, the model region undoubtedly contains areas of concentrated racial minorities besides Native Americans and low-income areas. It is anticipated that ISR sites could be located near EJ populations in certain circumstances. On a site-specific basis, a determination of potential impacts will be performed, as necessary; however, since, as a general proposition, ISR projects do not generate any significant adverse impacts, by definition, there will not be any disproportionate environmental consequences.

Uranium recovery operators cannot choose where to site their facilities. That choice is made for them by the location of the resource.

4.1.12 Potential Public and Occupational Health Impacts

Potential *non*-radioactive and radiological impacts to workers, the general public, and flora and fauna will be evaluated. These potential impacts are assessed for potentially significant exposure pathways. These are considered separately in the following sections.

4.1.12.1 Potential Non-radioactive *Impacts*

Potential *non*-radioactive impacts are considered for air quality and noise, groundwater contamination, ecological impacts, socio-economic impacts, and worker health and safety in the following sections.

<u>Air Quality and Noise</u>

Effects During Construction

During well field construction, principal emissions to the air will be suspended particulates and gaseous pollutants from vehicle and drill rig exhausts, dust from vehicular traffic on unpaved roads, and dust from disturbed and unprotected soil (NUREG-1508). The table below, taken from HRI, shows an estimate of the construction vehicle requirements for the construction of the Crownpoint, New Mexico site. Estimated source terms for pollutants discharged by construction vehicles are displayed in Table 4.1.

Table 4.1
Estimated Construction Vehicle Requirements from HRI for Crownpoint, New Mexico ISR Site

Drilling Contractors	
Drilling rigs, water trucks, support vehicles	4
Company Support	
Pick-up trucks	8
Forklift	1
Portable Air Compressor	3
Pump Hoist Trucks	2
Coil Tubing Trucks	2
Logging Trucks	1
Water Trucks	2

HRI also provided an estimate of the emissions from the applicable construction equipment, which is summarized in Table 4.2 below:

Table 4.2
Estimated Source Terms for Gaseous and Particulate Emissions from Construction Equipment

Emission Type	Emission Rate (grams/horsepower-hour)
Sulfur Oxides (SOx)	0.93
Nitrous Oxides (NOx)	11.01
Hydrocarbons	1.41
Carbon Monoxide	9.20
Particulates	1.44
Aldehydes	0.20

During well field construction, it is estimated that each project site will average 100 vehicle-hours per day annually (NUREG 1508). Dust emissions also will be present due to the movement of soil and the travel of construction vehicles over unpaved surfaces. This particulate matter likely will produce minimal potential impacts, if any.

Elevated noise levels will be found in the vicinity of the ISR site during the construction phase due to well drilling and truck movement. Drill rigs, construction vehicles, heavy trucks, and other equipment used to construct and operate the well fields and production facilities will generate noise that will be audible above background levels of 50 to 60 decibels (dB) in the normal (A-scale) auditory frequency band [dB(A)] during the day. Noise resulting from the proposed project could occasionally be annoying to residents within 300 meters (0.2 mile) of the noise sources. Noise levels (other than occasional instantaneous levels) resulting from the proposed project might reach or occasionally exceed 85 dB(A) at 16 meters (50 ft) from the source (NUREG-1508). At the Crownpoint, New Mexico site, the increased noise levels estimated during construction were found to be a possible annoyance to residents in the immediate vicinity of the site, but not harmful.

Potential Effects During Operation

During ISR operations, the primary source of airborne emissions will be airborne effluents generated from processing. Additional potential air quality impacts could include dust from vehicles traveling on unpaved roads, but many of the direct access routes to the facility likely will be paved. HRI's estimates of the process emissions that will affect air quality are presented in Table 4.3 below:

Table 4.3
HRI Estimates of Process Emissions

Emission Type	Annual Total (tonnes)
Sulfur Oxides (SOx)	7.1
Nitrous Oxides (NOx)	84.0
Hydrocarbons	10.8
Carbon Monoxide	70.2
Particulates	11.0
Aldehydes	1.5

As demonstrated above, potential adverse impacts from process emissions likely will be minimal at best.

Noise levels during ISR operations will be considerably less than those experienced during construction and of little or no concern. The primary source of increased noise levels will be vehicular traffic transporting chemicals and product to and from the facility.

Groundwater Contamination

Non-radioactive groundwater contamination could occur at an ISR site due to leakage of recovery solutions from process equipment. Contamination of groundwater from sodium-based alkaline uranium recovery solutions arises from (1) the addition of oxygen and sodium bicarbonate (lixiviant) to the groundwater, (2) the addition of chloride to the groundwater by the processing plant, and (3) the interaction of these chemicals with the mineral and chemical

constituents of the aquifer in the recovery zone (most significantly uranium, potassium, sulfate, arsenic, selenium, molybdenum, and other trace metals [HRI, 1997a]). The potential impact to the public will be controlled using well field balancing (including the process “bleed”), monitor wells around the perimeter and above and below the recovery zone, and pump tests. Excursions, which are unanticipated releases of uranium recovery solutions that move beyond the well field area, will be detected through the perimeter monitor well ring and contained if they were to occur. Monitoring will be conducted for both vertical and horizontal excursions. Thus, potential *non*-radioactive contamination of groundwater beyond the recovery zone can have short-term impacts, but such impacts likely will be minimal and readily controllable.

<u>Potential Ecological Impacts</u>

Potential Impacts During Construction

During the construction phase of the ISR facility, physical disturbances will be the primary source of potential impacts to the ecological system. Vegetation and habitats will have to be removed in order to facilitate the well field drilling. HRI also determined that construction of the Crownpoint site activities could also displace or destroy smaller, less mobile wildlife species. In general, it can be assumed that loss of various animal populations will be proportional to the amount of their habitat that is lost ([HRI, 1997a). Dust and increases in traffic will have some impacts on the flora and fauna in the vicinity of the site, but these impacts will be minimal.

Potential Impacts During Operation

During operation, there are potential impacts to waterfowl and mammals. Waterfowl in the surrounding area could be attracted to the wastewater evaporation/retention ponds, which contain a higher content of dissolved solids and have a composition similar to that of the fortified native groundwater. Concentrations of potentially harmful substances in the wastewater evaporation/retention ponds likely will not be high enough to harm any birds that might choose to use the ponds as a temporary stopover or resting place during migration. Larger mammals will be protected through the use of access control fences around the perimeter of the evaporation ponds. No additional impacts likely will be seen to the habitats of animals on ISR sites during operation.

Potential Socioeconomic Impacts

Potential socioeconomic impacts during the construction of an ISR facility are site-specific and dependent on the density and characteristics of the population within the facility boundaries and the surrounding area. Job creation and the addition of revenue to the local economy are significant benefits during both construction and operation.

Public concern over environmental and ecological impacts from construction and operation of the ISR facility is a potential impact. Public perceptions relating primarily to conventional uranium mining/milling facilities and uranium in general could result in increased apprehension about construction and operation of the ISR facility. These negative perceptions can be mitigated using public education and ongoing outreach to nearby members of the public, which demonstrate that the potential impacts from conventional mining since the early 1970s bear no relation to historic conventional mining conditions and, in any event, are not relevant to ISR operations. Conventional uranium milling has had no significant, adverse impacts on public

health and safety or the environments, and the potential impacts from ISR operations, as compared to conventional mining/milling, are minimal to non-existent.

Potential Worker Health and Safety Impacts

Though NRC does not specifically require an indication of occupational health and safety programs to manage, other than radiological, workplace health and safety, it is still identified as a recommended component and is critical to good business practices. OSHA provides federal regulation of the construction and operation of a processing facility. OSHA Part 1926 presents regulations for workplace safety during construction activities, and Part 1910 provides standards to be followed by all operating facilities in the United States, including standards to be used in the construction of facilities, creation of workplace emergency routes, and the handling of hazardous materials. Thus, OSHA regulations will be applicable to activities within the facility, except radiological health protection. *See* Anthony J. Thompson & Christopher S. Pugsley, *OSHA Environmental Compliance Handbook: Third Edition*, (July, 2004 to 2005).

Subpart E of Part 1910 gives detailed requirements for worker emergency response programs, training in emergency response and reporting, and review of the workplace plan. Subparts H and Z provide detailed guidelines on the labeling, handling, and control of hazardous substances in the workplace. Additionally, standards are provided on required personal protective equipment, mandatory equipment procedures and inspections, and means of controlling potential negative health impacts to workers. In addition to federal regulations for workplace health and safety, many states have individual plans and provide enforcement and consultative services with regard to these plans.

Non-Radioactive *Hazardous Materials*

NRC has previously developed a hazard analysis for process chemical hazards used in ISR surface facilities and a consequence analysis for spills and accidents involving process chemicals (NUREG-6733, September 2001). To perform this assessment, NRC identified chemicals commonly used in substantial quantity at ISR facilities. The 12 most commonly used chemicals are identified in Table 4.4, below. As described in Sections 2 & 3, above, ISR surface facility processes vary only slightly from licensee to licensee, although every facility does not use every chemical listed below. NRC's list was based on the chemicals most commonly encountered during site visits and review of uranium ISR license applications approved or under evaluation at the time of the study.

Table 4.4
Commonly Used Chemicals at ISR Facilities

Chemical	Use(s)
Ammonia	pH adjustment
Sulfuric acid	pH control Splitting uranyl carbonate complex into CO_2 and uranyl ions
Liquid and gaseous oxygen	Oxidation in lixiviant and precipitation of uranium as insoluble uranyl peroxide
Hydrogen peroxide	Oxidant in lixiviant, precipitation of uranyl peroxide
Sodium hydroxide	pH adjustment
Barium chloride	Precipitation of radium during groundwater restoration and wastewater treatment
Carbon dioxide	Carbonate complexing
Hydrochloric acid	pH adjustment

Table 4.4
Commonly Used Chemicals at ISR Facilities

Chemical	Use(s)
Sodium carbonate	Carbonate complexing and resin regeneration
Sodium chloride	Resin regeneration
Hydrogen sulfide	Groundwater restoration
Sodium sulfide	Groundwater restoration

The types of chemicals identified above are common to many types of mining, chemical synthesis, and processing facilities, including conventional drinking water treatment and municipal wastewater treatment facilities. Some of NRC's findings regarding the presence and management of these materials at ISR facilities are as follows:

- The twelve chemicals listed in the above table were commonly used in large enough quantities to pose potential hazards to workers at ISR facilities.
- Regulation of the use of hazardous chemicals at ISR facilities is performed by OSHA.
- NRC does not have the authority to modify the requirements of other agencies.
- Standards for handling and managing hazardous chemicals are generally applicable to all OSHA-regulated facilities (not just ISR facilities). The standards usually specify quantities or uses of chemicals that require certain types of controls, procedures or safety measures.
- The existing published standards generally are effective.
- NRC guidance should specify that ISR facility licensees follow the existing published standards for chemical management.
- Accidents involving hazardous chemicals could affect the ability of workers to respond to accidents involving radioactive materials. However, the consequences of accidents involving radioactive materials from ISR facilities are generally so small that no special precautions are necessary solely because of radiological consequences.

4.1.12.2 Potential Radiological Impacts

Given expressions of concern from some interested stakeholders at scoping meetings regarding issues from legacy uranium recovery activities, the objective of this section is to provide background information relevant to understanding how potential radiation exposure from uranium mining and processing is assessed and why there can be confidence about doses and risks that arise from these activities and the ways to put such doses and risks into context that is understandable to such stakeholders.

In considering these materials, it is important to understand that the potential radiological effects of exposure to ionizing radiation are based on incremental, that is "above background", levels of radiation. As will be discussed later in this section, the background radiation levels and radioactivity are not uniform across the country and vary considerably from place to place.

It is also important to understand that the potential health effects of ionizing radiation depend on dose received and that methods of estimating dose are well established. Also, it should be noted that the potential health effects of ionizing radiation have been studied for many years by expert national and international committees and are well understood.

Background Radiation

Regardless of where people live or work, they are exposed to baseline sources of radiation from naturally occurring radiation and anthropogenic (“man-made”) sources. The magnitude of background sources can vary significantly both in time and space. *Natural* background radiation, as defined by NRC, is the naturally occurring level of radiation present in the environment exclusive of anthropogenic sources. Naturally occurring sources are the overwhelming source of background radiation doses to humans, while fallout from above-ground nuclear testing and Chernobyl contribute only about 0.04 percent to background doses. Doses from anthropogenic sources account for only 18 percent of the total of natural and man-made background radiation sources (that is, doses from natural background radiation account for 82 percent of the total sources).
Naturally occurring ionizing radiation is ubiquitous in the human environment. As NRC has stated, “everything on the planet, including every living thing, is bathed in a sea of radiation from various sources. This is commonly referred to as ‘natural background’, ‘background radiation’ or, more simply, background” (NRC, 1994). The National Council on Radiation Protection and Measurement (NCRP) describes the exposure of people in the United States to natural background radiation and suggests that the annual average radiation dose to someone living in the United States is about 300 millirems per year (mrem/yr). (NCRP, 1987)

NRC defines “background radiation” more broadly, to account for both natural background radiation and anthropogenic sources of radiation outside of a licensee’s control:

> “radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. *“Background radiation”* does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.” [10 CFR § 20.1003.]

For present purposes, man-made sources such as medical/dental procedures are not included as part of background. In general terms, there are four major components (or sources) of ionizing radiation from natural background that comprise the ISR pre-operational radiation environment. These are cosmic radiation, internal radiation from the inhalation or ingestion of naturally occurring radionuclides, external gamma radiation from terrestrial sources and most importantly, the inhalation of radon (or more specifically, the short-lived daughters (radioactive decay products) of radon. As shown in Table 4.5, in the United States, the average annual dose from natural background radiation (including radon) is about 300 mrem/yr.

Table 4.5
United States Nominal Average Levels of Natural Background Radiation

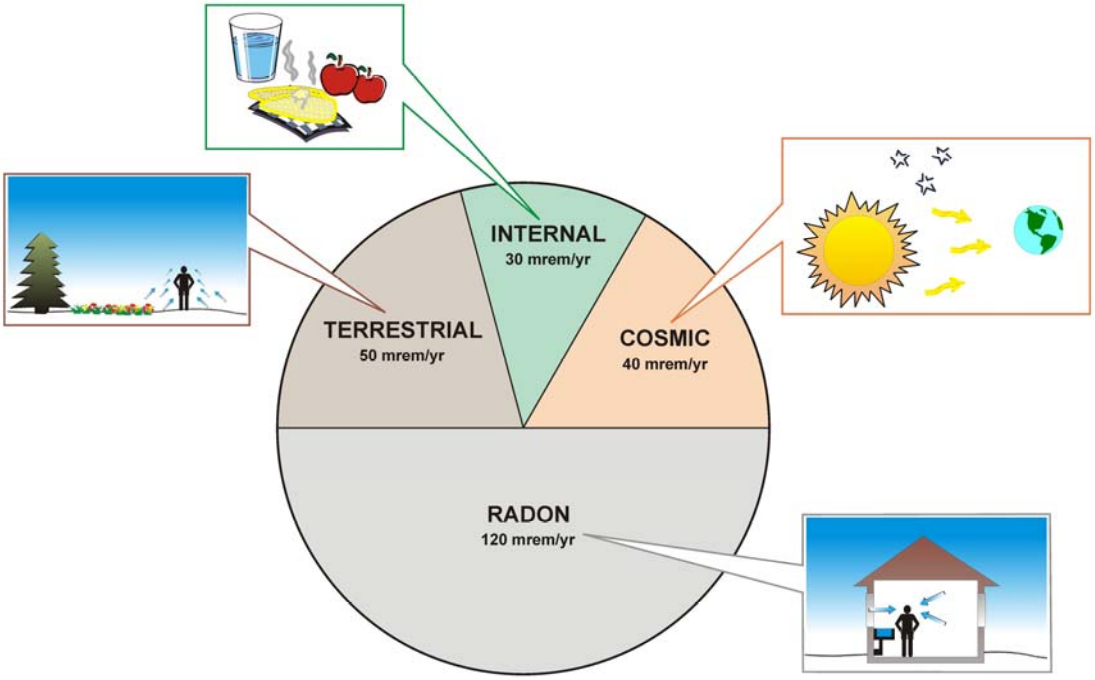
Cosmic and Cosmogenic	28 mrem/yr
Terrestrial	28 mrem/yr
Inhaled (Radon)	200 mrem/yr
Ingested	40 mrem /yr
Total (Average)	**300 mrem/yr (100 mrem/yr excluding radon)**

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), based on compilations of world-wide data, provides estimates of dose (and the range of dose) from natural background sources of radiation and radioactivity World-wide average values for these sources of radiation are shown in Table 4.6 below and are illustrated graphically in the pie chart below:

Table 4.6
Doses from Natural Background

Source	Worldwide Average Annual Effective Dose (mrem)[f]	Typical Range (mrem)
External Exposure		
Cosmic rays	**40**	**30 – 100** [a]
Terrestrial gamma rays	**50**	**30 – 60** [b]
Internal Exposure		
Inhalation (mainly radon)	**120**	**20 – 100** [c]
Ingestion	**30**	**20 – 80** [d]
Total	**240**	**100-1000**

Notes:
a Increases with altitude
b Depending on radionuclides in soils and building materials
c Depends on dwelling and can be much higher
d Depends on radionuclides in foods and drinking water
e. Doses from UNSCEAR, 2000 originally reported in units on millisievert (1 mSv = 100 mrem).



The earth is continually bombarded by high-energy particles that originate in outer space, called cosmic rays. These cosmic rays interact with atmospheric constituents, producing a cascade of interactions that contribute to cosmic ray exposures, and that decrease in intensity with depth

into the atmosphere from aircraft altitudes down to ground level. People at high latitudes and high altitudes receive the highest doses due to the focusing of cosmic rays at the earth's poles as a result of their magnetic fields, and due to the lack of shielding provided by the atmosphere at such altitudes.

Terrestrial radiation arises from naturally occurring radionuclides that are found in soil, rocks and home construction materials. The most important of the terrestrial radionuclides are uranium and thorium series radionuclides and potassium-40. Terrestrial radionuclides contribute to background doses from both external gamma radiation, and from radiation arising due to radioactivity taken into the body via inhalation or ingestion (NRC, 1994) The level of external gamma background radiation attributable to terrestrial radionuclides varies widely dependent on geographic location and related factors, particularly the background concentrations of various minerals.

In addition, the uranium and thorium series radionuclides and the radioactive potassium isotope (K-40), found in soil, rocks and sediments can be transferred naturally into air, water, plants and animals and ingested or inhaled by humans via food, water, and air. Some seafood, bananas and brazil nuts, for example, can contain high levels of naturally occurring radioactivity, and therefore, the variety, source and quantity of foods consumed by people strongly affects the internal dose.

UNSCEAR data suggests that on average, about half of the dose from natural background radiation comes from the inhalation of radon (radon-222) which is part of the radioactive decay chain of uranium-238. Uranium occurs naturally in varying levels in all rocks and soils and some fraction of the radon produced in rocks and soils escapes to the air; therefore, radon is present everywhere in the atmosphere. Data reported by the NCRP (NCRP, 1987) suggests that [average] soils release radon-222 at the rate of about 0.5 pCi per meter squared per second ($pCi/m^2/s$). For example, an acre of soil containing radium-226 at average concentrations [approximately 1 pCi per gram of soil] will release radon [contained in the pore space of soils being tilled] to the air at a rate of about 2000 pCi per second. Indeed, NRC's 1980 GEIS (NRC, 1980c) noted that farming (soil tillage) releases more radon to the atmosphere than will be expected from (post-operational) uranium mill tailings.

In addition to normal soils, which release radon, widely-spread mineralization will contribute regionally to an elevated ambient natural background concentration of radon-222. NCRP Report No 94 (NCRP, 1987) provides data indicating that ambient outdoor radon levels typically range from about 0.1 pCi/L to 0.5 pCi/L, with levels in Colorado Springs as high as 1.2 pCi/L.

A paper by Grasty and Lamarre (Grasty, 2004) reports average summer outdoor radon levels for 17 Canadian cities. The highest outdoor value reported was approximately 1.5 pCi/L in Winnipeg; an area with no elevated or unusual levels of radioactivity in the soil. UNSCEAR, which includes representatives from the United States as well as other countries, reports on scientific information on the levels and effects of ionizing radiation. UNSCEAR 2000 suggests a world-wide, nominal outdoor radon level of about 0.27 pCi/L, with a wide range from approximately 0.03 pCi/L to more than 3 pCi/L (UNSCEAR, 2000)Thus, ambient outdoor levels in the range of 1 to 2 pCi/L are not surprising in areas with local mineralization. Such levels are also well within the range of variability [of about 10] suggested in a paper authored by Dr. Gail de Planque, a former NRC Commissioner (NRC Workshop, 1994).

It is very important to understand that while outdoor radon contributes to levels of radon indoors, the predominant source of people's exposure to radon is from exposure to radon daughter

levels inside the home primarily originating from the soils beneath the home. As the United States EPA notes "people need to be occupying a structure and not just standing outdoors" for its radon risk estimates to be applicable (48 Fed. Reg. 15076, 15083). Indeed, the primary potential health concern with radon is build-up of radon daughters (decay products) in a confined area. As the National Academy of Sciences (NAS)/NRC explains, radon "has negligible ecological effects as it remains in the gas phase, has a short rendered time in the lung, and, thus, delivers relatively little dose to the lung tissue" (NRC, 1986a). On the other hand, radon in full equilibrium with its daughters, which are present as discharged ions on aerosol particles or as unattached ions, can lead to significant exposures.

As illustrated in Table 4.6 the dose from natural background sources is highly variable. As noted above, Dr. Gail de Planque, has commented on the variability in dose from natural background. For example, she noted that the dose from cosmic radiation in Denver, at an elevation of about one mile, is about a factor of two higher than the national average. She also notes that due to natural variations in the concentration of uranium and other radionuclides in the soil, the natural background gamma radiation can easily vary by a factor of 10 across the country [3]. NRC indicates that, in the United States, background radiation total effective dose equivalents (TEDE) range from 100 mrem/yr to 1,000 mrem/yr with higher levels in the higher altitudes in the mineralized areas of the western part of the country (NRC, 1984). Further, as the Health Physics Society has noted (HPS, 1994):

> "The United States Environmental Protection Agency has published estimated doses from cosmic radiation on a state-by-state basis (Klement, et. al., Feldman, 1977). Although the EPA data needs to be recalculated using more recent dosimetric data, they clearly indicate that the average cosmic radiation dose rate to the populations of the Rocky Mountain States (CO, ID, MT, NM, UT and WY) is more than double the United States average, and nearly three times the average rate experienced in eastern seaboard states."

The evaluation of a proposed ISR facility will include extensive characterization background radiation levels. The assessment program will include evaluation of all regions that could potentially be impacted by the operation of the ISR facility in order to provide an appropriate context for estimated doses arising from ISR activities. External gamma radiation, soil, air, and surface and groundwater all will be assessed as a part of the baseline modeling of the site (IAEA, 2005).

<u>Potential Doses from Mining and Processing</u>

Members of the public

Although the focus of this GER is on uranium recovery from ISR facilities, a few brief comments on radiological doses from uranium recovery activities in general is appropriate. Uranium mining for nuclear power has been carried out in the United States for more than 50 years. Traditionally, uranium mining has followed practices similar to the mining of other minerals, namely by mining mineral deposits in open pit or underground mines. These types of mining activities involve the excavation of overburden, waste rock, and ore (the rock matrix in which the mineral of interest is found), processing the ores to recover the uranium content of the ore (referred to as milling), and management of both the waste rock that results from the mining and the tailings that result from milling uranium ores.

In arid climates, the potential impact issues primarily arise from releases of radon and dust to the atmosphere and concerns with leaching from tailings or waste rock to groundwater. Chambers et. al. (Chambers, 1989) discusses the potential exposures from uranium mining/milling and summarizes the then-available information on doses to members of the public living nearby uranium mining/milling operations. They observe that the dose to the *hypothetical maximally exposed individual*, from all exposure pathways combined, will be (approximately) 50 mrem/yr or less, well within (indeed at the lower end of) the range of variation in natural background radiation exposures and well below NRC's 100 mrem/yr maximum dose for members of the public from NRC-licensed facilities.[106]

For ISR facilities, many of the exposure pathways relevant to conventional uranium mining/milling, for example wind-eroded dust or radon from waste rock or tailings, do not apply and potential doses to actual members of the public who live near ISR facilities will be significantly lower. In the following sections, the characteristics of radiation and expected doses from uranium mining/milling facilities will be discussed. Since there is no recent experience in the United States with conventional mining/milling of uranium ore, doses obtained from the Canadian National Dose Registry are summarized to provide an up-to-date basis for comparison. In addition, available information on health effects associated with mining/milling of uranium ores is summarized.

Before addressing health effects issues associated with conventional mining/milling, a few general comments on the relation of dose to increasing distance from an ISR facility are appropriate. First, consider radon. When released from a source (mining activity or processing), the radon gas is free from daughters (radioactive decay products). The concentrations of short-lived radon daughters increase with time and hence with distance from the source. On the other hand, the concentrations of radon (and daughters) decrease with increasing distance due to dispersion in the atmosphere. This pattern of ingrowth varies according to the relative length of the half-lives of the original radionuclide and its decay products. Radioactive equilibrium occurs when each radionuclide decays at the same rate at which it is produced. Evans (Evan, 1969) has developed an approximate method for estimating the ingrowth of radon decay products (referred to as fractional ingrowth F_{eq} here), namely that:

$\mathbf{F_{eq} = 0.023\ t^{0.85}}$ where t is in minutes.

For a windspeed of 5 mph, the fractional ingrowth at 1 mile (approximately 12 minutes downwind) will be about 0.18. EPA has noted that while secular (i.e., complete) equilibrium is a theoretical upper limit; it is difficult to attain due to the differences in half life (the time required for the disintegration of one-half of the original radioactive atoms) between the original radionuclide and its decay products.

NRC utilizes data models to estimate doses to receptors within 20km (about 12 miles) of a model conventional uranium mill site, taking into consideration changes in concentrations of radon daughters due to ingrowth and decay (NRC, 1980c). The findings are summarized in Table 4.7 below: (all doses given in mrem/yr).

As can be seen from the table above, the potential estimated total dose to members of the public decreases significantly with an increase in distance from the model conventional uranium mill site. A 1983 report by the EPA (EPA, 1983b) noted that "[t]he risk from radon emissions [from uranium mill tailings piles] diminishes rapidly with distance from the tailings pile".

[106] *See* 10 CFR § 20.1301.

Similarly, the National Academy of Science (NAS) (NRC, 1986a) concluded that "persons living at distances greater than a kilometre (about 0.6 miles) from most *uncontrolled* uranium mill tailings piles, and perhaps somewhat closer to some piles, will experience no significant increase in a lifetime radon lung cancer risk from the pile…".

Table 4.7
Doses from Model Conventional Mill Site (all doses in mrem per year)

Distance (km)	External Dose	Inhalation Dose	Ingestion Dose	Total Dose
0.64	42.03	3.16	22.02	67.2
0.94	22.10	1.72	11.29	35.1
2.0	6.34	0.451	2.857	9.67
5.0	1.56	0.085	0.533	2.17
10.0	0.54	0.025	0.144	0.707
20.0	0.19	0.009	0.038	0.240

In order to determine the estimated dose from gamma radiation, the following information is necessary: (1) strength of the gamma source; (2) proximity of the dose receptor to the gamma source; and (3) duration of exposure to the gamma source. For example, the weaker the gamma source, the further the dose receptor is from the gamma source, and the shorter the time of exposure to the gamma source, the less the estimated dose will be. As NRC notes "on open ground, about two-thirds of the gamma radiation dose comes from radionuclides contained in the top 15 cm (6 inches) of soil out to a distance of 6 meters (20 feet) from where a person is standing" (NRC, 1994).

Gamma radiation decreases rapidly with distance from uranium mill tailings piles. In response to a question on its 1980 GEIS concerning external gamma radiation, NRC notes that actual measurements at existing piles show that "…the external [gamma radiation] dose rate drops to background levels within 100 to 200 meters from the edge of the pile" (NRC, 1980c). Similarly, in discussing radiation from uranium mill tailings piles (very much larger sources of radiation than those found at an ISR facility) the EPA states that "The gamma radiation from a pile, however, decreases rapidly with distance; at more than a few tenths of a mile from most of the inactive tailings piles, the increase cannot be differentiated from the normal background" (EPA, 1982). Thus, to the extent that there is no public access to operating or restoring well fields where there might be some potential for gamma radiation exposure due to spills or leaks, effectively, there will be no public dose from gamma radiation at an ISR facility.

Uranium Mine/Mill Workers

In the early days of uranium mining, before the hazards of radon were recognized, underground uranium miners were exposed to very high levels of radon[107] daughters in the underground

[107] In addition to very high levels of radon and more importantly, radon decay products, miners were exposed to varying levels of noxious gases, dust and other workplace agents. In addition, most miners smoked unfiltered cigarettes.

workplace. This unfortunate experience resulted in an elevated risk of lung cancer in underground miners. In this respect, it is of interest to note that such risks also accrued to underground iron ore miners (e.g., Sweden), fluorspar miners (Newfoundland, Canada) and tin miners (China), among others. (e.g. [UNSCEAR, 2007; NAS, 1998]). Thus, while Navajo miners will be included in cohorts exposed in United States underground uranium mines, they make up about 3 percent of the total United States miners in this category. When this problem was recognized, action was taken to reduce exposures to underground miners and today, exposures are more than a hundred times less than exposures in the early days of underground uranium mining. In the United States, conventional uranium mining by underground or open pit methods has not taken place for many years; however, as noted above, current data are available from Canada.

These data are available from the Canadian National Dose Registry (NDR) and indicate the dose received by various worker categories in underground uranium mines. Table 4.8 summarizes the data obtained for the past 10 years for surface personnel, mill workers and underground miners[108]. The last year for which final data have been released is 2004.

Table 4.8
Dose Data for Canadian Uranium Miners[1]

Year	Underground Miners		Mill Workers		Surface Personnel	
	Dose (mSv)	Dose from Radon	Dose (mSv)	Dose from Radon	Dose (mSv)	Dose from Radon
1997	6.05	2.36	2.62	0.89	0.31	0.19
1998	3.27	2.55	2.05	1.44	0.52	0.41
1999	3.13	1.97	1.47	0.78	0.41	0.25
2000	2.57	1.03	2.03	1.18	0.64	0.47
2001	2.29	0.73	2.1	0.99	0.61	0.41
2002	2.65	1.09	1.66	0.85	0.41	0.28
2003	2.74	1.45	1.35	0.80	0.52	0.41
2004	3.71	1.62	1.59	0.88	0.34	0.27

1. The units of mSv are the units reported by the Canadian National Dose registry.
   1 mSv = 100mrem.

Using the data in Table 4.8, the average total effective dose equivalent (TEDE) for underground miners is about 3.3 mSv, equivalent to 330 mrem, which is approximately equal to the average dose received from natural background radiation in the United States and is approximately 1/17th of the annual worker dose limit in the United States of 5,000 mrem/yr.

By comparison, mill workers in Canada received an average dose of 186 mrem/yr, and surface mining personnel received an average dose of 47 mrem/yr. In 1975, 7 of 17 uranium mills in the United States reported an average whole body dose of 380 mrem/yr (NRC, 1980c). This value, although somewhat higher than the current value reported for Canadian mills, is well within regulatory limits and, again, is comparable to the average dose received from natural background radiation in the United States.

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[108] It is worth noting that the ore grades in the Canadian mines are very high, in some cases 10's of percent, and much higher than grades currently anticipated in United States mines.

In addition to dose limits, the concept of ALARA (As Low As Reasonably Achievable) is a required element of operation in nuclear fuel cycle facilities and uranium operators and regulators are continuously examining methods to reducing exposures to workers. Thus, future exposures to workers in conventional uranium mills are unlikely to be higher than in the past and likely will be lower as a result of ongoing ALARA activities, improved methods of limiting exposures through control at source, improved ventilation, shielding and other improved work practices.

Interestingly, the measured doses to surface mining personnel are very close to the estimates of doses to the hypothetical “most exposed” member of the public living near to a uranium mine or mill noted above (i.e., 50 mrem/yr or less). This suggests that the estimates of doses to people who live near such facilities are likely to be conservative overestimates. In any event, measured doses to surface workers and hypothetical doses to nearby residents are at the lower end of the range of variation of doses from natural background sources of radiation.

Exposures to workers at ISR facilities will generally be expected to be lower than at conventional milling facilities, since ISR facilities have no ore stockpiles, waste rock or tailings. The exposure calculations, which are discussed in greater detail later in this section, will address routine operations, non-routine operations, and maintenance and cleanup activities. The parameters used in exposure calculations will be representative of conditions at the site and include the time-weighted exposure that incorporates occupancy time and average airborne concentrations. Both full-time and part-time employees will be considered.

Workers at ISR facilities primarily will be subject to potential internal exposure from radioactive dust in the yellowcake drying and packaging operations, and to external gamma radiation wherever quantities of yellowcake are stored. In addition, radium-226 buildup can occur in resin columns, sand filters, calcite clarifiers, etc., resulting in the need for control and monitoring of external beta and gamma exposure during the maintenance of these systems (Brown, 2007). Exposure to radon and radon daughters could also occur throughout the facility, unless vented to the atmosphere or contained in pressurized IX columns.

Radiation protection program requirements at ISR facilities are very similar to those at conventional uranium mills. They will be designed to assess and minimize potential exposure to airborne dust and surface contamination and include (adapted from Brown 2007 (Brown, 2007):

- Airborne monitoring for long-lived alpha emitters (U, Th) in appropriate process areas, primarily drying / calcining and packaging areas, including combinations of grab sampling, breathing zone sampling, and continuous monitoring techniques. The monitoring will be consistent with Regulatory Guide 8.30 “Health Physics Surveys in Uranium Recovery Facilities” (NRC, 2002a).

- Surface area contamination surveillance and control throughout plant areas (NRC, 2002a).

- Respiratory protection programs. This could occur, for example, during non-routine maintenance work, and work for which Radiation Work Permits (RWP) will be issued in accordance with NRC Regulatory Guide 8.31 (NRC, 2002b); (Cogema License, 2007).

- Bioassay (urinalysis) program appropriate for the uranium products to which employees are potentially exposed (product-specific solubility characteristics can have metabolic

implications for bioassay – e.g, see NRC, 1988b (NRC, 1988). The bioassay program will be consistent with Regulatory Guide 8.22, “Bioassay at Uranium Mills” (NRC, 1988).

- Work control and training via formalized SOPs.

- Internal audit and quality control programs to ensure execution of safe work practices and regulatory compliance.

- Radon/ radon daughter monitoring, particularly at the front-end of the process where radon is most likely to evolve from solutions returning from underground. Radon/radon daughter equilibrium can vary greatly throughout the facility, ranging from very low values in areas of high radon emission, to high values within enclosed, poorly ventilated areas. As a result, monitoring of both radon and radon daughters will be included, particularly during startup phases, for proper dose assessment as well as to identify significant radon gas sources (Brown, 2007).

- External exposure monitoring, primarily in areas in which large quantities of aged uranium concentrates are processed, packaged, and/or stored, or where radium-226 buildup may occur in the process. External exposures will be monitored in accordance with 10 CFR Part 20.1502 (Cogema, 2007).

Overall, doses to workers at ISR facilities are much lower than those at a conventional uranium mine or mill, in part as a result of fewer opportunities for exposure as no ore is brought to surface and there are no tailings. Recent experience at ISR facilities shows that doses to workers are well below regulatory limits. As an example, at the Crow Butte Uranium Project in northwestern Nebraska, radon daughter exposures for the year ending December 2005 averaged about 0.1 working level month (WLM) for all monitored employees, with a maximum individual exposure of 0.213 WLM (Crow Butte Resources, Inc. 2006), compared to NRC’s limit on radon daughter exposure of 4 WLM/y. For inhaled uranium particulates, with a maximum Allowable Limit on Intake (ALI) in a year of 1 microcurie (1 µCi), the average and maximum intakes were 0.0059 µCi and 0.019 µCi, respectively. Average and maximum external exposures (deep dose equivalent based on TLD personnel badges) were 118 mrem and 435 mrem, compared to the limit of 5000 mrem/y. The Total Effective Dose Equivalent (TEDE), which combines all exposures, averaged 2 percent (individual maximum 15 percent) of the 5000 mrem/y limit.

Exposures for 2005 at URI’s Kingsville Dome ISR facility in Texas were similarly well below regulatory limits. The TEDE averaged over all employees was less than 2 percent (maximum of 7 percent) of the 5000 mrem/y limit. (URI, 2007).

These data indicate that radiation exposures to workers at operating ISR facilities are low, well below regulatory limits and that ALARA programs are effective.

All reporting and record keeping of worker doses will be done in conformance with Regulatory Guide 8.7 (NRC, 1982) and 10 CFR Part 20.2103. For pregnant workers, calculations for prenatal and fetal radiation exposure will be consistent with Regulatory Guide 8.36, “Radiation Dose to the Embryo/Fetus” (NRC, 1992) and Regulatory Guide 8.13, “Instruction Concerning Prenatal Radiation Exposure”(NRC, 1999).

Potential Health Effects to Miners and Members of the Public

Methodology for Calculating a Exposure to Workers and Members of the Public

The potential exposures from ISR plant operations to members of the public through all potential exposure pathways will be assessed. Figure 4.1 shows the potential exposure pathways, which include water, air, and external radiation exposures. Both internal (to the body) and external doses will be included in the analysis. Doses from all exposure pathways will be summed to estimate the incremental TEDE above background to be received by a member of the public from facility operations.

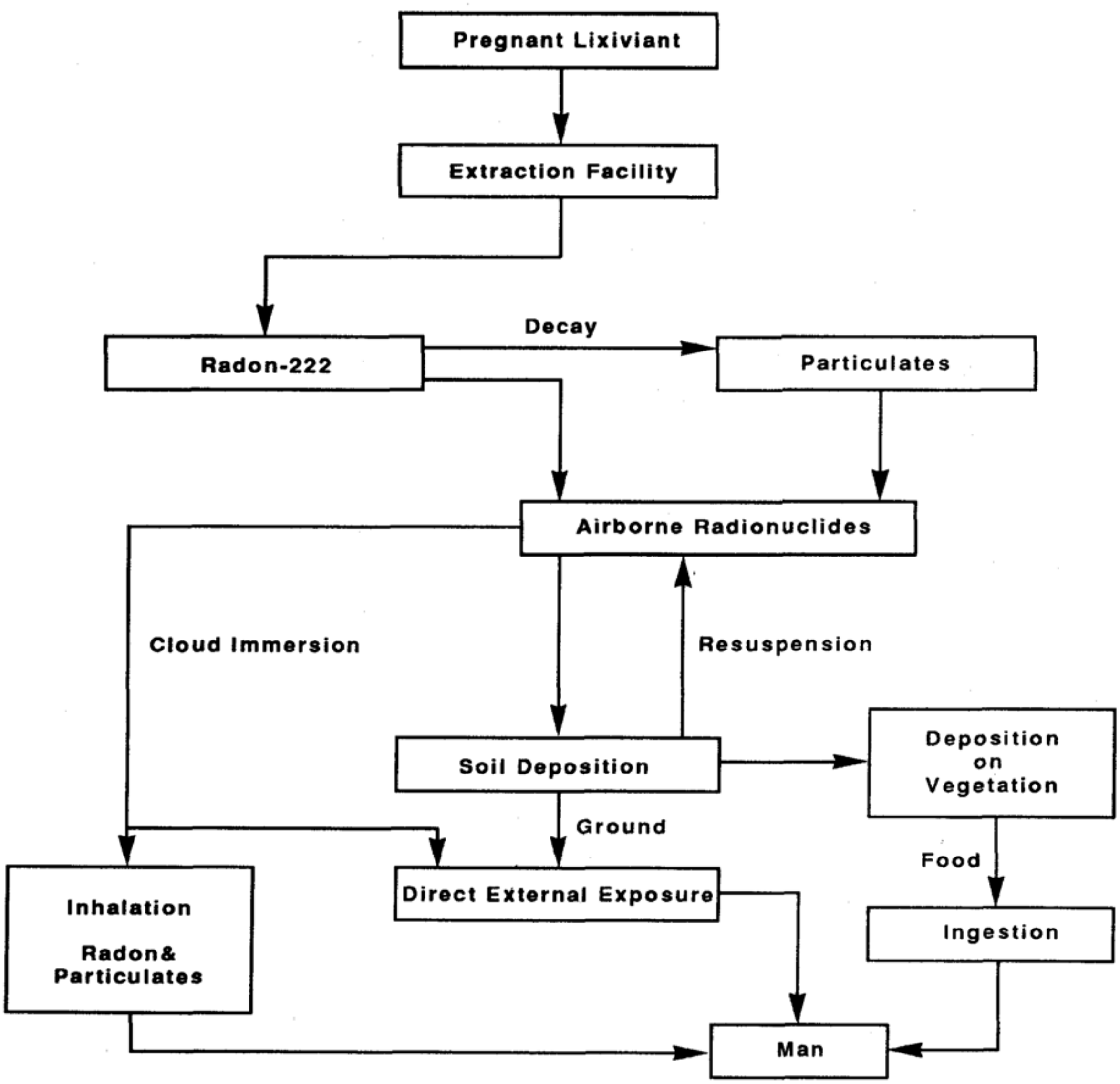

Figure 4.1 Potential radiation exposure pathways for ISR facilities

The methods used to determine the intake of radioactive materials for workers (NRC, 2003a) will be in accordance with 10 CFR Parts 20.1204 and 20.1201. Additionally, exposure calculations for natural uranium will be consistent with Regulatory Guide 8.30 (NRC 2002 Section 3) (NRC, 2002a). For radon daughter exposures (working levels), calculations will be consistent with Regulatory Guide 8.30 (NRC, 2002a) and Regulatory Guide 8.34 (Section C) (NRC, 1992a).

Potential exposures will be evaluated for the critical groups of receptors (a hypothetical individual living at the fenceline in the downwind direction) and also summed over the entire population living with 80 kilometers (km) (50 miles) of the facility.

Potential Exposures from Water Pathways

No radioactive waste will be released to surface waters. In addition, during normal operations, there will be no contamination of groundwater due to the retention ponds. As a result, no significant contribution to the radiological dose by water exposure pathways will be anticipated (HRI, 1997a). Under such conditions, then analyses of water pathways doses are not needed (NRC, 2003a). Environmental monitoring at the site will be used to confirm this.

Potential Exposures from Air Pathways

Air pathways are the most significant potential radiological exposure pathway at ISR facilities. The estimated release rates of airborne radioactivity from facility operations and the atmospheric dispersal of such radioactivity using the applicable meteorological data will be calculated. The corresponding dose estimates to individuals will be made at: (1) the point of maximum ground level concentration off site; (2) the site boundary in the direction of the prevailing wind; (3) the site boundary nearest the emission source; and (4) the nearest residence in the direction of the prevailing wind. The calculations will consider both the source term and exposure pathway components of the calculation and will include deposition of radioactive material on food crops and pasture grass, surface water and surface soil.

The estimates of annual total body and organ doses to individuals at these locations will meet the regulatory requirements in 10 CFR Part 20.1301. All calculations, data, and assumptions used will be specified clearly.

An acceptable computer code that calculates off-site doses to individuals from airborne emissions from ISR facilities is MILDOS-AREA (Yuan, et. al. 1989; Faillace, et al. 1996). Documentation will be provided for the source term calculations. All significant airborne releases from the facility will be addressed, including yellowcake dust from the dryer stack and radon emissions from processing tank venting and well field releases. If a closed processing loop is used, then radon release from processing is expected to be negligible. If a vacuum dryer is used for yellowcake, then dust emissions from drying may also be assumed to be negligible. For radon, Brown (Brown, 2007) suggests that on a Bq released per kg U_3O_8 recovered basis, radon from ISR facilities is approximately 50 percent of that from the model mill case described in the 1980 GEIS (NRC, 1980c). In addition, a (conservative) estimate of well field radon release is about 25 percent. However, with closed systems and pressurized IX columns, radon releases are much lower. The source term calculation will account for all material released during startup, production, and restoration activities. A listing of the relevant parameter information used in the model will be provided.

If a model other than MILDOS-AREA is used, the model used for calculating the source term and individual exposures (and/or concentrations of radionuclides) from airborne releases will need to be consistent with the methodologies described in NRC Regulatory Guide 3.51 (NRC, 1982). Details of models and assumptions used in calculations will be provided in an appendix.

The estimates of individual exposure to radionuclides at the site boundary will be compared to the regulatory requirements in 10 CFR Part 20.1302 with regard to annual average concentrations of radionuclides in airborne effluents or the dose limit in 10 CFR Part 20.1301. The estimates of individual exposure to radionuclides (excluding radon) indicate that the ALARA constraint on air emissions in 10 CFR Part 20.1101 (i.e., 10 mrem/yr) will be met.

Potential Exposures from External Radiation

Potentially significant external (to the body) exposures to off-site members of the public could only occur if land application of liquid wastes is implemented (e.g. HRI NUREG-1508) or if there is a significant spill or leak and a member of the public could have sustained access to the source of gamma exposure. Since land application involves regulatory uncertainties and members of the public will not have sustained access to areas within the facility where there could be spills or leaks, external exposures likely will not occur and need not be evaluated.

Total Human Exposures

The maximum annual dose that could be received via all pathways described above by an individual at the site boundary and at the nearest residence will be calculated.

These estimates will be compared to the regulatory requirements in 10 CFR Part 20.1301. These calculations can be executed effectively by the MILDOS-AREA code (Yuan, 1989). The population dose will be compared with a reference dose, such as the expected exposure to the same population from background radiation sources.

The total human exposure is acceptable if it meets the following criteria (NRC, 2003a):

(1) The estimates of individual exposure to radionuclides at the site boundary meet the regulatory requirements in 10 CFR 20.1302(b)(2)(i) with regard to annual average concentrations of radioactive nuclides in airborne and liquid effluents or the dose limit in 10 CFR 20.1301.

(2) Calculations of the maximum individual whole body and organ doses at the site boundary and for the nearest downwind resident and where biota of significance to human food chains exist meet the public dose limits in 10 CFR 20.1301.

(3) The exposure pathways include pathways relevant to all effluents expected from facility operations.

(4) The models used for calculating the source terms and individual exposures (and/or concentrations of radionuclides) from all effluents at the facility boundary are representative of conditions described at the site as described in Section 2.2.3 of this report.

(5) The parameters used to estimate source terms, concentrations, and exposures are representative of conditions described at the site as described in Section 2.2.3.

Potential Risks from Ionizing radiation

Ionizing radiation can result in various health affects to humans. As noted above, much is known about the effects of ionizing radiation through the work of national and international committees including those of the National Academy of Science (the BEIR Committees), the United Nations Scientific Committee on the Effects of Ionizing Radiation (UNSCEAR), the United States National Council on Radiological Protection (NCRP) and others. The recent reports of BEIR VII (NAS, 1998) and UNSCEAR 2007 (UNSCEAR, 2007) provide comprehensive evaluations of potential health effects arising from exposure to ionizing radiation. The key observations from these recent evaluations can be summarized as follows:

- DNA is the major target for the effects of ionizing radiation. Ionizing radiation can damage DNA directly as a result of interactions with radiation or indirectly via the transfer of free radicals or chemical intermediates
- To date, a statistically significant effect from exposure to ionizing radiation is only detectable for exposures *above approximately 10,000 mrem*
- A (true) threshold of effect is unlikely but the risk of radiation induced cancers is small at small doses
- Current scientific evidence is consistent with linear no-threshold (LNT) model for low LET (linear energy transfer) radiation, (i.e., gamma radiation)
- Non-cancer effects such as cardiovascular effects can occur but only occur at very high doses
- Radiation exposure has never been demonstrated to cause hereditary effects in people but has been demonstrated in plants and animals, and therefore, it is a prudent public health protection policy to assume such effects occur in people

For purposes of radiation protection, the assumption of linearity (i.e., the risk increases in direct proportion to dose) is assumed. A factor is then used to convert dose to risk. This is the approach taken in both BEIR VII (NAS, 1998) and UNSCEAR 2007 (UNSCEAR, 2007) reports which provide estimates of lifetime risk arising from exposure to ionizing radiation. Both reports assume a linear no-threshold (LNT) model for all cancers other than leukemia.[109], In addition, both models rely on the experience of the Japanese atomic bomb survivors (life span study) and use a dose and dose rate reduction factor to adjust for the difference in effect at different dose rates[110]. The recommendations of the ICRP provide guidance concerning radiological protection. The most recent recommendations of the ICRP indicate that "*the approximated overall risk coefficient of 5* percent *per Sv (1 Sv = 100,000 mrem) on which current international radiation and United States safety standards are based continues to be appropriate and should be retained for purposes of radiological protection*" (ICRP, 2007).

[109] A linear quadratic model, also based on the experience of the Japanese Atomic Bomb survivors is used for leukemia.

[110] The risk estimates derived form life span studies are for nominal doses of about 1 Sv received over a short time. To adjust for lower doses at lower dose rates, a DDREF is used.

Epidemiological Studies of people living near uranium mining/milling activities

A number of epidemiological investigations provide further context on the risks to uranium mill workers and people living near uranium mining/milling operations. An epidemiological study is a statistical study on human populations, which attempts to assess the potential links between human health effects and specific causes.

A paper by Pinkerton et al. (Pinkerton, 2004) reports on an evaluation of 1,484 men who worked in uranium mills on the Colorado plateau for at least one year. Overall, these authors found that mortality from cancer was less than expected based on United States mortality rates. Among other observations, the authors observed a small increase in lung cancer and emphysema but note that the excess was greater in men employed prior to 1955 than in men employed later. The authors go on to suggest that this reduction in risk may be a result of improvements in workplace exposures. The authors also note that due to lack of smoking data, small cohort size, and limited power that firm conclusions about the relation between excess risk and exposures to mill workers are not possible.

A recent update of an epidemiological study of uranium miners and processors, including uranium millers at the Beaver lodge Uranium Mine in northern Canada, provides additional information on potential risks to mill workers [Howe, 2006). This large study linked the exposures of miners and others who worked for Eldorado Nuclear Limited to mortality records (1950 to 1999) and national cancer incidence records (1969 to 1999). This study, therefore, updates an earlier study in which mortality in the cohort between 1950 and 1980 was ascertained. For miners exposed to high levels of radon decay products in the past, the study found a statistically significant increase in risk with increasing exposure to radon decay products. However, the study also found no effect of gamma ray exposure on risk of lung cancer mortality. For mill workers, the study found that there was no elevation in lung cancer rates and, moreover, for all causes of cancer, the mill workers actually experienced a lower risk than seen in the comparison data for Canada as a whole.

Several epidemiological studies have also been carried out on communities living near by to uranium mining/milling activities. Boice et al. (Boice, 2003) investigated the cancer mortality in Karnes County Texas, a county with a history of uranium mining and milling activities that includes 3 mills and over 40 mines. In brief, this paper concluded that there were no unusual patterns of cancer mortality among people living in Karnes County suggesting that uranium activities had not increased the risk of cancer. In a separate paper, Boice et al. (Boice, 2007a) report a geographical correlation study of cancer and non-cancer mortality in people living near uranium and vanadium mining/milling operations in Montrose County Colorado between 1950 and 2000. These authors found that cancer and non-cancer mortality rates among people who lived in Montrose County were comparable to those counties not affected by uranium mining/milling. The authors report on a number of occupational and environmental factors. In particular, no statistically significant increases in total risk of cancer or non-malignant respiratory diseases were observed. The authors found an increased risk of lung cancer but suggested they could be a result of cigarette smoking. Overall, the authors concluded that there was no evidence that people who lived in Montrose County experienced an increased risk from environmental exposures arising from uranium or vanadium mining/milling. Finally, another paper by Boice et al. (Boice, 2007b) discusses the mortality of people who lived in Uravan, Colorado, a town built around a uranium mill. This study found no increased risk of lung cancer in female residents of the town or in mill workers. Moreover, the authors also report that their study found no evidence that elevated above-background radiation exposures associated with

the operations of the Uravan uranium mill increased the risk of cancer to people living in Uravan.

4.1.12.3 Sample Exposure Data to the Public for ISR Facilities

The HRI Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico (HRI, 1997a) provides an estimate of population doses due to air effluent releases associated with that ISR project. Analysis was done within a 50-mile radius of the facility, and assumed that releases will come from the resin transfer/process circuit, the process circuit pressure vents, and the land application of restoration water. (Land application values were not presented in the report as, currently, land application of restoration water is problematic). The dryers proposed for the site are vacuum dryers that are assumed to have no radioactive releases. Thirty-eight receptor sites were used, and the estimated TEDE above background determined through the study indicated doses ranging from 0.07 mrem/yr at the nearest school to 0.76 mrem/yr at the nearest residence to the Crownpoint facility (0.6 miles away). Permissible dose limits in 10 CFR Part 20 are 100 mrem/yr TEDE and 2 mrem/hr from any external source. The conclusion was that the estimated doses modeled for babies due to their higher sensitivity to radiation exposure were far below the permissible dose level. The maximum estimated dose was less than 1 percent of the permissible limit and consistent with NCRP's negligible individual risk level (NIRL) (i.e., 1 mrem/yr) defined as "a level of average annual excess risk of fatal health effects attributable to irradiation, below which further effort to reduce radiation exposure to the individual is unwarranted."

<u>Overall Observations</u>

Conventional uranium mining/milling facilities can result in increased levels of radiation exposure to workers within facilities and potentially to members of the surrounding community. However, as can be seen through the discussion of average United States background radiation exposures and the higher end of the range of such exposures in the Rocky Mountain States and the survey of doses to mine and mill workers, the dose to workers is well-within the range of natural background exposures and far below NRC's annual exposure limit for workers in 10 CFR § 20.1201. Thus, as the Health Physics Society notes, "conditions that produce a distribution of radiation doses and risks to people within the normal range of background should be regarded as 'natural'" (HPS, 1993). Additionally, based on the review of the peer-reviewed studies noted above and with respect to the incidence of cancer in populations within close proximity to conventional uranium mining and milling facilities, the potential increased doses to members of the public have led to no observable impacts on human health.

The data presented in this document has been collected mainly for conventional uranium mining/milling operations. Due to the nature of the ISR process which does not involve bringing ore to the surface for processing to recover uranium, does not have ore storage pads, and does not generate mill tailings, all sources of potentially significant worker exposure to gamma or radon at ISR facilities necessarily will be lower, since doses will be lower and hence risks to workers and nearby public are also expected to be lower. Indeed potential worker exposures at ISR facilities only will be similar to those at conventional mills in the yellowcake drying and packaging areas which are essentially identical. If vacuum dryers are utilized potential doses will be even lower.

Potential Impacts to Nonhuman Biota

In the past, concern about radiation exposures arising from human activities has focused on the protection of humans. The assumption was that if people were adequately protected, then "other living things are also likely to be sufficiently protected" (IAEA, 1977) or "other species are not put at risk" (ICRP, 1991). In recent years, the validity of this view has been challenged (IAEA 1999, IAEA 2001b, IAEA, 2002). The concern has arisen mainly because of increased worldwide concern over sustainability of the environment, including maintaining biodiversity and protecting habitats, rather than because of the actual observation of ecological impacts in nonhuman species. In short, an interest nationally and internationally concerning the protection of nonhuman biota has developed.

Although NRC has no specific requirement to consider potential radiological impacts to nonhuman biota, the United States Department of Energy (DOE) has been active in the area of radiological protection of the environment for many years and has developed methods, models, and guidance, within a graded approach, for evaluating radiation doses to biota. An objective of the DOE's graded approach is to advance the inclusion of biota dose evaluation as a routine part of site radiological and environmental surveillance programs, and the inclusion of biota dose evaluation results in site annual environmental reports. (DOE, 2002)

The DOE's graded approach to biota dose evaluation consists of a three-tiered process which includes: (1) a data assembly phase in which the evaluation area and its characteristics are defined, and radionuclide concentration data for water, sediment, and soil are assembled for subsequent screening; (2) an easy-to-use general screening methodology that provides limiting radionuclide concentrations (termed Biota Concentration Guides [BCG]) in soil, sediment, and water such that the dose limits for protection of biota are not exceeded; and (3) an analysis phase containing three increasingly more detailed steps comprising site-specific screening, site-specific analysis, and site-specific biota dose assessment. The DOE suggests that any of the three phases of the graded approach can be used at any time, but the general screening tool usually will be the simplest, most cost-effective, and least time consuming (DOE, 2002).

RESRAD-BIOTA is a computer code that implements the DOE's graded approach methodology. RESRAD-BIOTA is available free of charge and can be downloaded from the RESRAD Web site (http://web.ead.anl.gov/resrad).

4.1.13 Potential Waste Management Impacts

Section 2.2.8 describes wastes generated at ISR facilities. Management of these wastes is described in Section 2.2.10.

Potential impacts to land use, soil, and water associated with ISR waste management are discussed in Section 4.1.1, 4.1.3, and 4.1.4, respectively.

Potential impacts from management of miscellaneous wastes such as waste oil, and maintenance wastes such as paint, cleaning solutions, and degreasers, could be similar to those resulting from off-site disposal, including impacts to soil from vehicular traffic as described in the discussion of land use impacts (Section 4.1.1).

4.1.14 Potential Cumulative Impacts

CEQ regulations for implementing NEPA define cumulative impact as “the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). The regulations further explain that cumulative impacts “can result from individually minor but collectively significant actions taking place over a period of time.” Thus, the proposed action could contribute to cumulative impacts when its impacts overlap with those of other past, present, or reasonably foreseeable future actions. For this GER, other past, present, and future actions in the project area include (but are not limited to) prior conventional surface or underground uranium mining, ISR recovery, road construction and maintenance; irrigation, farming, and livestock grazing; urban and residential development; and state, federal, and tribal management of land, water, and wildlife.

4.1.14.1 Land Use

The proposed action will not make a significant contribution to cumulative land use impacts in the region. Although construction and operation of the project will have adverse impacts on land use (Section 4.1.1), most of the impacts will be temporary because of the sequential nature of the ISR operations and the applicant’s plans for site restoration and reclamation.

At a representative ISR site, a total of approximately 300 to 1,500 - ha (750 to 3,700 acres) could be disturbed at various times during project construction and operation. This disturbance could contribute to the impacts of other past and present land uses in the area, possibly including uranium or other mining/milling, livestock grazing, road construction, and urban and residential development. However, because of the nature of ISR and the licensee’s commitments for site restoration and reclamation, the combination of existing land disturbance, new disturbance related to the proposed action, and disturbance from reasonably foreseeable future actions is not expected to represent a significant cumulative impact.

4.1.14.2 Transportation Risk

Shipments associated with the proposed action will contribute to transportation risk on roads in the region (Section 4.1.2), but the project's contribution to the potential cumulative impacts of other past, present, and future actions is not expected to be significant. In addition, there are no reasonably foreseeable future actions that will combine with the project to increase local transportation risk significantly.

4.1.14.3 Geology and Soils

The proposed action will contribute to potential impacts on geology and soils in the region (Section 4.1.3), but the cumulative impacts of this contribution combined with other past, present, and future actions are not expected to be significant. In some cases, the region's geology has been affected, and could be affected in the future, by conventional uranium mining. However, potential impacts from any conventional uranium mining will be addressed in separate NEPA reviews.

For ISR, the proposed action will involve disturbing up to 300 -1,500 ha (750 to 3,700 acres) for buildings and well fields, and production ponds could affect an additional 300 to 800 ha (990 to 2,200 acres). However, the contribution of this disturbance to past, present, and future impacts

on soils in the region is not expected to create a significant cumulative impact because the applicant will be required to decommission and reclaim each of the project sites. As has been demonstrated by the reclamation of other ISR sites, the proposed project's contribution to potential cumulative impacts on soils likely will be small and temporary.

4.1.14.4 Surface Water

The proposed action will not make a significant contribution to cumulative impacts on surface water in the model region. Because of the ephemeral nature of the surface water bodies in the model region and the relatively low level of surface disturbance associated with the project, potential impacts on surface water quality and quantity are not expected to be significant (Section 4.1.4.2). In addition, there are no reasonably foreseeable future actions that will combine with the action to significantly affect surface water quality or quantity.

4.1.14.5 Groundwater

In theory, the proposed action could make a significant contribution to cumulative impacts on groundwater in the region (Section 4.1.4.1). However, natural reductive conditions in recovery zone aquifers or portions thereof, ISR process safeguards, and NRC license conditions mandating operator well field management and well field restoration will mitigate these potential impacts. After successful groundwater restoration, some water quality parameters will be returned to below baseline/background, some to baseline/background, and some will be higher than baseline/background, but within NRC's or other federal or state secondary goals or to an ACL equivalent (which may in part be demonstrated to be protective by prior class of use). The total volume of groundwater that will be chemically affected in the short-term by ISR operations is estimated to be 2 to 4 million m^3 (1,600 to 3,200 acre feet). This volume is calculated from pore volume and restoration volume data from several operating ISR operations. In calculating this value, the following assumptions are made:

Recent experience with improved restoration techniques suggests that total water consumption for restoration likely can be reduced in the future. Table 4.9 provides an example of water consumption during restoration for arbitrary pore volume estimates of 4 and 9 pore volumes:

Table 4.9
Water Consumed During Restoration

	4 pore volumes		**9 pore volumes**	
Restoration alternatives	**Million m^3**	**Acre-feet**	**Million m^3**	**Acre-feet**
Groundwater sweep	12.9	10,525	29.0	23,681
Reverse osmosis	3.3	2632	7.4	5922
Brine concentration	0.03	24	0.07	54

During groundwater restoration activities, nearby water users can experience increased pumping costs at existing water supply well locations. In this case, the potential impact can be mitigated by an NRC requirement that the applicant reimburse the water user for any additional costs due to increased pumping.

The consumption of water by ISR operations pales when compared by the consumption of water by agriculture. The average American is estimated to use 101 gallons of water per day (*National Geographic - September 2002*). Depending upon your job, you may also use water to grow crops, support live stock, or perform a manufacturing task. Approximately 69 percent of

withdrawn water (from surface and underground sources combined) is used in agriculture, 21 percent for industrial purposes and a mere 10 percent is used by households on a worldwide basis (*National Geographic - September 2002*).

Past actions that have contributed to cumulative impacts on groundwater in the model region include underground uranium mining, which could have dewatered some area aquifers. Dewatering impacts could have lowered water levels in affected aquifers for some distance around the workings and may have oxidized some of the rock around the workings by exposing it to the atmosphere. After mining activities cease, normally groundwater levels return to pre-mining levels after several years. Water quality in the workings may be degraded, but groundwater quality outside the mine workings will not be affected.

Future actions that could contribute to cumulative impacts on groundwater in the model region may include continued or new conventional uranium mining/milling. The depth of the uranium deposits in the model regions suggests that in any future uranium recovery activities will probably feature both underground mining, combined with processing at a conventional uranium mill, and ISR recovery processes. Potential cumulative impacts from future actions cannot be generalized because future impacts will depend on the relative proximity of area uranium deposits and nearby towns, and whether the nearby population utilizes groundwater for drinking water. Such cases will require site-specific analysis.

ISR will geochemically change the groundwater in the recovery zone/ exempted aquifer at least in the near term, but not in a manner that likely will degrade its class of use after restoration. As noted above, potentially significant impacts on groundwater quality, if any, will be mitigated by natural reductive conditions in the recovery zone aquifer, ISR process safeguards, and NRC license conditions. Aquifers utilized for ISR operations universally are not suitable for drinking water due to naturally occurring metal contamination and radioactivity levels. Moreover, before ISR operations can occur, the aquifers of interest must be formally exempted from groundwater drinking water protection. Future uranium recovery in the area could affect groundwater flow velocities, water levels, flow direction, and water quality. Should conventional mining or ISR operations occur at other locations in the future, the potential impact of those operations on existing operations, on planned operations with licenses to operate, on the environment, and on the health and safety of the local community will be considered at that time.

4.1.14.6 Ecology

The proposed project will contribute to ecological impacts in the region (Section 4.1.5), but the cumulative impacts of this contribution combined with other past, present, and future actions is not expected to be significant. Ecosystems in ISR regions already have been affected by past actions such as livestock grazing and conventional uranium and other mining/milling. Land disturbance will be the primary source of any potential adverse impacts to ecological resources; however, the amount of land that temporarily will be disturbed by the project is small relative to the amount of similar wildlife habitat available in the region. Also, the land disturbed by the project will be reclaimed and revegetated upon project completion and can be released for unrestricted use (i.e., any potential future use). Compared to conventional uranium mining/milling operations, the proposed action will limit potential negative impacts by avoiding the ecologically damaging consequences of surface or underground mining and mill tailings production. In addition, there are no reasonably foreseeable future actions that will combine with the project to create significant cumulative impacts on ecological resources.

4.1.14.7 Air Quality and Noise

The development of the proposed action will not make a significant contribution to cumulative impacts on air quality and noise in ISR regions. Existing air quality in these regions is good, the potential impacts of the project on air quality are expected to be small (Section 4.1.6), and there are no reasonably foreseeable future actions that will combine with the project to significantly affect air quality. The proposed action will generate some impacts associated with additional noise in the immediate vicinity (Section 4.1.7). However, the combination of existing background noise, noise from the project, and noise from reasonably foreseeable future actions is not expected to represent a significant cumulative impact.

4.1.14.8 Visual/Scenic

The proposed project will contribute to visual/scenic impacts in the region (Section 4.1.9), but the cumulative impacts of this contribution combined with other past, present, and future actions are not expected to be significant. The typical ISR area's landscape reflects hundreds of years of use by the local and, in many cases, the Native American population. The natural aridity and soil conditions of the area, coupled with livestock grazing, have resulted in overgrazed landscape typified by rolling sparse grasslands interspersed with random tree growth. Other actions, including uranium or other mining/milling, road construction, and urban and residential development, have also had aesthetic impacts in the area. It is likely that the livestock grazing, uranium mining, road construction, and urban and residential development that have affected the area in the past will continue.

4.1.14.9 Socioeconomics

The proposed action will be expected to make a positive contribution to cumulative socioeconomic impacts in the region. The project provides the long-term benefits of employment, wages, and tax revenues without major potential adverse impacts to housing or the local infrastructure (Section 4.1.10). Potential impacts that will occur to the local infrastructure (e.g., the possible need to replace water supply wells) can be mitigated by NRC license conditions requiring the applicant to replace such wells or to fund higher pumping costs. In terms of present and future actions, the areas suitable for ISR are generally not targeted for other large projects or developments that could combine with the proposed action to create adverse socioeconomic impacts. It is likely that additional conventional uranium mining/milling operations will be developed in the model region in the future. If additional uranium mining/milling occurs, it is likely that the positive socioeconomic impacts described in Section 4.1.10 will be accentuated.

4.1.14.10 Environmental Justice

The environmental justice analysis described in Section 4.1.11 is, to a great extent, a cumulative analysis in that it considers the local community's previous experience with natural resource development activities, particularly conventional uranium mining/milling. Although this report concludes that potential impacts to groundwater quality and consumption could be significant, NRC license requirements and operator controls likely will reduce the severity and likelihood of such impacts significantly. Therefore, with only minimal impacts likely, no cumulative environmental justice impacts are anticipated.

4.1.14.11 Potential Health Physics and Radiological Impacts

The proposed project will make a minor contribution to cumulative impacts in terms of health physics and potential radiological impacts (Section 4.1.12.2). Annual doses to the population within 80 km (50 miles [mi]) of a representative ISR site from air releases are estimated as part of the MILDOS-AREA calculations. The total annual population dose will be estimated for the period of greatest releases from the site. The results likely will indicate a total population dose less than 0.01 mSv/year (1 mrem/yr). The population within the 80 km (50 mi) radius of the representative project is approximately 76,000 persons. Population dose commitments resulting from facility operations represent less than 1 percent of the dose from natural background sources. The population dose from natural background will be approximately 170 mSv/year (17,000 mrem/yr).

Many areas suitable for ISR have a long history of uranium mining and milling. Impacts of previous mining/milling operations in the area are considered here as they relate to the proposed action. In some cases, uranium mining was a large regional employer and many individuals worked in the mining/milling operations. Early mines/mills operated under much less stringent standards than exist today, and, in the case of underground uranium mines, this resulted in large exposures to radioactive materials, especially radon and its daughters. The exposures were large enough to suggest a high incidence of cancer among workers as a result, and information gathered on these workers has resulted in the development of risk factors for radon daughter exposure.

In addition, conventional mining/milling methods resulted in very large amounts of radioactively and chemically contaminated sands and slimes, also known as tailings. In 1978, the United States Congress passed the Uranium Mill Tailing Radiation Control Act, which required standards to be developed to control exposures from tailings and clean up existing active licensed and past abandoned, inactive uranium milling sites.

The proposed action will result in a negligible increase in potential cumulative impacts in the area from conventional uranium mining/milling. The proposed ISR process inherently does not result in large amounts of tailings or environmental releases of radioactive particulate material. Additionally, new ISR operations can utilize (1) vacuum dryers, which reduce the total releases of radioactive particulates to nearly zero, and (2) a pressurized process circuit with a feedback system to return radon to the recovery zone, which reduces environmental radon releases. The expected exposures from the remaining possible sources of radon at an ISR facility are a very small fraction of the allowable limits for exposure of the public. The amount of generated wastes (i.e., 11e.(2) byproduct material) is small, in the tens of cubic meters per year, and will be disposed of at an off-site licensed facility. In addition, the facility and related well fields will be required to be decontaminated and decommissioned to appropriate state and federal standards.

4.1.14.12 Cultural Resources

Cultural resource sites at ISR sites will be in protected zones where no activity will be allowed; therefore, significant impacts to cultural resources likely will not result from the proposed action (Section 4.1.8). The licensee’s leases preclude other activities at the project sites, so no cumulative impacts will occur to cultural resources. Also, the proposed action will not contribute to impacts on archaeological resources outside the project sites or traditional cultural properties located beyond the immediate vicinity of the ISR site.

4.2 Impacts of the No Action Alternative

No action means that "the proposed activity will not take place, and the resulting environmental impacts from taking no action will be compared with the impacts of permitting the proposed activity or an alternative activity to go forward" (Federal Register 46, 18026). Under the no-action alternative, baseline conditions will be influenced by natural processes and by any other industrial, commercial, or residential development in the model region.
Following are the environmental impacts of the No Action Alternative:

- **Land-Use Impacts:** Land use generally will not be subject to any direct, short-term impacts under the No Action Alternative. Long-term impacts could include reduced productivity of the land due to overgrazing as well as increased potential for erosion.

- **Geology and Soils Impacts:** The No Action Alternative will not have short-term impact on the soils and geology of the site and little to no long-terms impacts either. Long-term impacts could include continued degradation of topsoil quality from overgrazing as well as increased potential for erosion.

- **Transportation Impacts:** The No Action Alternative will not impact transportation patterns.

- **Groundwater Impacts:** Under the No Action Alternative, there will not be any impacts to groundwater quantity or quality, other than those typically associated with natural hydrogeologic and geochemical processes. The groundwater will continue to flow in the aquifer under the natural or undisturbed hydraulic gradient from the recharge areas, through the aquifer, and to discharge areas.

- **Surface Water Impacts:** No environmental impacts to surface water resources will result from the No Action Alternative.

- **Ecological Impacts**: No new impacts to ecological resources beyond those that will naturally occur (such as natural succession and habitat changes due to climate variances) will occur under the No Action Alternative.

- **Meteorology, Climatology, and Air Quality Impacts:** The proposed action will not be constructed under the No Action Alternative. Air quality will remain as it currently exists and there will be no immediate direct or indirect impacts to regional air quality

- **Noise Impacts:** The proposed action will not be constructed under the No Action Alternative. Noise levels will remain as they currently exist and there will be no immediate direct or indirect impacts to potential receptors. The No Action Alternative will not have noise impacts.

- **Historical and Cultural Impacts:** The No Action Alternative will not have impacts on cultural resources.

- **Visual/Scenic Impacts:** The No Action Alternative will not alter aesthetic conditions.

- **Socioeconomic Impacts:** The No Action Alternative will result in the failure to create new jobs, to generate tax revenue for localities and States, no royalties to lessees, if any, and no new energy generation.

- **Environmental Justice Impacts:** The No Action Alternative will not have impacts on identified low income and/or minority ethnic and racial populations.

5.0 MITIGATION MEASURES

Mitigation measures are those actions that can be taken to reduce potential adverse impacts and that will be incorporated into the proposed action and alternatives (40 CFR §§ Parts 1502.14(f) and 1508.20). The mitigation measures discussed in this section are tangible and specific, and cover the range of potential impacts of the proposed action. All relevant, reasonable mitigation measures that to the extent practicable can improve the project are identified, even if they are outside the jurisdiction of NRC. The anticipated effectiveness of the mitigation measures in reducing potential adverse impacts, the technical feasibility, and the costs vs. benefits of any recommended mitigation measures are discussed.

The following subsections provide detail on mitigation measures that could be used to reduce the potential environmental impacts presented in Section 4.0, including the following potential impacts of the proposed action: land use, transportation, groundwater (hydrology), surface water, ecology, air quality, noise, historic and cultural resources, visual and scenic resources, socioeconomic resources, environmental justice, and potential radioactive and non-radioactive risk.

As a general proposition and as will be shown below, active mitigation measures for ISR operations originate from two sources: (1) the nature of the ISR process and (2) NRC/Agreement State license conditions, which essentially are a series of protective or “mitigation” measures. Taken together, these measures result in the licensed site footprint exhibiting minimal, if any, evidence that site land and water (both surface and underground) resources will be impacted by licensed ISR operations.

5.1 Land Use Impact Mitigation

While potential land use impacts generally will be insignificant and temporary, as discussed in Section 4.1.1, mitigation measures are appropriate to further reduce any potential impact to future land use.

Potential land use impacts during active operations and groundwater restoration are extensively mitigated and are temporary due, at least in part, to the sequential nature of ISR operations. ISR operators are required to sequentially develop new recovery zones and simultaneously engage in active groundwater restoration for recovery zones where that portion of the ore body has been depleted. Previous licensing experience demonstrates that the sequential development of well fields minimizes the lands impacted by ISR activities (e.g., drilling) at any one time. For example, drilling activities for sequential well field development may be concentrated in small land parcels (i.e., 5 acres) at any one time (HRI, 1997b).

Remote IX/satellite well fields and toll milling arrangements also serve as methods by which potential short-term land use impacts can be mitigated. In the event that an ISR operator chooses to use remote IX technology for satellite well fields, the construction of more than one central processing plant and associated buildings and storage areas will not be necessary. (HRI, 1997b). Thus, due to the nature of the ISR process, potential long-term and short-term land use impacts are mitigated.

On an operational level, NRC/Agreement State license conditions prescribe requirements to mitigate potential short-term and long-term land use impacts. Generally, surface reclamation

requirements imposed by license conditions involve a series of measures designed to restore disturbed land to its pre-operational use or return the disturbed land to production capacity equal to or better than that which existed prior to mining (IAEA 2005). Soils, vegetation, and radiological baseline data will be used as a guide in evaluating final reclamation.

During operations, the most significant potential land use impact is to surface soils from well field spills/leaks of recovery solutions. However, license conditions mandate that ISR operators implement site SOPs to remediate lands impacted by such spills to meet appropriate radiation protection standards and to ensure that such lands can be returned to pre-operational uses and that public health and safety is protected adequately. As noted in above, any soils removed from lands impacted by such spills qualify as 11e.(2) byproduct material and will be transported off-site for disposal at licensed 11e.(2) disposal sites.

Other specific mitigation measures vary on a site-by-site basis, but likely include the following:

- Conduct site ISR reclamation in interim steps to minimize potential land use environmental impacts (HRI, 1997b). As noted above, sequential well field development results in minimizing land area impacted at any one time.
- Remediate drill pits by replacing excavated soil and re-grading to return lands to pre-operational appearances. As areas are restored, they will be contoured to blend with the natural terrain in accordance with the surface reclamation plan.
- After restoring groundwater in the recovery zone aquifers to NRC-approved conditions, properly decommission each well field and remove all well field lines and pipelines. Upon decommissioning, all wells will be sealed and capped (HRI, 1997b).
- All process facilities will be decontaminated and removed unless they are to be used for other future activities (HRI, 1997b).
- Evaporation ponds will be reclaimed and revegetated and the land returned to its previous uses, or as otherwise agreed with the regulatory body and landowners.
- Stockpile topsoil from the well sites, evaporation ponds, and facilities. Shape, seed the piles with a cover crop, or mulch the stockpiles to control erosion. Place identifying signs on each topsoil stockpile to prevent misuse of the stockpile (IAEA, 2005).
- Evaporation ponds, if used, will be reclaimed and re-vegetated and the land returned to its previous uses, or as otherwise agreed with the regulatory body and landowners.
- After restoring groundwater in the recovery zone aquifers to NRC-approved conditions, properly decommission each well field and remove or decontaminate in place all well field lines and pipelines. Upon decommissioning, all wells will be sealed and capped (HRI, 1997b). As areas are restored, they will be backfilled, contoured, and smoothed to blend with the natural terrain in accordance with the surface reclamation plan.
- The use of Class I UIC deep-injection well disposal for liquid wastes to mitigate the potential short-term land use impacts of settlement/evaporation ponds.
- Restrict normal vehicular traffic to designated roads and keep required traffic in other areas of the well field to a minimum (IAEA, 2005).
- In summary, once all ISR operations and site D&D, including groundwater restoration, is completed, the licensed site footprint will regain its pre-operational features.

5.2 Transportation Mitigation

NRC evaluated potential mitigation measures in the 1980 GEIS and NUREG-0535 for the transportation of yellowcake from conventional uranium mills and such measures will be the same for ISR facilities.

With respect to ISR facilities, specific transportation container and vehicle design for yellowcake, yellowcake slurry, loaded IX resins, 11e.(2) byproduct material, and process chemicals will mitigate potential dispersion from truck accidents. NRC and DOT regulations require that these materials, except for process chemicals, be transported in “strong, tight” packages or their equivalent. Process chemicals are required to be transported pursuant to appropriate NRC/DOT regulations. These regulatory requirements provide mitigation in the event of a truck accident.

During the transportation of yellowcake, yellowcake slurry, loaded IX resins, 11e.(2) byproduct material, and process chemicals from a central processing facility or a satellite well field, all transportation activities will be performed by transportation contractors or other personnel that receive appropriate training to ensure that potential truck accidents, potential impacts to truck operators and members of the public as a result of such accidents, and potential impacts to the environment from spills of materials are mitigated. Transporters will exercise professional judgment as to routes and transport times to minimize potential exposure to populations and vehicular traffic. For example, as discussed in the recent EA performed for R.M.D. Operations, LLC’s performance-based, multi-site uranium water treatment license, NRC found that, with respect to loaded IX resins, “any health and safety consequences are expected to be mitigated by the primary level of response, which will be from the transportation contractor’s established response team and procedures” (RMD EA 7).

License conditions also can require that trucks used to transport materials from ISR operations, including process chemicals, must carry appropriate certifications of safety inspections and must hold appropriate licenses. ISR operators also maintain strict reporting and recordkeeping requirements for all shipments of yellowcake, yellowcake slurry, loaded IX resins, and 11e.(2) byproduct material.

In the event of a spill, ISR operators are required by license condition to impose licensee-specific SOPs to ensure that spills do not cause any potential impacts to members of the public and that such spills are remediated properly. As discussed in NUREG-1508, in September, 1977, a commercial transport carrier hauling 50 drums of yellowcake (estimated 7,000 lbs.) spilled the yellowcake on the ground and in the truck trailer. Pursuant to appropriate SOP requirements, within three hours, the spill was covered with plastic sheeting to eliminate dispersion of the material to the atmosphere. In all cases, such spills will be remediated and yellowcake can be recovered for further transport.

While yellowcake can pose some risks of airborne dispersion, the nature of yellowcake slurry or loaded IX resins spilled due to a truck accident mitigates potential airborne dispersion. Yellowcake slurry and loaded IX resins have enough moisture content to render them extremely low risk for airborne dispersion. In the above-cited RMD EA, NRC found, with respect to loaded IX resins, “some treatment media [IX resins] and residual water could spill on the ground. However, the treatment media will retain the uranium and prevent contamination of soils at the accident site. Such a spill also will only spread a limited distance and will be easily recovered….All disturbed areas would then be reclaimed in accordance with applicable state

and NRC regulations. *Thus, the risk of potential impacts on the environment from such accidents is negligible*" RMD EA 7) . [Emphasis added].

Presumably, yellowcake slurry falls somewhere between yellowcake and loaded IX resins on the spill-risk scale. However, as stated in NUREG-6733, "[c]alculated expected radiological outcomes from transport accidents are relatively small, particularly for the more realistic analyses" (NUREG-6733 at 4-55).

ISR operators also can implement a variety of measures to further mitigate the possibility of a spill of ISR materials, including, but not limited to:

- Construct and maintain site infrastructure to minimize, if not eliminate, potential truck accidents or spills.

- Facilitate state, city, and county awareness of the transport operations and provide specialized response training and/or equipment for local police, fire, and other appropriate personnel.

Transportation improvements, such as intersection improvements, road widening and geometric alteration, bridge rehabilitation or replacement, will be instigated where warranted, feasible, and where unreasonable environmental impacts can be avoided.

5.3 Groundwater Impact Mitigation

As stated previously in this GER, NMA understands that the most significant impact-related issue associated with ISR operations is the potential impact to groundwater resources located in non-exempt aquifers adjacent to recovery zone aquifers, or portions thereof. As stated throughout this GER, ISR operations generally are environmentally benign and, by orders of magnitude, the lowest-risk licensed activity in the nuclear fuel cycle. The limited risk nature of these operations for drinking water resources is reflected, in part, by the fact that EPA's UIC regulations do not require ISR operators using Class III UIC injection wells for uranium recovery to engage in active groundwater restoration in exempted aquifers. Since the exempted aquifer's water can never, pre or post-ISR operations, serve as a USDW because of naturally occurring contamination, logically no restoration is required. Nevertheless, the existence of natural geologic, hydrologic, and geochemical conditions in aquifers amenable to the ISR process, the ISR process itself, and regulatory requirements for ISR operations and restoration taken together provide a significant package of mitigation measures to prevent potential short and long-term impacts to adjacent, non-exempt USDWs.

5.3.1 Groundwater Impact Mitigation: Natural Geologic, Hydrologic, and Geochemical Conditions

First, prior to the identification and definition of an ISR-amenable uranium ore body, there are several naturally-occurring geologic, hydrologic, and geochemical conditions that, in and of themselves, contribute significantly to the *isolation* of uranium and its associated heavy metals in a redistributed ore body from other portions of an aquifer that can serve as a USDW. As will be shown below, these natural conditions are common to most, if not all, ISR-amenable ore bodies and, in effect, serve to complement and enhance the benefits of existing NRC's regulatory requirements for groundwater restoration.

5.3.1.1 Regional Aquifer Conditions: Redox Front

As stated previous in this GER, uranium ore bodies amenable to the ISR process represent extremely small portions of the regional aquifer system. Development of uranium roll-front deposits requires broad areas of upgradient meteoric oxidation to keep uranium mobile until that oxidized water, which moves downgradient slowly encounters a zone of abundant reductant downdip. It is at this regional redox interface where the oxygenated water is reduced and uranium is deposited. The proposed recovery zone is extremely small as compared to the size of the regional aquifer, and it is logical that the regional reducing capacity of the regional aquifer will prevail over any small pockets of residual oxidation that might persist after injection of oxidizing agents ceases and groundwater restoration is completed. Accordingly, it is unreasonable to assert that a regional aquifer that maintains capacity to absorb meteoric oxygen from expanses of slow-moving ground water on a grand scale at the redox interface will be unable to absorb any oxygen in a similar form on a far smaller scale from slow-moving groundwater that may exist after restoration from an ISR project site (i.e., natural reductive conditions will continue to cause oxidized recovery zone constituents to precipitate in the areas where they were originally deposited). The impact of these natural reductive processes not only can be reasonably inferred as shown above, but also has been demonstrated by modeling at two sites in the State of Wyoming and bench-testing for NRC by Pacific Northwest Laboratories as noted above.

The presence of these naturally occurring hydrologic and geochemical processes supplemented by groundwater restoration techniques that have been and are being refined continuously with more industry experience, provide adequate assurance that the potential for post-restoration migration of recovery solutions can be, and has been, minimized or eliminated.

5.3.1.2 Overlying and Underlying Confinement: Aquitards

As stated previously, uranium ore bodies amenable to the ISR process typically are found in aquifers, or portions thereof, that are confined above and below by less permeable formations or aquitards which prevent vertical excursions of recovery solutions to adjacent, non-exempt USDWs above or below the recovery zone. Again, as stated above, to be amenable to the ISR process, uranium must be present in redistributed ore in permeable saturated sandstone that is adequately confined so that ISR operations can be conducted most efficiently in a *controlled* environment where operational controls and restoration efforts are focused primarily on horizontal (lateral) flows through the recovery zone. Confinement is a natural environmental condition that acts to create isolated deposits of minerals (e.g., uranium) as a natural result of groundwater flow forced by less permeable layers above and below through coarser sands into reducing environments. Indeed, without the confinement above and below the uranium ore body, such an ore body likely would not exist. The presence of these confining layers or aquitards helps to prevent excursions of recovery solutions into overlying or underlying sands in adjacent, non-exempt aquifers.

While uranium ore bodies amenable to the ISR process typically only exist within such geologic formations, ISR operators still must engage in geologic analyses to confirm the existence of such formations. Detailed engineering geologic analysis of borehole information is essential to verify that the site is suitable for ISR operations. Stratigraphic and structural cross sections should be constructed for license applications which represent local stratigraphic conditions. These cross sections will span entire recovery zone(s) from monitor wells on one side of the recovery zone to the monitor wells on the other side. As such, they will present detailed, site

specific geologic evidence which illustrates the strata that will comprise the recovery zone. Proper log correlation via geologic cross sections provides the local proof for the requisite confinement at a ISR site. In other words, cross sections provide the operational/licensing site characterization information that is described in SRP § 2.7.3 (3) as follows:

> "Hydrogeologic cross sections are recommended for illustrating the interpreted hydrostratigraphy. These cross sections should be constructed for the area within the license boundary. For very large or irregularly shaped well field areas, more than one cross section may be necessary. Cross sections must be based on borehole data collected during well installation or exploratory drilling."

Finally, the importance of pump tests to confirm confinement initially and throughout the project's life-cycle cannot be overstated. While geological cross sections provide a reasonable visual basis to demonstrate confinement, preliminary pump tests are conducted at a site to further demonstrate vertical confinement and horizontal continuity. As an additive protection and mitigation measure, multiple pump tests will be conducted throughout the project life-cycle *See* NUREG-1569, SRP § 5.7.8.3 (4). These pump tests confirm continuing confinement on a recovery zone-basis or dictate the need for additional monitoring or other corrective action.

5.3.1.3 Other Natural Conditions: Regional/Local Groundwater Travel Times

Natural conditions of porosity and permeability in and around ISR recovery zones affecting groundwater travel times also can impact the potential for migration of recovery solutions to adjacent, non-exempt USDWs both during recovery operations and after completion of restoration. For example, if groundwater travel time at a specific ISR project site is naturally slow, then any migrating recovery solutions necessarily will take longer to reach adjacent, non-exempt USDWs and, in turn, will be subject to the natural reducing processes of the regional aquifer system for a longer period of time and the operator will have more time to affect corrective action.

5.3.2 Groundwater Impact Mitigation: The ISR Process

In addition to the natural conditions noted above that assist in mitigating the potential for short and long-term impacts in the form of excursions of recovery solutions to adjacent, non-exempt USDWs, standard industry ISR processes provide additional mitigation of the potential for such short and long-term groundwater impacts. The combination of these process steps provides ongoing, iterative mitigation measures that have the flexibility to adjust to site-specific conditions.

5.3.2.1 Water Quality Parameters and UCLs

Prior to engaging in active ISR operations under an NRC license, an ISR operator must submit detailed pre-operational water quality data to NRC for review and approval to determine baseline water quality conditions, UCLs for excursion identification, and post-operation restoration goals. The ISR operator begins to develop well fields based on further defining of the identified uranium ore body and additional water quality sampling within well fields and at monitor wells. During well field development, the ISR operator can generate more accurate water quality data to better identify the geometric structure of the ore body and the best potential

location for monitor wells, so that excursions of recovery solutions can be detected readily and corrective action can be taken promptly.

Establishing these water quality parameters contributes to mitigation efforts, because it is inefficient and potentially ineffective attempt to determine whether an excursion of recovery solutions has occurred unless the water quality in the recovery zone and at the monitor wells is understood properly.

5.3.2.2 Well Construction and Integrity Testing

All wells are to be constructed in accordance with industry SOPs and state or EPA UIC regulatory requirements. Subsequent to completion of well construction and after the interval has been opened and cleaned (i.e., through air jetting, cross jetting, pumping, etc.), a mechanical integrity test (MIT) is performed to test for possible leaks. An inflatable packer is run into the well to a depth directly above the open interval. The packer is inflated and the casing is filled with water and pressured with air to some percentage above the maximum allowable wellhead injection pressure. After the test pressure is reached, the well is sealed to hold pressure and allowed to stand for a period of time. After standing, the well is passed if less than a specified percentage of the starting pressure is lost over the course of the test. If the pressure loss is greater than the specified percentage and the well fails the test, then action will be taken to locate and repair the leak and the MIT is run again. The subsequent MIT must be passed before the well is considered operational. An MIT is also performed on a routine periodic basis during the life of the well (e.g., every five years) and after well maintenance activities that could affect the integrity of the well casing.

Highly developed well construction techniques, as tested by the aforementioned MIT process, have mitigated, if not eliminated, potential *shallow* (i.e., vertical) excursions at ISR project sites. In the early days of ISR operations, prior to routine implementation of the MIT test procedure, shallow excursions posed a significant, potential risk at ISR sites. However, since these well-testing procedures have been employed routinely, the potential for such shallow excursions virtually has been eliminated.

5.3.2.3 Pump Testing

Pump testing of wells in new ISR recovery zone well fields is designed to determine the degree of communication, if any, between the recovery zone (exempted) aquifer, and (1) the overlying or underlying sands, and (2) adjacent, non-exempt USDWs. Properly designed pump tests will reflect the effects of hydraulic pathways, such as unplugged holes, and other pathways, to such zones. Also pump tests are used to prove that, in fluvial systems, monitor well spacing is adequate, so that potential excursions can be identified and corrected readily. A dysfunctional monitor well in an impermeable zone (outside a channel) would not draw down during a pump test.

5.3.2.4 Well field Balance and Process Bleed

In the well field, injection wells are arranged around extraction wells in patterns designed for optimum uranium recovery. The physical configuration of the mineralized ore zone, which is inferred from exploration geophysical logs, determines injection and extraction well depths and the intervals from which uranium is to be recovered. Typically, well patterns used in ISR operations can include alternating single line drive, staggered line drive and five and seven spot.

Each well field area consists of groups of these patterns, which are installed to correspond with the irregular geometry of the ore bodies as determined from geological interpretation.

Each well field is operated at the maximum continuous flow-rate achievable for that well field pattern area. Injection and extraction flow rates are monitored and adjusted as necessary on a daily basis, so that injection can be balanced with extraction across the entire well field, with the injection flow smaller than the extraction flow by the amount of the bleed rate. The process bleed rate varies according to ore body geometry, well pattern and magnitude and direction of the natural groundwater velocity.

Operating as a unit of EPA Class III UIC well field, multiple injection wells are paired with multiple extraction wells located within and around the uranium ore body, much like the well patterns in oil or gas well fields. The well field is operated effectively as a closed loop. Pumping water (extraction) out of the recovery zone aquifer (extraction) causes the injected native groundwater to move toward the extraction wells, passing through the uranium ore body in the process. The water is drawn to the extraction wells, pumped to the surface and through the surface IX facility and is re-injected. As noted above, injection is inextricably linked to extraction, i.e., without extracting at least as much water as is injected, the surface plant will run dry and re-circulation will stop. Injection cannot proceed without an equal or greater amount of extraction; so over-injection across the area cannot take place.

Proper well field balance, including the process bleed, maximizes recovery while protecting against recovery solution excursions.

5.3.2.5 Monitor Wells

An extensive groundwater-monitoring program is required for in situ recovery. Selected wells are monitored for water level and sampled for certain water quality parameters on a regular basis to ensure that the injected recovery solutions stay within the defined recovery zone. Locations of monitor wells are chosen to maximize detection of potential recovery solution excursions migrating outside of the recovery zone. Thus, with routine water quality determinations from monitor wells, early detection of any migration is possible, allowing prompt remedial action.

Recovery zone monitor wells are completed in the ore-bearing aquifer, encircling each well field at a distance of about 400 feet from the peripheral injection or extraction wells and at spacing of approximately 400 feet apart, well- within the boundaries of the AOR. This spacing convention is widely used by the ISR industry throughout the United States. Some state UIC programs require flow modeling to confirm the appropriate monitor well spacing. Appropriate well spacing is designed to locate monitor wells near enough to the recovery zones to assure that there is no significant area for potential recovery solution migration that is not monitored, yet beyond the planned extent of the radially transported recovery solutions during recovery operations. Monitor wells are also completed in the aquifers overlying and underlying the ore zone as appropriate to assure continuing confinement which, as noted above, assists in maximizing a *controlled* environment for radial transport of recovery solutions.

5.3.3 Groundwater Impact Mitigation: NRC and EPA Regulatory Requirements and Approaches

In addition to natural conditions and the ISR process, NRC and EPA also impose regulatory requirements that substantially contribute to the mitigation of potential short and long-term impacts to groundwater resources in the form of excursions of recovery solutions to adjacent, non-exempt USDWs during operations, during groundwater restoration, and post-restoration. Indeed, NRC licenses typically memorialize the ISR process features discussed above in specific license conditions, which makes them mandatory, thereby reinforcing their mitigation benefits.

5.3.3.1 Nuclear Regulatory Commission Groundwater Restoration

The natural reductive and confining conditions noted above and NRC's requirement that an ISR operator engage in active groundwater restoration in the recovery zone together serve as the primary bases for mitigation of any potential long-term impacts to adjacent, non-exempt USDWs.

Prior to the issuance of an NRC license for ISR operations, an ISR license applicant is required to prepare and submit detailed RAPs for NRC approval, which include detailed procedures for conducting groundwater restoration and financial assurance cost estimates for all site D&D, including specifically the number of "pore volumes" required for restoration.

After these RAPs are submitted and approved by NRC and an ISR operator receives all of its appropriate licenses/permits, the ISR operator sequentially develops its well fields, so that restoration can be performed after a well field is depleted of uranium concurrently with the development of subsequent well fields for future uranium recovery. Restoration can be conducted with a groundwater sweep (which is less favored except as a potential preliminary step) and/or using an ion filtration process such as RO to treat groundwater. RO-treated water is circulated through the production zone utilizing the injection-extraction well field configuration that was employed during production operations. By using the existing production well field pattern configuration, the efficient reservoir engineering design benefits that were employed during uranium production are available for restoration. In recent years, RO technology has been widely utilized within the ISR industry and the resulting restoration history has been highly successful. Either deep well disposal or evaporation ponds are used to dispose of the groundwater sweep fluids or the RO concentrated brine, which represents 25 to 35 percent of the feed volume.

As stated above, restoration parameters are developed by the ISR operator to reflect pre-operational water quality levels, which represent goal the levels to which the operator will attempt to restore recovery zone water quality. As a primary *goal*, the ISR operator attempts to return recovery zone water quality *consistent with* pre-operational (baseline) conditions, which even NRC concedes is unlikely for each and every constituent of concern. (SRP, 6-9). To the extent that it is not reasonably achievable for each and every water quality parameter to be returned to the precise pre-operational (baseline) level, the secondary goal will be to return water quality to relevant state standards, which are consistent with class-of-use and in many instances are based on MCLs as specified in EPA secondary, and primary drinking water regulations or relevant state standards. If it still is not reasonably achievable for a water quality parameter to be restored to its secondary goal, the ISR operator can make an affirmative demonstration that leaving the parameter at the higher concentration will not pose a significant

threat to public health, safety and the environment, and that water use, if any, will not be significantly degraded. As a result, the ISR operator can be granted the functional equivalent of an ACL.

After recovery operations have depleted the ore in a recovery zone, the introduction of solubilizing agents (i.e., oxygen and carbon dioxide) ceases. Restoration efforts are designed to flush recovery solutions from the recovery zone to enhance its natural pre-operational reductant properties. Logic dictates that these reductant properties which created the redistributed ore body in the first place will be more than adequate to retard movement of mobilized constituents (particularly heavy metals such as uranium) over the long-term. As noted above, modeling in Wyoming and bench testing by Pacific Northwest Laboratories support the logic of this fundamental restoration assumption. In addition to the existing reducing properties of the recovery zone, many operators employ reducing agents such as sodium sulfide or hydrogen sulfide that are added to the injection solution during active restoration treatment to re-establish reducing conditions more quickly.

5.3.3.2 Nuclear Regulatory Commission: Groundwater Restoration Using Bioremediation

Recently, bioremediation has been utilized in the ISR industry for groundwater restoration. Bio-reductants are introduced to invigorate natural bacteria (already living in the sedimentary formations for thousands of years) to re-reduce metals to an insoluble state. The introduction of bio-reductants enables naturally-occurring bacteria to reduce the oxygen levels of the formation causing the precipitation of metals, including selenium, uranium, arsenic and vanadium, thus duplicating nature's process of mineral deposition. A variety of nutrient sources can be added to the clean water stream being injected into selected wells to achieve predetermined restoration targets. The nutrients used will be based on the chemical attributes of the site or region and submitted to NRC for approval on a case-by-case basis.

Bio-reduction has been used to treat pit lakes (Paulson 2004). In the case of the Sweetwater Pit, the lake had dissolved hexavalent selenium in concentrations of approximately 0.5 milligrams per liter and dissolved uranium in concentrations of 8 to 10 milligrams per liter. Following addition of 1 million pounds of nutrients into the pit lake, which contained 1.2 billion gallons of water, selenium concentrations were reduced to 0.01 milligrams per liter and uranium concentrations reduced to below 5 milligrams per liter (a voluntary remediation goal). This same technique that worked in the Sweetwater Pit Lake is now being considered for aquifers.

Power Resources, Inc. is currently evaluating the application of this technique to ISR aquifer restoration. Native bacteria with metal reduction properties in the system will be nourished with externally provided nutrients (usually sugars, molasses, alcohols, fats and proteins). The bacteria metabolize these nutrients and respire on dissolved metals in the system (uranium, selenium, iron etc.) converting them to a reduced form and precipitating them in place.

Historically, without bioremediation, groundwater restoration has been achieved successfully using groundwater sweep and/or injection of RO-treated "clean water," and the addition of chemical reducing agents but, depending on site-specific conditions, it is believed that the use of bio-reductants can reduce the number of pore volumes and facilitate more expeditious restoration. In addition to enhancing restoration results, the reduction in pore volumes will minimize the consumption of groundwater that must be disposed of using deep-well disposal, evaporation and/or irrigation.

Bioremediation, while currently not a routine mitigation measure, has the potential to significantly enhance restoration as a mitigation measure.

5.3.3.3 Nuclear Regulatory Commission: Financial Assurance: Restoration Action Plans

As an important part of groundwater restoration, and prior to the issuance of a uranium recovery license, NRC requires all ISR operators to submit detailed groundwater restoration procedures and financial assurance cost estimates in the form of RAPs. As stated above, RAPs are designed to provide NRC with a complete list of line-item cost estimates that demonstrate how much financial assurance will be necessary to complete site D&D activities, including groundwater restoration, in the event that the operator is unable to perform such activities. While an ISR operator is not required to have the financial assurance instrument in place for a given project site until it is prepared to inject lixiviant in site well fields, the operator must receive NRC approval of its RAP prior to receiving an NRC uranium recovery license. The presence of these RAPs is a significant mitigation measure, as it guarantees that financial resources will be available for site D&D activities in the event that the ISR operator cannot perform such activities.

5.3.3.4 Environmental Protection Agency: Area of Review and Post-Restoration Excursion Remediation

EPA's UIC regulations require that an ISR operator include an AOR, which serves as a sort of "buffer zone" to provide additional mitigation of potential excursions during active operations and restoration. As stated above, AOR's at proposed ISR sites generally are a ¼ mile zone surrounding the exempted aquifer. The AOR acts as a "buffer zone" around the outermost boundary of the EPA-exempted aquifer and enlarges the area that must be evaluated by the ISR operator when seeking a Class III UIC permit for ISR operations. This "buffer zone" provides an additional mitigation measure to ensure that excursions from ISR operations do not result in adverse impacts on adjacent, non-exempt USDWs.

In addition, EPA's UIC regulations (40 CFR § 146.7) state that, in the event that post-restoration excursions to adjacent, non-exempt aquifers occur, the Administrator may order an ISR operator to perform additional restoration or other remedial action to correct the excursion and to ensure that no further post-restoration excursions occur. To the best of NMA's knowledge, EPA or a delegated state had occasion to exercise this authority to require such action at an ISR facility. Nevertheless, in the unlikely event that such an excursion occurs, EPA is empowered to order immediate remediation of such excursion. This provides a final regulatory "insurance policy" to ensure that any post-restoration excursions will not adversely affect adjacent, non-exempt USDWs.

5.3.4 Groundwater Impact Mitigation: Prevention and Management of Excursions

The potential groundwater impacts of ISR are related to short-term and long-term changes to groundwater quality. Potential short-term water quality impacts are a concern during ISR operations, while long-term impacts are a concern during and after groundwater restoration. (HRI, 1997a).

Excursions are unanticipated releases of mining solutions that move beyond the area encompassing the operating well field or recovery area to the larger area encircled by the monitor well ring. Identification and confirmation of excursions will involve the steps outlined in

Section 6.2. In the event of an excursion, the following corrective action will be applicable (HRI, 1997a):

- When excursion status is confirmed, corrective action will be required to return the water quality to the applicable upper control limit. During corrective action, sample frequency will be increased to weekly for the excursion indicators until the excursion is corrected.

- An excursion will be considered corrected when all control parameters were reduced to levels at or below their upper control limits.

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- NRC will be alerted by telephone within 24 hours and by letter within 7 days. A written report will be submitted to NRC within 60 days of excursion confirmation to include:

    - Description of the excursion event
    - Corrective actions taken
    - Corrective action results

5.4 Surface Water Impact Mitigation

Generally, the nature of the ISR process mitigates the potential for surface water impacts as the process does not implicate widespread use of surface water resources. Initially, all ISR operations occur in underground aquifers, or portions thereof, and do not involve recovery operations in surface water sources. In addition, due to the Commission's decision that restoration fluids from ISR operations are 11e.(2) byproduct material, ISR operators are not able to release treated restoration fluids to the environment pursuant to an NPDES permit. NPDES permits continue to be used by ISR operators when addressing potential storm-water runoff and serve as a mitigation measure for potential surface water impacts through their regulatory requirements.

On an operational level, license conditions impose specific requirements on ISR operators to ensure that potential surface water impacts are mitigated adequately. ISR surface facilities and well fields will be placed to minimize or avoid potential impacts to existing surface water resources wherever possible. In those instances where surface water bodies cannot be avoided, placement of facilities will be such that interference will be minimized and impacts on the surface hydrological features will be minor. To the extent practicable, all process facilities and impoundments, if used, will be placed well above any identified 100-year flood plains levels. Crossings of minor watercourses by access roads and pipelines will be minimized. Where crossings are necessary, access will be constructed to minimize alteration to surface flows. Appropriate best management practices such as soil erosion barriers will be used during construction, operation, and decommissioning periods in accord with the requirements of construction stormwater regulations to minimize potential impacts. Specific mitigation measures will be developed on a site-specific basis.

Previous licensing experience shows that ISR operators frequently choose to follow relevant NRC guidance for erosion control at ISR sites. Licensee commitments such as this provide additional mitigation of potential long-term surface water impacts

Surface piping will avoid any identified100-year or 500-year flood plains levels. Access road construction near surface water features will be selected and construction planned to minimize potential downstream impacts.

License conditions imposing a comprehensive water quality protection program (e.g., development of pre-operational surface water quality parameters) provide additional mitigation of potential short-term impacts to surface water sources. In the event that water from adjacent, non-exempt USDWs releases to surface water sources through seeps or springs, this comprehensive water quality protection program will provide significant mitigation of potential short-term surface water impacts by minimizing, if not eliminating, potential excursions to such USDWs.

Groundwater restoration of the recovery zone also provides significant mitigation of potential long-term surface water impacts. As discussed in Section 5.2, the purpose of restoration in the recovery zone is to minimize, if not eliminate, potential post-restoration excursions for recovery solutions to adjacent, non-exempt USDWs. Water from adjacent, non-exempt USDWs may release to surface water sources through seeps or springs. Thus, the minimization, if not elimination, of potential post-restoration excursions provides significant mitigation of potential long-term surface water impacts

5.5 Ecological Impact Mitigation

As a general proposition, potential impacts to ecological resources, including flora and fauna, may be mitigated either through natural processes or licensee-imposed mitigation measures. Prior to construction, site-specific surveys are conducted for species during the appropriate season to determine their presence in the Study Area. These studies evaluate various aspects of flora and fauna to determine what, if any natural or license-imposed mitigation measure can or should be implemented. Various aspects of the local ecological environment, including flora and fauna are evaluated, including but not limited to:

- Habitat, including habitat usage (breeding, food, shelter);
- Distribution and relative (qualitative) abundance;
- Relative importance of site environmental conditions relative to the regional area for living resources;
- For "important" species or species requiring special attention:
  - Identification of a specific causal link between the proposed ISR facility and the species;
  - Commercial or recreational value;
  - Threatened or endangered status;
  - Effects of species on commercially or recreationally valuable or endangered or threatened species

Additional parameters for such studies are included in Reg. Guide 3. 46 (June 1982). Where possible, key habitats will be avoided.

Flora and fauna with high reproductive potential that are prevalent throughout the region where the ISR site will be constructed generally mitigate potential short and long-term impacts to the ecological environment. More mobile species of fauna also mitigate potential short-term impacts by migrating from the project site. In addition, due to the temporary nature of the ISR

process, these species can migrate from the project site and return when the surface footprint is returned to its pre-operational features.

During construction of the ISR facility and the sequential development of ISR well fields, land use is minimized and, as a result, any potential short-term impacts to fauna are minimized. Specific mitigation measures that minimize potential impacts to ecological resources are imposed by license conditions, including, but not limited to:

- Surface process facility construction and well field development will avoid key habitats.
- Design and construction of transportation infrastructure can mitigate potential loss of animal populations and destruction of flora.
- Eliminating the need for evaporation ponds mitigates potential impacts to animal species in the area.
- Eliminating the use of land application minimizes potential salt or other constituent accumulation that potentially may impact flora and fauna.
- Where well field piping is buried due to meteorology or other conditions, potential obstacles to fauna migration are significantly mitigated.
- Placement of wells, roads or other facilities to avoid steep, currently eroding slopes.
- Vegetating and stabilizing top soil for subsequent use.
- Construction of drainage ditches to minimize flooding potential.
- Remediation of potential well field spills to ensure that native flora and fauna is protected and will be developed on a site-specific basis.

During site reclamation, an extended reference area that includes the primary vegetation types that potentially could be disturbed by the proposed action will be established and will serve as a reference for measuring the relative quality and quantity of vegetation established during reclamation. Fencing of vegetation in larger reclaimed areas prevents damage from livestock grazing until the newly established plant community is capable of maintaining itself under normal management practices. Criteria for determining the success of the reclamation efforts must include (1) post-recovery mining vegetation cover and production equal to that on an appropriate comparison area, (2) species composition and diversity capable of supporting the planned post-recovery mining use, and (3) a reclaimed vegetation community able to sustain environmental pressure at a rate equal to that of the surrounding native areas.

5.6 Airborne Emissions Impact Mitigation

As described in Section 2, above, airborne emissions can result from drilling, construction, and operation.

5.6.1 Mitigation of Drilling and Construction Emissions

Drilling and construction activities may produce fugitive dust, and generate exhaust gases from diesel and gasoline-powered vehicles and construction equipment. Mitigation of fugitive particulates/dust from drilling and construction is accomplished by use of best management practices for dust suppression, such as spraying of roads and dusty work areas with water

and/or dust suppression agents. Vehicles and construction equipment exhausts will be minimized by using properly-maintained equipment with properly functioning emissions control devices.

5.6.2 Process Emissions and Spills

Process operations may produce exhaust gases from standby generators and heating plant equipment, gaseous emissions, radon and radon daughters, aerosols of contaminated liquids, and yellowcake particulate emissions. Liquid and solid chemical emissions, both radioactive and non-radioactive, can result from leaks or spills from tanker trucks, storage tanks, drums, and containers, process vessels, piping, and evaporation/retention ponds.

5.6.2.1 Mitigation of Exhaust Gases

Emissions of combustion exhaust gases are minimized by the use of combustion equipment with properly functioning emissions control devices.

5.6.2.2 Mitigation of Yellowcake Particulate Emissions

Yellowcake from dewatering, washing and filtering steps, does not generate any significant particulate emissions due to its wet condition.

Yellowcake drying systems, both atmospheric and vacuum type, are equipped with emissions control devices, which serve as an intrinsic mitigation. Wet yellowcake is loaded to rotary vacuum dryers on a batch basis. As described earlier, these dryers operate at negative pressure and under a water seal. Off-gases from drying undergo a three-stage filtration process that achieves up to 99 percent filtration efficiency. As a result, these systems are virtually emissions-free by design. Open hearth dryers, which operate continuously and at atmospheric pressure, also have air emissions controls, including scrubbers, baghouses, or other filter devices, to remove particulates from the dryer emissions. For both vacuum and atmospheric dryers, the same emissions scrubbing and filtering systems that treat off gas during the drying step, are used to control emissions during dryer unloading and drum filling steps.

5.6.2.3 Mitigation of Non Radioactive Emissions from Spills

Non-radioactive emissions can result from leaks or spills form tanker trucks or process vessels containing process chemicals. Good management practices, including worker training, inspection/monitoring, and facility configuration (e.g. bermed concrete pads) can minimize, if not eliminate, the potential impact of liquid and solid chemical spills, and thereby any potential sources of volatilized chemicals and chemical dust emissions to air.

5.6.2.4 Mitigation of Radioactive Emissions from Spills

Radioactive emissions could occur due to surface or near-surface spills or leaks in well fields. Mitigation of spills is accomplished by the same management practices used to prevent spills of non-radioactive chemicals, described above.

5.6.2.5 Mitigation of Aerosol Sources

Aerosols originate from the vigorous mixing of air and liquids. Aerosols produced in ISR operations may be non-radioactive, or may contain uranium or radionuclide daughters of uranium. Minimization of aerosol dispersion will be achieved by both good management practices and facility design, including:

- Collection and containment areas around liquid transfer locations
- Elimination of splashing and vortexing, both by design and operational practice, in chemical mixing areas and in the precipitation circuit
- Installation of mist eliminators on wet gaseous exhausts from process equipment.

5.7 Noise Mitigation

As noted above, the nature of the ISR process generally does not create significant sources of noise to potential off-site receptors and, thus, is an inherent mitigation measure (HRI, 1997a). Potential noise impacts are mitigated naturally by the distance of off-site receptors to sources of noise such as site construction activities. As discussed in NUREG-1508, "noise levels diminish by about 6dB(A) for each doubling of distance from its source (HRI, 1997a). The existence of OSHA regulatory requirements for potential noise impacts to workers also mitigates potential impacts to any nearby members of the public. Noise abatement will not be warranted for the proposed action because off-site noise impacts are not anticipated. Within the ISR facility, workers will be protected according to OSHA regulations and NIOSH recommendations.

5.8 Historic and Cultural Resource Impact Mitigation

The potential for adverse impacts of the proposed project on cultural resources will be reduced or eliminated by the policy of avoiding all cultural resources detailed in pre-operational studies. Furthermore, operational SOPs pursuant to license conditions will ensure that no historic of cultural resources are damaged during site exploration, well field development, process facility construction, active operations, groundwater restoration, and final site D&D.

The procedural outline of pre-operational studies calls for inventory of historic and cultural resources at all project areas (a process currently under way), as well as site demarcation and development of specific avoidance procedures. Based on the data available to an ISR operator regarding the location of the uranium ore body, historic and cultural resources identified in the license area will be recognized and demarcated, if appropriate, as protection zones where human activity will be minimized or prohibited. This policy is regarded as reasonably achievable because ISR operation allow considerable flexibility in the layout of facilities, and the knowledge in these studies provides ISL operators with the ability to mitigate potential impacts to such resources during pre-operational site development.

During site development, ISR operators generally are required by license condition to immediately cease development activities in areas where previously unidentified historic or cultural resources are later identified. *Any* construction or drilling activity requiring subsurface disturbances (e.g., leveling for a well pad) will be preceded by archaeological testing and an archaeological monitor will be present during construction and reclamation activities. to ensure that potential impacts to previously unidentified historic and cultural resources during site development are mitigated.

Even with these precautions, the possibility exists that subsurface artifacts or unmarked graves could be discovered. In the event that previously unidentified cultural resources were discovered during site development project activities, an archaeological monitor will halt work in the area, and the artifacts or human remains will be evaluated for their significance in accordance with applicable laws and regulations. Thus, the protection of historic and cultural resources at ISR project sites is an ongoing, day-to-day process, and mitigation of such resources is part of the process.

Appropriate site-specific mitigation measures will be carried out for the proposed action where warranted. This will include measures agreed upon by the SHPO and Tribal Historic Preservation Officer to prevent or mitigate any potential adverse impacts to archaeological and/or historical resources. Thus, as discussed in Section 4.1.8, no significant adverse impacts are anticipated.

5.9 Visual and Scenic Impact Mitigation

Context-sensitive design techniques will be used to minimize potential impacts to the view in sensitive areas. These will include designated site-specific foreground and middle ground zones in identified sensitive areas near wilderness areas, wild and scenic rivers, park lands and/or communities.

Design fundamentals are general design principles and include:

- Proper siting or location
- Reducing unnecessary disturbance
- Repeating the elements of form, line, color, and texture

Design strategies are more specific activities that can be applied to address visual design problems and include:

- Color selection
- Earthwork
- Vegetative manipulation
- Structures
- Reclamation/restoration (during decommissioning)
- Linear alignment design considerations

These interrelated design fundamentals and strategies will be used in combination to mitigate potential visual impacts from the proposed ISR site development, operations, and D&D activities. However, as discussed in Section 4.1.9, no significant impacts are anticipated.

5.10 Socioeconomic Impact Mitigation

Because no adverse socioeconomic impacts are anticipated due to the proposed action, mitigation is not warranted or anticipated for socioal or economic conditions.

5.11 Environmental Justice Impact Mitigation

NRC will work to resolve issues related to potential impacts, if any, to communities, including those identified as having high concentrations of low income or minority ethnic and racial groups, in accordance with its policy under NEPA (69 Fed. Reg. 52040, August 24, 2004). As stated in Section 4.1.11, since no significant adverse impacts are anticipated, there can be no disproportionate adverse environmental consequences.

5.12 Radioactivity Mitigation

Operation of an ISR facility is not expected to have any significant potential radiological impacts to the site or to potential off-site dose receptors or to the environment or environs. As stated above, the potential primary potential radiological impact to nearby dose receptors (i.e., populations/individual members of the public) will result from naturally occurring background radiation that is independent of the ISR operations (HRI, 1997a). Dose to such receptors from ISR operations likely will be in the range of 1 mrem/yr or one percent of NRC's 10 CFR Part 20 dose limit for members of the public of100 mrem/yr from NRC-licensed operations and which equates to NCRP's NIRL.

At the conclusion of the project, all radiologically-contaminated materials (including brines, "bleed" or restoration sludges, spent IX resins, filters, evaporation pond liners, etc.), soil and structures will be removed from the site. Any radiologically-contaminated material accumulating at the site during operations or reclamation will be disposed of as 11e.(2) byproduct material at an appropriately licensed facility. Alternatively, once decontaminated ,structures or equipment can be sold or transferred to other entities for future use. Currently, in accordance with 10 CFR Part 40, Appendix A, Criterion 2, no 11e.(2) byproduct material will remain on the site.

The techniques proposed for removing and disposing of structures and equipment used will be consistent with regulatory guidance and sufficient to meet the applicable regulatory requirements in 10 CFR Part 40.42. The plans for dismantlement of structures and equipment include a preliminary assessment of anticipated hazards that will be considered before dismantlement. This will include the use of appropriate survey methods to determine the extent of contamination of equipment and structures before starting site D&D activities and reclamation work. Particular attention will be focused on those parts of the processing system that likely will have accumulated contamination over long time periods, such as pipes, ventilation equipment, effluent control systems, and, in particular, facilities and equipment used in or near the yellowcake dryer area. As noted above, preparations will be made for the removal and disposal of byproduct material to an existing uranium mill or licensed disposal site to ensure satisfaction that the requirements of 10 CFR Part 40, Appendix A, Criterion 2 (NRC 2003a).

Any equipment or buildings that can be decontaminated to levels acceptable for *free release (unrestricted use)* can be sold and/or left to be used for other purposes. All other equipment, buildings, foundations, piping, and associated support facilities will be removed, and appropriate radiation surveys will be conducted over the associated areas. In the well fields, where gamma surveys correlate well with actual radiation concentrations in soil, gamma surveys will be conducted as each recovery zone mining unit is decommissioned. Gamma survey results will be compared with baseline values, and soil samples will be obtained from locations that exhibit elevated gamma readings. Areas exhibiting elevated uranium, thorium, and/or radium-226 levels will be decontaminated in accordance with release limits specified in 10 CFR Part 40,

Appendix A, Criterion 6(6). Contaminated soil will be disposed of in the same manner as other radioactively contaminated 11e.(2) byproduct material. All survey results will be subject to verification by NRC or an Agreement State.

The survey methods provided in NUREG–1575 (NRC, 2006) along with the applicable site conditions will be considered in designing the proposed sampling techniques. The radium benchmark dose in 10 CFR Part 40, Appendix A, Criterion 6(6) applies to cleanup of residual radionuclides other than radium in soil and for surface activity on structures. The cleanup criterion for radium in soils is provided in 10 CFR Part 40, Appendix A, Criterion 6(6). This criterion states that the design requirements for longevity and control of radon releases apply to any portion of a licensed site or disposal site unless such portion contains concentrations of radium in land, averaged over areas of 100 m^2, which as a result of byproduct material, does not exceed the background level by more than:

(i) 5 pCi/g of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 cm (5.9 in.) below the surface
(ii) 15 pCi/g of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over 15-cm-thick (5.9-in.-thick) layers more than 15 cm (5.9 in.) below the surface.

Any proposed cleanup criteria for uranium or other radionuclides will be in accordance with the radium benchmark, using the methods as described in Appendix E of the SRP (NUREG-1569). For areas that already meet the radium cleanup criteria but that still have elevated Th-230 levels, a cleanup criterion for thorium-230 will be proposed.

Byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures, must not result in a TEDE exceeding the dose from cleanup of radium-contaminated soil to the above standard (*benchmark dose*), and must be at levels which are as low as is reasonable achievable (ALARA). If more than one residual radionuclide is present in the same 100-square-meter area, the sum of the ratios for each radionuclide of concentration present to the concentration limit will not exceed “1” (unity.) A calculation of the potential peak annual TEDE within 1,000 years to the average member of the critical group that will result from applying the radium standard (not including radon) on the site must be submitted for approval. As stated in 10 CFR Part 40, Appendix A, Criterion 5, lands with radium in soil concentrations which satisfy the 5/15 standard (or soils contaminated with other radionuclides which satisfy the 5/15 *benchmark dose*) can be released for unrestricted use. The use of decommissioning plans with benchmark doses which exceed 100 mrem/yr, before application of ALARA, requires the approval of the Commission after consideration of the recommendation of NRC staff. This requirement for dose criteria does not apply to sites that have decommissioning plans for soil and structures approved before June 11, 1999 (Source: 10 CFR Chapter 1 [1-1-00 Edition] Part 40, Appendix A, Criterion 6).

The reclamation/decommissioning plan and cost estimates will follow the outline in Appendix C to the SRP (NRC, 2003a), entitled, "Recommended Outline for Site-Specific In Situ Leach Facility Reclamation and Stabilization Cost Estimates." (This was a requirement of Cogema Irigaray License, 2007).

As stated previously, ISR operators also are required to provide detailed financial assurance cost estimates that ensure the performance of site D&D activities, including remediation and

disposal of soils impacted by well field spills or residual radiologically contaminated material, is performed in the event that the operator is unable to perform such activities. This mitigation measure serves as an “insurance policy” to protect against potential impacts to any resource due to the licensee’s failure to complete required site D&D.

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

This section describes the environmental measurement and monitoring programs for the proposed action. Specifically, sampling, measurement, and monitoring activities that are necessary to evaluate potential environmental impacts described in Section 4, as well as activities to implement the mitigation measures presented in Section 5, are discussed. The information in this section will be used to characterize and evaluate the baseline environment, to provide data on measurable levels of potential impacts, to provide data on the reduction of those potential impacts through mitigation measures, and to provide data on principal pathways of exposure to the public (where applicable).

The following subsections provide detail on environmental sampling, measurement and monitoring programs for the following resources and features: land use, the operational environment, surface water, ecology, groundwater, wastewater management, the radiological environment, and air resources.

6.1 Land Use Monitoring

Land use monitoring will be included in a site-specific reclamation plan. Uranium mineralization makes up only a small portion of the total mass of host sandstone; therefore, after recovery operations, the structural integrity of the host aquifer is maintained, and no land subsidence occurs. However, as part of a site reclamation plan, site inspections will be conducted to confirm that the integrity of the site has not been disturbed (HRI, 1997b). Geotechnical monitoring also will be conducted to determine if any settling, erosion, or movement has occurred as well as to monitor whether depressions appear at the surface due to subsurface collapse, and to determine that the land surface has been returned to its general contours as part of the project's surface reclamation activities.

6.2 Groundwater and Wastewater Monitoring

The following subsections describe environmental measurements and monitoring programs for groundwater and wastewater management at the model ISR site.

The site will be monitored for impacts before, during, and after active ISR operations and groundwater restoration. In effect, environmental measurements and monitoring will: (1) establish baseline conditions, (2) monitor for unintended or unexpected events, most likely excursion of lixiviant from the ISR recovery zone or leaks/spills from conveyance piping, and (3) monitor site restoration.

The measurement and monitoring schemes described below for the proposed model ISR site are based on the potential impacts to groundwater described in Section 4.1.4.1 and mitigation measures described in Section 5.4.

6.2.1 Pre-Operational Activities

Baseline Monitoring and Testing. Groundwater will be monitored prior to, during, and after the proposed recovery operations. Prior to lixiviant injection in a well field, data will be collected

to determine baseline water quality and define aquifer properties. Water quality data will be collected to establish UCLs and restoration criteria. Prior to lixiviant injection in each recovery zone, the following measurements and monitoring will be conducted:

- Baseline water quality data will be established at (1) all recovery zone perimeter monitor wells, (2) all upper and lower aquifer monitor wells, and (3) at least one extraction or injection well per four acres in each well field.
- UCLs and groundwater restoration criteria will be established

Baseline water quality and water level data will be collected from the wells within and around the well field and completed at the following densities:

- One well for up to four acres within the well field
- One well per 4 acres from the first overlying aquifer in the well field

Pumping tests will be conducted to characterize and test the vertical confinement of each well field and the horizontal communication with recovery zone monitor wells. The groundwater flow direction will be characterized in the overlying aquifers before operations commence.

Monitor wells in the first overlying aquifer will be placed at a density of one well per 4 acres of field production area and will provide an adequate population of reference points to conduct contour analysis and determine flow direction, flow velocity, and water quality.

6.2.2 Recovery and Restoration Activities

Recovery and restorative activities entail locating and sampling monitor wells, defining UCLs, excursions and corrective actions, conducting well casing integrity tests, and monitor well field operational flow and pressure, and detection of evaporation/retention pond leaks.

6.2.2.1 Location of Monitor Wells

Monitor wells will be located at the model ISR site to provide a sentry system for detecting excursions from the intended ISR recovery zone. Wells will be located according to the following general criteria: (Quantitative data provided below are examples for one such ISR site; each site will vary.)

- Monitor wells will encircle each well field at a distance of 140 m (400 ft) from the edge of the extraction or injection wells and 140 m (400 ft) between each monitor well.
- The angle formed by lines drawn from any extraction well to the two nearest monitor wells will not be greater than 75 degrees.
- Monitor wells will be located in the first overlying aquifer at a density of one well per 1.6 ha (4 acres) of well field.
- Deep monitor wells below the recovery zone will be completed within the boundaries of the well fields at the model ISR operations. (Like extraction and injection wells, deep monitor wells are drilled through the recovery zone. Therefore, they have to be completed carefully, so that they do not become pathways that could create a vertical excursion into the underlying aquifer.)

6.2.2.2 Sampling of Monitor Wells

Samples from monitor wells will be collected semi-monthly. Sampling will be performed using SOP sampling methods.

6.2.2.3 Upper Control Limits

UCLs are intended to provide early warning that recovery solutions are moving away from the well fields so that corrective action can be taken to assure that groundwater outside the monitor well ring is not significantly threatened. Adequate monitoring is accomplished by choosing groundwater parameters that meet the following criteria:

- Strong indicators of the ISR process
- Not greatly attenuated due to geochemical reactions in the aquifers (i.e., mobile)
- Easy to analyze to allow timely data reporting.
- UCL parameter concentrations will be set high enough that false positives (false alarms due to natural fluctuations in water chemistry) are not a frequent problem, but not so high that significant groundwater quality degradation occurs by the time an excursion is identified.

<u>Potential Groundwater Parameters:</u>

- Chloride: Considered a strong indicator parameter for use as a UCL parameter because it is directly attributed to the ISR process, not readily attenuated by geochemical interactions within the aquifer, and found at levels significantly higher in the ISR mining fluids than in natural groundwater.
- Calcium, sodium, and bicarbonate: Each is also found at significantly higher levels in ISR recovery solutions than in natural groundwater. The transport of calcium and sodium will be affected by IX reactions between the solution and the sediment. As a result, bicarbonate is the preferred excursion indicator because it is mostly a direct result of the injection of the sodium bicarbonate in the recovery solution and will reach a high concentration early in recovery operations in a well field.
- TDS: TDS can be used as an excursion indicator whether the ISR site has relatively high TDS groundwater quality, as is often found in Texas, or relatively low TDS groundwater quality, as is often found in Wyoming. TDS has advantages as a UCL because it is little affected by IX reactions, is considerably elevated in concentration by the ISR solution, and is a general indicator of the chemical species elevated in the groundwater by ISR operations. TDS will be measured as changes in specific conductivity and is easily measured in the field, providing a good method to estimate the TDS concentration if, as is the case with ISR, large amounts of organic matter are not present.
- Uranium: Uranium can be used an indicator, however, while it is mobilized by ISR, it is not considered an early indicator of excursions from the well field and therefore is not considered a suitable parameter for a UCL.

UCL Concentration:

In choosing the concentration for a UCL parameter, NRC staff guidance (NRC, 1981) states, "…In order to account for the spatial and temporal variations in excursion indicator concentrations, upper control limits will be determined on a statistical basis. One such statistical technique is the student 'T' distribution" (NRC, 1981).

The same NRC staff guidance also recommends that, in some cases, a simple percentage increase over baseline values may be used; a 20 percent increase over the established baseline is suggested. NRC staff states that it is acceptable to set baseline concentrations based on the mean plus a defined number of standard deviations. In areas of good water quality, NRC has found the mean plus 5 standard deviations to be acceptable. However, in aquifers with good water quality, chloride populations have been found to have such a narrow statistical distribution that the mean plus 5 standard deviations, plus a defined concentration, has been used.

6.2.2.4 Excursions and Corrective Actions

Identification and confirmation of excursions at the model ISR site will involve the following steps:

- An excursion will be defined as any two excursion indicators in any monitor well exceeding respective UCLs, or a single excursion indicator exceeding its UCL by 20 percent.
- A verification sample will be taken within 24 hours of receipt of initial results of the first analyses.
- If the second sample does not indicate that UCLs has been exceeded, a third sample will be taken within 48 hours after the second set of sampling data is acquired.
- If neither the second nor the third sample indicates that UCLs have been exceeded, the first sample will be considered in error.
- If the second or third sample contains indicators above UCLs, an excursion will be confirmed.

In the event of an excursion at any proposed project site, the following corrective action programs will be applicable to return the water quality to the applicable UCL:

- Sample frequency will be increased to weekly for the excursion indicators until the excursion is concluded.
- An excursion will be deemed to have been corrected when all control parameters are reduced to or below their UCLs.

6.2.2.5 Well Casing Integrity Testing

If wells are not properly completed, recovery solutions can flow through casing breaks and into overlying aquifers. Casing breaks can occur if the well is damaged during well construction. Casing breaks also can occur if water injection pressures exceed the strength of the well

materials. The following procedure is recommended for inspecting for casing leaks after a well has been completed and opened to the aquifer:

1. A packer will be set above the well screen, and each well casing will be filled with water.
2. At the surface, the well will then be pressurized with either (e.g., nitrogen or air) or water to a designated pressure at the land surface or 25 percent above the expected operating pressure, whichever is greater.
3. The well will pass the test, if the pressure loss in a designated timeframe does not exceed a designated or accepted criterion as provided by state regulation or permit condition.

6.2.2.6 Well Field Operational Flow and Pressure Monitoring

The actual maximum injection pressures used in each of the recovery zones will be determined when the operating wells are completed. Flow rates on each injection and extraction well and injection manifold pressures on the entire system will be measured and recorded daily and manipulate well field balance. During well field operations, injection pressures must not exceed the integrity test pressure at the well heads (injection pressure can be monitored for all wells with one measurement at the injection manifold). No injection well will experience pressure significantly greater than that exhibited at the manifold.

6.2.2.7 Retention Pond Leak Detection Monitoring

Any wastewater retention (evaporation) ponds will be provided with leak detection monitoring. Because small amounts of condensation can accumulate in leak detection sumps, if water levels greater than 6 in. are detected, chemical assays for specific conductance and chloride will be used to confirm the source of the water. Elevated levels of these constituents will confirm a liner leak and will be reported to NRC within 48 hours. Corrective actions will commence upon leak confirmation and will consist of transferring the solution to another pond so liner repairs can be made. All assay results will be reported in writing as soon as they are available. Monitoring for pond leaks will include:

- Performing and documenting pond freeboard and checks of the leak detection system daily, including weekends and holidays.
- Setting a level or volume of fluid that, when exceeded in the leak detection system standpipes, triggers analysis for selected chemical constituents.
- Setting action levels for the selected chemical constituents which, when exceeded, will confirm that the pond is leaking. The selected chemical constituents will be easy to analyze and will be reflective of the ISR process.

In the event that evaporation pond standpipe water analyses indicate that a pond is leaking, the following actions will be taken:

1. NRC will be notified by telephone within 48 hours of verification.
2. Standpipe water quality samples will be analyzed for leak parameters once every 7 days during the leak period and once every 7 days for at least 14 days following repairs.

3. A written report will be filed with NRC within 30 days of first notifying NRC that a leak existed. This report will include analytical data and describe the mitigative action and the results of that action.

A log of all significant solution spills will be maintained at the site. NRC will be notified by telephone within 48 hours of any failure that could have a radiological impact on the environment. The notification will be followed, within 7 days, by submittal of a written report detailing the conditions leading to the failure or potential failure, corrective actions taken, and results achieved. This will be done in addition to the requirements of 10 CFR Part 20.

6.3 Surface Water Monitoring

Historically, results show that ISR operations have no measurable impact on surface water during normal operations. The primary purpose of surface water monitoring is to ensure that no adverse impacts to nearby surface water resources will result from ISR operations and to determine the potential impacts of surface water flooding on the ISR facility.

Information and areas of assessment include, but will not be limited to:

(1) Descriptions of surface-water features in the site area (up to a 2-mile radius) including type; size; pertinent hydrological or morphological characteristics; and their proximity to ISR processing plants, well fields, evaporation ponds, or other facilities that might be negatively affected by surface erosion or flooding.

(2) Assessment of the potential for erosion or flooding using available geomorphological and topographic data or analysis of paleodischarge information that may require special design features or mitigation measures to be implemented.

(3) An assessment of typical seasonal ranges, averages, and the historical extremes for levels of surface-water bodies and aquifers.

(4) An assessment of seasonal and, if data are available, the historical variability for levels of surface-water bodies, allowing for seasonal variability.

Surface-water data will be included in specific assessments, including maps that identify nearby lakes, rivers, surface drainage areas, or other surface-water bodies. Stream flow data (if available) and an assessment of the likely consequences of surface-water contamination from ISR operations also will be included. General characterization of perennial surface-water bodies will be conducted.

Pre-operational samples, taken at least three months before operations began, will be taken from nearby surface water locations to determine baseline values. During operation, samples will then typically be taken quarterly. For ephemeral surface water bodies, samples will be taken on a runoff event basis.

Typical baseline water quality indicators to be determined, as relevant, during pre-operational data collection are provided in Table 6.1, below.

Table 6.1
Pre-Operational Surface Water Quality Parameters

Trace and Minor Elements			**Common Constituents**	
Arsenic	Copper	Nickel	Ammonia	Magnesium
Barium	Fluoride	Selenium	Alkalinity	Nitrate
Boron	Iron	Uranium	Bicarbonate	Potassium
Cadmium	Manganese	Vanadium	Calcium	Silica
Chromium	Molybdenum	Zinc	Carbonate	Sodium
			Chloride	Sulfate
Physical Indicators			**Radiological Indicators**	
Specific Conductivity	Total Dissolved Solids		Gross Alpha	Gross Beta
pH			Radium-226 and -228	

6.4 Ecological Monitoring

An assessment of the flora and fauna in the vicinity of the licensed area, their habitats, and their distribution will be conducted. Special attention will be paid to species that (1) are threatened or endangered as listed in 50 CFR Part 17, “Endangered and Threatened Wildlife and Plants,” (2) are commercially or recreationally valuable, (3) affect the well-being of species that are threatened or endangered, or (4) are critical to the structure and function of the ecological system or to a biological indicator of radionuclides or chemical pollutants in the environment. As threatened or endangered species are added to or withdrawn from USFWS, BLM, or other Federal or state agency lists, appropriate modifications will be incorporated into site-specific assessments.

An inventory of the majority of the terrestrial and aquatic organisms on or near the site and their relative (qualitative) abundance, the quantitative abundance of the important species, and species that migrate through the area or use it for breeding grounds will be conducted. In addition, a general assessment of the potential environs of these living resources in the total regional area will be completed. Inventories of locally significant domestic flora and fauna, in particular cattle, sheep, commercial fish, and other meat-producing animals and commercial crops, will be based on recent production figures from local, state, and federal agencies (e.g., the United States Department of Agriculture).

For operations involving drying of yellowcake, disposal of waste, or generation of hazardous effluents, information regarding the count and distribution of important game animals and domestic fauna, in particular cattle, sheep, and other meat-producing animals that may be involved in the exposure of man to radionuclides, will be provided.

Other information provided will include:

- A map showing the distribution of the principal flora and faunal communities.
- Discussion of species-environment relationships, including descriptions of area usage (e.g., habitat, breeding) for important species, life histories of important regional animals and aquatic organisms, normal seasonal population fluctuations and habitat requirements, and identification of food chains and other interspecies relationships,

particularly when these contribute to prediction or evaluation of the potential impact of the facility on the regional biota.

- Any definable pre-existing environmental stresses from sources such as pollutants, as well as pertinent ecological conditions suggestive of such stresses and the status of ecological succession.
- Any pertinent published material dealing with the ecology of the region and ecological studies of the site or its environs currently in progress or planned.

Information on the various species will be presented in separate subsections addressing terrestrial ecology and aquatic ecology. Descriptions of area usage (e.g., habitat, breeding) for important species and discussions of life histories of important regional animals and aquatic organisms, including normal seasonal population fluctuations and their habitat requirements, will be provided. Food chains and other interspecies relationships will be assessed, particularly when these may bear on predictions or evaluations of the potential impact of the proposed facility on the stability of regional biota.

Any pre-existing environmental stresses from sources such as pollutants, as well as pertinent ecological indicators suggestive of such stresses will be assessed as well as ecological succession.

Historical sightings of listed species, as defined in the “Standard Format and Content of License Applications, Including Environmental Reports” (NRC, 1982) will be included in the inventory, if available. If information regarding historical sightings does not exist, inventories will be prepared based on a radius within which impacts could be reasonably expected to occur. Nonpermanent inhabitants migrating through the area or using it for breeding grounds will also be taken into consideration.

All inventories will be prepared in consultation with appropriate local, state, and federal agencies to confirm the presence or absence of important species (especially threatened or endangered species). Inventories can be based on historical data, but will be updated to within 2 years of the time of operation to establish current baselines.

Any provided statistics will cover at least 3 years, if available.

6.5 Air Monitoring

The primary radiological impacts on air quality arise due to releases of radon and particulates during ISR processing. The releases from the ISR facility are inherently much lower than those from conventional milling because solid process tailings are not stored on surface. Radon and radon daughter releases to the surface environment can be further reduced by enclosure and pressurization of IX equipment. This pressurization returns the radon and decay products to the well field and inhibits emission of radon from the recovery solutions. This protects workers from exposure as well as minimizing increases in local ambient radon levels.

The air impacts vary temporally and spatially. The spatial variation is accommodated through specification of monitoring locations based on predominant wind directions and considerations of predicted impacts. The presence of temporal variability (hour-to-hour and seasonality) is accommodated through continuous measurements.

6.5.1 Pre-Operational Air Monitoring

According to Regulatory Guide 4.14 guidance, the air monitoring locations are established at site boundaries (three locations), at the off-site location(s) with the highest predicted impact from the ISR facility, and at a site unaffected by facility operations(usually upwind). Air samples are collected continuously for a consecutive 12-month period and measured for U, Th-230, Ra-226, Pb-210 and Ra-226.

6.5.2 Operational Monitoring

The operational monitoring program includes the same sampling locations, sampling frequency, and analytical parameters as the pre-operational monitoring program; however, it continues throughout recovery operations. The airborne radiation monitoring program is acceptable if it meets the following criteria:

(1) The applicant provides one or more drawings that depict the facility layout and the location of samplers for airborne radiation. Locations are based, in part, on a determination of airflow patterns in areas where monitoring is needed, and determination of monitoring locations is consistent with Regulatory Guide 8.30, “Health Physics Surveys in Uranium Recovery Facilities” (NRC 2002a).

(2) Monitoring equipment is identified by type, sensitivity, calibration methods and frequency, availability, and planned use to accurately measure concentrations of airborne radioactive species. The application also demonstrates that the ranges of sensitivity are appropriate for the facility operation.

(3) Planned surveys of airborne radiation are consistent with the guidance in Regulatory Guide 8.30 (NRC 2002a).

(4) The proposed monitoring program is sufficient to adequately protect workers from radon gas releases from venting of processing tanks and from yellowcake dust from drying operations, spills, and maintenance activities, and is consistent with Regulatory Guide 4.14, Sections 1.1 and 2.1 (NRC, 1980a). The air sampling program is consistent with Regulatory Guide 8.30 (NRC, 2002a).

(5) Plans for documentation of radiation exposures are consistent with the requirements in 10 CFR Parts 20.2102, 20.2103, 20.2106, and 20.2110.

(6) The applicant demonstrates that respirators will be used routinely for operations within drying and packaging areas and identifies the criteria for determining when respirators will be required for special jobs or emergency situations. The respiratory protection program is consistent with guidance in Regulatory Guide 8.15, Revision 1, “Acceptable Programs for Respiratory Protection” (NRC, 1999) and Regulatory Guide 8.31, Section 2.7 (NRC 2002b).

(7) For license renewal applications, the historical results summary of the airborne radiation monitoring program is included through the most recent reporting period preceding the submittal of the application. The effectiveness of the historical program is discussed with regard to all applicable 10 CFR Part 20 regulatory requirements identified in the preceding paragraphs. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

6.6 Radiological Monitoring

The primary objectives of radiological environmental measurements and monitoring programs are to characterize the radiological environment, to provide data on measurable levels of radiation and radioactivity, and to provide data on principal pathways of exposure to workers and members of the public (NRC 2003b). The monitoring programs at ISR facilities are designed to meet the objectives specific to ISR operations.

6.6.1 Applicable Guidance

Two key guidance documents related specifically to radiological monitoring are Regulatory Guide 4.14, which concerns design of monitoring programs, and Regulatory Guide 4.15, which concerns quality assurance (QA) of the monitoring programs.

Regulatory Guide 4.14 provides judgmental guidance on monitoring programs for uranium mills that includes attributes to be measured, placement and number of monitoring locations, and frequency of measurements. This guidance has been applied to both ISR and conventional mills, although generally potential impacts from ISR operations on the environment are much less than the potential impacts from conventional mills. The guidance predates the statistical-based data quality objectives (DQO) approach currently used in recent guidance but nevertheless provides a reasonable judgmental sampling approach to the design of monitoring programs around ISR facilities, particularly if specific differences between conventional and ISR are considered. A statistically designed monitoring program is not required, but differences in ISR and conventional milling will be recognized. Elements of a monitoring program include the following (NRC 2003 b):

- Maps or aerial photographs of the facility, with proposed monitoring and sampling locations clearly identified along with effluent release points

- A brief description of the monitoring program including:

    - Number and location of sample collection points, measuring devices used, and pathways sampled or measured
    - Sample size, sample collection frequency, and sampling duration
    - Type and frequency of analysis including lower limits of detection
    - Principal radiological exposure pathways
    - Location and characteristics of radiation sources and radioactive effluent (liquid and gaseous)

Reg. Guide 4.15, a more recent guidance document, provides relevant approaches to ensuring the quality of the data collected from monitoring programs and data reporting.

The decommissioning phase requires radiological classification of waste materials and verification that the remediated site meets applicable criteria. Recent guidance, e.g. Multi-Agency Radiation Survey and Site Investigation Manual and Multiple Airborne Reconnaissance Sensor Assessment Model are based on statistical decision making and provide bases for the design of monitoring programs, as well as allowing characterization of many types of materials.

6.6.2 Monitoring Requirements by Project Phase

The purpose, and therefore the specific design, of environmental measurement and monitoring programs depends on the ISR project phase. Pre-operational monitoring provides a description of existing radiological conditions and doses as a reference for operational conditions and for decommissioning activities.

Pre-operational monitoring requirements programs specific to ISR (NRC 2003a) are:

(1) Monitoring programs to establish background radiological characteristics, including sampling frequency, sampling methods, and sampling location and density, established in accordance with pre-operational monitoring guidance provided in Reg. Guide 4.14, Revision 1, Section 1.1 (NRC, 1980a). Air monitoring stations are located in a manner consistent with the principal wind directions.

(2) Soil sampling is conducted at both a 5-cm [2-in.] depth, as described in Reg. Guide 4.14, Section 1.1.4 (NRC, 1980a), and 15 cm [6 in] for background decommissioning data.

6.7 Environmental and Operational Monitoring

Environmental and operational monitoring to ensure satisfactory mitigation of potential environmental and health impacts is a critical component of ISR. Monitoring that is specific to environmental media (air, groundwater, surface water, etc.) and receptors (plant workers for radon gas and radioactive particulate emissions) are described elsewhere in Section 6. While these monitoring programs address the main potential impacts of concern, in addition, NRC has identified various specific potential chemical and radiological risks associated with ISR plant operations (for example spills, chemical interactions, tank ruptures, transportation incidents) that will be addressed by management controls and operating procedures (NRC, 2001).

Management controls take many forms, including the following:

- Use of SOPs
- SERP oversight
- A defined training program
- Audit and inspection programs
- Specified training and qualification requirements for specific positions
- Facility security

Written SOPs will be created and followed for any routine activities involving radioactive materials. Written operating procedures also will be used for any activities associated with environmental monitoring, occupational health physics, emergencies, and general safety. Formal reviews will be required to approve these procedures, and the facility radiation safety officer must be one of the approving officials. Standard operating procedures will be reviewed annually by the radiation safety officer for currency. Changes to procedures will be reviewed formally and approved, and copies of relevant procedures will be kept at appropriate operating stations.

For any non-routine activities that could involve exposure to radiation but for which standard operating procedures do not exist, a radiation work permit will be required. A radiation work

permit defines the radiological safety precautions, equipment, specialized clothing, and radiation surveys required for the work. This radiation work permit will be issued by the radiation safety officer or an appropriately trained delegate.

Performance-based ISR licenses require that a SERP be established. The purpose of this SERP is to review proposed changes, tests, or experiments to determine whether they require a license amendment. Changes, tests, or experiments may be conducted without prior NRC approval if (i) they do not conflict with any requirements specifically stated in the license or impair the licensee's ability to meet all applicable NRC regulations, (ii) there is no degradation in the essential safety or environmental commitments in the license application or those provided in an approved reclamation plan, and (iii) they are consistent with NRC conclusions regarding actions analyzed and selected in the facility environmental assessment.

The applicant will establish a management audit and inspection program that addresses items such as

- Inspections of radiation safety control practices
- Reviews of monitoring and exposure data
- Adequacy of survey records
- Compliance with the ALARA program
- Compliance with license conditions
- Sufficiency of any quality assurance/quality control program

The applicant will define appropriate qualifications for key staff members involved in the radiation safety program, to include the Radiation Safety Officer (RSO) and the radiation safety technicians. Employees and contractors will be trained in radiation safety. This training must include topics such as radioactive material handling and emergency procedures. Contractors and visitors to ISR sites must receive hazard training on radiation safety requirements and on survey requirements to be applied when leaving the restricted area. Permanent employees must receive training on such topics as:

- Fundamentals of health protection
- Personal hygiene at uranium processing facilities
- Facility-provided protection
- Health protection measures
- Emergency procedures

Specialized training will be provided for supervisors and persons responsible for the radiation safety program. Written tests will be required to demonstrate adequate knowledge after training. In addition, radiation safety technicians will have specific on-the-job training requirements. All permanent employees will receive ongoing radiation safety training, usually as part of quarterly safety meetings. Training records will be prepared for each employee and will be kept for a period of 5 years after the training is received.

Security measures will be an impact at ISR facilities. Normally, entrances to the property will be posted to inform visitors that radioactive material may be present and that permission is required for entry. The permitted areas will be fenced and equipped with gates that can be locked. Licensees are exempted from the specific requirements of 10 CFR Part 20.1902(e) provided that all facility entrances are conspicuously posted in accordance with 10 CFR Part 20.1902(e) with the words, "any area within this facility may contain radioactive material." Visitors will be required to register and will not be allowed inside the process facility or in well fields without escort. Visitors and workers in the processing plant, well fields, and related areas will be required to wear standard safety equipment such as hard hats, safety glasses, and safety shoes.

Operations will not begin prior to review and approval of a SOP-level detailed environmental monitoring plan or an Environmental Management and Monitoring Plan. The plan will indicate SOPs for sampling methods, equipment, analytical procedures, and lower limits of detection. The plan also will indicate proposed environmental monitoring locations based on “as built” construction, and provide the rationale for their selection.

7.0 COST-BENEFIT ANALYSIS

Pursuant to Section 84(a)(1) of the AEA, as amended, NRC regulations require a description and analysis of the costs and benefits for the proposed action and each alternative (10 CFR Part 51.71). "Cost-benefit analysis" can be defined as a decision-making technique for evaluating the advantages and disadvantages of a government action. This section generally describes the potential benefits and costs of ISR projects for members of the local communities, local governments, and States. These potential benefits and costs include those brought about by the proposed operation, including the expansion of tax bases related to the recovery and processing operation, and any additional demands on the infrastructure and public services that are imposed by the project. They also include the beneficial effects of employment (HRI, 1997a).

Due to the programmatic nature of the GER (and the ISR GEIS, once complete), specific technical options for an ISR project on a specific site have not been selected. Therefore, cost-benefit analysis on a programmatic level can only be described in broad, general terms, as presented in Section 7.1. Specific cost-benefit analysis will be completed on a site-specific basis using the guidelines presented in Section 7.2 (NRC 2003b).

7.1 Programmatic Cost-Benefit Analysis

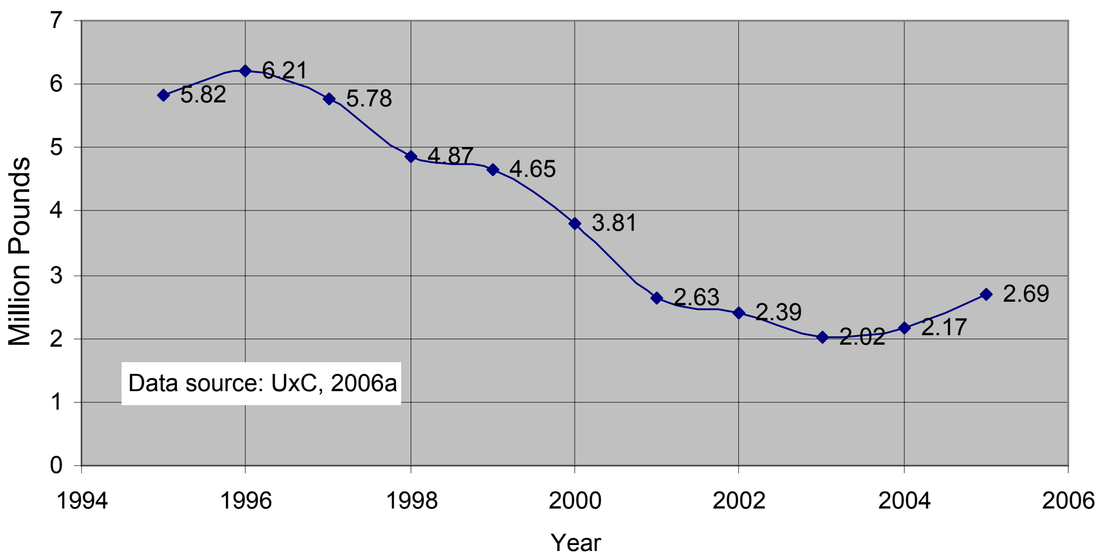
The ISR facilities will be private ventures and, as such, will not have a direct public purpose. However, because the projects will provide a domestic source of uranium that eventually will be used in nuclear reactors to generate electricity, they will have a public benefit. Existing statutes oblige the United States Secretary of Energy to have a "continuing responsibility" for the domestic uranium mining industry "to encourage use of domestic uranium" (42 U.S.C. 2201b and 2296b-3). NRC recognizes that the viability of the industry is a federal concern and that there is a public interest in the uranium supply. Between 1985 and 1994, annual domestic uranium production decreased by 75 percent, while annual imports of uranium increased by 300 percent (HRI, 1997a). In 1994, domestic uranium production was less than 5 million pounds, while uranium imports totaled more than 35 million pounds (HRI, 1997a). Figure 7.1 shows uranium production trends from 1995 to 2006.

As outlined in Section 1.2, the United States is significantly dependent on foreign uranium sources in an ever tightening international market. Owners and operators of United States civilian nuclear power reactors purchased a total of 67 million pounds of uranium from United States and foreign suppliers during 2006. Approximately 16 percent was purchased from United States suppliers, and the remaining 84 percent (56 million pounds) of uranium was imported. As of the end of 2006, cumulative unfilled uranium requirements for United States civilian nuclear reactors for 2007 through 2016 were estimated at 276 million pounds (EIA, 2007a). By approving an increased number of appropriately vetted licenses for ISR facilities in the United States, NRC effectively will generate beneficial effects for energy production that will help offset the current and projected deficit in domestic production.

The benefit of the projects will be the revenues generated from the sale of processed uranium and increased production. These benefits are discussed in more detail in Section 7.1.1. The costs will be the expenses, including the cost of land, labor, and capital, required to recover and process the uranium. There also will be costs to meet regulatory standards, including those for assuring adequate protection of public health, safety, and the environment. These costs are

discussed in more detail in Section 7.1.2. The amount of revenue that the project(s) generate ultimately will be subject to the uncertainty inherent in the world uranium market. The benefits and costs that are internal to uranium recovery companies are not subject to government regulation and are therefore not assessed in this report.

Figure 7.1
Uranium Production Trend



7.1.1 Benefits of the Proposed Projects

The major potential benefits to the local community will include employment income, royalty income, and tax revenues that will be generated by ISR operations. The projects will develop little in the way of infrastructure, such as roads or buildings that will be useful to the surrounding communities once the projects are completed. They could help improve over-grazed lands by limiting grazing during construction and operation of well fields. However, this may be a very small benefit because the amount of land affected is small and, therefore, will have a very small value for grazing.

7.1.1.1 Potential Production

Both the employment generated and the taxes paid by uranium recovery companies will depend on the level of production of yellowcake. The amount of yellowcake produced will depend on the market price and the cost of production. The spot market price of uranium declined from approximately $14 per pound in 1997 to a low of $6.50 per pound in 2000, and climbed back to $14 per pound in 2003 (Ux Consulting Company, LLC 2006b). From 2004, it rose sharply to a spot market price of approximately $90 per pound in September 2007 ($38-140 per pound in the summer of 2007 and recently it settled in at $92 per pound).

Uranium recovery operations will remain viable so long as the market price of uranium remains above loaded costs for production. The important point in assessing the project's potential benefits to the local community is that the benefits depend on the costs of producing yellowcake

being lower than the future selling price of yellowcake. If the selling price of yellowcake is less than the costs of operation, then operations likely will be discontinued. If this happens, there will be no economic benefits to the local community.

7.1.1.2 Benefits from Employment and Royalty Income

The most important local benefit from the proposed project will be opportunities for employment and earnings. The degree to which the local communities could benefit will depend on the available supply of qualified labor and the company's hiring policies. ISR facility jobs could be very attractive to members of the local community. Based on the skill levels required and attractive wages relative to existing opportunities, many jobs could be filled by members of the local community depending on how well uranium recovery companies execute their stated intent to hire from the local community.

Table 7.1 presents a summary of annual community earnings at several proposed or existing facilities as examples of the types of impacts ISR facilities could have on the local economy.

Table 7.1
Example Summary of Annual Community Earnings at Existing Facilities

Facility	**Period**	**Local Employment**	**Earnings**
Church Rock	1997 - 2003	44	$1,053,000
Unit 1	1999 - 2016	38	$ 905,500
Crownpoint	2001 - 2006	47	$1,124,700

Note:

Source: HRI, 1997a.

There also could be annual royalty income for holders of leases negotiated with uranium recovery companies, depending on production from ISR facilities and the price of yellowcake. However, this income likely will be concentrated to just a few lease holders and probably will not have a widespread effect.

7.1.1.3 Benefits from Tax Revenues

Table 7.2 presents examples of benefits to communities around a proposed ISR facility. As shown in Table 7.2, significant tax revenues can be collected by the Counties and possibly Indian Reservations, depending on the actual project location. Although not shown in Table 7.2, States can also collect severance and natural resource taxes. Native American Tribal governments can impose taxes on activities that occur in areas where the Tribe has jurisdiction.

Table 7.2
Example Benefits to Communities Around Existing ISR Facilities

Benefit	**Native American Government**	**Native American Community**	**County**
Crownpoint			
Employment	NA	100 long-term jobs	40 long-term jobs
Earnings	NA	$24,000 annually	$36,000 annually
Royalties	NA	$1,099,000 annually	None
Taxes	$957,000 annually	None	$539,000 annually
Other benefits	NA	Jobs related to increased expenditure in community and incidental services	Jobs related to increased expenditure in community and incidental services

Note:

Source: HRI, 1997a

7.1.2 Costs of the Proposed Projects

Table 7.3 presents an example of the potential costs of the future project to the local communities. Infrastructure costs related to population changes will be insignificant because population change will be small.

Table 7.3
Costs to Communities Around Existing ISR Facilities

Cost Element	**Cost**
Infrastructure related to population increases induced by employment	No significant cost
Fire and emergency related to potential accidents on public roads	Additional training to deal with potential transport accidents; ISR operators may pay for training specialized equipment and health care facilities.
Risk of contaminating and/or degrading public water supply	Capital costs, as well as operation and maintenance costs for replacement wells and distribution systems, will be paid for by ISR operators.

Note:
Source: HRI, 1997a

The local communities will require increased emergency response and medical treatment capabilities because of the small risk of a process chemical, resin/slurry or yellowcake truck transport accident on public highways. ISR operators will be willing to provide training or cover the costs of training for the local health clinics. Similarly, ISR operators will be willing to provide training and equipment to local fire departments so they can respond to a hazardous material accident. Therefore, these requirements will not result in additional costs to the local community.

The most significant potential risk of the future projects to the local community is the potential that a local water supply will require relocation due to ISR operations. However, NRC staff will require that ISR companies replace the local water supply wells before beginning operations at sites where this is deemed necessary. Thus, the communities will not have to bear the costs of replacing any such wells.

A replaced water supply wells and water delivery system(s) may increase the costs of operating and maintaining the wells. NRC staff's groundwater mitigation actions will require ISR companies to take appropriate mitigation measures.

7.2 Guidelines for Site-Specific Cost-Benefit Analysis

The following presents general guidelines for completing site-specific cost-benefit analyses related to ISR. This section of the site-specific NEPA document will describe the major costs and benefits for each alternative. The costs and benefits will not be limited to a simple financial accounting of project costs for each alternative. Costs and benefits also will be discussed qualitatively (e.g., environmental degradation or enhancement). Extensive detailed analysis will be presented in an appendix to the site-specific document to avoid diverting attention away from primary issues such as public health and safety. The cost-benefit analysis is not simply a mathematical formula from which to justify economic parameters; other applicable qualitative factors will be discussed and weighed in the decision. Table 7.4 presents general costs and benefits that can be addressed in site-specific documents.

Table 7.4
General Costs and Benefits that Will be Considered in Site-Specific Studies

General Costs	General Benefits
Qualitative discussion of environmental degradation	Qualitative discussion of the environmental benefits
Decreased public health and safety	Increased public health and safety
Capital costs of the proposed action and alternatives (including land and facilities)	Capital benefits of the alternatives (potential production, employment, and royalty income)
Operating and maintenance costs	Tax revenues received by local, state, and Federal governments
Post-operation restoration	Incremental increases in regional productivity
Post-operation monitoring requirements	Enhancement of recreational values
Other costs of the alternatives (e.g., lost tax revenue, decreased recreational value, degradation in transportation corridors, etc.)	Creation and improvement of transportation corridors and facilities

The project proponent will describe the costs and benefits for the proposed action and each alternative. Potential qualitative environmental costs and benefits can be compared to the discussion of potential impacts within the other sections of the site-specific document. Standard project costs can be reviewed using standard cost estimating databases. Socioeconomic costs and benefits can be reviewed and compared against similar projects as applicable. The following NRC guidance documents will assist in the analysis:

- NUREG/BR-0058 provides guidance for determining public health and safety impact valuation.

- NUREG-1530 provides background material and information relating to NUREG/BR-0058.

Future costs and benefits will be discounted to present worth, as discussed in "Economic Analysis of Federal Regulations Under Executive Order 12866" (http://www.whitehouse.gov/OMB/inforeg/riaguide.html). This site also provides general guidance on calculating costs and benefits. The methods used for discounting will be explained, and applied consistently to both costs and benefits. NUREG-1727, NMSS Decommissioning Standard Review Plan, provides guidance on determining costs and benefits for decommissioning projects. The cost-benefit analysis provides input to determine the relative merits of various alternatives; however, NRC must ultimately base its decision on public health and safety issues (NRC 2003b).

8.0 SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

This section provides a comparison of the proposed action and the no action alternatives, as well as a summary of the potential environmental impacts presented in Section 4.0. Table 8.1 presents a summary of the actions described under each alternative. Table 8.2 presents a summary of the potential impacts of implementing each alternative. Information in Table 8.2 focuses on different levels of potential impacts that can be distinguished quantitatively or qualitatively among alternatives. Also considered in Table 8.2 are unavoidable adverse environmental impacts; irreversible and irretrievable commitments of resources used in project construction, operation, and decommissioning; short and long-term potential impacts; short-term uses of the environment; and the maintenance and enhancement of long-term productivity.

Table 8.1
Summary of Proposed Activities

Proposed Activities	**Alternatives**	
	1 – Proposed Action	**2 – No Action**
Construction of ISR Facilities	• Drill for and construct process wells (including injection wells, production wells, and monitor wells) • Install field piping • Construct main plant, satellite plant, header houses, berms around all process equipment, sump and pump systems, and other buildings (for offices, control equipment, and piping manifolds and instrumentation) • Install instrumentation and control systems	None
Operation of ISR Facilities	• Prepare fortified native groundwater • Inject into ore body via injection wells • Recover pregnant recovery fluids from ore body via extraction wells • Extract uranium from pregnant recovery fluids (resin loading; resin elution; uranium precipitation; radium precipitation; yellowcake washing; and dewatering, drying, and packaging) • Amend barren lixiviant and return to injection wells • Treat production bleed to reduce volume of liquid waste (unless production bleed can be directly injected into a deep disposal well without treatment) • Dispose of solid wastes as 11e.(2) byproduct material • Dispose of liquid wastes in deep wells or evaporation pond Process Options: • Recovery from old stopes recovery solutions • Recovery from loaded resin from other facilities • Recovery from pregnant eluate from other facilities	None
Decommissioning of ISR Facilities	• Restoration of groundwater • Plugging wells • Removal of all buildings and structures from the site • Removal, transport, and ultimate disposal (or reuse) of all equipment and demolished debris	None

Table 8.2
Summary of Potential Environmental Impacts

Alternative 1 – Proposed Acton	Alternative 2 – No Action
Land Use	
• Transformation of open rangeland or forest land to an industrial facility (temporary, as the land will return to original state) • On-site and surface disturbance and restrictions during project construction and operations (1,500 to 15,000 acres) • Increased use of land for access roads and facility buildings • Increased use of land for waste disposal (mud pits, deep-well injection, process pad, evaporation and retention ponds)	• No direct, short-term impacts • Naturally occurring long-term impacts, such as reduced productivity due to overgrazing and increased potential for erosion
Transportation	
• Minor, temporary impacts related to the construction/operation entrance resulting from construction and demolition activities • Minor potential impacts related to forms of transportation other than highways and the roadway network will be expected, and will be analyzed in site-specific traffic studies • A range of potential impacts could result from a potential truck accident, including minor to major vehicle damage and spills of hazardous materials spills (although secure containers and tanker trucks will be used to ship yellowcake, yellowcake slurry or loaded IX resins which will help to minimize spills should an accident occur)	• No impacts
Geology and Soils	
• Potential impacts on geology include potential subsidence, landslides, and disruption of natural drainage patterns; but more likely, geological resources may exert an impact on the proposed action (e.g., seismic or volcanic hazards) • Potential impacts on soils will include removal and disturbance of topsoil, compaction, altering of natural drainage paths that could affect soil, and erosion. Overall, the potential impacts to the soil will be minimal, and impacts typically will not be due to the ISR process itself, but rather due to ancillary activities such as waste disposal and construction.	• No short-term impacts • Little to no long-term impacts (could include continued degradation of topsoil quality from overgrazing as well as increased potential for erosion)
Water Resources and Hydrology	
<u>Groundwater</u> • Consumption of groundwater (e.g., water will be pumped from the aquifer but not returned to it) • Short-term changes to groundwater quality (e.g., changes to the chemistry of the water) that could impact groundwater in adjacent, non-exempt USDWs from recovery fluid excursions, infiltration from spills, or rupture of wells • Potential long-term impacts to groundwater quality in adjacent, non-exempt USDWs after restoration <u>Surface Water</u> • Potential direct impacts due to physical intrusion into streams, seeps, springs, and wetlands • Potential indirect impacts occurring from construction of access roads, which will cause increased sedimentation and erosion potential	<u>Groundwater</u> • No impacts to groundwater quantity or quality, other than those typically associated with natural processes • The naturally occurring radiological and *non*-radioactive contamination of groundwater will not be characterized or

Table 8.2
Summary of Potential Environmental Impacts

Alternative 1 – Proposed Acton	Alternative 2 – No Action
	known for use avoidance in the future. Surface Water • No impacts
Ecology	
• Potential site-specific impacts to threatened or endangered species and habitat • Potential loss of habitat through access roads, development of facilities, and development of wells, indirectly leading to a loss in biodiversity with regard to terrestrial ecology • Construction activity can temporarily displace wildlife due to noise, human presence, and heavy equipment • Potential marginal increases in traffic-related wildlife mortalities (due to increased transportation in the area) • Operation noise and lighting also would impact wildlife • Potential beneficial impacts resulting from the introduction of water habitat (installation of evaporation ponds)	• No new impacts beyond those that will occur naturally (such as natural succession and habitat changes due to climate variances)
Meteorology, Climatology, and Air Quality	
Construction • Potential air quality impacts from pollutants from vehicle and drill rig exhausts, dust from traffic, and dust from disturbing soil • Mobile sources of air pollutants will be diesel engines on the drill rigs and diesel water trucks and diesel construction equipment (most other mobile vehicles will be gasoline powered and equipped with pollution control systems) • Construction likely will meet NAAQS and local requirements; federal or state air quality standards likely will not be exceeded Operation • Negligible impact on the surrounding area from atmospheric emissions, including carbon dioxide, diesel generator exhaust gases, and road dust • Carbon dioxide from the combustion of LPG or fuel oil as a heat source for the yellowcake dryers (if necessary), from diesel combustion for power generation and equipment operation, and from the precipitation of yellowcake • Radioactive airborne discharges will be produced as a result of recovery operations with radon and radon decay products accounting for the majority of these discharges • Operations in the well fields will emit low levels of radon gas present in processing solutions • Operations likely will meet NAAQS and local requirements; federal or state air quality standards likely will not be exceeded	• Air quality will remain as it currently exists and there will be no immediate direct or indirect impacts to regional air quality
Noise	
Construction • Construction noise will be comparable to current ambient noise levels with occasional, discernible construction noise at irregular intervals • Drill rigs, construction vehicles, and heavy trucks will generate noise that will be audible above background levels of 50 to 60 decibels • Construction noise likely will not exceed the 24-hour sound energy guidelines because well field construction will occur primarily during daytime hours Operation	• Noise levels will remain as they currently exist, and there will be no immediate direct or indirect impacts to potential receptors

Table 8.2
Summary of Potential Environmental Impacts

Alternative 1 – Proposed Acton	Alternative 2 – No Action
• Noise in areas with human activity is not expected to increase beyond ambient levels due to plant operations • No detrimental off-site noise impacts are anticipated due to the increases in commuter and truck traffic volumes • General operational noise sources will be pumps and occasional truck traffic • Noise levels generated during operation of the facilities are not expected to result in any significant impacts or to violate any noise standards	
Historic and Cultural Resources	
• No direct, indirect, or cumulative impacts are anticipated if an avoidance policy is implemented • Potential impacts depending on geographic location and proximity of resources to the proposed action (to be determined, by on-going vigilance, site-specific background research, investigation, and/or coordination with SHPO)	• No impacts
Visual and Scenic Resources	
• In general, ISR activities are not visually intrusive and will not constitute wide-scale impacts to the landscape • No indirect or cumulative impacts will be anticipated • Potential impacts to wilderness or Wild and Scenic Rivers depending on geographic location and proximity of resources to the proposed action (to be determined by site-specific analyses)	• No impacts
Socioeconomic Resources	
• Minor, short- and long-term changes in employment, demographics, economy, housing, and tax base resulting from the immigration of workers to the specific regions (short-term during construction and long-term during operation) • Slight increase in demand for public facilities and services (covered by increase in tax base) • Existing infrastructure (water and sewer) service areas will have capacity to accommodate the increased demand in population centers for such services	• Loss of tax revenue, royalties, economic development, and jobs
Environmental Justice	
• Direct, indirect, and cumulative impacts will be evaluated on a site-specific basis, as warranted, should minority or low-income EJ populations be identified • It is anticipated that ISR facilities can, but will not typically be located on Native American lands. Therefore, site-specific studies will be required to assess proximity of Native American populations and presence of Native American lands to proposed ISR facilities. Appropriate coordination will be conducted as necessary.	• No impacts
Public and Occupational Health Impacts	
• The proposed action will result in small radiation doses to workers and to the population immediately next to and in the local environs of the facility (small fractions of typical background doses) • These doses are typically found to be far less than the occupational and public dose limits set out in 10 CFR Part 20 • Standard radiation protection programs, such as used as conventional uranium mines and mills, will be put in place to monitor and minimize the potential environmental, worker and public exposures • Programs such MILDOS-AREA and GENII can be used to determine site-specific exposure values for the proposed facility	• Background radiation will remain at the current level characteristic of the specific site

Table 8.2
Summary of Potential Environmental Impacts

Alternative 1 – Proposed Acton	Alternative 2 – No Action
• All efforts will be made to ensure that radiation exposures are kept as low as reasonably achievable (ALARA)	
Waste Management Impacts	
• Typically, the proposed action will create domestic sewage which will be serviced by a conventional septic tank or leach field system – current infrastructure will have the capacity to handle anticipated increased levels • The proposed action also will produce nonradioactive (i.e., uncontaminated) solid wastes. Potential impacts could include changed ecology and geology/soils from on-site disposal (burial); impacts to soil from vehicular traffic, habitat fragmentation, vegetation disruption, and soils erosion from construction of new roads (for off-site disposal); and increased demand for licensed disposal facilities. • Liquid waste disposal: Mud pits could minimally alter the footprint of the immediate environment, including geology, soils, vegetation, animals, and ecology. • Other impacts associated with the process pad and evaporation and retention ponds. • Radioactive byproduct wastes produced during facility operation (production bleed, other liquid waste, other solid waste), and post-operational waste (miscellaneous liquid and solid waste produced during groundwater restoration and facility decommissioning) will be disposed of off-site at an appropriately licensed facility	• No impacts

9.0 LIST OF PREPARERS

	Consultant Contributors
	Petrotek Engineering Corporation
	SENES Consultants Limited
	Straughan Environmental Services, Inc.
	Tetra Tech, Inc.
	Thompson & Simmons, PLLC
	Industry Contributors
	Denison Mines (USA) Corporation
	Energy Metals Corporation
	Kennecott Uranium Company, a Rio Tinto company
Mesteña Uranium, LLC	Mesteña Uranium, LLC
	National Mining Association
	Power Resources, Inc., a Cameco company
	Powertech Uranium Corporation
	UR Energy
	Uranium One
	Uranium Resources, Inc.

10.0 DISTRIBUTION LIST

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Appendix A

Transcripts of 2007 NRC Public Scoping Meetings for ISR GEIS

Appendix A-1

Transcript of August 7, 2007 Scoping Meeting in Casper, Wyoming

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Public GEIS Scoping Meeting

ANN RILEY & ASSOCIATES, LTD.
Court Reporters
1250 I Street, N.W., Suite 300
Washington, D.C. 20005
(202) 842-0034

Docket Number: (n/a)

Location: Casper, Wyoming

Date: Tuesday, August 7, 2007

Work Order No.: NRC-1707 Pag

Washington, D.C. 20005
(202) 234-4433

UNITED STATES OF AMERICA

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NUCLEAR REGULATORY COMMISSION

+ + + + +

PUBLIC GEIS SCOPING MEETING

+ + + + +

TUESDAY

AUGUST 7, 2007

+ + + + +

PARKWAY PLAZA HOTEL AND CONVENTION CENTER

123 WEST E STREET

CASPER, WYOMING 82602

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Adjourn

P R O C E E D I N G S

7:01 P.M.

MR. CAMPBELL: First of all, I want to welcome everybody here tonight for our Generic Environmental Impact Statement meeting for uranium recovery. This is a public scoping meeting and so this is the initiation of a scoping process for developing a Generic Environmental Impact Statement for uranium recovery facilities.

I do ask that everybody who is here to turn off your cell phone or at least put it on buzz so that we're not interrupted while we're speaking.

I also ask that when people are speaking that we have one conversation at a time or one person speaking at a time, that you speak directly into the mic and that you identify yourself and your affiliation for the court reporter. If he gives me a funny look, I'll just ask you to repeat your information so that he can record it accurately.

I will say this is a transcribed meeting and what that means is we will obtain a transcript from tonight's meeting and if you gave us your email address, we will email that transcript to you. We also intend to ultimately have a website put up with the slides from the presentation that will be

available on the NRC website.

Okay. What I'd like to do is identify myself. I'm Andy Campbell. I'm going to be the facilitator tonight. I'm also the Deputy Division Director for Environmental Protection and Performance Assessment in the Division of Waste Management at the Nuclear Regulatory Commission. And the Division of Waste Management is responsible for uranium recovery licensing, for environmental reviews, and for a number of other activities, low-level waste, decommissioning, and associated activities.

So what we're going to focus on tonight is the GEIS for uranium recovery. What I want to do is introduce the NRC staff and some staff from the Center for Nuclear Waste Regulatory Analysis which is our contractor in San Antonio, helping us develop this.

To my left is Mr. Gregory Suber. Greg is the Branch Chief for Environmental Review. Bill von Till, he's the Branch Chief for Uranium Recovery. And Joan Olmstead, who is with the Office of General Counsel for the NRC. Also Brad Werling, here for the Center for Nuclear Waste Regulatory Analysis. Philip DuBois and Larry Canter, and they

are helping us, they're here to listen and they're helping us develop the GEIS.

Okay, the agenda as we have now is to go over the NRC's roles and responsibilities in uranium recovery GEIS, an overview of uranium recovery facilities. That will be Greg Suber talking about the uranium recovery GEIS. And the overview of uranium recovery facilities will be Bill von Till. There will be a brief question and answer period, just for clarifying questions and then we're going to open it up to public comments on the scoping meeting.

So with that, what I'm going to do is I'm going to go ahead and turn it over to Greg. I'll have a couple opening remarks here and I'll be standing here.

If you could go ahead and move the slide up one. Okay.

So we want to cover our roles and responsibilities at the NRC. Greg will do that with one slide. Greg will talk about the environmental review process. Bill will talk about our safety review process for uranium recovery and then public comments on the proposed GEIS. So I'm going to let Greg introduce himself in more detail.

Go ahead, Greg. Thank you.

MR. SUBER: Good evening, everyone. First of all, I'd like to thank you all for coming out to our scoping meeting. We know that it's important, well, we appreciate the fact that you took time out of your schedule to come and to comment on our scoping process. I was talking to a few people, so I know some of you traveled quite a distance to participate in the scoping meeting. And I just want you to know that all your comments mean something to the NRC and we take them sincerely.

My name is Gregory Suber. And as Andy said, I am the Branch Chief for the Environmental Review Section that's responsible for reviewing the uranium recovery licenses.

Right now, I'd like to take a few minutes to just basically outline where I'm going in my presentation. First, I'm going to discuss the environmental regulations that the NRC itself has to follow. Then I'm going to give you details about the environmental review process that we're going to undergo in producing this Generic Environmental Impact Statement. And I'll end with describing ways that all members of the public can participate in our scoping process.

Next slide, please.

The first point I would like to make is the NRC is an independent agency. And what that means is that the NRC reports only to the Congress of the United States. As an independent agency, we do not own or operate any of the utilities that we regulate. We don't own mills. We don't own mines. We don't own nuclear power plants. We regulate people who do. And in that, our priority in fulfilling our regulatory responsibilities is health and safety of human beings and protection of the environment.

And so the key message is that we regulate. We are a regulatory body. Actually, it is the Department of Energy's job to promote the use, the civilian use of nuclear materials. It is the NRC's job to make sure that anyone who uses that material, uses it in a safe manner that protects human health and protects the environment.

Next slide, please.

The National Environmental Policy Act, also known as NEPA, was enacted in 1969. NEPA requires that all federal agencies use a systematic approach to consider the environmental impacts of major federal actions. It is what we call a

disclosure tool. And by that, what we mean is the Agency, the NRC, uses NEPA to communicate to the public what considerations are being evaluated when we analyze a licensing action. What we do is we disclose to the public the exact things that we're looking for and then we invite the public to communicate to us and to comment on our process, to comment on the elements of our analysis that you think are important.

Next slide.

NEPA also established the Council on Environmental Quality within the Executive Office of the President. Now the Council on Environmental Quality, or CEQ, has two major responsibilities. The first is to advise the President on environmental matters. And the second is to coordinate the development of environmental policies and initiates. Now the CEQ regulations allow federal agencies, like the NRC, to do several things and one of those is to combine related actions and to a single course of action and evaluate them in a single EIS. And that is what is known from the NRC's perspective as a Generic Environmental Impact Statement.

Now other federal agencies do something

similar and most of the time it's just nomenclature. They call their reviews a Programmatic EIS. But what a Generic Environmental Impact Statement allows us to do is take related topics, whether they're related geographically or whether they're related by subject matter, and group them so that you can have an analysis that encompasses a majority of the resource areas and the impacts that are going to occur due to those actions. And the NRC has done this several times in the past. One of the most recent examples was the Generic Environmental Impact Statement for license renewals of operating nuclear power plants.

Next slide, please.

I'm going to use the next few slides to explain how the NRC plans to develop and use the GEIS, or Generic Environmental Impact Statement, for uranium recovery licensing. First, I will discuss the purpose of the uranium GEIS, and importantly, discuss how the NRC plans to use it. I'm going to describe the proposed scope of the GEIS. And I'm going to identify what resource areas we're going to look at in our evaluation. And lastly, I'm going to explain to you how you can comment on our process.

The purpose of our uranium recovery GEIS

is to address generically the environmental issues common to in situ leach milling. The GEIS will analyze environmental impacts of in situ leach milling and compare them to other feasible alternatives to that process. We plan to use the GEIS as the basis for site-specific license applications when those applications are submitted to the NRC.

The NRC will adopt the conclusions of the GEIS where they're appropriate and perform additional site-specific analysis in cases where there are unique attributes at the site that cannot be covered generically by the GEIS. In this way, the NRC fulfills its obligation to NEPA in that you have a generic evaluation supplemented by a site-specific evaluation that addresses areas that cannot be covered under the generic EIS.

Next slide, please.

In the environmental scoping process, we tried to identify issues that should be addressed in the GEIS. It's one of the most important parts of our evaluation because first of all, it's at the beginning of evaluation and what it does it sets the bounds for our evaluation. And also, it allows the public to participate in that and what public

participation does is it helps us focus on things that are important. There are a lot of things we're going to evaluate, but what we want to do is we want to find out what you think is important so that we can focus our evaluation on those issues. In that way, we get your buy-in on our process. And the information that you give us will add to the quality of our environmental review because it will make it more relevant.

Next slide, please.

This is a list of some of the resource areas that we look at when we're doing our environmental impact statement. One thing I would like to note is that this is just a general generic list. There may be other things in a site-specific analysis that we need to look at and we don't necessarily look at all of these issues at the same depth. For instance, if noise is not an issue, then we're not going to concentrate on noise. If air quality is not an issue, then we won't concentrate on air quality. What we concentrate on, what we focus on are the things that from a technical standpoint are important and things from a public perspective viewpoint are also important.

So when you look at this list, realize

that it's not all inclusive. That it's just a generic list to try to give you an idea of the areas where we look.

Next slide, please.

This slide gives you the schedule that we have for the completion of the GEIS. As you know, presently the scoping period which started on the 24th, opened on July 24th with the publishing of the Federal Register notice, goes until September 4th. So from now until September 4th, you have an opportunity to communicate with the NRC in a number of ways which I will explain to you on the next slide, to give us your input.

This is not the only opportunity you will have, however. We will also have a draft environmental impact statement meeting with you where we will come to you and we will show you your comments and we will show you our evaluation. You will be able to review what we wrote in our draft EIS and once again comment on our process. So if you think even after the scoping meeting and we have our draft document, if there's an area where you still think we're deficient, you'll have another opportunity to comment on that area. And the final issuance we predict at this time will be

January of 2009.

Next slide.

Okay, there's a number of ways that you can communicate your scoping comments to us. First of all, as Andy said, this meeting is being transcribed. And I would like to emphasize the point that every comment made at this meeting is going on a transcript and will be reviewed for us, by us and incorporated into our review. So something that you say at this meeting tonight carries as much weight as it would as if you wrote us a letter or as if you sent us an email.

Your comments tonight are important to us and they count. But if you don't want to comment tonight, that's not a problem. You can write to us. You can send us your comments in a letter with the address here, and by the way this information is also on a handout paper that's outside on the table. So if you don't have it now when you leave, you can get a contact list. So you can write to us to submit your comments, or you can send your comments by email.

Either way you choose is fine because all your comments will carry the same weight.

Next slide.

The key staff to contact at the NRC if you have questions for the environmental review is Mr. James Park. He actually works for me and he is the project manager for the Generic EIS. And also, Mr. Bill von Till who is here this evening and who will speaker after I do, after I get his name right, is also here and you can contact him by the contact information that you see on the screen.

In conclusion, I'd like to thank you all for coming and I'd like to re-emphasize that scoping comments are important to us and we take our responsibility in protecting human health and protecting the environment very seriously and it's important for you to understand that we are a regulatory body and that our emphasis is protecting you.

Thank you very much.

(Applause.)

MR. CAMPBELL: Thank you. Our next speaker is Bill von Till from the Uranium Recovery Branch.

MR. VON TILL: Again, welcome. I see a lot of familiar faces out there. My name is Bill von Till. I'm the Chief of the Uranium Recovery Licensing Branch. I've been working in this program

for about eight years. I'm familiar with all of the facilities here in Wyoming and New Mexico, Nebraska.

Our branch handles all of the policy and oversight issues with these facilities. We handle the technical and safety reviews for individual applications. As Greg mentioned before, Greg's branch handles the review of the environmental part, the NEPA part of these applications. And our office in Region 4 in Texas handles the inspections of these facilities.

What I want to do is just open it up by going through what exactly is covered here. The NRC regulates these facilities under the Atomic Energy Act and the facilities in question are conventional uranium and thorium mills in situ leach uranium extraction facilities. I want to make a distinction that conventional uranium mines are not regulated under the Atomic Energy Act. They're not regulated by the NRC. They're regulated by the states, Mineral Divisions, Mine, Mineral and Resources. They're regulated by the Mine Safety Health Administration. But they're not regulated by the NRC.

Over the years, the NRC has mainly dealt with conventional uranium mill tailing sites. These

facilities create a large amount of tailings from waste and they also have involved the uranium mines. Nowadays, most of the industry would rather in America go with in situ leach uranium extraction facilities if the site conditions would permit that. And so in the next three years, we're expecting on the order of 14 new applications for brand new facilities in a number of states here in the western United States. Eleven of those facilities are in situ leach facilities. So that's one of the reasons we're concentrating on that particular technology as far as the scoping.

I'm just going to go through what happens when the NRC receives a site-specific application for a mill. The first thing, even before this process begins, as I said, we're anticipating about 14 of these new applications. We've been meeting with companies, some companies we've met with over five or six times, pre-application meetings to make sure that when the applications come into us they're of high quality and they're complete.

So the first thing we do when the applications come in our door is we perform an acceptance review. The purpose of that is to make

sure that these applications are complete and that they are of high quality. Because we've had to try to ramp up with our resources with this new resurgence in the industry, we have a limited number of resources and we're going to be very stringent with our acceptance reviews. If the applications are not of high quality and are not complete, we will send them back to the companies and have them try again. So we've been working with the companies ahead of time to make sure that these applications are complete.

Then what happens is once we deem that the application is acceptable for full technical review, it goes into two separate reviews which are parallel. One is in my branch which is the safety and technical review, the actual license application for these mills. And the other is the environmental review handled by the Environmental Review Branch with Greg Suber.

I wanted to point out that when we deem the license application acceptable, we put a notice of opportunity for hearing on our website. This enables the public, if they choose, to try to petition for a hearing for this particular application.

I also want to point out that we work with stakeholders on a site-specific basis. We always work with the states and in Wyoming, of course, we work with the State of Wyoming DEQ. We're going to work with BLM, US EPA, EPA regional offices. There's some people here tonight from EPA and EPA Region 8; and Indian Tribes.

Once the facilities have been granted a license, we continue our oversight with monitoring reports and licensing reviews and our Arlington, Texas office conducts inspections. These inspections can be yearly or they can be twice a year. They can be every two years, depending on a particular facility. Now I just want to go through and what do these things look like?

I apologize for the lighting. It's kind of hard to see some of these photographs, but this is a typical conventional mill site. It's a pretty large facility. It's a typical industrial-looking facility. What you don't see here is the actual waste products for this operation which is called the tailings. Now one distinction between the conventional sites and the ISL sites is that for conventional mill sites they're going to be handed over to either the state or the Department of Energy

for long-term care in perpetuity. We have to make sure that these tailings piles are safe to the public health and the environment for a thousand years. With the in situ leach operations, they're decommissioned and reclaimed and restored for unrestricted release. So there's a big difference on these two facilities.

Now I'm just going to go over the ISL process. Here's just a schematic of a typical operation with an ISL facility. As you can see here, this is the aquifer that they would actually extract the uranium from. Whoops, let me use another laser pointer.

Most of the aquifers that people are mining or people are extracting uranium from in the United States are low-grade ore bodies that were formed by oxidation reduction and they're these roll front deposits as depicted here. Now you have to have right conditions to conduct ISL extraction. You have to have a situation where there's actually ground water in the aquifer. You have to have the right permeability for these aquifers and you have to have confining layers above and below.

What the companies do is inject some chemicals, small amount of chemicals like oxygen and

bicarbonate or carbon dioxide to loosen up the uranium out of the formation and put it in solution and then pump it up for processing. This goes into header houses which I'll show in a second here and that is pumped into either satellite plants or central processing plants for continued processing.

One thing I wanted to point out too is there's a lot of monitoring involved. With these type of facilities, the main potential environmental impact is groundwater. There's very little surface disruption. And so most of the potential environmental impacts are groundwater. Because of that, the NRC and the states require a lot of monitoring and we require restoration once the companies have finished extracting the uranium.

Here's the monitoring wells, here horizontally. We also require monitoring above and below the confining layers here to make sure that there's not an excursion of the contamination to other aquifers that are used for drinking water or livestock purposes.

This is hard to see, but this is a typical look at one of these facilities. These little things here are the actual well heads and there are actual covers for the well heads. Some of

these facilities have almost 10,000 wells or more. These wells are a number of production wells, injection wells, and monitoring wells. These all are tied into these little houses here which are called header houses. The header houses are then -- the product is then pumped into either a satellite operation or a central processing plant.

What does a central processing plant look like? Here's a typical facility. Just a typical industrial-looking operation. This is a central processing plant that receives the water, production water from the well fields. And it goes on to further processing the end product, this yellowcake which then goes on to other uranium field cycle facilities with conversion, for enrichment, and then fuel fabrication on its way to nuclear power plants for fuel rods.

This slide, I just want to point out a couple of things here. As I mentioned before, there's a lot of monitoring involved with these operations. And this is a typical well field operation here. You have a monitoring well ring that surrounds this extraction operation. These are normally about 400 to 500 feet apart from one another.

And the other thing I want to point out is that before -- the NRC has its own process with licensing these facilities, but the EPA also requires that these aquifers where they're going to extract uranium are exempted under the Safe Drinking Water Act before they can ever come in and extract uranium. These aquifers or portions of these aquifers already have elevated levels of radionuclides, of metals, and so what the EPA does is look at criteria to exempt this aquifer in perpetuity for particular use. In this case here, the aquifer exemption boundary, this is the well field and this is monitoring well ring.

One other thing I wanted to point out is again, after the facility is licensed, the NRC continues its oversight out of our branch for licensing reviews and we inspect the facilities on a yearly or every two years or twice a year we inspect it for safety and health and environment. We also work with in this state, the Wyoming DEQ that also regulates these facilities under the underground injection control program.

That's the end of my slides. So what we're going to do now is turn it over to Andy and turn it to your comments.

MR. CAMPBELL: Can everybody hear okay? My voice booms out, but if you need the mics turned up a little bit, we can turn them up. It's just we were getting some feedback.

What I would like to do now is I have people who filled out the yellow cards. I've kind of sorted through them and more or less spread them out in terms of some of the areas of interest. I will introduce very briefly the person just to let you know who is going to speak next and then I'll just say the next person after that will be so and so, just so you don't get hit cold.

I do ask that you identify yourself at the microphone and your affiliation and I think we have time for certainly five minutes. There will be probably some time at the latter part of the meeting if you had not requested to speak, there may be some time for that, but before we get started on that, what I wanted to ask is if there are any specific questions for either of the speakers that would clarify your understanding of what they've presented?

(No response.)

If not, why don't we go ahead and get started with the public comments. The first speaker

will be Nancy Hunter.

Nancy, please introduce yourself, identify yourself and speak clearly in the mic. And let's hope it's on. Sounds like it.

MS. HUNTER: Good evening. My name is Nancy Hunter and I am with United States Congresswoman Marilyn Musgrave's office of Loveland, Colorado. Congresswoman Musgrave represents the Fourth Congressional District of Colorado. We cover the eastern plains where agriculture indeed is king. And I have a letter here from the Congresswoman that I wanted to read this evening and Mr. Campbell, I'll present you with a copy of that.

MR. CAMPBELL: Thank you.

MS. HUNTER: This is directed to the Chairman, Dr. Dale Klein for the U.S. Nuclear Regulatory Commission.

"Dear Dr. Klein: I write today to express my concerns and strong opposition to any effort to degrade water quality standards by the Nuclear Regulatory Commission as it prepares a Generic Environmental Impact Statement for uranium milling facilities. Many of my constituents have contacted me to express their concerns over proposed in situ uranium mining site in Weld and Laramie

Counties. Chief among their concerns is the potential impact this proposed mining could have on our groundwater resources in northern Colorado. I oppose any effort by the NRC to usurp the authority of state health departments and the Environmental Protection Agency over water quality, and it is my firm conviction that any effort to impose inferior water quality standards by the NRC would undoubtedly impact public health, the environment and local agriculture. Therefore, in situ mining operations must not be allowed under any circumstances to flaunt either state or EPA water quality standards. Colorado and the Rocky Mountain west are blessed with an abundance of natural resources and as stewards of these resources we are required to ensure that resource development is done in a responsible way that ensures the health and safety of the public. On behalf of my constituents and the Colorado Fourth Congressional District I again reiterate my strong opposite to any actions during this GEI process that in any way lowers water quality standards. Sincerely, Marilyn Musgrave, Congresswoman from Colorado's Fourth Congressional District."

MR. CAMPBELL: Thank you, Nancy. I

appreciate that.

MS. HUNTER: Thank you, sir.

MR. CAMPBELL: Next speaker is Rick Chancellor from the State of Wyoming, Department of Environmental Quality.

After Rick, would be Wayne Heili of Ur-Energy, USA, Inc.

MR. CHANCELLOR: Good evening. I'm Rick Chancellor of the Wyoming DEQ. Welcome to Wyoming. I'd like to say that thank you for inviting us here but I can't say that because you didn't contact us in advance and we like to cooperate with the NRC in this process, but so far we need to have a two-way street there. So please contact us when you come to the state. We'd be happy to show you around and work with you.

The Governor's office has asked that we be a cooperating agency in this process. A formal letter was sent from this office to NRC. Wyoming is very interested in this process because of those 14 new facilities you talk about over half, three quarters of those will be in Wyoming. So Wyoming is very, very interested in their process. We want to cooperate in the permitting of these new facilities and want to work with you to that effort.

I'd like you to think about the possibility of opening an office in the west. In the past, there was an office in Denver that we cooperated with very closely in the past and with all these facilities in the west coming up, maybe you should be thinking about that also.

We're very interested in how you view the groundwater cleanup. In the past, NRC was not involved with the groundwater cleanup at in situ sites. That position has now changed and we'd be interested in how you plan to do that in the future. Thank you.

MR. CAMPBELL: Okay. We do apologize to Wyoming. We normally would have done a little bit of a heads up contacting the State of Wyoming prior to the release of the July 24 Federal Register notice. Because of the rush of things, we did not -- that did not happen. We will make use that does not happen in the future with Wyoming or any other states that are involved in this process.

And we did receive the request from the State of Wyoming to be a commenting agency, a cooperating agency, excuse me, on the EIS process and the NRC is considering that. That has to work its way through the NRC system and we'll be talking

to the State of Wyoming about that.

Thank you, Rick.

The next speaker is Wayne Heili. Please identify yourself and your association.

MR. HEILI: On behalf of Ur-Energy USA, I'd like to express my appreciation to the NRC staff for considering the adoption of the Generic Environmental Impact Statement for uranium mining and milling facilities.

My name is William Heili and I am the Vice President of Mining for Ur-Energy. I've been involved in conventional uranium milling and ISR uranium mining for nearly 20 years. Ur-Energy is actively developing license application documents for a new ISR facility in Wyoming with the expectation of submitting that application to the NRC later this year. If market conditions remain favorable, it's likely that Ur-Energy would be submitting additional applications for additional facilities in coming years. With the current activities centered around licensing, Ur-Energy has a full appreciation of the rigorous nature of the regulatory requirements for modern uranium recovery facilities.

Ur-Energy strongly supports this GEIS

initiative. We believe that an industry-wide standard environmental impact statement can be a comprehensive and robust document that fully addresses all of the foreseeable environmental impacts of this growing, yet mature, industry. Ur-Energy is committed to ensuring that the GEIS rigorously addresses the common environmental aspects and impacts from ISR facilities.

While supporting the GEIS effort, we also recognize that each facility will have unique aspects that will require site-specific review. Ur-Energy believes that with a broad-based environmental report in place, the regulatory community and the public will be enabled to better focus on reviewing the critical site-specific aspects of the application.

The end result will be a more efficient and more thorough license application review process with ample opportunity for public involvement. Thank you again for your time and consideration of these comments.

MR. CAMPBELL: Thank you, Wayne. The next two speakers would be Suzanne Lewis of the Biodiversity Conservation Alliance. Suzanne. And after Suzanne would be Donna Wichers of the Energy

Metals Corporation.

MS. LEWIS: Good evening. My name is Suzanne Lewis. I'm with Biodiversity Conservation Alliance, a small nonprofit conservation organization based in Laramie, Wyoming. We are a watchdog group that works hard to protect wildlife and wild places in this great State of Wyoming.

We certainly don't oppose extraction of minerals or any resources in the state. Our goal is to do what we can to make sure that that's done in a responsible manner and that when folks leave the state it's the groundwater, the land, the wildlife and the other resources are about the same as they were when people came. So that's our mission.

We're disappointed that this is a Generic EIS, but we can't change that at this point. So there are a number of requests that we have while you're preparing this Generic EIS. One is that you take the time and I think it's particularly crucial in the scoping process to take the time to get to know the individual sites where these mines are going to be placed. It's not enough to sit in Washington and make regulations and do business.

I encourage you to get out here on the land, meet the people, talk with them. This meeting

tonight and the others that you're holding are a good starting point and I thank you for having the opportunity to be here, but you really need to get out and meet the people in the communities that are going to be impacted by this. And you need to see the area where these mines are going to be. I grew up and lived in the East for many years and lived in Washington, D.C. for a number of years, so I know what it's like there, but the west is completely different. And that's where most of this is going to occur. So I would ask that you extend the scoping period. It's just a little over 30 days and that really isn't adequate time, I don't think, for the public to be able to have input, particularly those citizens in areas that are going to be impacted the hardest. So I would ask that you extend the scoping period.

I would also ask that you get as much input as you can from the people and not just from industry. There are always at least two sides and frequently more than two sides to every issue and so it's important to get a broad-based look at what's going on and what the impacts really will be for those communities involved.

I would ask that you identify the issues

with regard to restoration of sites when the mining is complete and you shouldn't streamline this part of the Generic EIS. That's a very critical part. As I said earlier, we want to be sure that when those folks leave this State that the State is in at least the same position, if not a better position, than when they came here.

It's important to recognize that ISL is not a one size fits all, that there are all definitely mining sites that are not appropriate for that and that you take a very careful and close look at each application and each site. I know that's not necessarily part of the GEIS process, but I encourage you to take the time to make it part of that process.

Again, get out on the ground, look around, see what's happening. See what's there and what we as citizens want to protect in our great State.

Groundwater, unlike in the east, is the bloodline of the west. Water for us is what enables to be here and exist here at all. If it's contaminated, we can't go on. So I think you need to understand that it's a very different situation here in the west, that it's a critical resource that

has to be protected and if it costs a little more to do that, then that's the price that needs to be paid for the right to come in and take the resources.

I encourage you also to acknowledge in your Generic EIS, talk about the history of what has gone on in the past, what the legacy of that has been. Be candid and forthcoming about what wasn't done right the first time around and how we're going to do it better this time around.

I think the NRC needs to make a special effort to be aware of what technology is out there and this will take time and take work. But that's critical because if you don't know what's available, you can't require the best available technology. So I encourage you again to take the time to learn what you need to learn in this process, so that you can do the best job that you can for protecting the other resources out there.

I encourage you also to address what the cumulative impacts will be from any mining site. Among other things, what about depleted uranium, hardened metals, nuclear waste. Take a look at the unique geology of each place, the hydrology, the culture of the place, because the west isn't all the same. Each place is unique.

Look at what the current land uses are for that area. What do the people here value? What do they want to see protected?

And I guess I would close with saying that I think the NRC, it behooves you to have as broad a knowledge as possible going into this permitting process so take the time now to learn what you need to know to do the best job that you can because when we get in the middle of it, it's too late to be learning at that point. It's better to know ahead what you're getting into and plan well and act well.

Thank you again for the opportunity to be here.

MR. CAMPBELL: Thank you. I think Greg can address the question about the time frame for the public comments.

MR. SUBER: Actually, thank you for those comments. There are actually a couple of things that I'd like to address. First of all, this is a scoping meeting and it is the beginning of our process, but one thing we need to realize is that most of the things are still on the table, so we don't have to rigidly go with the present schedule that we have with respect to scoping comments. We

can take that and we can go back and we can look at that and reevaluate whether September 4th is a realistic date for scoping comments.

But I would like to make one clarification. When we were talking about the GEIS review, every site-specific application will receive another environmental review. And if I didn't make that clear in my presentation, I apologize. The GEIS is a bounding review, but when an application comes in, the NRC will perform a site-specific environmental review and a site-specific safety review for that particular location. And during that review, we always have site visits and we always come out to check out the lay of the land and to examine local features and look for things that are particularly unique to that site so that we can include those in the review. And I just wanted to make that point that there are two reviews, the generic review which is a bounding review, but a site-specific review that are going to look at those unique issues that everyone here seems to be interested in.

MR. CAMPBELL: What we're going to do is I see a hand up, but what I'd like to do is go through the people who have submitted cards. There

will be time for questions from the audience at that point. Thank you.

Donna Wichers.

MS. WICHERS: Wichers.

MR. CAMPBELL: Thank you. From Energy Metals Corporation.

MS. WICHERS: My name is Donna Wichers. I am the Senior Vice President of Energy Metals Corporation, a publicly-owned energy company listed on both the New York Stock Exchange and the Toronto Stock Exchange.

Energy Metals' corporate strategy is to become the premiere uranium producer in the United States through the acquisition, development and production of our multi-million pound uranium resources, most of which are amenable to the low-cost environmentally acceptable in situ recovery process.

This would be within the States of Wyoming, Texas, New Mexico, Colorado, and Utah.

We've assembled one of the most experienced operational teams of ISR uranium mining professionals in the U.S. Currently have a full-time staff of more than 60 geologists, engineers, environmental managers, land specialists and

operational personnel. We've reached almost $2 billion in market capitalization and we feel that we're ideally poised to take advantage of the current market demand for uranium.

Our first uranium production center will be in south Texas at the Palangana ISR satellite which will feed our existing Hobson Central Processing Plant also in south Texas. Licensing with the State, the TECQ in Texas is well under way and we expect first production in late 2008.

Our second planned production center is the Moore Ranch ISL property located here in Wyoming in Campbell County. Later this summer, we will be submitting our environmental and technical reports to the NRC in support of a new source material license for uranium production at Moore Ranch.

Energy Metals Corporation is supportive of the NRC's initiative to prepare a Generic Environmental Impact Statement for in situ recovery operations, as we believe that a document such as this would be beneficial for informing the general public of the small impact from ISR mining and also because it could reduce the costs and time involved in assessing the common aspects of these facilities. A document such as this would also be valuable

reference for NRC non-agreement states such as Wyoming, as well as agreement states such as Texas.

However, we do have concerns that the overall NEPA process and preparation of the Generic EIS for both the conventional and ISR facilities could take away valuable staff time from their review of pending and future licensing actions including our Moore Ranch submittal to be turned in this summer. We would therefore ask that NRC use to the extent possible contract sources for the GEIS preparation. I see the center is here so I guess that would be considered contract source. And this would allow current NRC staff to continue their review of pending and future licensing actions.

In all probability, the GEIS for ISR uranium recovery will not be issued in time or be available to us as a resource for the review and approval of Energy Metals' Moore Ranch license application. We therefore strongly encourage NRC to continue its 20-year long practice of licensing new ISR facilities under an environmental assessment or EA which still falls under the NEPA process and public scrutiny.

Energy Metals does not agree with NRC's new policy that equates ISR to milling because

milling is crushing, grinding, and processing rock for its uranium content above ground with the ultimate surface disposal of large volumes of radioactive mill tailings that must be deeded over to the U.S. Government or the state for long-term surveillance, and none of these things occur in the ISR process.

So we can understand why NRC requires the full EIS to issue the milling licenses, but we do not understand the need for an EIS for individual ISR facilities when clearly the potential environmental impacts are much smaller and more manageable than for a true milling operation.

So we are hopeful that the Generic EIS for ISR facilities will conclude that an EA is sufficient for the continued licensing of ISR projects. So thank you again for the opportunity to present our comments.

MR. CAMPBELL: And did you want to go ahead and submit that to the NRC?

MS. WICHER: Yes.

MR. CAMPBELL: Thank you very much. Our next speaker will be Mike O'Brien, Cook County Land Use Planning and Zoning Commission.

Mike. And then after Mike will be Glenn

Catchpole.

MR. O'BRIEN: Hi, I'm Mike O'Brien. I'm representing the Crook County, Wyoming Land Use Planning and Zoning Commission. I'm the Vice Chairman.

We currently have some exploratory drilling going on in Crook County for in situ mining and our main concern is the possibility of water, groundwater contamination. I'm not a geologist or a hydrologist so I don't fully understand all of the potential ramifications, but just looking at your slides up there I can see potential for groundwater contamination.

We, as a county, we have no mechanism to protect the groundwater per se, and so we were very glad to get this announcement and see that you guys were going to produce a Generic Environmental Impact Statement. We plan on commenting on the process throughout it and want to be as involved as practicable.

Our main concern again is groundwater and we hope that in the monitoring of the ISL process that it's not just the mining company that's doing the monitoring. That is kind of like the fox guarding the henhouse. So we hope that in your

process you detail some third party monitoring or oversight of the monitoring and also there be sufficient bonding required of the mining company so that if there is contamination that the land owners and other water users of that area are compensated sufficiently. And I don't know how you do that. If the water is contaminated, I would think that they would end up having to supply groundwater for quite some period of time or providing drinking and stock water.

But our concern is making sure that our groundwater is protected. We want to see the mining. We want to see the development. We just want to make sure it's done in a very responsible manner and that there are avenues for compensation if the unfortunate happens and there's contamination.

MR. CAMPBELL: Thank you, Mike.

MR. VON TILL: Thank you for comments. I just want to make one clarification that I didn't include in my slides, but for an NRC licensed uranium milling facility, we do require financial assurance. We require enough financial assurance so that we can come in and have a third party do all the work that the actual licensee would do which

would be the decommissioning and reclamation of the site and also groundwater restoration. So I just wanted to make that distinction. And we do agree that groundwater, the groundwater monitoring and restoration part is very important. And that's why I was pointing out on the slides that we have quite a lot of monitoring wells for these facilities. Thank you.

MR. CAMPBELL: Thank you, Bill. I was just checking with the court reporter, again, reminding people to please speak clearly in the mic. The mic is adjustable a little bit, if it's too low or too tall, and we're going to put up on the screen also the information for contacting us. I think I can do that, just by hitting a button. Let me see. Yes. Okay.

And so I'm going to leave that up there. Again, if you don't get a chance tonight or you don't want to tonight, make a comment, you can certainly submit comments to us.

Glenn Catchpole. And after Glenn will be Jill Morrison.

MR. CATCHPOLE: This is the first time I've ever had to raise a mic, so I feel pretty good.

(Laughter.)

Good evening. My name is Glenn Catchpole and I'm the President and CEO of Uranerz Energy Corporation. Uranerz is a U.S. public corporation, traded on the American Stock Exchange and our offices are here in Casper, Wyoming. Our company has uranium properties in Wyoming that we plan to bring into production using the in situ recovery method of extraction. And we have informed the U.S. Nuclear Regulatory Commission of our plans to submit a source material license application to them by the end of this year.

To begin with, I want to thank the NRC and their staff that is here today for allowing our company to make a few brief comments on the initiative by the NRC to prepare a Generic Environmental Impact Statement for in situ recovery and conventional milling facilities. Before going further, I want to state that my remarks pertain to just in situ recovery method of mining and not conventional milling and my comments are as follows.

First, our company is concerned with the statement in the NRC news release that this GEIS is intended to address the common issues associated with environmental reviews of ISL and conventional facilities located in the western United States.

It's our opinion and contention that there are only a limited number of common issues related to the aforementioned methods of uranium extraction and processing and that industry and the public would be better served if the NRC prepared separate GEISs for each. The operational and environmental issues associated with these two types of production facilities are substantially different and therefore it is our recommendation that the GEIS process should not lump conventional milling facilities and in situ recovery facilities into the same document.

Second, we question why the NRC has decided that planned, new in situ recovery facilities in Wyoming must go through the full environmental impact statement process in order to receive a source material license.

Wyoming has had continuous uranium in situ recovery operations for about 30 years. And while the first operations were required to go through the full EIS process for licensing, the NRC must have determined that based on the demonstrated compliance of these early operations, including groundwater restoration, it was not necessary for the later projects to go through the full EIS process.

It's our understanding that a recent change in federal regulations on 11(e)(2) material may have prompted the NRC to require a full EIS on new in situ recovery projects. If this is the case, then we would like to suggest that any GEIS on in situ recovery facilities focus just on the 11(e)(2) issue which should significantly shorten the process.

Third, this comment does not relate directly to the purpose of the meeting, but Uranerz, and most likely other companies are concerned whether the NRC will have a large enough professional staff to timely review the source material license applications for in situ recovery facilities that are expected to be submitted over the next couple of years and on into the future.

We recognize that the NRC is a large, regulatory body that has grown up around the nuclear power plant industry. And there is a concern that the growing human resources' needs on the reactor side of the Agency may leave the uranium recovery sector of this Agency understaffed. It is requested that the Commission be informed of our concerns on this issue. Nuclear reactors are not of much value if they cannot get the uranium they need for fuel.

I have a couple of additional comments I would make that are not written, but I would encourage the NRC and the DEQ to resume their discussions on a possible Memorandum of Understanding regarding the regulation of in situ recovery mines. As it exists today, there's duplicity between these agencies, occasionally conflicting, that the Applicant has to sort out and deal with, and we think it would be a much more efficient process if somehow those two agencies could get together and decide and to eliminate the duplicity that we have right now.

I want to thank you very much for organizing and conducting this meeting and especially for holding the meeting in a city that once was the uranium capital of the world and in the state that has the largest uranium resource. Thank you.

MR. CAMPBELL: Thank you very much.

Greg, did you want to say anything? Okay, we'll take these as comments.

Jill Morrison of the Powder River Basin Resource Council.

After Jill, Marion Loomis, of the Wyoming Mining Association.

MS. MORRISON: Thank you very much. My name is Jill Morrison. I work with the Powder River Basin Resource Council. It's been around since 1973. It's an organization of citizens and ranchers, land owners concerned about resource development in Wyoming and ensuring that that development is done in a responsible manner, protects health and safety of the public, involves the public in our democratic process to the fullest extent and arrives at good stewardship of our beautiful state and important resources.

And I thank you very much for your time and for the effort you made to come here and involve the public.

I would like to ask first off that you do extend the scoping comment period. I do know that we just found about this very recently and we try to watch for these things, to act as a sort of clearinghouse or outreach to the general citizen, landowner, public in Wyoming that might not know. We have recently been contacted by a lot more landowners who are very concerned about uranium mining in their backyard, on their land, around their communities, and those impacts. And I think the word needs to go out in a much greater public

outreach effort. I do appreciate the notice that I saw in the paper, but I think we need to get a few more of those out in the smaller newspapers in the state and just try to involve the general public as much as possible, particularly those people that are going to be directly affected.

I would also like to address -- I'm a little confused about a Generic Environmental Impact Statement. Although I think when you compare it to a programmatic statement I do have a little better understanding, although I don't think I've ever seen a programmatic EIS cover the entire western U.S.

I'm not sure if you're biting off more than you can chew. Maybe it's important to do this great big one for some particular reason, which I haven't had enough time to think about and explore, but I'd like you to possibly delineate those in this document in some way why we're looking at a huge document covering the entire western U.S.

I do think it's very important to have an environmental impact statement that covers the cumulative impacts of many of these projects. I want -- ask that you disclose the numbers of projects that are being proposed that you are aware of, their exact locations, and as much as you know

about those facilities at this time in this document.

I also ask that you disclose how these properties are leased, how the split estate or surface landowner can have a say at what points because I think there's a lot of confusion among the landowning public what their rights are as surface land owners in the uranium mining staking or leasing or however that whole process works.

I also ask that you very clearly disclose and describe the history of uranium mining and disclosure of the environmental impacts to extreme and particular interests is groundwater and surface water; people's water resources that have been impacted and how and potentially will be impacted and how.

I think there's a lot of documentation studies. I ask that you cite in document studies that show the extent of groundwater contamination, the extent of that existing contamination to aquifers that are or were used in the past for livestock and domestic use.

One of the things that we have here in Wyoming are overlapping impacts of other resource development and something that a couple of

geologists have mentioned, one being the late and very famous Dr. David Love is the impact of uranium in situ mining and cold bed methane dewatering operations. And I'd like to see some analysis and disclosure of potential impacts between those two types of resource mining industries and any others that we might not currently be aware of that you may or others may. I think you have a big job ahead of you in terms of volume of information that exists and the need to pull that together in this document so that we can fully understand the implications of the potential development.

I would like to make sure -- I didn't see it on your incomplete list. I want to make sure, because it's a very important resource in Wyoming is our wildlife. Impacts to wildlife, impacts to habitat fragmentation, impacts in relation to the mobilization of other contaminants that can affect wildlife like selenium or that can affect livestock. I know there have been some problems in the past and I'd like to see those disclosed and discussed in the document.

I think the cleanup and restoration is an area of much confusion to the public. We hear that yes, contamination occurs with the in situ

uranium mining, but we are able to go in and clean this up. Could you please describe how that's conducted, how that's done, how it's worked in the past, if it's been successful or not, what the differences are within the state regulatory bodies in terms of how much cleanup has to take place or at what level do we have to come back to because I know here in Wyoming we've relaxed some of those regulations for restoration groundwater and I think that needs to be fleshed out.

Please clarify bonding and bonding requirements in the document and disclosure of those. I think those are the basic concerns and issues we hope to see addressed.

One of the things I don't understand and I haven't seen and maybe you want to discuss a little bit, there's a lot of interest by foreign corporations primarily in many foreign corporations in mining uranium in the United States and in Wyoming. I'd like to know what regulations govern foreign corporations when they come to mine in our country. Do we prohibit certain companies and allow others? Can we have China mining uranium? Is it just Canadian companies? Is it Russian companies? How do we -- how is that determined and decided?

I'd also like to know more about how -- what's the completeness criteria for applications that are submitted, so those are some of the other questions that came up.

There were a lot of citizens that wanted to be here tonight that are actually in Crook County at a Commissioner meeting about some proposed development in that area, so I do again want to emphasize the need to extend the comment period so that we can get the word out to more folks who are going to dealing with this directly. Thank you very much.

MR. CAMPBELL: Okay, thank you, Jill. Greg? I think Greg wants to make some clarifying comments.

MR. SUBER: Thanks a lot for those comments. There are two issues that I wanted to address just quickly because they've come up a couple of times. This concept of cumulative impacts, I just wanted to reiterate or maybe state for the first time that cumulative impacts are evaluated in our environmental reports. We're going to do it at the initial stage for the GEIS and of course we're going to do it on a site-specific basis because that's one of the analyses where the

cumulative impacts are going to change from location to location so I just wanted to make that clarification, that cumulative impacts are going to be evaluated in a GEIS.

I also wanted to make a statement about decommissioning because when a licensee wants to get rid of his license, they have to come to have that license amended. And when they try to amend that license they have to apply again to the NRC to have decommissioning -- they have to have a decommissioning plan. They have to have that decommissioning plan approved. And the NRC is active in ensuring that they meet our decommissioning criteria. So I just wanted to make those two clarifications that cumulative impacts are going to be evaluated and it is the licensee's responsibility to meet NRC's regulations for decommissioning.

MR. CAMPBELL: Joan, did you want to address the applicability of our regulations to companies, whatever country they come from?

Joan is from our Office of General Counsel.

MS. OLMSTEAD: Yes, I'll have to get back to you on that because that's not an area I've

dealt with right now, but I'm sure I can find somebody in the office that has.

MR. VON TILL: One thing I wanted to point out, most of these companies are United States companies. They may have parent companies that are French or Canadian, but again, Joan can get back on the details of our exact review from a foreign corporation standpoint, but most of these companies are American companies here in Casper, Wyoming and Denver, Colorado and throughout the United States they may have parent companies, like Chemeco or Kojima, French, Canadian-type companies, Australian companies, but we do look at that. Thank you.

MR. CAMPBELL: And I will say that our regulatory framework, I don't believe distinguishes between foreign ownership or U.S. ownership in terms of what regulations apply. Our regulations apply to a particular process, apply to a nuclear power plant, applies to materials facility, fuel cycle facility, a number of other operations that we regulate or the states regulate through the agreement state programs. Those regulations apply across the board regardless of where that company is located, if that was the issue. The details of how we would address a foreign company, I think Joan can

probably provide some more information, but let me make clear. Our regulatory framework applies to actions occurring within the United States.

MS. OLMSTEAD: I just want to clarify. I think your question was how a foreign company takes over another company or gets permission to come in?

MR. CAMPBELL: Why don't we take this up afterwards, separately, so that we don't interrupt the other people who wanted to provide comments at this point in time.

Marion Loomis from the Wyoming Mining Association.

MR. LOOMIS: Thank you. It's a pleasure to be here and I appreciate your coming to Wyoming. I am Marion Loomis, the Executive Director of the Wyoming Mining Association. We represent the bentonite, coal, trona and uranium companies in Wyoming. As you probably know, Wyoming leads the nation in the production of uranium with about two million pounds of production. Since the increase in the price of uranium the last two years, we've seen a tremendous increase in activity in uranium exploration in Wyoming and we feel it's very important that the United States use more uranium

produced from secure sources here in the United States, rather than from foreign countries.

And it's already been mentioned, but Wyoming has the largest reserves of uranium in the United States and we feel that that resource needs to be developed. If we're ever going to reduce our reliance on foreign sources of energy, it's going to be imperative that we produce significant portion of the 50 million pounds of uranium used in U.S. nuclear power plants from domestic sources. In order to do that, it is critical and the permitting of new facilities proceed in a logical and timely manner.

Many of the comments I have here have already been stated, so I'll be brief on them, but we support the NRC's initiative to prepare a Generic Environmental Impact Statement for ISR uranium mining. There are a number of pending projects in Wyoming and other states that will benefit from these efforts to assess a common environment aspect and impacts of these low-impact facilities on a generic basis. We feel that could reduce the cost and time involved in licensing of the projects and will allow the staff to concentrate on the site-specific aspects of each project.

We also support updating the 1980 Generic EIS for conventional uranium milling. There are several existing facilities that have announced plans to resume production at a future date and at least one new milling facility has been announced. The 1980 GEIS is out of date, but could be updated to assess new milling techniques and technologies and their environmental impacts.

We believe that an update to the conventional uranium milling GEIS should be performed independent of the preparation of the Generic EIS and that comment has been made before and we certainly support those companies that have stated that.

We're concerned that an effort to prepare a Generic EIS for conventional milling and ISR mining may adversely affect the progress by the staff on pending and future license applications, therefore we would encourage the NRC, as much as you can, to use outside sources to supplement the NRC staff in preparing the draft documents to avoid the adverse impacts to NRC review of pending license applications.

We believe that a Generic EIS for in situ recovery and updated GEIS for conventional

uranium milling will provide potential licensees with up-to-date guidance and information on environmental impacts of ISR and uranium milling that will further improve future baseline environmental evaluations and license applications.

I thank you for the opportunity to comment and look forward to working with you in the future.

MR. CAMPBELL: Thank you very much.

At this point I have three cards from people who weren't quite sure if they wanted to say anything. If you don't mind I'll call out your name. If you don't want to say anything just say no.

Mark Hollingbach?

MR. HOLLINGBACH: It's been said.

MR. CAMPBELL: Okay. Linda Layman.

MS. LAYMAN: Kind of bear with me, I kind of knew about being around people. My name is Linda Layman and my husband worked in Lucky MC Mine in 1976 and in May 27th of 2002 he passed away from uranium poisoning in his right lung. I'm here to try to help a lot of these people have come up dying or being sick. I got letters from people around Wyoming. I want to read you one of them.

"Dear Mrs. Layman, I was told about you and your wanting to change the laws on the time dates that are involved in getting the money on this uranium issue. I am all for you and also willing to help change these rules. I also have cancer, T-cell lymphoma. I worked in the uranium mine in mill for Union Carbide in the gas hills for a long time. This has caused me a lot of money, hardship, and much pain as I will have the rest of my life take very expensive treatments for the rest of my life. However, lung, that is my main cancer, doctor is in Houston, Texas at a cancer center in the hospital which the cost is astronomical. I also would like to get involved in helping change the rules as my dates also fall just short of receiving any money from the fund, even though I worked in very dangerous and dirty and hot uranium active places. I will need to get the government to work with us as well as increasing amount of the paycheck money we should have already gotten which would not be much now. I have already spent a lot of more money than they are talking about as well as many hardships to do so. I am willing to go to Cheyenne or Washington, D.C. to help change these rules. Thank you. Larry Schroeder from Riverton, Wyoming."

I've checked into a lot of people that have passed away in Wyoming from working in the mill. That's what my husband was working. I'm here to hopefully help all these people to make sure that they won't come up sick. And this is why I'm here.

I'm not post-testing anything, but there's a lot of people that are coming up dying and being sick. And I'm wondering about their safety in the mill when you start over again in starting the mines. Can you give me an answer on that?

MR. CAMPBELL: I think that what we can do is if you would like you can submit the letters or we'll be happy to take copies of the letters, if you'd like. There is an extensive safety review that goes on during the licensing process. We do that through the environmental -- not the Environmental Review Branch, the Uranium Recovery Branch and I think we can take those as comments. I'm not sure what the specific question is.

MS. LAYMAN: What I'm worried about is the people that are working in the mill today. Are they going to come up sick from working in the mill around the yellowcake?

MR. VON TILL: Let me address one thing. We are aware that in the past there was a lot of

exposure from people working in the uranium mines, the conventional uranium mines. Today, we have stringent regulations with these facilities, these uranium mill facilities. We just toured one of the facilities today. They have a lot of environmental monitoring, radiological monitoring and the NRC performs inspections and licensing reviews to make sure that these workers are safe from these operations.

These facilities, anything that's regulated by the NRC is particularly -- has a lot of oversight relative to other facilities like chemical facilities because it includes radiation exposure. So I just want to assure you that today in modern times, the NRC does look out for the workers at these plants. They look out for the people that surround these plants and we feel that the operators in the industry right now are doing a good job of trying to protect the workers of these plants. Thank you for your comments.

MS. LAYMAN: You're welcome.

MR. CAMPBELL: Thank you very much. We had one more person, Echo, did you want to comment? I can't pronounce your last name, if you could pronounce it for me that would be great.

MR. MOORE: Good evening. My name is Echo Moore-Klaproth and I think you heard the Moore Ranch over here. Our ranch is a little south of the particular area that's being explored now and as a landowner our questions are very similar to all of the ones that have already been mentioned this evening, so I don't intend to reinvent the wheel here. However, I do want to stress the significance of our concern for water.

As a rancher, my dad always said to us, you are not in the livestock business. You're in the grass and water business because without them you are not in the livestock business. And on our particular small place it's in southern Campbell County, northern Converse County. We straddle the border. And in our particular situation, as a child we had several, like eight or nine natural springs on our land, just on our place alone. Those are now all dried up. And it's due, in part, to all the beautiful resources that are underneath that soil that has raised our livestock. First, it was the oil. And now it's methane. And they are now in the upper nine mile.

Our place is called Nine Mile, on upper Nine Mile, on a cousin's ranch and here we go again,

taking more water out of the precious aquifer in the Powder River Basin.

So please be very, very aware of our concerns about water. Not only the aquifers, but of course, the contamination part of it and I just wanted to reiterate that.

We're such a small voice, we ranchers here in the west. We're just totally outnumbered, but we do appreciate the opportunity to have our voices heard at meetings like this.

I also have a question. Can land owners stop licensing? And I think I know the answer to that because we've been watchdogs for a number of years with the other companies that have come in and while it has taken a younger brother of mine who is out there and he does it full-time now, he monitors all the activity that is on our place because the damage to our surface, to our grass, to our livelihood is extensive. And even though you say that these little pods are a few hundred feet apart, it just involves roads and more acreage and more grass eaten up and I want to be sure that you examine and be sure that these people who are asking for licenses understand that they're involving another lifestyle and another person's business and

that there needs to be compensation. It never does compensate totally because our grass so low, such a short powered stuff and the soil is so hard it doesn't recover, not quickly and not easily. And particularly in these days we're suffering a terrible drought here. And it could be 50 to 75 years. I'm serious about this, before our soil and our land ever recovers.

So on top of that, we're going to add one more impact so please be very aware of the licensees need to be aware that we've had imminent domain threatened, condemnation threatened for the other minerals that are underneath our land. I hope we don't have to keep hiring attorneys just to protect. We're four generations on this grass and we will keep hiring as long as we're financially able to, but hopefully an Agency like you can help protect us by trying to assure the licensee people that compensation does need to be made to people.

And I also wanted to thank Jill Morrison from the Powder River Resource. I applaud you, ma'am, for all of your questions and comments. You're right on as is the lady from the Biodiversity Conservation Group. Thank you both very much for all that you do to protect this previous state that

we call Wyoming and my home.

I thank you very much for letting me speak.

MR. CAMPBELL: Thank you very much, Echo. I think there was at least one person who wanted to speak.

Could you come to the mic and identify yourself and your affiliation?

MR. BLEIZEFFER: Dustin Bleizeffer, the Casper Star Tribune.

MR. CAMPBELL: Can you get a little closer to the mic?

MR. BLEIZEFFER: Dustin Bleizeffer, the Casper Star Tribune. I was just curious if after you complete the Generic EIS and you do the individual reviews, is there a chance for public comment in those individual reviews?

MR. CAMPBELL: Okay, I think Greg can address that.

MR. SUBER: Presently, we are looking at our process and we are, like I said, we're at the first stages of the -- we're at the first stages of the review and we're trying to design our process to maximize public interaction. So what we're doing is we're taking your comments here and we're seeing to

what extent we're going to have public involvement during the other phases of the review. But I'd like to reiterate that not only at this meeting, but at the draft stage for the GEIS, we'll come back and have another public meeting so the public has several opportunities to input into the decisions that are being made.

MR. CAMPBELL: Greg, I think that also if an environmental assessment is developed, that is derived from a GEIS. There is also public comment period and maybe you can address that as well.

MR. SUBER: That is correct. Presently, the way -- like I said, there are going to be two reviews done. The first, of course, is the GEIS. And the second is a site-specific environmental review. Now that site-specific environmental review will start off as what we call an environmental assessment. And in an environmental assessment we look at -- we look at the effects of all the attributes that are under evaluation and we come out with one or two things. We either come up with a finding of no significant impact or we come out with a finding that we need to do a full-blown EIS. And if we decide that we need to do an full-blown EIS, then we'll have another scoping meeting and we'll

have another draft environmental impact statement meeting.

So there's the potential that at the stage of the site-specific reviews we will have one or more additional public meetings. Does that answer your question?

MR. CAMPBELL: And I believe that a finding of no significant impact is also subject to public comment.

MR. SUBER: It is subject to public comment, yes.

MR. CAMPBELL: Do we have other questions? Please step to the mic and identify yourself.

MS. ELDER: Hi, I'm Deirdre Elder. I'm a graduate student at Colorado State University and I have a question for Bill. You had a slide and you talked about an aquifer exemption for perpetuity and I want to know more about how that works because does that assume that there's no movement within the aquifer, if there's any contamination within that exemption that it's not going to move or how does that work so that the groundwater for people who are outside of that will be protected?

MR. VON TILL: Sure. Thank you for your

comment. Let me first state that the aquifer exemption process is not done by the NRC. But it's done by the Environmental Protection Agency or the state that handles that for them. The State of Wyoming, well, the EPA does the aquifer exemption. The state also does an underground injection control permit.

Now the EPA, when they exempt that portion of the aquifer and it's only a portion of the aquifer where you're going to have mining. They have to satisfy particular criteria. One of the criteria is that that aquifer, that portion of the aquifer is not being used presently for drinking water purposes.

The goal is to make sure that the operation does not exceed EPA Safe Drinking Water Act maximum concentration limits outside that aquifer exemption boundary. So the goal is to protect the US DWA or the U.S. drinking water which is outside the aquifer-exempted area. There are some EPA folks in the room tonight. What I would say is maybe after the meeting ends, you might want to approach one of them and get more information on that.

Thank you.

MR. CAMPBELL: Not to put anyone on the spot, but did the EPA, did anybody from the EPA want to make a comment?

MR. SETLOW: I'm Loren Setlow. I'm with the U.S. EPA Office of Radiation and Indoor Air in Washington, D.C.

I will probably make a more formal statement at the Albuquerque meeting, but we certainly would be available to discuss with anybody who has questions after this session is completed regarding groundwater protection issues under the Safe Drinking Water Act as well as the Uranium Mill Tailings Radiation Control Act which has not really been discussed at any length here today.

MR. CAMPBELL: Thank you. Are there any other questions at this point? Anybody else wishing to make comments, statements, provide us with further input?

Yes, sir. Please identify yourself and your affiliation.

MR. KUNERTH: I'm Bill Kunerth from Crook County, Wyoming and there is some exploration going on in that area. And I would like -- a couple of persons who commented or your experts to comment on a couple of things.

One statement that there are certain sites that are not appropriate for ISL and I wondered if there's any general or specific explanation of that. And the second did refer to contamination of a couple of aquifers and I just would like some more specific information about that.

MR. VON TILL: Thank you very much. Your first question, when I did my presentation, I pointed out that some formations are not amenable to in situ leach recovery operations. For example, if you don't have water in a particular unit, they won't be able to do in situ leach operations. They'll have to use conventional mining and milling. If the permeability of the sand units where the low front deposits are located are not adequate for pumping out the formations, they won't be able to do that. If they don't have the right confining units above or below, let's say you have a situation where you have an aquifer unit that has the uranium deposit and right above it is a drinking water aquifer with a confined layer, that would not be a good situation for in situ leach recovery.

So as we move forward with this resurgence, you're always going to have some

facilities and some ore bodies that it will have to be -- will have to use, utilize conventional mining and milling. That's why out of the 14 applications that we're expecting to receive in non-agreement states, this doesn't include Texas, Utah, and Colorado, most of them are in in situ leach operations because the companies feel that's a cheaper way to go and also more environmentally friendly way to go, but as I said before, some of the formations are not amenable to that kind of technology.

MR. KUNERTH: Can these issues be explored by exploration?

MR. VON TILL: Absolutely, yes. Right now as we speak some of the companies in some of these states are doing exploration drilling to look into that very issue. Is this an appropriate aquifer for in situ leach recovery, or is it more appropriate for conventional mining and milling?

Your other question referred to groundwater contamination and that is one of our -- a lot of people voiced that concern. We're very aware in the western United States that groundwater is gold out here and that's why I've got four hydro-geologists on my staff that do nothing but look at

groundwater monitoring and restoration reports to make sure these operations are conducted in a manner that cleans up the aquifers after they've finished their exploration and extraction and also that the aquifers surrounding the extraction are protected, a lot of monitoring wells in these operations. So I hope I answered your questions.

MR. CAMPBELL: Any other questions that anybody else in the audience would like to raise tonight? Okay, if not, if you feel that after this evening's meeting you would like to provide comments, you can send your comments to us by email. You can send a letter or even a report to us at that address. We at this point in time are asking that you postmark by September 4. We certainly will take into consideration a possible extension of the comment period. We've done that in many other cases. I hope we've answered questions that were directed straight to us and I certainly hope that those that may have hesitated to provide comments will do so.

I see one hand up here. Did you want to say something, sir? Yes, please come to the mic.

MR. BAUMGARDNER: Yes, my name is Enoch Baumgardner, I'm a land owner here in Wyoming.

MR. CAMPBELL: Could you speak into the mic, please?

MR. BAUMGARDNER: I have a three-part question or two parts. What's the -- you mentioned that there would be 14 different companies applying for a license. What's the standard period of time to issue those licenses? How long a process? That's the first part of the question.

The second, these companies that do the ISL mining, once the ore is extracted and it has to be turned into the yellowcake form, the plants that do that, is that ore transported to those plants or are those plants typically built near the mining site or the extraction site itself?

MR. VON TILL: Thank you for your questions. Yes, I mentioned earlier that we're anticipating based on conversations with the companies in the industry 14 new applications in non-agreement states and that's not 14 companies, but that's actually 14 new applications.

The number of companies is less than that. Some companies have multiple sites that they're interested in.

How long does the review process take? We anticipate that once we begin the review process

with one of these applications that it would take approximately two years. Now with this GEIS effort, we're hoping to gain efficiencies with our review process and have that shortened process to maybe a year and a half or so. It depends on the site-specific application and what's necessary as far as what stakeholders need to deal with, but approximately two years.

Let me see, the second question was --

MR. BAUMGARDNER: Once the ore is extracted --

MR. VON TILL: Right. And you're talking about in situ leach operations?

MR. BAUMGARDNER: Yes.

MR. VON TILL: The paradigm with how these companies operate is changing somewhat, but basically the facilities that we're regulating right now that are operating right now have a situating where central processing plant is near the actual ore bodies. Now they also have a situation where they may have ore bodies that are some distance away from the central processing plants and those are called satellite operations where they have the well fields that go into the groundwater, extract the uranium and then feed it to satellite operations

where they run it through the ionic exchange resins and then the resins are trucked from those satellite facilities to the central processing plant.

So under the new paradigm shift, you might have companies that only extract the uranium to the resin point in time and then they take it to an actual mill that then takes the resin and processes it to yellowcake. You may have situations where people only have a central processing plant and they take resins from other companies.

So the paradigm with how these operations, the business plans is changing, but to answer your questions, normally the central processing plant is nearest to the biggest ore body, but they do have satellite operations that can be even 110 miles away from that particular plant. It's truck. The resins are then trucked to the central processing plant.

MR. BAUMGARDNER: Well, then the third part of that question would be if you have 14 different new applications in this Rocky Mountain region, it would be safe to assume then that probably the companies will be building these processing plants in addition to the extraction itself? Is that correct?

MR. VON TILL: Some of the applications would have central processing plants and some of the applications would have only the well fields and the satellite part of the operation, so it varies.

MR. BAUMGARDNER: Thank you.

MR. VON TILL: Thank you.

MR. CAMPBELL: I think at that unless there are any other questions, I want to thank everybody here for coming out. For those that made comments I want to thank you for making comments. I do want to thank Greg Suber, Bill von Till, Jill Olmstead and you haven't seen Carol Walls, Carol did a lot of the work to set this meeting up. She's our licensing assistant. She's been very helpful. I want to thank the Center Staff for coming out here and so again, thank you all for coming. We appreciate your comments and again, if you want to provide further comments, we would be happy to receive those.

So thank you and have a very good evening. Good night.

(Whereupon, at 8:48 p.m., the public scoping GEIS meeting was concluded.)

Transcript and slides for the August 7, 2007 Scoping Meeting in Casper, Wyoming will be available on the U. S. Nuclear Regulatory Commission's website under Accession Number ML072670246

http://www.nrc.gov/materials/fuel-cycle-fac/licensing/eis.html#scoping-comments

Appendix A-2

Transcript of August 9, 2007 Scoping Meeting in Albuquerque, New Mexico

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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PUBLIC SCOPING MEETING

ON THE

URANIUM RECOVERY

GENERIC ENVIRONMENTAL IMPACT STATEMENT (GEIS)

ALBUQUERQUE, NEW MEXICO

Thursday, August 9, 2007

Colorado Room

Hilton Albuquerque

1901 University Boulevard, Northeast

Albuquerque, New Mexico

The above-entitled meeting was conducted at 7:00 p.m.

BEFORE:

LANCE RAKOVAN, Facilitator

ALSO PRESENT:

On behalf of the NRC:

JEANETTE ARCE, Nuclear Safety Professional Development

ANDY CAMPBELL, Acting Deputy Director, Environmental Protection and Performance Assessment

JOAN OLMSTEAD, Office of General Counsel

GREG SUBER, Branch Chief, Environmental Review

BILL VON TILL, Branch Chief, Uranium Recovery

CAROL WALLS, Licensing Assistant

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P R O C E E D I N G S

MR. RAKOVAN: Good evening. If everyone could, please find your seats. We're going to get started now.

(Pause.)

MR. RAKOVAN: Okay. Good evening. I'd like to welcome you all to NRC's public meeting to obtain comments on the scope of the Uranium Recovery Generic Environmental Impact Statement, or GEIS. Chances are you're going to hear that used a lot tonight. So if especially these guys sitting over here start saying, "GEIS," a lot, that's what it stands for: Generic Environmental Impact Statement.

My name is Lance Rakovan; I'm going to be facilitating tonight's meeting. By that, I mean I'm going to try to make sure that the meeting runs smoothly for everyone involved. It's a pleasure to be here tonight in New Mexico. The purpose of tonight's meeting is to provide you an opportunity to ask questions and provide comments on the scope of the Generic Environmental Impact Statements for uranium recovery licensing.

We are transcribing the meeting. We have our transcriptionist right here. I'm going to try to speak and I'm going to ask everyone else to when you speak use a microphone if you will, identify yourself and any group that you're with if it's the first time that you're speaking. We've got a couple mics in the aisles here that

we'll be using once we go to the comment portion, but please try to keep one person speaking at a time. And that way we can get a clear transcription of the meeting.

Right now, I'd like to go over the agenda. Hopefully, you picked up a copy of that in back. Basically, we're going to start out with a few quick presentations by NRC just to kind of orient you and give you some information on what the GEIS is. From there, we'll go to a comment and question and answer session.

I have a huge stack of people who have signed up to speak. I'm going to do my best to give everybody a chance, but, given the fact that I have over 30 people signed up, I'm going to ask that when I call you up here, if you could, try to keep your comments down to a few minutes. That will give everyone a chance to speak or at least get us as close as we can to that. But I can't guarantee that you're going to have a chance to speak.

Given the fact that we are here to receive your comments and we are here basically to listen, I'm going to try to move through things as quickly as possible, but we'll be going through the other ways that you can get in contact with us and that you can make comments if you don't have a chance to do so at the meeting.

If you picked up a public meeting feedback form in the back of the room, if you could, fill that out and

give us some suggestions on how we could improve things. Or if things went fine, we'd appreciate that. If you could, silence your cell phones or put them on vibrate at this point. That, hopefully, will take away any disruption that that could cause if they go off during the meeting.

Having said that, I'm going to turn things over to Andy Campbell, who is, hopefully, going to go very briefly through NRC's roles and responsibilities.

MR. CAMPBELL: Thank you, Lance.

I'm Andy Campbell. I'm Acting Deputy Director of Environmental Protection and Performance Assessment at the Nuclear Regulatory Commission. I'm here tonight to introduce Gregory Suber, who's Environmental Review Branch Chief in my directorate. Greg is in charge of developing the Generic Environmental Impact Statement. And also, I want to introduce Bill Von Till. Bill is chief of the Uranium Recovery Branch. Bill does -- his group does an awful lot of the licensing for uranium recovery type of facilities.

Also, Joan Olmstead, who's with the Office of General Counsel at the NRC. And Jeannette Arce is a recent member of our staff; she joined us four weeks ago. She's in the Nuclear Safety Professional Development program at the NRC.

So what we're going to cover tonight are -- very briefly, I will give you NRC's roles and responsibility. Rather than go on and on about that, you can go to the NRC's website and you can get a lot of information about what we do, what we regulate and how we regulate the commercial nuclear industry. The regulation of that industry is focused for the NRC on the commercial sector.

We are not the Department of Energy. We do not regulate -- except in some cases -- for example, the high-level waste program at DOE -- we do not regulate the Department of Energy. And we have nothing to do with the weapons program at DOE.

We're also going to -- Greg is going to cover the NRC's environmental review process, and Bill will cover some of the safety review process and give you some information if you're not familiar with the in-situ leach mining. And then we will open this up for public comments on the proposed GEIS.

We are an independent federal commission. What that means is we have five commissioners, who are appointed by the president and confirmed by the senate. Those are the only political appointees in the US Nuclear Regulatory Commission. The rest of the staff, from the executive director of operations on down, are career civil

servants.

The commissioners have five-year terms, and those terms are set. They cannot be removed when a new administration comes into office. The president can appoint a chairman to the commission and new commissioners, and that is the extent of interaction with the executive branch. So we are much closer to congress than we are to the normal departments, such as the Department of Energy or even the Environmental Protection Agency.

Our regulatory responsibility, our safety and security reviews for the commercial use of nuclear materials, nuclear energy, nuclear power plants, the medical uses of isotopes that are used, for example, for cancer treatments, industrial uses of nuclear materials. The production of smoke detectors, for example, are licensed by the NRC.

Our responsibility is to conduct environmental reviews and licensing. That's the process that -- where we have to review with public comment license proposals from the industry. We conduct inspection at licensed facilities, and we conduct enforcement at licensed facilities. We can shut them down if we feel they are being unsafe and they are violating our regulations.

So with that, what I'm going to do is -- I'm

going to turn this over to Greg Suber to talk about the Generic Environmental Impact Statement and the process that we're following. This is the beginning of the process.

So, Greg?

MR. SUBER: Thank you, Andy.

First of all, I'd like to thank everyone who took time out of their busy schedules to come to this meeting today. Public participation is very important to the NRC, and that's the reason we hold these meetings. It's important for us to include the public in our decision making and make sure that we have buy-in on how we regulate the industry.

My name is Gregory Suber, and, as Andy has already stated, I am the chief for the branch that is responsible for conducting environmental reviews for the uranium recovery licensing. Right now, I'm going to take a few minutes to discuss the environmental regulations that the NRC has to follow, to give you details of the environmental review process and describe the ways that you can participate in our scoping process to inform that process.

Okay. The slide that you see before you details our responsibilities under the National Environmental Policy Act. It's also known as NEPA. NEPA

was enacted in 1969, and NEPA requires all federal agencies to use a systematic approach in considering the environmental impacts of major federal actions.

In short, what that means is that before the NRC allows a licensee to do anything major, we have to conduct a thorough environmental review and we have to evaluate those impacts. NEPA is what we call a disclosure tool. And what that means is that under NEPA we are responsible for disclosing to the public what we are looking at in our environmental review. Our reviews have to be transparent. We have to inform the public what information we're using in our reviews, and we also have to invite the public to inform us or participate in those reviews by allowing them to participate in scoping meetings.

Now, this is not the only public participation opportunity that you will have in this generic EIS process, and I'm going to talk about it a little bit more later, but this is the beginning of the process; we're just starting the process, and we've inviting you to come in and help us decide how we're going to bound that process, what areas you think that we should look at in the process and how we should concentrate on that process.

NEPA also established the Council of Environmental Quality within the executive office of the

president. The Council has a couple of responsibilities. One is to advise the president on environmental matters, and the second is to coordinate development of environmental policy and initiatives.

Now, CEQ has promulgated regulations that federal agencies like the NRC have to follow, and one of those regulations allows federal agencies to combine proposals into a single course of action or, in other words, take several actions and combine them into one EIS. For the NRC, we call this process a generic environmental impact statement; other agencies like DOE use other terms, like programmatic environmental impact statement, but it's the same concept.

What you do is -- you have related actions, and they're related either -- by geography, and sometimes they're related by subject matter. But we have these related actions that we can combine and treat as a single action. And the NRC has done this several times in the past, and one of the most prominent examples is what we've done for reactor license renewal. There's a generic environmental impact statement that's used for reactor license renewals.

Okay. The next few slides, I'm going to discuss how the NRC plans to prepare the generic environmental impact statement for uranium recovery

licensing. I'm going to start by discussing the purpose of the GEIS and how the NRC plans to use that GEIS. I'm also going to describe the proposed scope, and I'm going to identify what resource areas we will include in our evaluation. Lastly, I'm going to discuss and explain to you how you can participate in the process.

Now, this slide talks about the purpose of the uranium recovery GEIS. And the purpose is to addresses generically the environmental issues common to in-situ leach milling. The GEIS will examine the environmental impacts of in-situ leach milling and also other feasible alternatives. We plan to use the GEIS as a basis for site-specific applications when those applications come in.

So in other words, what we're doing is -- we plan to prepare two documents. What the GEIS will do is -- the GEIS will look at broad issues that are common in in-situ leach milling to all sites. And after we complete that document for each application that we receive into the NRC, we will prepare a site-specific analysis for that particular location.

And what we will do is -- we will look at our generic GEIS, and we will look at the site. And in areas where we can use or adopt the conclusions for the GEIS, we'll adopt those, but we also recognize that often there

are particular site-specific characteristics that are totally unique to that site, and in that case, we will cover those characteristics in a site-specific review. In this way, the NRC will fulfill its NEPA obligations in the most efficient manner.

In the environmental scoping process, we endeavor to identify issues that should be addressed in the EIS. It's an important step in the process because it basically defines the boundaries in the process. And we conduct these public scoping meetings so that we can increase public participation in our process and, hopefully, use the public to help us to identify issues that may have historically been overlooked or issues where the public can inform our decision.

The big thing about public participation is that when it's done properly, it increases the quality of our evaluation. These are your communities. This is where you live. You're there every day. And it would be foolish of us to come in and try to conduct an analysis in your neighborhood without talking to you. And that's why we're here today. We want to get your input on where you -- on the issues that you think are important.

Here we have a list of some of the impact areas or resource areas that we look at. Now, the first point I would like to make is that this list is not all-

encompassing; I just put it up here to give you an idea of some of the things that we look at when we do our evaluations, some of the resource areas.

Now, when we conduct our site-specific evaluation, of course, some of these resource areas will have been covered by the GEIS, but some of these resource areas are going to be the focus of our site-specific evaluation, because they are totally unique to that particular site.

Here I wanted to give you an idea of the schedule that we are working with for the GEIS. The notice of intent to prepare the GEIS was issued on July 24, and right now we're in our scoping comment period. And presently, the scoping comment period is scheduled to end on September 4. We've already received a number of comments where people encouraged us to expand that period; they felt that the scoping period wasn't long enough. And we're entertaining that tonight.

If you have similar comments, I would like for you to make those tonight. That's the kind of feedback that we're looking to receive from you.

Now, once we've received those scoping comments, we're going to analyze them. And we're going to include them in our analysis, and we're going to issue a draft environmental impact statement.

And we'll come back to Albuquerque again, and we're going to show you the conclusions of our draft statement. And once again, we're going to give you, the public, an opportunity to comment on our draft environmental impact statement. You have an opportunity to tell us where we got it right, and you have another opportunity to tell us where we got it wrong.

So we are definitely trying our best to include the public in this process. And ultimately, we plan to issue the final GEIS in January of 2009.

Here we have the address for methods to communicate with the staff outside of this meeting. The first thing I would like to say is that the comments that you make in this meeting tonight are being transcribed, and we treat those comments and those comments carry the exact weight as if you wrote a letter and signed your name to it.

We're going to go through the transcript, and we're going to listen again to what you told us. And we're going to take that, those comments that you make tonight, and make that part of our evaluation.

If you choose not to make a comment tonight or if time doesn't allow everyone to get their comments in, you can always mail your comments to the NRC at the address that's on the screen, and you can also send us an

e-mail. Now I would also like to say that this information on this slide is also available on the table outside in case you don't have an opportunity to write it down or in case you would just like to conveniently pick it up on your way out.

Here you have the main contact people for the two reviews. Mr. James Park is conducting the Generic Environmental Impact Statement review; that's the environmental review that is going to produce the GEIS. And he can also talk to you about the site-specific environmental reviews that we'll be doing later. Mr. William Von Till is going to get up and speak to you in a few minutes about the uranium licensing process and about the safety review that goes along with the site-specific application.

All right. I'd like to conclude by saying thank you very much for coming out to attend our meeting tonight. And I do want to emphasize that public participation is very necessary in this process. And the reason we're here tonight is because we value your input, and we really want to hear from you, and we really want to take into consideration what you have to say.

Once again, thank you for coming. And we appreciate it.

(Applause.)

MR. VON TILL: Thank you, Greg.

Can everybody hear me?

VOICES: Yes.

MR. VON TILL: Great. Again, welcome. I'm glad to see a lot of people from the community out here tonight. My name is Bill Von Till; I'm the Chief of the Uranium Recovery Licensing branch in Washington. Our job in our branch is to -- uh-oh.

(Pause.)

MR. VON TILL: Here we go. It's working.

The job of the uranium recovery branch is a total oversight of these facilities, uranium recovery facilities. We develop policy for these facilities, and we oversee all the licensing and technical and safety issues with these facilities. I want to point out a couple of other things.

As Gregory mentioned, for the site-specific reviews and the GEIS, the environmental review branch is responsible for that. I also want to point out that we have an individual from our Region IV office, Jack Whitten, over here, who is responsible for inspections of those facilities.

What are we talking about here? What kind of facilities are we talking about? The NRC regulates under the Atomic Energy Act two main types of facilities which

are processing facilities for uranium in the beginning part of the field cycle process: Conventional uranium mills that we're used to, because a lot of these sites indeed are existent in New Mexico, and; in-situ leach uranium extraction facilities, which is kind of the wave of the future for most of these facilities.

One thing I want to point out is that the NRC does not regulate conventional uranium mines. The states and the Mine Safety and Health Administration are the appropriate licensing bodies for conventional uranium mines.

Here's the review process for a site-specific application. We've had quite a resurgence in the uranium recovery industry. We're expecting approximately 14 new applications for brand-new facilities across the western United States; 11 of those are in-situ leach facilities, and the three or so are conventional facilities.

The first thing we do is get with the companies that are interested in submitting an application to the NRC and having pre-licensing meetings. The agenda of that is to see what the companies are interested in and to have discussions early on so that we have a quality application when it's submitted to us.

When an application comes to our door, the first thing we do is conduct an acceptance review. The

purpose of the acceptance review is to ensure the application is complete and is of high quality. We have very limited staff to handle these applications. And if the applications are not complete and of high quality, we'll give them back to the licensees or the applicants and try again. So we've been working with the companies already, having meetings to make sure that we do have high-quality applications.

Once the NRC deems that a license application is acceptable for full review, the first thing we do is publish on our website a notice of opportunity for hearing for groups that may be interested in challenging this action. Then once that occurs, we have two separate reviews that are in parallel. One is conducted by the uranium recovery branch, which is the safety and technical review. And under Greg Suber's branch, the Environmental Review Branch, there's an environmental review.

And as Greg pointed out before, this is in addition to the GEIS. This is a site-specific environmental review that covers the site-specific actions of this application.

I want to point out that as part of this process, we work with all stakeholders involved. We work with the states, the EPA, the DOI and, especially in New Mexico, the Indian tribes: The Navajo Nation, the Acoma

Pueblo, the Lagunas, the Hopis, everyone who is near a facility that has an interest in this particular action.

Once we grant a license for these facilities, our oversight does not stop there; our office conducts licensing reviews, and Jack Whitten's office in Arlington, Texas, conducts inspections on those facilities. The purpose of the inspections is to ensure that these facilities operate in a safe manner to protect the workers at these facilities and the public and the environment.

Next slide. This is a typical conventional uranium mill site. I wanted to show you what these facilities look like.

Next slide. Now, most of the applications that we're going to receive are in-situ leach operations. So that's what we're going to focus on the most. In most cases now, industry -- if site conditions are right, the industry would rather -- okay. I'm sorry.

(Pause.)

MR. VON TILL: Can you hear me? Let me do this. Okay.

The -- most of the applications -- if the site conditions are right, most companies will prefer to use the in-situ leach form of extraction. And what I mean by, Conditions are right? You have to have groundwater in the aquifer where they're doing the extraction from, you have

to have upper and lower confining units, and you have to have the right permeability conditions.

This kind of operation does not have the conventional mining aspect. It does not have the tailings impoundment that is transferred to the Department of Energy or the state for long-term care.

Here's a typical look at an in-situ leach operation. And I just want to point out a couple things here. This is where the ore body is located. It's normally in a sandstone unit. In the state of New Mexico, it's mainly in the west water formation. These are roll-front deposits that have deposited themselves within the sandstone units.

And what the companies do is inject water with small amounts of oxygen and carbon-dioxide or sodium bicarbonate to loosen up the uranium so that they can pump it out of the ground for further processing. This then goes on to a processing plant. The end product is yellowcake.

A couple of things with this slide I want to point out. Because this is in the groundwater and groundwater is a precious resource in the western states, we have a large amount of monitoring involved. We also require that the companies restore the groundwater to the way it was before they started the operation. We have

monitoring horizontally, and we have monitoring above and below the confining units.

Here's a look at a typical in-situ leach extraction operation. This is the well field. As you can see, it's not very disruptive to the surface. Mostly, you see a bunch of well covers, which look like beehives, all throughout the field here. These are covers for individual production and injection wells and monitoring wells. These wells are then fed to a header house, which then pumps the product to a processing facility.

This is a look at the actual processing plant. It's just a couple of warehouse-looking buildings. This is the administrative staff here, and this is where all the processing occurs. The water is here and is run through ion exchange resins and then goes through a chemical process to finally end up with yellowcake, which then goes on to fuel cycle facilities, which then go on to nuclear fuel rods at the nuclear power plants.

With this slide, I wanted to illustrate kind of an aerial view of what this operation looks like. This is the extraction area, the well fields, right here. As I said before, we have a lot of groundwater monitoring involved. And this is a monitoring well ring that assures that this operation does not influence the other aquifers that are used for drinking water sources, livestock and

the other uses that are not of a mining type purpose.

Another thing that I wanted to point out is: Before the companies can extract uranium out of these aquifers, they also have to go to the Environmental Protection Agency for an aquifer exemption under the Safe Drinking Water Act. And these aquifers or portions of these aquifers, because they have uranium ore bodies, already have elevated levels of radio nuclides and other metals.

And so what the EPA does is look at some criteria. For example, this aquifer cannot be used presently for a source of drinking water. Once the aquifer is exempted from the Safe Drinking Water Act and they have an NRC license and an underground injection control permit from the state or the EPA, then they can proceed with licensing.

And again, I wanted to point out that once we license the facilities, our job is to make sure that these plants are run in a safe manner that protects the worker, protects the public, protects the wildlife and protects the groundwater resource. And I wanted to emphasize again that the main purpose of this meeting tonight is to listen to you. So at this point, I'm going to stop talking and let you come up and state your concerns. Thank you.

MR. RAKOVAN: Thank you, Bill.

(Applause.)

MR. RAKOVAN: I'm going too start going through the cards of the people who have signed up to speak. If you'd like, when you have your chance, you can come up and take the podium or you can take one of the mics in the aisles, whatever works best for you. If you could, please try to limit your comments or your question to a couple of minutes, given the fact that we do have quite a few people who have signed up to speak and I'd like to try to get to as many as possible.

I'd like to start out with Senator David Ulibarri

SEN. ULIBARRI: Right here. Good evening. My name is David Ulibarri, and I'm a state senator. I represent District 30, which encompasses Cibola County, northern Socorro and a small portion of Valencia. I'm also the county manager for Cibola County.

I welcome the NRC to New Mexico and appreciate your efforts to seek public comment for GEIS on in-situ leaching. I also appreciate the opportunity to be here tonight to share with you and the NRC that Cibola County is proud to be the home of the uranium capital of the world and that the Grants community is a key stakeholder of the output of the decision you make with regards to the EIS.

The uranium source in Cibola County can provide a secure domestic source of energy for the US. The future can be a significant reduction by national dependence of foreign oil. Nuclear energy is one of the most common cost-effective and efficient alternative sources of energy fuel without emissions and greenhouse gases. It is essential that we do all that we can to enhance domestic production and address environmental and safety concerns and will help to ensure uranium production of the future.

We are confident that mining and milling can be conducted according to modern standards and regulations that are protective of the health of the uranium workers and the public and the environment. We appreciate the NRC taking the lead in ensuring that this will happen.

The renaissance of mining and industry in Cibola County and neighborhood counties is already re-establishing a significant tax base and providing local employment and contractors with high wages and important benefits that will enhance the quality of life and bring a much-needed economic stimulant to our region. Thank you for being here and for the opportunity to speak. I have attached some copies of resolutions of support from the Cibola County Commission and also the City of Grants. Thank you.

MR. RAKOVAN: Thank you, Senator.

(Applause.)

MR. RAKOVAN: Sandy Brewer, from the Bluewater Valley Downstream Alliance.

MS. BREWER: I'll be brief and come up here. Good evening, ladies and gentlemen. I'm Sandy Brewer, and I am from Grants, New Mexico; I have lived there for 50 years. I represent the Bluewater Valley Downstream Alliance. This is a statement of the Bluewater Valley Downstream Alliance to NRC's Generic Environmental Impact Statement for uranium mining and milling facilities.

The Bluewater Valley Downstream Alliance states the following as our position regarding a Generic Environmental Impact Statement for uranium mining and milling activities in New Mexico or anywhere in the United States of America:

Number One, our research has not found an in-situ project in the United States that has successfully cleaned the water back to the original water quality nor to drinking water standards. Therefore, in-situ leaching of uranium should not be allowed in New Mexico or the United States. Due to the many and varied locations plus geologic and hydrological conditions, it is impossible to prepare a generic environmental impact statement to adequately include and successfully regulate these various conditions.

I thank you very much for my time.

MR. RAKOVAN: Thank you, Ms. Brewer.

George Byers from Neutron Energy, Incorporated.

MR. BYERS: We appreciate the NRC's coming here.

We hope that you have had your red and green chili, Bill.

Neutron Energy is a privately held company. We are engaged in the exploration and development of uranium by conventional, not by ISR, methods in New Mexico, but we believe it's imperative that the US use more uranium produced from secure domestic sources in order to sustain the 20 percent of America's base load energy production that comes from safe, clean and non-greenhouse-gas-emitting nuclear power.

If America is to reduce its reliance on foreign sources of energy, it makes no sense not to use every domestic energy resource that's available to us, including domestic uranium and nuclear power. Today's nuclear power industry requirements of about 55- to 60 million pounds of uranium per year to fuel America's 104 reactors will soon begin to grow as the 30 proposed new reactors in our country begin to operate.

The companies that I'm familiar with and that our industry's a part of that are engaged in producing

uranium in America are committed to working with the public, with the state regulatory bodies and with you at the NRC to protect the environment, to conduct safe operations and provide hundreds if not thousands of well-paying, safe and high-tech new jobs and a much higher tax base where we operate.

In short, we plan to recover uranium safely because our country needs it. And in order to provide this fuel, it's critical that permitting of new facilities proceed in a logical and timely manner.

As I said earlier, at this time, Neutron plans no in-situ recovery operations in New Mexico; instead, we're planning to undertake conventional underground mining and perhaps limited surface mining on our properties based upon the nature of those deposits. However, we do support your plans at NRC to assess the impacts of these environmentally safe ISR facilities on a generic basis.

And, Mr. Suber and Mr. Von Till, you made very good sense in your earlier statements for three very good reasons. Having a GEIS for the common elements of ISR operations will also allow you at NRC and you and your staff to have more time to review conventional milling and mining operations in New Mexico and other States.

Number Two, preparing a generic EIS will also

allow NRC staff to concentrate on the site-specific aspects of proposed ISR operations without compromising the public's ability to review those projects. You made those points very clearly earlier.

Preparing a GEIS will also reduce the time of permitting future ISR mines without compromising the care and detail in which site-specific environmental impacts for those ISR operations will be conducted.

Again, Neutron proposes conventional mining operations. And because of that -- you're not covering it here tonight, but we do support NRC's plans to update the 1980 GEIS for conventional uranium milling. It's out of date, and it needs to be revised to assess new milling techniques and technologies, improved methods for tailings disposal and the associated environmental impacts.

Neutron Energy believes that the NRC's plans for a GEIS on ISR recovery will provide the public and potential licensees with up-to-date guidance and data on which to make science- and fact-based decisions and will improve future baseline environmental evaluations and site-specific license applications and their environmental assessments, as this GEIS is not going to preclude future site-specific EISes. And that's what I want to make sure everybody here understands.

More importantly and most importantly, we do

not agree that a GEIS will preclude ample opportunities for public involvement in future licensing actions. Rather, it will allow the public and the states, such as New Mexico, and the NRC to focus on the site specifics of all applications and make them unique. Thank you.

(Applause.)

MR. RAKOVAN: Thank you, Mr. Byers.

Commissioner Ernest -- and I apologize if I get your name wrong -- Beecafi.

MR. BECENTI: Becenti.

MR. RAKOVAN: Ah, Becenti.

MR. BECENTI: Thank you. Good evening. My name is Ernest Becenti, Jr. I'm a McKinley County commissioner.

Perhaps more than anyone here tonight, McKinley County has the greatest interest in the future of uranium development in nine states because the county has been one of if not the largest domestic producer of uranium and has one of if not the largest remaining resources of domestic uranium yet to be produced.

Depending on one's point of view, what is at stake is a strong economic development and hundreds of jobs that we desperately need or a potential for an increase in pollution. Both of these issues are important to McKinley county, and our commission needs accurate

information to make proper decisions. That brings me to the generic environmental impact statement that NRC has proposed.

My understanding is that NRC will perform an evaluation of broad impacts of modern uranium technologies that would apply to the licensing of new facilities. In this process, NRC will evaluate the historic uranium operation and reclamation in the western United States and thus will review the success and the failures and use the information to determine the impacts of new operations and development and mitigation requirements that will incorporate into new licenses to ensure that the failures of the past are not repeated.

It is also my understanding that this generic environmental impact statement would provide a sort of a boiler plate for new licenses so redundant information would not have to be evaluated over and over again, but that during the licensing of each site, NRC would evaluate local futures and solicit public comments for each license review.

McKinley County strongly supports the preparation of this generic environmental impact statement. It will result in a single document where local decision makers can evaluate the pros and cons and the successes and the failures of historic operations, yet

we can be assured that this evaluation quality of individual licenses would not be compromised. There is a simple, no-down side to this effort.

In closing, let me say that I often hear from our constituents who assert the support of modern uranium development because it is safe, and I often hear from constituents who oppose uranium development alleging it is dangerous. Now we are presented with an opportunity to have the federal government prepare an unbiased, broad study to evaluate the safety, yet some don't even want the study. This makes me ask why. Could it be that some people simply do not want to be confused with true facts?

So I thank you very much for coming here tonight to hear our statements. Thank you.

(Applause.)

MR. RAKOVAN: Thank you, Commissioner.

Paul Robinson from Southwest Research.

MR. ROBINSON: Good evening. My name is Paul Robinson. I live about three miles northwest of here, upwind as the radon flies. I was really enjoying seeing --

MR. RAKOVAN: Would you get a little closer to the microphone, please?

MS. ROBINSON: -- the presentation here. It looks to me like the GEIS is going to be finished before

any of the new applications are in. Therefore you can just guess at what actually is going to be proposed, because there won't be real applications filed within a year.

Bill and Ron Linton were out here, had presentations from the operators. They're going to take a year or two before they even get their application filed. Then it has got to be reviewed, as Bill said.

So the timing is inappropriate. It's dysfunctional. It might provide some information. You might be able to get some conceptual ideas about in-situ mining or conventional mining, but each different well field within a body has to have a different fluid. The fluid has to be adjusted.

It's not just three chemicals, Bill. It's a carefully concocted fluid, and it's going to be mobilizing not just uranium, but all the heavy metals and the radio nuclides in the ore zone. You've avoided looking at the environmental impact issues in your presentation.

You had a picture of uranium, Bill, without a tailings pile. That's where the problems lie. That was the reason to do the last generic environmental impact statement, because there was a new set of regulatory requirements that brought a whole new set of wastes into the NRC's area of coverage: The uranium mill tailings.

And that motivating factor is not here today.

It's nice, Greg, to hear your strong interest in public involvement. Go to the places where the facilities are proposed. Albuquerque is two hours away. You spent more time driving to get here than you made available. Make enough time for people to talk. Provide an opportunity for dialogue and communication, not just a two- or three-minute conversation.

There's more activities being proposed for other kinds of energy development than uranium, and the uranium facilities are proposed based on reactors that haven't been licensed. There's assumptions that none of the existing reactors, which are about as old as the bridge in Minneapolis -- that they're never going to shut down. So we're going to lose reactors unless we get 109 new ones.

So looking at what the demand is, whether the existing inventory of weapons-grade uranium and depleted uranium and the enrichment tailings -- whether they can meet domestic needs. There's more uranium in those sources owned by the government than there is in the deposits that are being described as being developed.

As Mr. Becenti just mentioned, the biggest deposit in the state is not amenable to in-situ mining. Many deposits are not. And for that reason, the scope of

the GEIS does not appear to reflect the experience here in the state.

And the last point is the Bureau of Mines had a history of in-situ mining that they published in 1977. NRC and the regulating agencies have not published a summary of the performance of those in-situ sites. They haven't identified which ones of those have not been able to meet their restoration standards and had alternative concentration limits.

I heard Bill say that the NRC is going to require restoration to the way water was when the operation started. that's a high standard. I appreciate your recognizing that standard, and that's the standard that needs to be met for groundwater to be protected. It's not just drinkable water out here. It is the key resource, and every different place has important groundwater. Groundwater is not a generic issue.

Thank you very much for your time. I look forward to talking to you again.

(Applause.)

MR. RAKOVAN: Thank you, Mr. Robinson.

Next I'd like to invite Cassandra Bloedel from the Navajo Nation EPA.

MS. BLOEDEL: Good evening, and thank you, NRC members, for coming to Albuquerque. We hope you come back

more readily.

Navajo Nation has four UMTRCA sites on our nation: One in Shiprock, New Mexico, one in Tuba City, Arizona, and we have one that kind of borders between Arizona and Utah with Monument Valley; we also have one in Mexican Hat, Utah. The only thing is there is radioactive waste existing at the Tuba City site in two locations: One at a former open dump, and one right across the street from the UMTRCA site.

This site was discovered because I took the time to go to Tuba City to look at our groundwater. When I was there, I started listening to the local people, that there was burials done back in the '50s and the '60s of waste. So I had no idea of a connection between the UMTRCA site and this site.

Later, we had US EPA emergency response come out. They did their own investigation in 2004. The site was discovered in 2003. I have submitted a document to you to show the waste. There is milling balls. There's laboratory waste. There is actual radio nuclides that are above the threshold for safety levels.

You have every year -- each person should have a dosage of five millirems per year. This situation has soil samples where there's -- some of the samples show 400. That is quite a bit above the levels. You have lack

of vegetation there.

You even -- we even found -- had to go the extra step than what US EPA emergency response did. We had a forensic specialist in radiation come out, and I was out there during the investigation with him. We found the milling balls. We found the soil samples. Once those were analyzed, we found Radium 226, 288, which was way above the levels.

You talk about the UMTRCA law that -- in your booklet -- has expired, because it went to 1978. And so that law in itself considered vicinity properties. This site is -- would be considered a vicinity property.

Now we're looking at trying to get all of this radioactive waste cleaned up appropriately, because it shouldn't have been there in the first place. It should not have been buried. It's a threat right now to the major primary water drinking water source of the Navajo aquifer. There are several communities that -- plus the Hopi tribe and the Paiutes that just live right outside of Navajo Nation. They all utilize this drinking water source.

If this radionuclide that has already been showing in the shallow groundwater gets through that fractured Navajo sandstone, it will devastate all those communities. So is the US government, NRC in particular,

going to provide safe drinking water for the rest of their lives and their children's lives? That's a question that I would like answered.

And so the document does show that there is waste, and I hope that this gets cleaned up. There is also yellowcake out there that has now surfaced and now has threatened the actual communities there. For some reason, this yellowcake has an affinity for plant roots. You wanted information about your environmental impact statement. Well, this is a biological threat.

There are levels of radionuclides shown in here that are above the MCL levels that US EPA has in their standards. There's the milling balls, all in a bag. For some reason, US EPA did not discover this. It took additional work by Navajo Nation, using their own funds, to find this waste, and that waste is scattered throughout a whole area. We understand there could be other areas. So something has to be done with this.

The UMTRCA law, hopefully, will be fixed to allow for those vicinity properties to be appropriately cleaned up. And this radiation that is being emitted right now into the atmosphere for these communities will be diminished with a proper cleanup.

And so when you talk about permittees wanting to do -- go through a specialized shortcut with your GEIS,

I think you have to consider things that are existing. This is existing now, and so you need to really appropriately consider what you're doing when you're going to be allowing permittees to do things like this.

We do have sites that -- of course, the in-situ leaching is a concern. Of course, there, McKinley County -- I was one of the past members of the McKinley County Water and Soil Conservation District. And so this is something I am a part-time member of Cibola County, also. But there is things my position -- I cover sites in Arizona, Utah and New Mexico. So it's really important that this be considered, and I hope you do that. Thank you so much.

(Applause.)

MR. RAKOVAN: Thank you.

And she brings up an excellent point. If anyone has brought a statement or any information like she has that they'd like included as part of the transcript for the meeting, just flag me down, and I'll make sure that it gets included.

Next I'd like to offer to comment Jerry Pohl.

(Pause.)

MR. RAKOVAN: It looks like, from -- I can't read the first word -- Land Grant.

MALE VOICE: Seboyeta Land Grant.

MR. RAKOVAN: There you go. Thank you.

MALE VOICE: He's not here.

MR. RAKOVAN: I guess he must have left.

Robert Tohe from the Sierra Club.

(Pause.)

MR. RAKOVAN: Do you guys like it a lot better if they come and use one of these?

If you want to, come use one of these. I think they'd prefer it. Up to you.

MR. TOHE: Good evening. My name is Robert Tohe; I'm the environmental justice organizer for the Sierra Club. And for the record, I'm a member of the Navajo Nation. I have a homesite lease in Mexican Springs, a New Mexico site in McKinley County. I'm here to offer my comments briefly, and I thank you for your attention so far.

What we understand this generic environmental impact to state is that all communities are generic, they're all the same, there is no difference, and, yet, when you go into each of those communities, groundwater's different. They hydrology's different. The geology's different. The water and the weather is all different in these communities, and, yet, we're being lumped into one generic community. There's diversity out there, as New Mexico is well aware of.

One size does not fit all. The NRC needs to do definitive consultation with all communities and, in particular, to the Navajo Nations and pueblos, to our sacred sites, such as Mount Taylor. These areas are special and significant culturally to the people in these areas.

And there is Dr. David Begay, who is a special advisor to the Dineh Tah Association. The Dineh Tah Association is recognized by the Navajo Nation as people with the expertise and the knowledge to speak about sacred sites, and including Mount Taylor.

We also want to express that these hearings should be conducted out there, not here in Albuquerque. There's no uranium mining here. There's no ISL proposed sight here in Albuquerque. They should be out there in the communities.

And the New Mexico state minerals department has also said -- and this goes back to what Paul Robinson says -- there are no ISL permits currently. New Mexico does not have one ISL permit presently, so you have to ask, What is the purpose, and what is the need? Is the need just for the marketing, for the industry? That's what we have to answer through these public comments.

I also want to submit opinions -- and these comments will be forthcoming -- from the Sierra Club and

also other tribal groups in the area. Thank you.

(Applause.)

MR. RAKOVAN: Thank you, sir.

Alvin Rafelito from the National Indian Council on Aging.

MR. RAFELITO: Good evening. Thank you for giving us the opportunity to address this public hearing. I work with the National Indian Council on Aging and am also a board member for the Hunger Grow Away, addressing hunger issues throughout the world.

For this licensing process, discussion and input into this project, I'd like to say no. No.

(Applause.)

MR. RAFELITO: We have enough health disparities that we're dealing with right now with our elders and our young people to have this also added on to our situations that we have in our communities. We're concerned with diabetes, we're concerned with kidney disease and with cancer; a lot of these are three times the level of the national average that we have in our communities of color, and allowing in-situ licenses for this to happen is only going to make this worse in the future to come, for my kids, my grandkids and their kids' kids.

The other thing also to consider here in the

southwest is we're in the middle of a drought and water is precious, and water is what we're going to be fighting over here soon. And contaminating that process and then leaving us to deal with it? No. No more. We want our waters pure -- if it's radioactive, fine -- the way it is. It's drinkable, without having to add things to it and making it more radioactive than before.

And as mentioned earlier, there's other sites that still have all this radioactive waste. It's still happening. It's in our atmosphere. There was no cleanup made; they just left the dirt and the waste, and they took off and took the money and ran. No more.

So with this little comment, thank you for giving me the time. And say no to that licensing process. Thank you.

(Applause.)

MR. RAKOVAN: Thank you very much for your comments, sir.

Loren Setlow, US EPA Office of Radiation and Indoor Air.

(Pause.)

MR. RAKOVAN: I think they'd rather you come to one of these.

MR. SETLOW: Oh. All right.

MR. RAKOVAN: Up to you.

MR. SETLOW: My name is Loren Setlow; I'm represent EPA's Office of Radiation and Indoor Air in it's Radiation Protection Division in Washington, D. C.

EPA will be preparing a written response to the Nuclear Regulatory Commission's request for comments on the proposed scope of its GEIS for uranium milling facilities. While our comments will more extensively detail the principal environmental issues which should be addressed in the scope of the GEIS, in addition to the areas which were mentioned in NRC's Federal Register notice, I wanted tonight to outline just a few important issues.

First is groundwater protection. Conventional uranium mills but certainly ISL facilities have the potential for damage to underground aquifers, as well as surface sources of drinking water.

The GEIS should effectively address the protection strategies and methods that will be used for the affected water bodies; this must be overlain by the Uranium Mill Tailings Radiation Control Act's requirements, EPA's implementing regulatory standards for uranium extraction facilities and NRC's regulatory requirements. This should also include the complementary regulatory requirements under the Safe Drinking Water Act, which EPA and the primacy states implement through the

Underground Injection Control permitting process.

As well, NRC should consider discussing its new regulations being developed for groundwater protection at ISL facilities. The discussion could examine how they will fulfill the requirements of UMTRCA and EPA's standards for mills, plus provide complementary standards derived from the EPA UIC regulations to demonstrate how water resources inside and outside the license area will be protected.

Secondly, summaries of decades of existing data from previous and existing ISL operations should be reported. This could include histories of groundwater excursions, restoration and reclamation issues, including commonness of using alternate concentration limits rather than background levels or MCLs for hazardous constituents, volumes of radioactive and hazardous wastes, including evaporites and drill cuttings, to be disposed in conventional mill impoundments, radionuclides and metal levels in evaporation ponds, acreage of disturbed surface from facilities, roads and pipelines, occupational radiation and exposures and accidents, measurements of radon emissions from the ponds and processing facilities and how this can be effectively controlled by the requirements of EPA and NRC.

Thirdly, social, cultural radiation and

environmental impacts on Native Americans and other disadvantaged populations, as well as ranching communities, from the proposed actions should be considered an important aspect in the GEIS, given past impacts on future geography of ISL in mill development.

Lastly, the NRC's 1980 GEIS on conventional uranium milling is out of date. Over 25 years of data on the mill and tailings impoundment, performance and adherence to regulatory controls or violations, and reclamation history have now been accumulated by the NRC in its agreement states.

In a letter to the NRC from the director of EPA's radiation protection division in 2002, it was stated that the proposed use of alternate feed for mills or disposal of waste in tailings impoundments that was not physically and chemically similar to the tailings generated from ores warranted a new evaluation under NEPA. With a likelihood of additional licenses for new mills, as well as suspended-activity mills restarting, NRC should consider the robustness of discussion devoted to conventional milling and reclamation and an elaboration of their environmental impacts in the GEIS.

We look forward to working further with the NRC on uranium recovery issues, their new proposed regulations and evaluating the associated environmental impacts. And

as I mentioned before, we will be providing written comments. Thank you for the opportunity to speak to you tonight.

(Applause.)

MR. RAKOVAN: Thanks.

James Martinez.

MR. MARTINEZ: Hello. I'm James Martinez; I'm from the Juan Tafoya Land Grant Corporation, and I want to thank you guys for coming out to listen to the positive and the negative about this uranium industry. Also Seboyeta -- they couldn't be here, but they're also for the uranium industry. And there is a lot of positives, you know.

I did get all my people from my community to come out because they are concerned about everything that's going on, and we are for the uranium industry to come in. And New Mexico is one of the -- we need it, you know, and we are for it. And there is a lot of positive, and there is some negative, but maybe everybody together could make a good thing of this and our people could come together and make a positive.

There's a lot of -- you know, we have a lot of water in ours, and we have protected our water for generation after generation, and we will continue to do that. Whether these companies come in or not, we will

continue protecting our water sources. And I just want to say that we are for the uranium industry to come in. And maybe working together, we could help it be positive for everyone.

And I just want to say that thus Juan Tafoya have joined in and we will continue to help the uranium industry and help New Mexico grow. Thank you.

(Applause.)

MR. RAKOVAN: Thank you, Mr. Martinez.

Jerry Slim from the Eastern Navajo Allottee Association.

MR. SLIM: Good evening, everyone, the members of the Nuclear Regulatory Commission. On behalf of the Eastern Navajo Allottee Association, I thank you for letting me come up here to speak. My name is Jerry Slim, and I'm an allottee, and I'm the vice president of the Eastern Navajo Allottee Association. I am from Crownpoint.

The association is glad to hear and to have learned the new proposal on the generic environmental impact statement and in-situ and recovery and mining activities. The allottees support uranium in Church Rock and in Crownpoint because of having much need for the economic impact form the employment for all the local residents. We strongly support the NRC to generate the

generic environmental impact statement for uranium recovery operation. And I thank you very much.

(Applause.)

MR. RAKOVAN: Mel Stairs.

MR. STAIRS: Hi. My name is Mel Stairs, and I've been an independent small miner for the past 20 years. I was educated here in this state.

FEMALE VOICE: We can't hear.

MR. STAIRS: Is this better? Can you still hear?

(Pause.)

MR. STAIRS: Let me try this one. Okay. How's that?

My name is Mel Stairs, and I've been an independent small miner for the past 20 years. I was educated here in New Mexico at the school of mines, and I just wanted to make two comments.

The first is: With my experience in geology and my experience in the mining industry, the large problem that you have with this is containing the solution that they use to make the mine. In other words, you inject solution into the ground and into the aquifer, you pump it back up, and you have a large ring of monitoring wells to make sure that it doesn't escape into the water that everyone's gong to drink.

If you put the wells that monitor on a 1,000-foot basis or if you put your injection wells on a 200-foot basis like is one of the industry standards, there's a lot of ground in between that that the geologic study is just a guesswork.

If this room's 120 feet wide and that screen is only 30 or 40 feet wide and you put a well monitor at either side of that, you may miss a fault in the ground that is part of your containment, your clay layers on the top and the bottom, that would allow this to seep out. And the only time that you would realize that is when it has contaminated water far downstream.

So in effect, you're not going to stop uranium mining, and you're not going to stop solution mining. These two things are necessary for our economy, they're necessary for our energy security, but, more importantly, to protect the environment, you're going to have to do much tighter monitoring than is an industry standard now. You're going to have to put those wells that do monitoring on a 50-foot or 100-foot at the most grid pattern instead of the 1,000-foot that rings current proposed solution mines.

The other thing I wanted to comment about was the fact that there are a lot of people here who are emotionally upset about the idea of radioactivity being

released into their community. The people that are here from McKinley County, all you have to do is look north to your neighbors in Farmington. The Bloomfield/Aztec/Farmington area has a large cancer cluster, and studies have shown that that may be related to the coal-fired power plants there.

So if you're all concerned about making sure that no radiation gets into the environment, you should think twice about coal-fired power plants. Nothing in nature is pure. If you have three or four parts per million uranium in your coal and you burn 25 billion tons of coal a year, you're going to be putting a few thousand pounds of uranium back into the atmosphere to get into people's bodies.

So I think that it's a very good thing that we have government agencies to monitor these, but they need to be much more scientifically stringent to make sure that the monitoring is done on a basis that actually catches these isotopes when they get loose in the environment. Okay. Thank you.

(Applause.)

MR. RAKOVAN: Thank you, sir.

Tomi Jill Folk, Hunger Grow Away, Incorporated.

MS. FOLK: Hello. My name is Tomi Jill Folk. Hunger Grow Away is an organization that works around the

world, but especially right now, we're concentrating in the southwest, working where we are invited, to be able to help people grow their own food. We see places where the food supplies are very, very limited, and we work with a small, micro-intensive gardening system.

But I'm here tonight as a storyteller because as we have spent so much time in the pueblos and among the Navajo communities and the chapters and are working side by side with the elders, with the young and with so many people, we understand how desperate the need is for jobs, but we also hear some other stories. I recently released a compilation of some of the stories I have heard, and in addressing the historic and cultural issues as one of the areas of your concern, I have a story for you tonight.

This is how the story was told to me, and I thank my Navajo friends for allowing me to relay it:

Long, long ago, the Great Mystery came to the people, and they were hungry. And the Great Mystery told the people, "You have a choice. You have a yellow choice. You can plant and grow, and your corn will have yellow pollen, and that will remind you of the friendship of the sun. And you will live in happiness and harmony, and you will know peace. This you grow upon the earth.

"Or you can dig into the earth, you can wound and scar the Mother and take the yellow stones. And if

you do this, you will know suffering and pain and ignorance and great sorrow. And your children will pay for many generations yet to come for your ignorance and folly."

This is what you need to go to Mount Taylor again to discover. You also need to be doing the following. It is very important.

This is what was said to me: "You are a voice." I am a former pastor. "Go to your friends in Acoma and Laguna. Go to your friends in the hogans. Talk to them. Collect their stories, their stories of the mines, their stories of the pain and the death that followed them out of the mines. I tell you this: If you meet your friends, collect these stories, write them down, hear them and tell them. Tell them so the world knows, that the world will join with you to plant the corn and leave the Mother Earth in Peace!"

Thank you for listening and this opportunity to share what I have heard from the elders and my fears for the future.

(Applause.)

MR. RAKOVAN: Thank you, Ms. Folk.

I'd like to thank all the speakers up to this point for keeping your comments brief; that's helping us really cruise through these cards and helping us get a lot

of people up here. So thank you very much for that.

Just make sure that you're keeping your mouth close to the mic so that people can hear you. She did a great job there, but, you know, there's a lot of people, and this is a big room. So do what you can if you would.

Next I have Mike Bowen from the New Mexico Mining Association.

MR. BOWEN: Good evening, and thank you for the opportunity to provide comments this evening. My name is Mike Bowen, and I'm the executive director of the New Mexico Mining Association.

New Mexico has the second-largest deposits of uranium in the United States. As the price of uranium has continued to rise, so has the interest in New Mexico's vast uranium deposits. We have seen significant increases in uranium exploration in the last couple of years, and our association believes it's very important for the United States to reduce its reliance on foreign sources of energy.

We currently use almost 50 million pounds of uranium in the United States' nuclear power plants, and we should be producing most of that here in our own country. It's very important that permits be issued for new facilities in an orderly and timely fashion.

Our association supports the NRC plan to

prepare a generic environmental impact statement for in-situ recovery; we believe that this statement would be beneficial for informing the general public of the minimal impact from ISR mining and also because it could reduce the cost and time involved in assessing the common aspects of these facilities. It would allow the NRC staff to concentrate on the site-specific aspects of each project.

Our association supports the NRC updating the 1980 generic EIS for conventional uranium milling; it is out of date but could be easily updated to incorporate new milling techniques and technologies, as well as the environmental impacts.

The New Mexico Mining Association believes that it would be more beneficial to prepare an update to the conventional uranium milling GEIS independent of the preparation of a generic EIS for ISR mining. Our main concern is the negative effect doing both together could have on the progress by the staff on pending and future license applications. We would encourage the use of outside sources to supplement NRC staff.

And finally, it is the association's hope that a generic EIS for in-situ recovery and an updated generic EIS for conventional uranium milling will result in potential licensees being provided with up-to-date information and guidance on environmental impacts of ISR

and uranium milling that will improve future environmental evaluations and license applications. Thank you.

(Applause.)

MR. RAKOVAN: Thank you, sir.

Rosamund Evans.

MS. EVANS: Thank you for coming to Albuquerque to hear some of us. Most of the people here tonight that would be opposed to this program really had no advance notice that I know of; most of us heard about this, if at all, in the Journal this morning. I will address that in a separate comment. But it is very distressing that a process that was put in place to hear the public and to have a dialogue is being subverted, and I think our governor also issued a statement about that today.

Having generic scoping is, of course, very objectionable because, as several people have talked today, there are very specific reasons not to do that. If you have lived in the west as I have all of my life and you know a little bit about the geology as I do, you know that some of the statements that are being said here recognize that there is no protection of the groundwater.

The very important life of the west is in the groundwater. There is no protection for this kind of a mining process, where they pump chemicals down and then you hope it doesn't contaminate the rest of the aquifer.

In this room today, there are many people that have made a career out of promoting nuclear energy -- at well-paid salaries and career advancement. I recognize that. I respect that. There are many people in this room who expect to profit from the opening up again of uranium mining in this state and throughout the west and indeed the world.

There has been untold -- and I mean untold -- damage from uranium mining. I lived on the Navajo reservation for 12 years in two different places where people had mined. Now, you're going to say, This is a safer process. They were definitely not told that they were in an unsafe process, and they're not being told now.

There are ways to have energy independence. There are ways to have our country be energy-independent of oil, and, indeed, we will have to be, because there's not going to be the oil, but to dangle nuclear power as the solution and indeed coal mining as the solution is really allowing people, and a very few people, to profit enormously -- a very few corporations.

It takes six to ten years to bring a nuclear power plant online for producing electricity. There's an enormous amount of waste, there is an enormous amount of cost and the global warming that occurs during the mining, reprocessing -- if you're in the milling -- I should start

it the other way: The mining, the transportation, the milling, the building of the plants. And then you have the waste. And then you have the more energy that goes into the plant itself.

What we are also doing is allowing a proliferation of, you know, nuclear material, of plutonium, around the world. Uranium -- the reprocessing is being done in such a way that we are really putting ourselves at risk, much more danger, and contributing to global warming.

This -- my comments probably won't be even included because -- I think you try to narrow these. This is about scoping, and I'm really talking in a broader way and having a dialogue because what we should be addressing is, Do we really want to be spending what is now borrowed money on starting up nuclear power?

And of course, a lot of this is designed to go into nuclear weapons. Is this really what we are wanting to do now with the borrowed money -- because that's what it is in the US now, is this the path we want to take, and not whether we're going to have some short-term gain with a small job that puts our health at risk?

I'm sorry to have to say that, but that is what it amounts to. Thank you.

(Applause.)

MR. RAKOVAN: Thank you, Ms. Evans.

Cindy Ardito.

MS. ARDITO: Good evening. Thank you for the opportunity to speak tonight. I just want to say I've been -- my company, INTERA, has been involved in environmental closure issues associated with uranium mines since the late 1980s. And we find ourselves now --

Can you not here me?

MR. RAKOVAN: Just a little louder.

MS. ARDITO: Okay. Let me try this. Is that better?

We find ourselves now in the position of looking at some of these sites for opening uranium mines, given the changing conditions. And I appreciate the concern that people have been expressing here.

We've been tracking this issue for a long time. I think there's a lot of misinformation that's out there. I think there's a lot of emotion. And I think one of the good things that could come out of this process is what we're seeing here tonight, an opportunity for people to express their concerns in open dialogue and perhaps educating each other about what the true issues are and trying to get down to things that we can really agree to and come to terms with.

So I think it's an unfortunate choice of words

for the process. I think "generic" has a connotation that maybe does leave a lot of people cold and think of the K-Mart brand of an EIS. I don't think that was intended.

I think that there's an opportunity to collect a lot of information that can be valuable to the process in general that people can use and maybe help with the scientific soundness and efficiency of going forward and trying to do environmental assessments of these processes. So thank you again for starting this, and I look forward to more of these kinds of meetings. Thank you.

(Applause.)

MR. RAKOVAN: Thank you.

Floy Barrett.

MS. BARRETT: Yes. I'd just like to read -- my name is Floy Barrett, and I live in Albuquerque. And I'd just like to read part of a short comment from Governor Richardson, because he is not here tonight, and he does have a grave concern about this.

"Governor Richardson" -- this is dated August 1, just a few days ago -- "today petitioned the US Nuclear Regulatory Commission to reconsider its plans to create a Generic Environmental Impact Statement concerning newly proposed uranium recovery operations, including in-situ leach recovery facilities and conventional mills to be located in the western United States."

"The NRC has stated that the purpose of this is to aid in a more efficient environmental review for each separate license application. There is nothing generic about the concerns that many New Mexicans have with proposals to re-open or start new uranium mining and milling operations in their communities."

I'm still quoting: "I believe that this proposal will negatively impact the ability of New Mexico's citizens to participate in the NRC licensing process for individual facilities. Under the NRC's proposal, new mining activities and the public's right to comment on them would fall under one single generic environmental impact statement rather than individual statements on a site by site basis. Our citizens have a full -- have a right to full involvement in decisions that could have far reaching impacts on their homes and water resources.

"Given the concerns of many citizens in New Mexico about the public health environment and cultural impacts of new uranium mining, a process to eliminate public review of individual NRC permit actions in New Mexico would be disrespectful to our many sovereign Native American tribes and pueblos and the general public. This GEIS proposal would also be contrary to the State of New Mexico's public participation permitting process.

"In New Mexico's state discharge permit applications for uranium operations are evaluated in a case-by-case basis. And this individual review is particularly important for uranium. Such a review allows the state and the public an opportunity to address site-specific concerns. If uranium mining and milling are to resume in New Mexico, the state must be sure that the public is given a robust opportunity to participate in the decisions, and that all environmental water, resource, and potential public health issues are thoroughly examined for each operation."

And I think I have to agree very much with Paul Robinson about the fact that you can't do this in two minutes or three minutes, or two hours or five hours. You need a process that will take along time, and if you've been working on this preparation and just now we are getting an opportunity at this, we need a dialogue, we need to be able to talk to the people who are doing this to us. So I suggest that we look at many, many, many, many more meetings. Thank you.

MR. SUBER: First of all, I'd like to thank you for that comment. And this is scoping process, and we take that comment that you are interested in having more meetings about this topic, but I would like to make one clarification, and I mentioned it in my presentation.

The generic environmental impact statement is one part of the review. Each application that comes into the NRC is going to receive two other reviews. The one is a safety review that Bill Von Till's section is going to do, and one is the supplemental environmental review that the NRC is going to do.

So I just wanted to make the clarification that this generic review does not cover the site-specific aspects and that there is a site-specific environmental review that will be done for each and every license application. Thank you.

MR. RAKOVAN: Thanks, Ms. Barrett.

And thanks, Greg, for the clarification.

Next, Chris Shuey.

MR. SHUEY: So like Mr. Stairs, I'm a little height challenged so I'm going to use this here. You may be surprised that I actually agree with a comment that Mr. Stairs made, which points to the difficulty of a generic approach to these issues.

He pointed out and called for improvements in the generic monitor well approach to ISL operations. It's actually 400 foot uniform spacing, and all these ISL operations that we've looked at have ore bodies in much narrower channels than that. And so the issue is that you can still get excursions moving between monitoring wells,

and you'll never detect them until it's too late.

This is an example of what you, the NRC, has already done to reduce ISL operations to some form of generic cookie-cutter, you know, one size fits all. And this is why, an example of why, a generic approach is not going to be able to deal with all the site-specific issues that will arise in every licensing decision that you make.

You're careful to talk about the safety evaluation report that Mr. Von Till's office does, and Mr. Suber's office does the -- you said supplemental environmental review. None of you, unlike the gentleman from Neutron Energy, is the only one who's assured anyone here that that doesn't eliminate the need for an EIS for every licensing decision.

So you're being very careful. So this is why we're a little dubious about this approach, this GEIS, the generic approach, because it sounds -- and I think that several of the commenters from the industry side, have made this point pretty clear -- it sounds like it's simply a way to streamline a process, and to keep the public out.

As many of you know, we've spent 13 years, parts of 13 years, going through and in sub-part L, licensing adjudication over the HRI license. We learned a lot. I'm not supposed to say too much about it because it's on appeal. But we've learned a lot from that effort.

There is tremendous site-specific information at each one of these sites that has to be taken into account. It is a -- every license decision is a major federal action significantly affecting the human environment. That's the trigger for NEPA, and EIS. What you're telling us is, is that it's quite likely that we'll never see an EIS for any of these site-specific licensing decisions. That's what gives us heartburn about the GEIS approach.

My view is that you could spend your resources more wisely by conducting, through some sort of independent third party, an actual evaluation of ISL performance over the last, what, 35 years. The last published ISL evaluation that you did was 1985. The lead author was William Staub.

Well, gee, 14 years later he turns into one of the experts for our case in the HRI matter. Okay. Why? Because he was pretty concerned about the issues that he was seeing in a new application, some of the same issues that he had evaluated with -- on ISL performance back -- it was back in the '60s -- excuse me, the '70s and into the early '80s.

That has not been done. You haven't done an independent evaluation of this technique that you are now saying is going to be the model for the rest of the

industry from here on out. It's -- you have to understand that half my time is spent out in these mining impacted areas. Not just with mines that you don't regulate, but with mills that you do regulate, dealing with the legacy that has affected these communities and affected the people.

We just had, what, two months ago five families relocated from their homes for two weeks while six to 12 inches of radium-contaminated soils were removed from around their home so it'd be, quote, "Safe for them to live," sandwiched between two mines.

You know, you can talk about the benefits to McKinley County, or Cibola County, or Sandoval County. There's 150 some abandoned mines in McKinley County, nobody's making any money off of those right now. There's another at least 50 that we know of in Cibola County. The St. Anthony open pit mines are still open, they're still contaminating ground waters and surface waters on Seboyeta land grant draining into Laguna Pueblo.

There's no reason to believe that any of these impacts from the past have been addressed to the extent that they need to be addressed, while we're talking about doing a generic impact study that will generate very few site specific answers for you.

We -- as you know, you held meetings with,

what, HRI in April, Strathmore and Rio Grande Resources two days later, Homestake in between. Several members of the community took advantage of the opportunity to do that. We went along on one of the tours. People protesting in Crown Point took part in that to make it clear to you that the world doesn't just revolve around the regulated community.

My suggestion is, is that it's time to spend some time in the communities that have been affected. Learn and listen. Go to Mr. Ness's house and sit in his living room, sleep at his house for a while, while you're in the shadow of an unreclaimed mine 500 feet away.

It's really time to change the agenda from being what -- from giving the appearance of being supportive of the industry and start to support the public interest for what your statutory authority it's what you're supposed to be doing. Thank you.

MR. RAKOVAN: Thank you very much for that comment, sir.

Eric Jantz, New Mexico Environmental Law Center.

MR. JANTZ: Thank you. My name is Eric Jantz. I'm a staff attorney with the New Mexico Environmental Law Center, and I'm here on behalf of the Southwest Research and Information Center and the Haaku [phonetic] Water

Division of the Pueblo of Acoma.

The first thing I'd like to say is that the GEIS process that we're involved in right now is most notable, I think, for its absences. What's missing? I think the first thing and the most -- possibly the most important thing that was missing from this process is that there has been no, absolutely no public discussion about whether there should be a GEIS on this issue at all.

To my knowledge this -- it's been a foregone conclusion that a GEIS is going to be made and now, only now, do we get -- the public get to be involved in the process. And that's important, because the GEIS process, or a GEIS itself, doesn't do two very important things. It doesn't address site-specific issues. By definition it only addresses generic common issues.

So it's absurd to think that site-specific issues like hydrology, geology, cultural property, existing pollution, environmental justice issues can be addressed in a generic environmental impact statement that covers an entire region at least, if not the entire nation.

And my question to the Nuclear Regulatory Commission staff, and I think we deserve an answer, is what's left, what are the common issues that are going to be addressed, given that the site-specific issues can't be

addressed in the context of a GEIS?

Second, a GEIS is ultimately going to limit public input and environmental analysis. Again, Mr. Suber was very careful to note that a supplemental environmental review would be done, but he did not say an environmental impact statement. If the supplemental environmental review consists of environmental assessments, then public participation in those is limited, if not completely restricted.

And I think most importantly is that analysis is that by the NRC's own legal analysis, environmental justice analysis isn't required for an environmental assessment. That was made clear in its final federal register notice of its environmental justice policy. So I think for site-specific environmental justice analysis we can say good-bye, that in the event of a GEIS, at least the way things stand now.

Going to the scoping process itself, it's been woefully inadequate. The scoping process had not had any meetings in any of the communities. There's nothing been done in Grants, the Navajo Nation, the Pueblo of Acoma, the Pueblo of Laguna, South Dakota, Colorado, Utah, Virginia, the list goes on.

Casper, Wyoming and Albuquerque were the extent of the public comment periods to date. It would be good

to get a commitment from the NRC for widespread and far flung public community meetings.

There's been no indication that any tribal consultation has been done. As trustee for tribes, the federal government has a legal obligation to consult. That, to my knowledge, has not bee done. Again, a commitment by the NRC in writing to consult with affected tribes, or potentially affected tribes, is necessary.

There's been no indication of the track record of the ISL industry, as Mr. Shuey pointed out. And I think this is particularly important of light of Mr. Von Till's Powerpoint presentation which seemed to, with all due respect, to be more of a commercial for the uranium mining industry than an objective analysis of the industry itself.

And to that end I'd like to say that you can look forward to comments, written comments, from the law center on behalf of its clients. And to that end, I'd like to put on the record that we'd appreciate additional time beyond the September 4 comment deadline in order to submit those comments. Thank you.

MR. RAKOVAN: Thank you, sir.

Next I have Joni Arends from CCNS.

MS. ARENDS: Good evening everyone. My name is Joni Arends. I'm with Concerned Citizens for Nuclear

Safety, a Santa Fe based non-profit organization that has been watch dogging the Department of Energy in New Mexico for almost 20 years.

I have a couple of specific comments, as well as general some comments. I would appreciate it if the presentations would be available for us to have copies of in terms of the public participation, to be able to take those materials home and to be able to study them and to use them in my comments on the GEIS.

A lot of the presentations emphasize that the NRC wanted public input. However, this meeting was not properly advertised. As many people have said, they just learned about it today. That's not okay.

The *Federal Register* notice was releases less -- or a little bit more than two weeks ago. That's not enough time to allow for the public to, especially during the summer time, to come out and -- when people are on vacation, to be able to come out and make comments.

And as Eric Jantz said, and others have said, further scoping hearings need to be scheduled with more than two weeks notice. They need to be -- scoping hearings need to be held in impacted communities, not only here in New Mexico and Arizona and Utah, but also in the Black Hills of South Dakota.

The fact that the NRC did not go over to South

Dakota where there's a major -- also in a major boom for uranium mining is woefully inadequate.

And I just want to note that today is the 62nd anniversary of the bombing of Nagasaki, which was a bomb made from uranium.

In order to provide informed public input, the public needs a 60 day extension of time for public comment on the scope. We need more scoping hearings in the impacted communities. Okay. So now I'm going to start about specific scoping comments.

In the draft GEIS, you need to include specific examples of where industry has been able to restore ground water to meet safe drinking water standards. And you need to document that and you need to provide citations for that so that we can go back and look at examples where industry has met those requirements, because as far as I understand, industry has never met those requirements.

Secondly we need information as to using, in terms of this monitoring well network, we want to see what are the requirements for the sampling and analysis plan. What are the sampling requirements? What is the analysis requirements? Are you using the most sensitive sampling methodologies in order to find the lowest detection limit for any of these radionuclides or other solvents?

We want to see those numbers, we want to see

those methods, we want to see the numbers, we want to see the, you know, ATSM numbers, whatever numbers, we want to see those numbers because we want to find out if there's even lower detection methods out there. Because our organization works with the Department of Energy, and this is a little thing that they like to do, is they don't like to use the most sensitive detection, most sensitive analysis.

We want you to look at energy conservation. We want to look at how much energy can we save by conserving in this country, as opposed to opening up uranium mines again. We want to see that comparison in the GEIS.

And if you're going to use the global warming argument as justification for the GEIS, then what we want to see is we want to see a document that talks about all of the existing waste right now that hasn't been dealt with from past uranium mining, milling operations throughout the United States. And we want to see the path forward for all of that waste.

We want to see the numbers in charts, we want to see them in numbers that make sense to people, we want comparisons to football field size amounts of waste spewed all over this country. And we want to see that comparison to where the path forward is for the disposal of all that waste.

Finally, sir, you talked about a separate analysis with regard to the security. And what I want to -- we want to find out is, if you're going to do a security analysis, is it going to be like for the LES facility, the Louisiana Energy Services facility? Is it going to be that you have to sign a confidentiality agreement in order to review the security analysis, even if it's available?

So you need to state that in GEIS. What are the requirements in terms of security. What requirements need to be -- do you have to sign an agreement, do you have to be a party to any protest to that? How are we going to find out about how that security process is going to go forward analysis?

And finally, Mr. EPA, where are you? Would you please come to the Greater Than Class C hearing next Tuesday night in Los Alamos and talk about the Office of Radiation and Indoor Air, and talk about concerns about the burial of greater than class C DOE waste?

Because they're proposing to do that at Los Alamos National Laboratory located on the Paharito Plateau above the Rio Grande where detections of plutonium 238 have already been found in the Sante Fe drinking water supply.

So if you could come to that hearing, we would

appreciate it, and be as forthcoming to the Department of Energy about the concerns about public health and protecting the environment. We would surely appreciate it. So thank you very much.

MR. RAKOVAN: Andy Campbell.

MR. CAMPBELL: Yes, for -- to all those --

MR. RAKOVAN: I'm not sure if that one works. You might as well come up here.

MR. CAMPBELL: We did not want to bring 100 or more pounds of paper with us to hand out paper copies of the presentations. So we ask for your e-mail addresses and we will e-mail to you PDF files of the presentations.

We'll scope them down in font -- I mean, in the size of the file, so those of you that have dial up can receive those files. We'll make them small enough that a dial up person can receive them.

So if you haven't provided your e-mail address, please do so. That will also give us a database for future meetings, interactions, notices, and so on. We're going to try and build a database.

And one last thing, we will be building a website on the NRC's website and post these materials and try and keep people up to date. We feel that would be a good way to stay in touch with people rather than bringing hundreds of pounds of paper with us on the airplane.

Thank you.

MR. RAKOVAN: We have a question about -- if you're going to ask a question, I'm going to have to ask you to come to a mike though so we can get it on the transcript.

VOICE: Not everybody has computer access, internet access. So what are you going to do about people who want the information who can't get it by e-mail?

MR. CAMPBELL: I would hope that we would drop it in the mail to them.

VOICE: Okay.

MR. CAMPBELL: So provide your --

VOICE: Thanks. You should have made that clear.

MR. CAMPBELL: -- snail mail address.

MR. RAKOVAN: Michael Jensen.

MR. JENSEN: Hi. Michael Jensen. I work for Amigos Bravos. We're a statewide river and water protection organization up in Taos with an office here in Albuquerque.

What's driving this -- if you look at the national media, *LA Times*, *New York Times*, *Wall Street Journal*, if you look at some of the industry coverage of this, it's being driven by speculation, prices are being driven up by speculation.

And I would imagine that one of the things that driving the GEIS process is that getting a GEIS out is going to make it easier for speculators to start trade in permits. I don't think that we really need to expedite the process.

Also, out of concern for the NRC's limited staff time and budget, and the express concern by the conventional industry that the 1980 GEIS get reviewed, I would suggest that they just take this one off their table now until they get that one done and fit it into the time line of ISL production and the need perhaps some decades from now for more uranium.

Common ISL issues. The only common ISL issues that I'm aware of are not very good for the public health and the environment. And if we're going to have a GEIS based on those common ISL issues, learn from decades of analysis here and elsewhere, I would suggest, again, that perhaps in the interest of limited resources and time just take it off the table.

What else? Let's see, we work, to the extent that we work with mining issues, with the hard rock mining industry. And a study came out last year analyzing the U.S. hard rock industry and how permitting and remediation claims actually work out in reality.

The general conclusion of that report was that

you could flip a coin and get a better conclusion, a better guess about the permit living up to its stated claims. In reality, and I'm not saying that the mining community is pernicious or evil or bad, but in all sincerity, people put their best case forward, they make their stated claims, you know, for the -- as, you know, a regulated community.

The best case scenarios and the regulators, we all know they come from and they hope to go back to the regulated industry, because, my God, they pay a whole lot more, and what you get is permits that don't reflect reality and remediation that doesn't work.

That's -- the hard rock mining industry groups that work with other regulated communities can tell you the same thing. It's the way the process works. So take everything that you hear here with more than a grain of uranium. Okay.

Energy. NREL in Colorado, the National Renewable Energy Laboratory, did a study on the amount of U.S. energy demand that could be reduced through conservation and renewable energy. They put that report up on their website, and during the run up to the energy development plan out of Dick Cheney's office, that report was ordered taken down.

The conclusion of that report was that we could

significantly reduce energy demand in the U.S. through conservation and renewable energy technologies. Again, there's not a big press to do this, and in the interest of your limited resources and time, why don't you just wait a little while.

Jobs. I have an incredibly deep respect for the people who need jobs in these communities. I would believe that all of us on the environmental justice side of the equation here respect that because we actually spend a lot of time in those communities. We know what goes on in those communities. Please don't make this a jobs versus public health and environment issue. It isn't. Okay.

Study after study, including one that just came out last week, show that in the west recreation and tourism provide way more jobs, sustainable jobs, than the mining industry does. So if you want jobs, go to Senator Ulibarri and the other policy makers in your cities and your counties and ask them to go after those good, sustainable jobs.

The Western Governors Association this whole decade has been pushing for that they call the restoration economy. Abandoned mines, partially cleaned up mines, there are a lot of jobs available cleaning up the mess that has already been made. We don't need to make more of

it before we clean up what's already out there, and it provides jobs, good jobs.

ISL, you saw those presentations, there are a lot of machines, there weren't very many people there. It's not going to provide very many jobs. The jobs it provides should be well-paying, but it's not going to provide a lot of jobs. There were three cars in the parking lot in that picture they showed of the facility.

Okay. Thank you.

MR. RAKOVAN: Thank you for your comments, sir.

I just want to point everybody out that it's a little after 9:00 right now. We've still got a lot of people that need to talk, so we're going to try to get through them as quickly as possible.

If someone has made a comment that you are -- just want to reiterate or that you agree with, you can just go ahead and say that. It'll be in the transcript so we'll have all that language down.

Next I've got Ruth Armijo.

VOICE: Armeeho [phonetic].

MR. RAKOVAN: Arribo? Sorry. Sorry. This is an Ohioan trying to wrap my tongue around this stuff.

MS. ARMIJO: Okay. My name is Ruth Armijo. I'm president of the Juan Tafoya Land Grant, and I'm also a rancher from Mount Taylor area.

We leased our land for uranium mining. I'm all for uranium mining and support the jobs it will bring to our people. I hope that our nation can continue to depend on our resources and not foreign countries. Thank you.

MR. RAKOVAN: Thank you, Ms. -- aw, I'm going to -- I got it wrong right off the bat. I'm not even going to try anymore.

Melvin Capitan?

MR. CAPITAN: Good evening. My name is Melvin Capitan, Jr. I'm a geologist for HRI Energy. I just had a couple of comments.

First, I work with the EPA, NEMO EPA, for six years under the underground injection control. A couple of comments I have is that -- or anti-groups are sending out the wrong messages of uranium. Quit using annihilation, genocide, holocaust. The top three killers on the Navajo Nation is poverty, alcohol and drugs.

Another comment I have is, have you, the groups, media, have shown the Navajo people what the EIS is all about? I don't think so. I have asked throughout New Mexico and Arizona and Utah.

They don't know what an EIS is all about. You have to explain to it in Navajo to them, not only in a day, two, week, month, years. It takes some time to get grandma and grandpa to get so in with you to understand

what you're talking about. Thank you.

MR. RAKOVAN: Thank you for your comments, sir.

Rosemary Blanchard?

MS. BLANCHARD: Okay. I was coming here on my own behalf and I was given a paper -- I was given a set of comments by Mr. James Zion, who is an attorney representing the Nation Indian Youth Council and the Forgotten People, who used to be called the Forgotten People of the Bennett Freeze Area. And so I'm going to very briefly address their statement, because it's in writing, and so it can also be submitted in writing.

What in particular this statement addresses is the fact that there needs to be -- in each and every individual case of application for a site license there needs to be a robust environmental justice analysis. It's very, very briefly in your *Federal Register*.

But, in fact, in the areas in the Southwest where uranium has been mined in the past, where uranium miners have died, where water has been polluted, where ways of life have been affected, it's going to be necessary that you, in fact, address -- and they had -- they introduced me to something I didn't know about.

Executive order 12898, which is the executive order that requires that all federal agencies have a process for an environmental justice analysis whenever

they're activities are affecting minority populations and low income populations.

And I'd remind you there's another executive order, and I never can remember the numbers of these things, that specifically requires that whenever an action of any federal agency affects Indian people, that there has to be -- the agency has to have specific ways that it will interact on a government to government basis with American Indian nations to address those issues.

And so I think it's important to ask the question, how are you going to generically do that? And my recommendation, the recommendation of the statement also, is you probably cannot do that. You're going to have to look at the history of the effects of uranium mining on particular minority and indigenous populations in looking at what are the environmental justice issues that arise around those people.

Now the GEIS -- getting back to what I was going to say -- the GEIS is not in place of an individual analysis of the applications, but it is going to set the parameters for that individual analysis. There's going to be things that are not within the scope of what you look at in the individual analysis, because that wasn't in the frame of reference that the GEIS created. That's going to be a problem.

Now another concern, one speaker said the GEIS is going to have -- be a really good thing to have because it's going to be unbiased. And I hope, frankly, that we will all have access to the full transcript of this meeting, not only the transcript of what we, the public, have said, but the transcript of what the presenters have said. And not only what they've put up on the screen, but what they've said.

Because I think in what they've said, there's a question that certainly arose in my mind as I was taking notes about the unbiasedness of the presentation. In one case ISL was called -- I think it was Mr. Till who called it the wave of the future. Now the GEIS hasn't happened yet and we already know it's the wave of the future? That's sort of the cart before the horse.

In another case there was a description of how there was the requirement to return the water to the state it was before. And I've got to read the transcript to figure out how we got from there to where we ended up, but the last thing in that sequence was talking about how you get an exception to the Environmental Protection Act for the site where you're doing the in-situ leaching.

Well, if already you're talking about how you get an exception to the Environmental Protection Act, then are you really talking about restoring that water to the

state it was in before? How did those two things end up in the same little piece of the presentation? So I really hope we get to read the transcript too, and not just a transcript of the parts that we said.

Now, very briefly, I want to give two experiences from my own past. I am now a professor of education at California State University, Sacramento. Fortunately I still get to hang out around here in the summer time. But I spent six years working with the Navajo Division of Education, I spent eight years on the faculty of UNM Gallup.

In both of those situations I bumped into the consequences of the uranium mining of the past. I saw -- a student turned in part of a sociology project, had found a report from the Indian Health Service. Some of you may remember that there was a big uranium tailing spill at Church Rock and a lot of the water went down the watershed of Rio Puerco to the west and to the south.

I saw a report, a report published by the Indian Health Service. It was as official as they come. What it said to the traditional people along that waterway was that they could grow their sheep, but they probably shouldn't eat them. I'm not kidding. That's what it said.

Now I don't know how that translates into

Navajo, but it was a pretty cynical statement I thought. So did the student who used it as an attachment to their social problems report.

Before that I had been -- when I was with the Navajo Division of Education, I was in a meeting with the Indian Health Service, the Bureau of Indian Affairs, and some of us from the Navajo Nation about the people who were going to be living in the new lands.

Interesting thing, they were going to have to dig -- the Indian Health Service was going to have to dig deep artesian wells for those people. Why? Because the ground water, the aquifer, was so polluted with uranium tailings as a result of the spill.

We wanted to tell the local elementary school these kids were going to be going to, because they were using that water. The Indian Health Service said it wasn't their business to tell the school. The Bureau of Indian Affairs said it wasn't their business to tell the school.

Thank God there were a couple of us there working for the Navajo Nation who figured maybe it was our business to tell the school, so we told the superintendent you might want to check the water.

My question is, who's responsibility is it going to be to deal with failures of containment when they

happen? Will it be the Nuclear Regulatory Commission? Will they fix it? Will they clean it up? Who will be responsible? Nobody was responsible in regard to the wash down the Rio Puerco. Who will be responsible both if and when it's not as clean as everybody says it is?

Thank you. And here's the statements.

MR. RAKOVAN: Thank you. And I've got your statements.

MS. BLANCHARD: And I will be sending you a written version of mine too.

MR. RAKOVAN: Okay. Rick Van Horn?

MR. VAN HORN: I would like to yield my time to Ben House, who's here representing 14 allottees, if I could.

MR. RAKOVAN: You'd like to yield your time? Sorry. Could you come to a mic and say that so we can get that on the transcript?

MR. VAN HORN: Yes, sir. My name is Rick Van Horn. I represent Uranium Resources. I would like to yield my time to Benjamin House who's representing 14 allottees who've traveled all the way from Crownpoint to address this meeting.

MR. RAKOVAN: Okay.

MR. HOUSE: Mr. Chairman and members of the NRC Commission. On behalf of the Eastern Navajo Agency

Allottee Association, I'd like to thank you for allowing me to make a statement reflecting the uranium issue.

My name is Benjamin House, an allottee and president of the Eastern Navajo Allottee Association representing more than 400 allottee who own allotments or lands in the Eastern Navajo Agency. Allottees wholeheartedly supports the in-situ recovery mining of uranium on their properties.

As U.S. citizens, we have the constitutional rights to utilize our land in any way, any manner that we choose. We feel that we have been denied these opportunities because of lack of assistance from our elected tribal leaders.

We feel that knowledgeable and reasonable decisions by our tribal leaders are hampered by the continual interference and drummed up misconception of the in-situ recovery by Eastern Navajo Allottee -- Eastern Navajo Dine Against Uranium Mining.

Members of the panel, what we lack in the Navajo Nation are economic development and jobs. The Navajo Nation and its people have serious social problems with alcohol and drugs that result from lack of employment. We have the resources to improve our economy. A very important natural resource within the Navajo Nation is uranium.

New Mexico leads the nation in known uranium resources. The allottees, our neighboring Navajo communities, and citizens of New Mexico will benefit from a strong and needed economic boost. Some of us allottees and Navaho Nation officials have visited HRI's parent companies' operations. We learned they were clean, safe and environmental benign.

The proposed mining affects our environmental interest, but in our opinion and belief that there has been sufficient studies, particularly evidenced by a final environmental impact statement to proceed opening the mine.

The allottees appreciate and support the NRC's efforts on the generic environmental impact statement for in-situ recovery mining and milling. We believe it will separate facts from fiction and finally provide the truth about the methods so all citizens can make informed decisions. Thank you.

MR. RAKOVAN: Thank you, sir.

Danny Charley.

MR. CHARLEY: Good evening, ladies and gentlemen. My name is Danny Charley. I'm an allottee landowner. I just would like to say that I support ISL, in-situ leach mining, in our area because of the jobs that are needed. We have people -- we are in dire need of jobs

in our community.

We have people that are selling drugs just to make ends meet. People have to sell their stuff at flea markets to put bread on the table. And what about these people that are against uranium? Will they bring us jobs? No. They don't come to our community and see what's in our refrigerators. No.

Like the man said, why can't we all sit down at one table, at one table, and make something positive out of this? Why can't we all get together and work -- and make this work? Why do we have to instill fear into our people and say [speaking Navajo].

You know, we don't need to talk like that. Why can't we just all work together and make something positive out of this and make it work? Yes, we're going to -- it's going to put a good amount of money in our pockets. But it's also going to help our community, my community of Crownpoint.

I've known HRI for 20 years, and I myself, as an allottee, will not just sit there while something's going wrong. Before I sign the lease, I'm going to make sure that my people, my Navajo people, are protected first. I'm going to make sure that they're going to be safe.

We need jobs in our community, in our

surrounding areas. That's all I have to say.

MR. RAKOVAN: Thank you, sir.

Steve Cabaniss from the University of New Mexico.

MR. CABANISS: Thank you. My name is Steve Cabaniss. I teach chemistry at UNM, but I'm not here representing the university. I hope you'll forgive me if this sounds a little academic. I have here an NRC report published on the web in January; it was written by U.S. Geological Survey scientists at the request of NRC's Office of Nuclear Regulatory Research.

So, Mr. Shuey, Mr. Jantz, you both commented there had not been a systematic review of ISL, and that's true. This is not a systematic review; However, this paper does give two examples of completed ground water restoration at uranium ISL sites. One of them is the A-Wellfield, Highland in Wyoming, the second is the Crow Butte Mine, Unit Number 1, in Nebraska.

The A-Wellfield restoration took seven years, from 1991 to 1998. They further collected stabilization data until 2003, and in 2004 the NRC determined that the A-Wellfield had been restored in accordance with the applicable regulatory requirements. That's a quote from this document.

Well, what does that actually mean? What

does -- in particular, what does it mean to restore the water? Here come a few numbers, I can't help, but I'm a chemist, please bear with me. In 1987, before they started, there were 50 micrograms of uranium per liter in that ground water. At the end of mining that had gone up to 40,000 micrograms per liter.

And that was when they began the remediation. And they knocked that all the way down from 40,000 to 3,500. That's a factor of 10. That sounds pretty good. But the EPA does have, on these MCLs, the so called maximum contaminant level, but some idea of how low the uranium should before it's going to be consumed.

Their idea is with people, but I think the same level holds true for sheep. And their level is 30 micrograms per liter. So on one hand it's true, before these people started mining that water was high in uranium relative to the EPA expectation.

But when they were finished and when the NRC had given their approval and said this was restored, it was 30 times higher than the EPA level. It was -- excuse me, it was 100 times higher than the EPA level. It was 70 times higher than the level it had been before they began the mining.

I won't go through the other site in quite the same detail. I'll just tell you that that took nine years

total restoration and monitoring, and that at the end of it the restored ground water had 30 times as much uranium as it had before they started -- excuse me, 30 times higher than the EPA limit, 10 times than before they started.

So on the one hand Mr. Von Till has stated that, "We require that the companies restore the ground water to the way it was." Well, I think that's a worthy goal, but it doesn't seem borne out by NRC history and practice.

Restored should not mean less poisonous than mine drainage. Restored, I think, ought to mean safe to drink. But if it doesn't mean safe to drink at a minimum, it ought to mean that it's no worse than the water was before they started mining.

So, Mr. Charley, when you sign that lease, because I expect at some point you will have an opportunity like that, why don't you make sure that the people you're signing it with understand that the water, when they're finished, is supposed to be as clean as when they started. Thank you.

MR. RAKOVAN: Thank you, sir.

Okay. The next card -- and I apologize. It looks like Paul, either Frye or Faye.

MR. FRYE: My name's Paul Frye. I'm speaking

here on behalf of the Navajo Nation Attorney General. There will be written comment submitted later. I'll summarize some of the -- falling microphones -- some of the comments that will be submitted to the NRC.

First of all, greetings to a lot of people who I haven't seen for a while. My old client, Commissioner Becenti, [speaking Navajo]. The Allottees Association, you don't know it, but I represented you for 13 years in litigation against the United States, in part because the United States claimed to own the uranium under some of the allotments under the Atomic Energy Act of 1950.

And after the United States Department of Justice was found to be intentionally obstructing justice in that case it, it was settled so that the allottees now own all of the minerals, including the uranium under the allotments. And that was -- that litigation was funded, in part, by the Navajo Nation. I know we have our differences now, but the Navajo Nation generally supports the rights of allottees.

The findings of the Navajo Nation Council last year include the following, the fundamental laws of the Dine, the Navaho People, support preserving and protecting the Navajo Nation's natural resources, especially the four sacred elements, and it's the duty and responsibility of the Navajo to protect and preserve the natural world for

future generations.

Social, cultural, and natural resources and economic damage to the Navajo Nation from past uranium mining and processing is ongoing due to the continuing need for full monetary compensation for former Navajo uranium workers and their families, for their radiation and mining induced diseases and death.

I've heard some people refer to this as an emotional issue. You bet it is an emotional issue when you've got your family members dying around you.

(Applause.)

MR. FRYE: The Navajo government respectfully submits to the NRC that there is no other political or geographical area in the United States, and perhaps the world, that has suffered and continues to suffer from the environmental impacts of past uranium mining and processing to the same extent as the Navajo Nation.

So when we talk about a generic environmental impact statement that deals with environmental justice, it's either not going to work at all because that has to be dealt with on a site-specific basis for each of the proposed mining areas on the Navajo Nation, or it has to result in basically a no action recommendation in the environmental impact statement for the entire Navajo Nation.

In the Eastern Navajo Agency where the current activity is being proposed, there's a superfund site that the government has long been trying to clean up since 1979. There's a 100 million gallons of radioactive sludge going down the arroyo that everybody lives next to and their livestock inevitably graze in. There's no end in sight.

A few miles up the road from the superfund location, contractors under the direction of the EPA are conducting an emergency removal operation at a former uranium mine site that within the past few months required the temporary relocation of Navajo families.

So here's a few recommendations, and some of these come from personal experience, so they may not represent the views of the Navajo Nation. First of all, sort of borrowing from the medical profession, the first thing is to do no damage. In this process, let's make sure that there isn't misinformation given to the public.

I almost left to redo my last will and testament when I found out that the water at Crownpoint was already contaminated with uranium because I lived there for four years, and thank God somebody over in the site told me that that water actually is pure. And I was drinking for four years that water completely untreated, and it's pristine. It's not contaminated in Crownpoint.

(Applause.)

MR. FREY: Now I agree with the comments as well about supporting wholeheartedly the NRC in its standard that it will require the water to be restored to the level prior to the mining activities. So the environmental justice question is central to the Navajo Nation.

Ms. Bloedel asked a question that wasn't rhetorically, but it's easily answered. Is the NRC, after this experiment, the new experiment on the Navajo Nation is completed, is the NRC going to restore the water?

The water of the Westwater Canyon, which the presenters have said is the aquifer where this activity will take place, that water is pristine and it serves and area probably larger than the States of Rhode Island. I'm not exactly sure. But there's about a two million acre area that relies on the Westwater Canyon aquifer.

No, the NRC will not restore the water, and no, the BIA won't, and no, the EPA won't, and yes, the Navajo Nation's going to have to deal with this problem.

What is the NRC's record to date with respect to environmental justice? Well, we have one permitting decision that's been reached, and what it does, in my opinion, it ignores all of the past contamination. It says, We aren't going to look at the existing health

problems that people are now actually facing in the Church Rock area when we do this licensing decision and consider whether additional radiation exposure is going to harm them.

I think that kind of sweeping the past under the rug does not comply with the environmental justice responsibilities of the agency. There has been no consultation to my knowledge with the Navajo Nation, despite the executive orders, and despite the trust responsibility.

So the Navajo Nation will, I think, urge that the NRC examine all of the alternatives. One of the alternatives is not more coal, not more uranium, but some other kind of energy. Someone said that there is no such thing as a clean energy source.

Well, you know, I get sunburned and maybe that's the reason the sun isn't clean, but there's solar energy, there's wind energy, there's conservation, there's all of these other things, and the NRC should examine those.

(Applause.)

MR. FRYE: It should examine quite seriously in the context of the GEIS the no action alternative, especially for the Navajo Nation.

And, let's see, finally, the site-specific EIS

should be required in all cases because the conditions are site specific, the environmental justice issues are site specific, the geology and hydrology are site specific, and real people depend on this aquifer for their very existence. Thank you.

MR. RAKOVAN: Thank you, sir.

I'd just like to point out that it is after 9:30 at this point. I just want to compliment everybody for sticking around this long. It's very impressive and it obviously shows how important this issue is to you.

We're going to keep on going and try to get through everybody. If people could please remember to be brief. I've still got a stack of speakers and I really do want to try to get to everybody. I'm not sure what happens at 10:00 though, so I'm hoping to be done by then.

Having said that, Leona Morgan? Leona Morgan, are you here?

(Pause.)

MR. RAKOVAN: Oh, I'm sorry, I didn't -- there's movement throughout, I didn't see someone approaching.

MS. MORGAN: Good evening. I'd like to thank everyone who stayed and is listening to all of our comments. And I'd like to thank the presenters here this evening. [Speaking Navajo] Leona Morgan [speaking

Navajo].

Hello, my name is Leona Morgan. I am a resident of the Navajo Nation and New Mexico. I am a recent graduate of UNM, and I am also the lead organizer of the organization Eastern Navajo Dine Against Uranium Mining. And I am here to make comments on the generic EIS that has been proposed by the NRC.

First of all, I'd like to ask for an extension of the public commentary period. I believe that with a release date of July 24, and given the time up to September 4 is not sufficient time to inform all of Western United States that we have time to make comments about this supposed generic EIS. So please, I'd like to have that commentary period extended

Also, I'd like to speak to a comment made by, I believe, Von Till earlier today. There was a statement that was made about the already polluted sources of water. And I know that's not true because where I work in Crownpoint, New Mexico -- Crownpoint, New Mexico has some of the most pristine drinking water, and that's water that I drink, that's water that I know my family gives to their animals, and I know that's water that we use on our plants.

So for someone to say that the water is already polluted, that is just not true. I know there's people

that have been researching it and have done testing on test wells, and that their tests have concluded that the water level -- the uranium in the water is at a safe drinking level, which is less than one part per billion. So that is false information that the water is already -- in that area anyways, and that's us, where I reside.

Another comment I would like to make about false information being given out by the organization, ENDAUM, and this was a comment made by Ben House, the president of the Allottees Association.

If anyone has any questions about any of the information distributed by ENDAUM, I will be happy to rectify any questions or concerns that you might have about misleading information, because that is also a false statement.

And I can direct you to a website, a SRICs website. They're an organization that we've been working with who has been researching the uranium mining in the area for many years, longer than I've even been alive, and their website is, www.sric.org.

And I just want to make a comment to the recent incidence of -- well, someone mentioned it, the recent anniversary of an incident at Church Rock, which was the uranium tailing spill that happened on July 16. And I believe this was an action that took place where many of

the residents in the area had no idea of the harms of the uranium mining.

And that is also the current situation of today. I am 26 years old, and I'm learning -- I'm just learning about all of this, and that's where I live, this is where I want to raise my family, and this is how the United States, NRC, is approaching us is to tell us that our water is already polluted and that we're going to come in and help these companies to get through this process much quickly -- much more quickly because we need the energy, I guess. Or maybe we need the resources for weapons manufacture. I'm not sure.

However, I'm coming to make a comments specifically on our land as Navajo people. We as a nation have had a ban on uranium since 2005, and I believe that this proposal to create a generic EIS that will help uranium mining to continue is a direct assault on our sovereignty as a Navajo Nation, as native peoples.

And this is a common theme that has been happening many, many, many years, and it's been happening all over in every indigenous culture, in every indigenous nation, that is affecting all of our cultures.

And, yes, I do believe that it has affected our cultures, not only at the time when there was the spill we were told not to eat the sheep. There's a lot of other

things that involve the use our animals, we use the whole animal.

And I understand back then they told some of the people you can't eat the intestines, or you can't do this and that. Well, that's also a direct assault on our way of life, which is believe is our first amendment right as American citizens is our right to practice our religion. And though the Navajo culture may not be considered a religion by the U.S. standards, that is how we practice our belief, our belief systems and how we live.

And so the United States, NRC, to help these companies to do uranium mining, especially proposed mining on a sacred site such a Mount Taylor, it is atrocious because this is not only contesting our sovereignty, this is affecting our culture and our way of life, and the future of our generations who will not be able to learn the traditions the way they were meant to be taught. The -- Mount Taylor is a sacred -- one of four cardinal directional mountains, one of six sacred mountains of the Navajo people.

And I would like to further comment that there's not been one single mention of tribal consultation that I can think, that I can attest to right now, and so my question is to the NRC, and my comment is to work with

all of the tribes. There's Navajo and there's many other tribes, not only in New Mexico, but in all of the Western United States. And to do a generic EIS is to undermine all of the site specific situations that each tribe and each environmental area will -- how they will be affected.

And I'm sorry, but earlier someone mentioned emotion, and, of course, this is a very emotional topic because you're talking about my people, you're talking about my future.

And, yes, we need jobs, there is a lack of economic development on my reservation, and that doesn't mean that we need to run to uranium mining to -- just to come to -- try to come to a resolution to the economic development problem. The problem with economic development is an internal problem that we have a nation.

However, that does not mean that uranium mining is the answer. There's solar power, there's wind power, there are other sources of renewable energy that we need to look toward before trying to consider polluting and destroying more of our pristine waters.

Not only the aquifers and the waters will be affected, but the entire -- everything that drinks the water. That's all life. That's all of our plants, that's all of our animals, and for the future.

I don't know how much of you guys have seen the -- if anyone watched the "Nova" special on Tuesday night about the -- was it the epigynums. Well, not only are things affecting our genetics by what we eat, but there's environmental impacts that have not been studied. There are health studies that have not been completed. There are people who have died because of cancers caused from radiation that have been studied.

And I'm asking the NRC to consider all of these effects before thinking about even considering to create a generic EIS statement. There are too many issues to look at to try to create a generic EIS. That doesn't make sense, and I think the purpose for EIS was to study the environments, and there is nothing generic about our environment. [Speaking Navajo].

MR. RAKOVAN: Thank you, Ms. Morgan.

Hildegarde Adams?

MS. ADAMS: It is getting late. I'm going to keep my comments very brief. I'm totally opposed to any more uranium mining in New Mexico.

I think New Mexico has already made plenty of sacrifices on behalf of the nuclear industry, and I'd like to see no more. And I also think native people in our area have made enough sacrifices. Thank you.

MR. RAKOVAN: Thank you.

Shrayas Jatkar?

MR. JATKAR: My last name is pronounced with a J, to confuse you some more.

My name is Shrayas Jatkar. I'm here as an outreach resident of New Mexico, and I'd like to start off by first saying thanks, as many other people have, but not thanks to the NRC. Thanks to all the people who have been in this struggle for many, many decades and who have forced agencies like the NRC to be legally obligated to hold public meetings like this.

Oh, come on, you can clap.

(Applause.)

MR. JATKAR: I want to keep my comments to things that have not already been said. First I want to talk about the cumulative impacts that need to be taken into account. In the area where the uranium mining is being proposed, there's already two existing coal fired power plants, possibly a third.

We're also talking about pit production that triggers nuclear weapons being more in production at Los Alamos with its constantly expanding its operating permit to expand, include more and more waste.

And the uranium enrichment facility is opening up in Eunice, and that's not to mention all the other possible nuclear facilities, reprocessing plants somewhere

else in Southeastern New Mexico, and somewhere -- nuclear production here at Sandia in Albuquerque.

And so the cumulative impacts needs to be taken into account when we talk about -- instead of looking at all these in isolated incidences. And when we talk about cumulative impacts, or impacts in general, I think people may not -- nobody has spoken to the fact that doses -- when we talk about radiation doses, those are considered only for what they call a reference man.

And a reference man is defined as being between 20 to 30 years of age, weighing 154 pounds, is five feet seven inches and lives in a climate with an average of from 10 to 20 centigrade. He is a Caucasian and is a Western European or North American in habitat and custom. These are not my words. These are the words of the International Commission on Radiological Protection.

That means to say that the people of New Mexico are not mostly being taken into account when we talk about the acceptable doses of radiation. We need to be setting standards for the most vulnerable in our society, women and children who are much more affected by smaller doses of radiation.

And I also want to make another case about environmental justice. Hopefully environmental justice is considered and it's also taken into account. And I think

if it's taken into account, we'll find that there is no excuse for more uranium mining in this state.

And I think I want to also focus on the benefits of clean energy, or real renewable energy, because most folks have been mentioning it, but I want to give some numbers to folks who may be thinking that that's just fluff language.

There's a report by the Union of Concerned Scientists, I've got many copies with me, if you want one let me know. If New Mexico had a renewable electricity standard of 20 percent by 2020, which is really nothing. You know, people have said that New Mexico has the second largest, you know, uranium deposits, well, we've also gotten the second largest solar potential in the United States.

And if just 20 percent by 2020 of renewable electricity was supplied to people, there would be 2,860 new jobs, $2.21 billion in new capital investment, $100 million in income to farmers, ranchers, and other rural landowners, $71 million in new local tax revenue.

And in terms of consumer savings, that's everybody, $190 million in lower electricity and natural gas bills by 2020 growing to $390 million by 2030. And the impact on global warming would be a reduction equal to taking 36.4 million cars off the road.

And that's only 20 percent renewable energy. We've got a lot more potential here in New Mexico.

The other thing I want to talk about is water. People are talking about these things again in isolation, but folks have probably heard about Desert Rock, a proposed coal power plant. Desert Rock would use four and a half million gallons of water per day. Per day.

And so I think when we talk about the impacts on our water resources and other natural resources, we need to take all fo these things into account, because the nuclear industry is a huge consumer of water from the mining and milling and to the production.

And with that I'd like to close by offering a new initiative that I think we should be launching, which I would like to call the NMPTP, that the New Mexico Potty Training Program. And I think that needs to be held for the companies who have already polluted our water, our air.

And, you know, I mean, I know that folks are probably individually potty trained, but I think we need to be doing that at an institutional level. Okay. We should be cleaning up the waste before generating more. And if anybody wants to talk to me about the NMPTP, I'll be in the back.

MR. RAKOVAN: Thank you for your comments.

Laura Watchempino. Laura Watchempino?

VOICE: She's coming.

MR. RAKOVAN: Oh. Okay.

MS. WATCHEMPINO: [Speaking Navajo] My name is Laura Watchempino, and I work as a water quality specialist with the Pueblo of Acoma. I wanted to remind everybody that may not remember what the purpose of the National Environmental Policy Act is. I think sometimes we lose sight of this very important goal, and that is to restore and maintain the environmental quality to the overall welfare and development of man. That's everybody.

The -- NEPA declares that it is the continuing policy of the federal government, in cooperation with state and local governments, and other concerned public and private organizations to use all means and measures, including financial and technical assistance, to foster and promote the general welfare, the conditions under which man and nature can exist in productive harmony and fulfill the social, economic and other requirements of present and future generations of Americans.

It is the responsibility of the federal government to use all practical means consistent with other essential considerations of nation policy, to fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

And this is something that we have to look at in a bigger context, perhaps even a whole millennium that native peoples have survived in their homelands here in the Southwest.

The area that I wanted to talk about is the area surrounding Mount Taylor, a sacred site. And as you can see, it's a very prominent geologic, historic, cultural feature in the Southwest. Many watersheds emanate from this mountain. This is our life blood here in the Southwest, both surface and ground water.

And some of the areas that are being looked at to the west of the mountain will eventually flow into the Rio San Jose, the life blood of the Pueblo of Acoma. We're directly downstream. We've lived through one -- several decades of mining in the 1960s through the 1980s.

We've suffered the health impacts, we've suffered the effects on the river, wildlife, plants, vegetation, water quality, have all suffered and we're continuing to see these effects into the new millennium.

This watershed surrounding Mount Taylor is a principal watershed, the ground water and the surface water, for all of Northwestern New Mexico. This wasn't known at the time, or if it was known it was ignored during the original mining boom beginning in the 1960s through the 1980s.

This is something we want to protect because we're thinking of future generations. The generations who will come after us into the next millennium. This is a big responsibility, Nuclear Regulatory Commission, as a trustee for future generations.

The impacts that I'm talking about are environmental justice impacts because if you're looking at a generic impact statement for this area again, yes, we have been impacted. Our water is one of the watersheds that has been impacted, and if you restore it back to the way it was, we've already been told we don't know, it's already contaminated.

We have a superfund site at the end of the San Mateo watershed that you know you're looking at remediating by expanding it because you have not been able to contain the contaminant plume. We're downstream. And probably the only reason that we haven't really, really felt the true impact is because the river is dry upstream of Acoma.

All this ground water dewatering, or mine dewatering, has sucked the river dry above Acoma. So there are many, many impacts, in particular the ground water so connected to our culture and our way of life at Acoma that you need to address both culture and ground water. This is something that a generic environmental

impact statement cannot adequately address in our responsibility as trustee for future generations.

So I'll leave you with a copy of a statement from Acoma that I believe you already have in your record, and a companion resolution that was adopted by the All Indian Pueblo Council earlier this year during the month of June.

There was one last year during the month of December, but this new one really highlights the impacts to regional ground water, the La Jara and San Mateo Creek drainage areas of the mountain to the west of Mount Taylor and the cultural properties within this area that are -- will not only result from any future mining or milling, but that are resulting right now from the exploration that's going on.

People don't realize because we look at -- we've been told this is a minimal impact activity, exploration. But these exploration drill holes are going 2,000 feet deep into the base of Mount Taylor, or the surrounding area of Mount Taylor. This is a desecration. The is a desecration to all the cultures that depend on this sacred mountain, this feature that will be here long after any of us are ever here.

And that's something you need to look at. It's probably impacting several aquifers besides the Westwater

one that was mentioned earlier. And this is allowing pathways for water to migrate both upward and downward. Cleaner aquifers may be affected by polluted water. And the exploration itself needs to be addressed.

So that was mentioned by the All Indian Pueblo Council, as well as a request, or a demand, for consultation with the tribal communities that you're impacting so that we can state our request that this whole area be declared unsuitable for mining activities due to its widespread cultural significance as a sacred site by all the tribes here in the Southwest, including the 19 Pueblos, the Hopi, the Navajo, the Hickoria Apache. And I'm sure there's other tribes that I haven't mentioned because this is such a sacred site.

And I believe that all the wisdom of the native peoples that have lived here for many millennia is the knowledge of the watershed and the ground water resource is contained within that, as well as the importance of all life, not just human life, but the plants, the animals, the air we breathe, and other elements.

So thank you for this opportunity.

MR. RAKOVAN: Thank you.

We've got a few left and so let's try to get through these quickly if possible.

Eliza Pintor?

MS. PINTOR: My name is Eliza Pintor, and to ensure that all of our people who are directly affected by this get a chance to talk, I'm going to yield my time to Esther.

MS. YAZZIE-LEWIS: Good evening. You all still awake? I'm ready to go to bed. It's past my bedtime.

(Laughter.)

MS. YAZZIE-LEWIS: Ya at eeh. I didn't like that answer. Telling me to go home? I'm here to express myself and my life being a part of the Navajo Nation. I'm Navajo. [Speaking Navajo.]

I've worked with Navajo people that have been affected by uranium, that are out there still trying to struggle to get some kind of payback for the life that they have suffered for their families. They're fathers, they're brothers, and they're uncles that have mined in these mines out in the Four Corners area, in Shiprock, Utah, Colorado.

You know, this evening, I was watching people getting water from those orange barrels back there. How many of you got water there because you felt like you needed a drink? And when you got that water, you felt safe to get that drink. Right?

(Pause.)

MS. YAZZIE-LEWIS: Right? You don't want to go

over there and get that water if there's something in it. Right? Well, I would like to know that if I go to a well on the reservation -- where all the Navajo people go to haul their water a distance -- some of them have to go into Gallup just because their water's polluted. Some of them have to go a long ways.

I know. My mother and my father -- they all hauled water. Even my sister today hauls water because of her livestock, just so that she can have water in her house. We don't even have running water where we can take a shower and wash our face every day; we have to have a wash basin to pour a little bit of water in there. No -- who has lived like that? I'd like to know who lives like that in this group right now.

(Pause.)

MS. YAZZIE-LEWIS: We all get to go to the bathroom, wash our hands, go to the sink and drink our water, and we feel safe. Right? We live in that comfort zone of security. Right? Some of our people don't have that privilege. We don't even have good roads. When the rain comes, we have to struggle in the mud.

You know, you talk about your GEIS -- acronyms -- BIA and others. And so I see that, you know, we have people here that say, We're for uranium. And it's really hard for me to say that I'm for uranium when I see

my own brother losing his teeth because he was working in a mill. It hurts.

What are we going to do? In Navajo life, elders have said, Don't ever mess with anything if you don't know how to make it right again. How are we going to make it right once we disturb something that is dangerous, that's hazardous, that is not to be fiddled around with? I don't think any of us here would want to be a part of that. I don't want to be a part of it.

And I speak like this because it affects my people. We've got dollar bills and human people over here. And I've heard testimonies of Navajo people that your life is not worth a dollar. Your life? Once you're gone, you're gone. Money won't buy it back.

Have I heard anything else somewhere? Has somebody given me something different to say that money will buy a human life back? We hear of cloning, but I don't think -- even that Navajo people feel is a tabu. There's something wrong in that. It's not right. It's not natural.

And so we forget all these things that bring us here. And we think that, having to, you know, herd sheep and having to be out there doing for ourselves. There was a time in my life when I grew up -- and money wasn't even a part of my life. I didn't know that money was a value

until I went to school, until I graduated from high school and realized that I had to work for money in order to sustain my own life.

But I grew up in a time when my father had a farm. My father had livestock. And we could go onto the farm and pick our own carrots and pick our own vegetables, and nobody said, Give me some money. And we traded. And we were all happy.

We've come to a time in our life when we now feel like the more money we have, we feel that we can look down on others. I live with it every day, and I understand it. And so my feeling is I don't believe in uranium, because uranium has done a lot of harm to my immediate family. At the time we -- my brother used to feel it was safe.

I was a little girl when we used to go up to Mexican Hat thinking that that was the thing, because it was money. Yeah, my brother worked, gave money so that we could have school clothes at this time of the year to go back to school. But you know what? Today, like I said, he's suffering.

But, you know, there are a lot of people out there that are trying to get funding, and there's so much red tape that they can't get any money for themselves. And they are dying off. That's the consequence of it.

Right here at the surface is money now, but [speaking Navajo]. In Navajo, that's what they say: In the future -- it is unknown, the consequences of what things will bring, because in our lifetime -- when I grew up, my elders used to say [speaking Navajo].

The people we come from [speaking Navajo] they prayed for us so that we would have a life. Now from here [speaking Navajo] into the future, the generations to come [speaking Navajo] we're the ones [speaking Navajo]. That's what they say. We will think for them. We will make the decisions on their behalf so that they can have a life where we are now.

The young people will stand here to say this is the way it was. This is how it was. [Speaking Navajo].

I wish you were all Navajos so you could understand just what I said, because I sure feel good about it.

(Applause.)

MS. YAZZIE-LEWIS: I appreciate you listening to me. I think you know what I mean. I think here -- these people here that have come -- I say, These people. They work for the government. They work for NRI. And so, you know, they're companies.

There's so much competition out there. There's so much out there that people want. It's a time of

grabbing opportunities, and stuff like that. And so I think in our future and in our time -- I feel like if I don't come up here and say something, what will the future be like?

And, you know, the other night -- and I'm going to end with this. The other night, we're all here -- we all carry around bottles of water. Right? We buy them in stores. Am I right? How many of you carry water and you feel like that's what you need to sustain your life for that day or that moment?

(Pause.)

MS. YAZZIE-LEWIS: Nobody? I'd like to see all the hands go up, because I know you all drink water -- we have to have water -- not unless you're drinking soda and other things that aren't water.

But, you know, I saw on there that everybody was buying these bottles of water and feeling like this is their security. And we see all the labels of where the water is made pure, clean, but then we found out it was tap water. That's what I'm talking about.

Have a nice evening. I hope you take to heart what I said. Thank you.

(Applause.)

MR. RAKOVAN: Thank you very much for your comments.

I've got a few speakers left.

Annie Sorrell.

MS. SORRELL: Good evening. I know it's late, but I'm glad you're all still here to listen to our comments. I thought I'd have to turn 67 before my time comes.

I'm 66 years old, and I am an allottee from Crownpoint. And I always say that I know everybody's bringing their own ways of living, everything. I live about maybe a mile-and-a-half from a mine, and I grew up and did some herding of sheep when it was going on -- all the dust, everything. And when we'd come to a puddle of water, what did we do? Just blow and push the bugs away and drink it.

And the same thing -- we had a lot of cactus around where my uncle Wilson Sittee's mine was. And we'd just dust off all our cactus and just eat it for lunch. Now where in the world -- it's just nothing but cancer killing people. People died from uranium. People died from diarrhea. I know. I've lost about -- three brothers with that.

There's different contaminants that came around when we were young. My mother had 15 children, and she lost five because of drinking, you know, from where water wasn't purified. But somehow, we just don't think

everything is cancer. Not everything. And I always say that the Lord has provided a land with richness. Why can't we use it?

Just like pertaining to our government -- you know, back in the 18 -- 1989, people had pushed good leaders out of their offices. And I know within the four years -- I don't know how many chairmans or presidents we had. Today, they can't plan what our future's going to be like especially for our young people. We see how many thousands of graduates every year? Who talks about their employment? Who talks about their scholarship being available?

You know, I always think that I was one of the lucky parents. During the '70s and '80s, we had a strong, strong president. Chairman we call it, not president. Well, let me tell you. They scratched services. They scratched service for scholarships. They just happened to be available. As long as the child was making 2.5, they were eligible to get scholarship.

And I sent all my children to college, and they had the benefit of getting their degree. They have their jobs today, and they have their families. And let me tell you I was the one that was put into prison. I spent five years in prison for what? I didn't steal money. I didn't sleep with anybody else. I just protected my family, and

this is what was done to me.

What kind of leaders do we have that can't plan but throw people in jail for what they want for their people? I don't see any other president has a plan. Today, we're down to zero, with a zero fund. They're not doing anything but buy a piece of range for so many thousands of dollars. That is ridiculous. That's why we're searching for money. Eastern Navajo can help by replenishing a revenue back to the tribe and help them out. That's what I'm for. I am for uranium mine.

(Applause.)

MR. RAKOVAN: Thank you.

Anna Frazier.

MS. FRAZIER: [Speaking Navajo.] Good evening. My name is Anna Marie Frazier, and I'm from Delcon, Arizona, from the Navajo reservation, southwest part of the Navajo Nation. And I work with Dine Citizens Against Ruining our Environment.

And I only heard about this generic environmental impact statement just this morning through the internet, and it just so happened that I was coming to Albuquerque from Delcon. And so I'm here this evening. I did not prepare any speech or anything like that, so I'm going to be speaking from my heart. It could be in anger or it could be whatever.

So because -- I have worked with people on the Navajo Nation for the past close to 20 -- over 20 years on environmental issues that have affected their lives, their land, their way of life and everything -- you know, just affected their health in every way you -- every sickness or whatever that came around has affected them. And the main thing was mostly cancer.

And I've worked with -- on the Radiation Exposure Compensation Act back in -- for about maybe six years. And we were very involved in amending that bill.

And so -- and we also worked with the Blanding White Mesa Uranium Waste Facility, where -- the people there in White Mesa, Utes and the Navajo people down there in the Aneth, Utah, area did not want any more uranium waste coming to the area there in White Mesa, near Blanding, so -- because they were afraid that it might contaminate their water, their drinking water, because they lived downgrade from the facility there, so -- and then also, with the Radiation Exposure Compensation Act

To work with these kinds of people that have been affected by uranium mining, contamination from the radiation from uranium mining -- it's very, very devastating to work with these people, because they are hurting and because many have lost their loved ones. And today or back when we worked with them about ten years

ago, I mean they were carrying oxygen tanks around, and all these things.

I mean it just really hurts to work with these kinds of people. And they are my people, the Navajo people. And when we worked on this issue on the Radiation Exposure Compensation Act, we did not only work with the Navajo people. We worked with people from four states -- that was Colorado, New Mexico, Arizona, and Wyoming, and people also from the state of Oregon.

And we all banded together because we were all affected by radiation contamination. And we all were able to come together and to amend the RECA to increase the compensation for our people that were only getting -- I think it was 100,000. So we upped it to 150,000, and we also included the downwinders from our Navajo area, the Navajo County, Apache County and all those other counties there.

And the devastation of -- the encroachment of uranium mining has really left our people just really devastated -- their way of life, their land and their health.

And I guess what I want to say is that to open this uranium mining back up again -- although you might say that it's safe with the in-situ mining and whatnot, our people, the Navajo people, say that, How do you know

what it's like down there underground. You may be scientists and whatnot, but you just really don't know whether it's really truly not going to contaminate the water.

These are some of the elders that talk this way to us. So the same way with the Desert Rock Power Plant that's being built -- you know, it's the same thing, you know: People wanting to get coal from underground and to bring it to surface. And it's contaminating the whole valley of Four Corners.

And so what I want to say is that we know that the groundwater is going to be contaminated and it's going to be permanently contaminated if it does ever be mined, because you don't know, you know, how it's really going to work. I don't know if it ever has been proven.

I know that there was one mine that was down in Texas that I heard about -- in-situ mining -- and then also the site-specific that other people were talking about here. Yes, there is a lot of difference between, you know -- off the reservation, you know, even out here in this area. Throughout the whole United States, there's a lot of Native Americans who live throughout this whole country, and there's a lot of artifacts that have been left behind in those areas. So that's where the environmental justice issue should come in -- the law --

to protect those areas.

And so that's where the difference is with the site-specific, instead of developing this EIS as a generic policy -- I don't think that's really right. And then the community cumulative impact to the community people there? There's history that tells us that this uranium is dangerous, a history of it. Those studies ought to be done, and the should be included in the EIS, as well.

And then the cleanup. We have experience not only with the uranium, but also with the oil companies. Oil companies come in. Uranium companies came in -- Kerr-McGee and all those companies -- and they left. And they left all these holes in the ground. And they have devastated the land on the Navajo reservation -- the oil companies. And they left and left the people in the area to hold the bag and try to clean it up, but there's no money.

And that ought to be something that NRC should put that money in there just like we did with -- when the -- when we amended the RECA, the Radiation Exposure Compensation Act. We had to ask for billions of dollars to study the uranium on the reservation and how it affected the people.

MR. RAKOVAN: Please try to wrap it up.

MS. FRAZIER: Okay.

And then I agree with Leona about extending the public hearing for this, because I came from Arizona and I haven't even -- never heard about -- that there was going to be public comments regarding this GEIS. So that's it. Thank you very much.

(Applause.)

MR. RAKOVAN: Amadeo Martinez.

MR. MARTINEZ: Hello. My name is Amadeo Martinez; I'm a future heir of the Juan Tafoya Land Grant. I support the GEIS because I feel that it will allow permitting of new facilities while watching over environmental impact for the future generations like myself. I feel that everyone is looking to the past and we need to protect our future.

And I would like to add that all these groups that are completing surveys on lands that were polluted have never come to my community. In my community, we raise crops and cattle, and none of this is polluted. And we are a uranium area. I live in between both a mill and a mine, and it's still safe today because our people have protected it. That's all I have to say. Thanks.

(Applause.)

MR. RAKOVAN: I had two people sign up as maybes: James Thief and Hank Bruce. Since these are the last two cards I had, I wanted to extend an invitation to

them to take the stage.

Hank Bruce and James Thief?

(No response.)

MR. GREENSLADE: I'm Jim Greenslade. Is that who you have?

MR. RAKOVAN: I'm sorry?

MR. GREENSLADE: I say I'm Jim Greenslade. Is that who you have?

MR. RAKOVAN: Yes -- well, yes. I've got -- James Thief and Hank Bruce are the two cards that I have. I'm sorry.

MR. GREENSLADE: Well, do you want me, or not?

MR. RAKOVAN: Do you wish to speak, or not? These are the last two cards that I have.

(Pause.)

MR. RAKOVAN: If you could, give us your name, sir.

MR. GREENSLADE: I'm Jim Greenslade. You know, it's kind of a wonder, when you're the relatively last speaker, how the things that you thought you were going to say get changed, and some of them don't. I was a uranium miner. I worked in Moab, Utah, and Grants for 31 years total. And so I know a lot of the problems.

(Applause.)

MR. GREENSLADE: And I know a lot of the

problems that the NRC is getting tonight. And I guess, to sum it up, in my point -- it may be wrong, and it may be right, but the way I see it, right or wrong -- we need to have the NRC as quickly as they can -- and if they need more people, let's get it done, both for the people and the companies that may be able to do the mining in a safe and good way.

You know, we've been talking about energy since 1973. We've been mining uranium in the first big deposit by a fellow named Charlie Steen in Moab, Utah. And that was in 1954 when I went there. The same problems are here. And with all of the technology and all the people we have, can't we get some of these things done for the Native Americans? And I'm a Welshman, so I guess I'm a minority.

But it seems like, with all the technology that we supposedly have, we can get these things done. Is it the NRC? I don't know. Is it the operators? I don't know. Is it the Native Americans? I don't know. But they've all got problems. So -- and the way I look at it, we haven't solved a thing on energy for the United States. It gets worse every day.

And the United States was blessed with cheap energy. You know, we talk about -- one man mentioned wind energy -- solar energy. Well, it just seems, you know,

that PNM has got an energy plant -- wind. And it costs me if I went in it two cents more a kilowatt hour than you get from a coal-fired plant. And, you know, the coal-fired plants, uranium plants and others pay severance tax into the severance tax fund, which helps all the schools in New Mexico.

And I asked the man that gave a talk on the -- I think they call it Blue Sky. And I said, You know, these companies pay those severance taxes; I wonder what the severance tax is on wind; you're stealing my wind. And he didn't know what it was.

So I think we've got a lot of problems. And we talked about water, and it's a problem. I keep asking the water people here, Why are we dumping water from the Chama River Project to us in the river, when it's going to get dirty; and we could put a pipeline and generate power. Well, they say there's problems building a pipeline.

And I'll be through in a minute.

(Laughter.)

MR. GREENSLADE: And I think we all have to get together and solve these problems. I think this is a major, major problem. And if the NRC needs more people, tell us, and we'll talk to our congress people. But, you know, the congress house building had higher radon readings than the mines, because it was made out of

granite.

And I remember a water report of Steve Reynolds, whom you all know from -- the old state engineer. And he knew more about water than a lot of us. He gave a report on every domestic water supply at that time in, oh, the 1950s or so. And Clovis, New Mexico, had the highest uranium content in their water.

And all I can say is you see chemicals in this in-situ leach. My understanding -- and, now, I've been out of the mining and retired for 20 years -- is that they're using oxygen and mostly water in the chemicals. I'm not sure. Carbon dioxide? We got it all the time. But those are problems that need to be addressed.

And I think the NRC ought to thank everyone that's here tonight for staying this late, and I think we all learned a little bit. Thank you.

(Applause.)

MR. CAMPBELL: I want to reiterate that. I really appreciate everybody who has hung in here and stayed through. I especially appreciate those that, because of the luck of the draw at the last, are the last few words to speak.

I do want to remind people that if you've provided your address to us and your e-mail address to us, we will be sending you the transcript and the slides.

Is that correct, Carol?

MS. WALLS: That's correct.

MR. CAMPBELL: Is that going to be through the normal mail or through the e-mail, or both?

MS. WALLS: They have an option.

If you signed up for the e-mail, it will come to you --

MR. CAMPBELL: Carol, use a mic.

(General laughter.)

MR. CAMPBELL: Let me introduce Carol Walls. Carol is our licensing assistant. And Carol has done a tremendous job in setting up these meetings, both here and in Casper. And I think she deserves a hand.

(Applause.)

MS. WALLS: Good evening. I'm Carol Walls. And if you signed the blue card, it will come to you via regular mail. If you signed the form where I asked for your name and your e-mail, you'll get it electronically. And if you signed both, you'll probably get duplicate copies. Okay? Good night.

MR. CAMPBELL: Again, I want to thank everybody for coming. I thank you for your input. This has been a very good experience for all of us, and we're going to take your comments to heart and incorporate them in our process. Again, thank you for participating in this

meeting tonight. Have a good evening, and thank you for staying. Good night.

(Whereupon, at 10:40 p.m., this meeting concluded.)

Transcript and slides of the August 9, 2007 Scoping Meeting in Albuquerque, New Mexico will be available on the U. S. Nuclear Regulatory Commission's website under Accession Number ML072640680

http://www.nrc.gov/materials/fuel-cycle-fac/licensing/geis.html#scoping-comments

Appendix A-3

Transcript of September 27, 2007 Scoping Meeting in Gallup, New Mexico

UNITED STATES OF AMERICA

U.S. NUCLEAR REGULATORY COMMISSION

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PUBLIC MEETING

PROPOSED RULE: GEIS SCOPING MEETING

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SEPTEMBER 27, 2007

+ + + + +

GALLUP, NEW MEXICO

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The public meeting convened in the Best Western Inn and Suites, Banquet Room, 3009 W. Highway 66, Gallup, New Mexico, at 7:07 p.m.

Present on behalf of the Nuclear Regulatory Commission:

SCOTT FLANDERS
GREGORY SUBER
PAUL MICHALAK
JOAN OLMSTEAD, ESQ.
PERRY CHARLEY
LANCE RAKOVAN
LIZETTE ROLDAN
CAROL WALLS

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P-R-O-C-E-E-D-I-N-G-S

7:07 p.m.

MR. RAKOVAN: Good evening, everyone. My name is Lance Rakovan. I am a communications assistant at the Nuclear Regulatory Commission, or NRC, based in Rockville, Maryland, and it's my pleasure to serve as your facilitator for tonight's public meeting.

The purpose of tonight's meeting is to obtain comments on the scope of the uranium recovery Generic Environmental Impact Statement, or GEIS, as I'm sure you'll hear a number of NRC types refer to it tonight.

It's my pleasure to serve as your facilitator for tonight's meeting. Before things get started, I wanted to go over kind of what to expect from tonight and also go over a few ground rules in terms of participation at tonight's meeting.

If you take a look at tonight's agenda, which there were copies of on the back table, where hopefully you registered when you came in. If you want you can go grab one right now.

We're going to start out with some presentations that we're hoping to give you some background and some base information about the topics

that the Generic Environmental Impact Statements will cover and also about NRC's rules and responsibilities, and the safety review of the uranium recovery's application and amendments.

So we're going to start out with those. After that, we're basically going to turn the meeting over to why we're here tonight, and that's to listen to you, to get your opinions on what we should take into account when looking at the scoping of this Generic Environmental Impact Statement. So we're going to be opening up the floor to you.

When you walked in, hopefully you were given a choice to fill out your yellow card, which would designate that you were hoping to speak tonight, or a blue card which meant that you were just here more or less to observe.

Now, if you didn't sign up to speak, that's okay, you can always change your mind during the meeting. If you would like to sign up to speak as I'm done, simply put your hand up, get my attention. I have a few yellow cards. Essentially what we're going to do is once we're done with the presentations, I'm going to go through the cards as I have them, call people up to the microphone. Given the amount of time that they have and the number of speakers that we

have, I'm going to try to ask that you limit your comments to a few minutes.

I'm probably going to ask about five minutes maximum. That way that gives a chance for everybody who signed up to talk, and for those who were too shy to sign up initially and wanted to get up after everybody else is done, they may have a chance to say something too. So we're going to try and give everybody a chance to come up here.

I just want to stress that getting a statement at tonight's meeting is not the only way that you can have your comments taken. We'll be going through the other ways that you can do that tonight during our presentations. And also tonight at the meeting, if you want to provide a written statement, again just get my attention, and we'll have that included into the record of tonight's meeting.

Which again I want to point out that we are transcribing tonight's meeting. So it's very important when you're speaking to use a microphone, to make sure that you have only one person speaking at a time, and that way we could get a clean transcript.

And also, so we know who's speaking, when you come up to speak, if you can identify yourself, and if there's any group that you're with, give us that as

well; and that way we'll get a clean transcript and we'll have a good idea of who all of our speakers were tonight.

Just a few ground rules again, try to be respectful of everyone who's speaking, especially when they come up to the podium and the floor is theirs, even if you don't agree with their opinion. That'll help the meeting go smoother.

Also if someone previous to you made a statement that you agree with, if you just want to go ahead and say, you know, this gentleman has already said this and refer back to them, that's okay too. That helps us remember -- or get down in the transcript that we had more than one person who agreed with a particular point and helps the meeting to go faster.

I'd like to introduce Mr. Perry Charley who is going to be doing some translating for us tonight. He is associated with DinDoña Shiprock Campus. He's been our cultural consultant while we've been here and hopefully he'll be providing some interpretation in Navajo tonight. So if anybody's speaking too quickly like I probably am right now, you know, throw something at us and hopefully we'll slow down.

For those of you who came in and signed up, there were some public meeting feedback forms on the back table. If you could fill those out and either give them to an NRC person or drop them in the mail. Once they get to us, those give us an idea on how we can improve our public meetings in the future.

Also, if everyone could please silence your cell phones or any other electronic equipment you have at this point. I was at a meeting recently where I think at least four or five times during the meeting a different person's cell phone or pager or whatever rang and it really disrupted the meeting. So we appreciate silencing those at this point.

The restrooms are when you leave, on your right, both men and women. Obviously the exits are in the back of the room, so if anything happens, emergency-wise, hopefully not, but obviously your exits are going to be behind you.

I appreciate all your help in making tonight a productive meeting and I'm going to see if Mr. Charley wants a little time to translate and I'm actually going to give him my notes as well, just in case he would like to use them, if you could read my writing.

(Mr. Charley translates in Navajo)

MR. RAKOVAN: It sounds so much cooler when he says it.

Again, if you have not signed up to speak and yet would like to, I have a couple of the yellow cards here that would help us, you know, keep track. So if you want to raise your hand I could bring those to you now. With that, I will turn things over to Scott Flanders.

MR. FLANDERS: Good evening, everyone. Can you hear me okay? Good evening. My name is Scott Flanders. I'm the Deputy Director of the Division of Waste Management, Environment Protection at the Nuclear Regulatory Commission.

And I first want to welcome you and thank you for coming out to our meeting tonight. We recognize that you all have busy schedules and we appreciate you taking the time to come out and participate in the process.

As Lance mentioned earlier, the purpose of tonight's meeting is to -- is for us to receive comments from you on the Generic Environmental Impact Statement (GEIS) that we're working on for in situ leach uranium recovery facilities.

The public process and public comment portion of the -- of our process is very important to

us, and we really appreciate again the time that you take -- you've taken out of your schedule to come and participate in our meeting.

Before I go any further let me introduce some of the NRC staff who's here with us. At the far end of the table, there's Mr. Gregory Suber, who is the Branch Chief of our Environmental Review Branch and has lead responsibility for preparing the Generic Environmental Impact Statement.

Next to him is Ms. Joan Olmstead, who is a member of our General Counsel's Office. And sitting on the other side of Mr. Charley is Paul Michalak, which, which is one of our senior project managers and technical experts on the area of the uranium recovery in situ leach recovery activities. So with that, if I could have the next slide, please.

Before we go -- we get too far, I want to just spend a little bit of time giving you a brief overview of what to expect tonight.

First, we're going to start off with a brief overview of the NRC's roles and responsibilities for those of you who may not be as familiar with the Nuclear Regulatory Commission. I know some of you are, but for those who might not be, we're going to spend just a few minutes going over the NRC's rules

and responsibilities. And I'll do that in just a few moments.

Next, we're going to have Mr. Paul Michalak talk about the NRC safety review process and we -- for in situ leach recovery. And we thought this was an important piece, to give you some background as Mr. Rakovan -- or Lance -- mentioned earlier about the process, to ensure that you have good background, to provide his comments on the Generic Environmental Impact Statement.

And then Mr. Suber is going to discuss the environmental review process for in situ leach uranium recovery facilities and he is going to, in that presentation, talk about how the Generic Environmental Impact Statement fits within that overall site-specific review for -- again, in situ leach facilities, when -- if and when we receive applications for actual site-specific facilities.

And then the final, and the heart of the presentation or the meeting tonight is going to be the public comment process. The -- that is where you are going to get the opportunity to provide us comments on the Generic Environmental Impact Statement.

So that is the key part of the meeting, so we're going to try to keep our presentations as brief

as possible and then move on from there. Now Paul's motioning for Mr. Charley.

(Mr. Charley translates in Navajo)

MR. FLANDERS: Okay. If you could make that the next slide.

I'm just going to briefly go over the NRC's roles and responsibilities. And the Nuclear Regulatory Commission is an independent federal agency that's headed by a five - five-member Commission, one of which is designated by the President as the Chairman. The other five, the other members are also appointed by the President and confirmed by the U.S. Senate into their positions.

Now the NRC's primary mission is to regulate the nation's civilian uses of radioactive materials to ensure adequate protection of public health and safety, to promote the common defense and security, and to protect the environment.

We have regulatory authority over a diverse set of facilities, nuclear facilities and uses of nuclear materials. However, you can group them to three primary categories. One being reactors; we regulate commercial nuclear reactors that generate electricity, and we also regulate research and test reactors that you may find in a university for

academic research activities.

The next wide grouping, you can consider as materials which uses -- which involves the use of nuclear materials in medical, industrial and academic settings, as well as facilities that produce nuclear field.

The last and third group would be waste. And that group include transportation and storage of -- and dispose of nuclear materials and waste and the decommissioning of nuclear facilities.

So if you think about them in those three bar groups, that demonstrates a diverse set -- of responsibility that the U.S. Nuclear Regulatory has.

How do we carry out our mission? If you can think of three primary guideposts that -- and keep this in mind, you'll understand how the NRC carries out its mission.

The first is, that we establish regulations and standards by which licensees are originally licensed and must meet throughout their operating life, their facility or for their use of nuclear materials.

The next is the licensing process, and once we establish the regulations, we then evaluate each application to ensure that that application

satisfies the regulations that have been established for that particular technology or use of that particular material.

Once, and if we decide that a facility should be licensed and meets all of our safety standards, then we continue to inspect them throughout the lifetime of the facility or the use of the material to ensure that they're in compliance with those regulations; and if we determine through our inspection process that they are not in compliance with those regulations then we will use enforcement action to bring them back into compliance.

This was just a quick overview of our regulatory process. You will hear more about the licensing process as it relates to in situ leach facilities in Mr. Suber and Mr. Michalak's presentations.

So in closing, I want to leave you with one final thought, and if you take this away, that the Nuclear Regulatory Commission's primary mission is to protect public health and safety. And we do this by focusing on our licensing activities, inspection activities and the regulations that we generate.

Again, if you want to find out more about the U.S. Nuclear Regulatory Commission, you can go to

our website at www.nrc.gov. With that I'll stop and let Mr. Charley provide translation, and then turn it over to Mr. Michalak.

(Mr. Charley translates in Navajo)

MR. MICHALAK: Hi. My name's Paul Michalak, I'm the Project Manager with the Uranium Recovery and Licensing Branch of the NRC.

The focus of my presentation today will be the safety review portion of the NRC's site-specific uranium recovery application review process.

But before I get into the safety review, I'd like to briefly describe in situ leach uranium recovery.

(Mr. Charley translates in Navajo)

MR. MICHALAK: What I've done is I've broken down the process into three general components. The first component is subsurface injection and recovery. The second component is surface, where there's further processing performed, and the third component is restoration of ground water.

(Mr. Charley translates in Navajo)

MR. MICHALAK: The subsurface component involves taking a mixture of native ground water, oxygen, bicarbonate, sometimes carbon dioxide and injecting it into the ore zone. That mixture is known

as a lixiviant and it dissolves the uranium into the ground water. That ground water is then pumped to the surface.

(Mr. Charley translates in Navajo)

MR. MICHALAK: In the surface component that uranium mixture called a lixiviant is pumped into a processing plant. This is a processing plant at the Smith Ranch ISL near Douglas, Wyoming. In the processing plant, ion exchange, elution, precipitation, thickening, drying and then packing is performed on the liquid. The final product is a commodity known as yellow cake. It's a yellowish-greenish powder, uranium oxide.

(Mr. Charley translates in Navajo)

MR. MICHALAK: When the in situ leach process is completed, ground water in the ore zone is restored to either pre-operational levels, EPA drinking water standards, or secondary standards if there are some constituents that prove problematic with respect to restoring to either pre-operational or EPA drinking water standards.

Before any secondary standards are approved, the applicant or licensee must show that U.S. EPA drinking water standards will not be exceeded in any potential drinking water source.

(Mr. Charley translates in Navajo)

MR. MICHALAK: The applicable uranium recovery regulations for the NRC are found in 10 CFR Part 40 Appendix A. The primary reference used by the uranium recovery branch in our safety reviews is NUREG-1569, the Standard Review Plan for In Situ Uranium Extraction License Applications.

NUREG-1569 is a comprehensive document that contains all the acceptance criteria that we use in our safety reviews, and this is available on the NRC website.

(Mr. Charley translates in Navajo)

MR. MICHALAK: In general ISL facilities must be designed and operated such that radiation dose is in -- is kept within specific regulatory limits.

The facility must also have a monitoring program to verify that they keep the radiation dose within specified regulatory limits. Beyond just the regulations, the NRC expects the applicant to design a system where radiation is as low as reasonably achievable. We call that program ALARA. And then finally, personnel have appropriate radiation safety training.

(Mr. Charley translates in Navajo)

MR. MICHALAK: The scope of the NRC's

safety review covers effluent control systems, operations, radiation safety controls and monitoring, which is really a subset of operations, ground water and plant decommissioning.

(Mr. Charley translates in Navajo)

MR. MICHALAK: The safety review evaluates the effluent control systems with respect to gases and airborne particulates, liquids and solids and contaminated equipment.

A good example of this would be the monitoring and controls in the facility's yellowcake drying and packing areas. These are locations where there's a potential for airborne particulates that contain uranium.

(Mr. Charley translates in Navajo)

MR. MICHALAK: The safety review will also include an evaluation of -- a detailed description of operational components. I think a good example of this would be the applicant's radiation safety training program.

ISLs will likely hire large amounts of plumbers, electricians and mechanics who will not have any radiation safety training backgrounds. It's going to be important for these people to be trained, and an application will not be approved unless it contains a

rigorous and comprehensive radiation safety-training program.

(Mr. Charley translates in Navajo)

MR. MICHALAK: The safety review will also evaluate detailed descriptions of the applicant's radiation safety components.

A couple of good examples of this will be our evaluation of methods, instrumentation and equipment associated with external radiation and airborne radiation monitoring programs. Another good example will be our evaluation of their bioassay program. We will expect a program in which baseline bioassay urinalyses are collected at the time of hire. We will also expect periodic testing during operation, and exit urinalysis at the time of employment termination.

(Mr. Charley translates in Navajo)

MR. MICHALAK: Our site-specific safety review will include an evaluation of ground water data and information with respect to preoperational conditions, operational conditions, and post-operational conditions.

A good example of this is the need to verify the hydraulic connection between the ore zone and the monitoring network. This is important because

the monitoring network will be used to verify the existence of an inward gradient in the well field; and it's the inward gradient, which is one of the components that controls the uranium solution in the well field. The hydraulic connection between the ore zone and the monitoring network is also important because that monitoring network is sampled because it's monitored -- because they use that monitoring system to identify if an excursion of uranium mixture occurs outside the ore body.

(Mr. Charley translates in Navajo)

MR. MICHALAK: In plant decommissioning, the NRC evaluates methodologies used to clean up the site when operations are completed.

Of particular interest on this slide is the need for a - for the applicant to have a surety, a financial surety. When -- at the time the first shovel breaks ground at the facility, the licensee is required to have a financial note, a bond, or some kind of insurance that would have sufficient funds to decommission the site. In this way, if they would become bankrupt, there would be enough money to perform decommissioning, reclamation and ground water restoration.

(Mr. Charley translates in Navajo)

MR. MICHALAK: I'd now like to turn the floor over to Greg.

MR. SUBER: Thank you, Paul.

First of all, I'd like to thank everybody for coming out. We know that you made a sacrifice to come out to our meeting today, but we would like to thank you because the kind of interaction that we get here is very important to us. Public participation is important to the NRC, it's important to our process.

In fact, the reason we are here tonight is because when we had a meeting in Albuquerque, you told us that we needed to come to this area because if this is where the activities were potentially going to be sited, then the people here wanted to have their voice heard in this community. We heard you and we're here tonight, and we welcome your further comments.

My name is Gregory Suber and I am the Chief of the Environmental Review branch that is review -- that is producing the Generic Environmental Impact Statement. This is -- Lizette Roldan is here also, she's one of my staff members and if anybody would prefer to communicate in Spanish, then they can feel free to talk to Ms. Roldan and she will facilitate that for us.

Okay. Scott has already talked to you

about the NRC, what we are and what we do. And Paul has given you an overview of our safety review for ISLs. What I would like to do is I would like to discuss the environmental regulations that the NRC must adhere to. To detail for you the review process that we go in -- that we're going to undertake for this GEIS process, and also describe the ways that you can participate in this process.

(Mr. Charley translates in Navajo)

MR. SUBER: I'd like to quickly just reiterate something that my supervisor Scott Flanders mentioned today. Our goal, our mission is to protect human health and to protect the environment. That's why we're here, and we are fulfilling our obligations.

In fact, when we do our safety review, we're fulfilling our regulatory responsibilities to protect the environment through implementation of the National Environmental Policy Act. Now the National Environmental Policy Act, also known as NEPA, was enacted in 1969. And what NEPA did is it required all federal agencies to conduct a systematic review of the environmental impacts for their federal actions. What that means is the NRC has to take a hard look at the implications to the environment for all of its licensing actions.

NEPA is what we call a disclosure tool, and what that means is that we gather information and then we disclose to the public what information we're going to use in our analysis; and then we invite the public to comment to us as to what they think is important, what part of our analysis we should concentrate on and how they think we should conduct our analysis.

What this results in, is it results in an exchange that allows our review to become better, because it reflects what's important in your community. So right now, I'm going to take a few minutes to do a couple of things. I'm going to discuss the purpose of the uranium covering GEIS, I'm going to describe the review process that we're going to use and then I'm going to identify the areas in our evaluation. And then we're going to get out of the way and let you comment on what you - on where -- what aspects of our review you think we should concentrate on.

(Mr. Charley translates in Navajo)

MR. SUBER: And now I'd like to discuss the purpose of the GEIS. The NRC proposed doing the GEIS because they wanted to take advantage of a framework that we wanted to create in grouping issues

that are common to ISL facilities and creating one document that examined those issues, and then on a site-specific basis, create another document that looks at the unique features of a particular site that couldn't be covered in the GEIS.

Now what this approach did, is it allowed us to eliminate or reduce redundancies in our analysis. Once we did an analysis, if it was applicable to other sites, we wouldn't have to repeat it time and time again. It was an efficiency that we gained in reviewing our applications. And what that did, and what we hoped to achieve by this is to take our resources at the site-specific level and be able to target those resources into the areas that are most important.

And that would allow us to focus our review on the site-specific aspects of the application when we receive an application, focus that review on those important site-specific areas that are unique and that need a very thorough and rigorous evaluation.

(Mr. Charley translates in Navajo)

MR. SUBER: Here we have a graph of the review process and how we envision going forward from this point. But in order to create the GEIS, we have to gather information and that information comes from

a variety of sources, but right now we're doing what we call the scoping process.

And in the scoping process, we go to the public and we look for public input on our process. We look for exchange between the NRC and the public as to how you think we should go forward in our review, and what areas you think we think -- you think we should cover in our reviews, excuse me.

And we also use technical information that we gather to come together and to draft a Generic Environmental Impact Statement. Now, we have public participation here at the scoping meeting, but also once we finish the generic -- once we have the draft Generic Environmental Impact Statement, we have another public comment meeting. And the reason for that meeting is to come out and to let you evaluate the draft GEIS and to tell us how well we reflected your comments that you submitted to us through this scoping period.

Now, once issued, and we receive the comments from the public, we'll issue a final draft -- a final GEIS. And upon receiving site-specific applications, we will take those applications and we will evaluate those applications with respect to the GEIS. And what we'll find is, we'll find that there

are resource areas in that site-specific application that may be bound by the GEIS, meaning that the conclusions of the GEIS are applicable to that specific site.

There may also be areas, resource areas in the site-specific evaluation that are not bound by the GEIS, and at that point, we'll have to focus our attention specifically on those areas that are not bound by the GEIS.

Now, if we look at those areas, and we can evaluate them, and we can come to what we call a finding of no significant impact, then we'll prepare an environmental assessment and we'll look close at the findings. However, and this is important, if we evaluate that resource area in the site-specific review, and we cannot come to a finding, then we will have to initiate a supplemental EIS for that site.

So there's two possibilities for a site-specific review. We can either have an EA that closes with a FONSI or we can have a supplemental EIS.

Now, to go to another point, in our last meeting at Albuquerque, you made it quite clear that you wanted to be sure that you could comment on an EA that we issued. And there was not -- it was not certain at that time whether the process would allow

that. But because of your comments, we've gone back and we are going to release -- we are going to -- when we issue our draft environmental assessment, we're going to issue those for public comment. So you'll have another opportunity to comment, even if we conclude that the site-specific review can be closed with a FONSI.

And of course, if the site-specific review is closed with a supplemental EIS, then we'll have another scoping meeting and we'll have another draft public environmental impact statement meeting.

So all along the process, there's a variety of points where you, the public, can inform us as to how you think our evaluation is going, and give us input as to what the scope of that evaluation should be.

(Mr. Charley translates in Navajo)

MR. SUBER: Now this slide was put here just to illustrate a point that this is not a new undertaking for the NRC. We've done several Generic Environmental Impact Statements in the past. In fact, the one that's probably more -- most similar to the one that we're doing now is the GEIS that we did for license renewal where we performed the Generic Environmental Impact Statement for license renewal,

and then for each individual plant, we did a supplemental environmental impact statement.

Now the term “generic” may be throwing some people off. Other agencies use what they call programmatic EIS’s. Well, we just call them generic EIS’s, but it's basically the same term.

(Mr. Charley translates in Navajo)

MR. SUBER: Now what you see on this slide are the typical or traditional impact areas that we look at. Now this slide is not all inclusive, maybe that -- there may be some areas up here that you think are important that are included on the slide. And that's where this scoping process comes in handy, because we are looking for comments for you -- from you as to which areas here you think we should concentrate the most effort on, and also, and more importantly, if there are some areas that you know of, there are some concerns that you have that are not reflected on this slide, what this does is it improves our process.

It improves the quality of our review because we know from you what's important. We don't live in this community. You live in this community. You know the resources in this community. You know the areas of this community. You know the values of

this community. And the more you communicate those values to us, the more quality and the better review we'll be able to prepare.

(Mr. Charley translates in Navajo)

MR. SUBER: Now this slide shows a proposed schedule for the GEIS. I would like to pull your attention to this slide here. The scoping period, the scoping comment period has been extended. Initially the scoping period was due to end on September the 4th, and we received comments from the public that that just wasn't enough time. And we consequently extended it to October the 8th, but after reviewing our schedule and understanding the amount of concern that we had from the public, we went ahead and extended it 'til October the 31st.

And that's basically because we want to be responsive to your concerns, and we want you to have time to give us input in this process.

The next line I'd like to pull your attention to is the draft GEIS stage. Presently, this schedule -- we are scheduled to issue the draft GEIS around April of 2008. Now once we issue that draft document, we'll have another public comment meeting where we'll come out again into your community and accept your comments on the draft GEIS; and

ultimately, we'll -- we plan to issue the final GEIS in January of 2009.

(Mr. Charley translates in Navajo)

MR. DALY: Excuse me, Mr. Suber, Chief Suber. We're now an hour behind our schedule. I called for the order today, can we get on with this meeting?

MR. RAKOVAN: Just for the transcript, the gentleman stood up and complained about the length of time that it was taking. I was going to address that when we started again, and thank you for your patience, but I guess it's a little too late for that.

The fact is, is that tonight is maybe the only night that we have in Gallup to convey this information to you, so we thought that it was important to do so. As you can see -- well, okay. That's -- it's gone.

As you could see on the previous slide, you have until October 31st to comment on this process, so tonight is not the only night that you have to get up here and comment. So we understand that this is taking a long time. We believe that having the translation is very important and we wanted to provide that service and to do that. So I apologize if it's taking a long time, but we think it's necessary. So

if -- please. And we can stay a lot longer than nine o'clock. I understand it's taking a long time, but we can be here for a while.

MR. FLANDERS: Excuse me. We're about to wrap up. We have just one more -- two more slides that give you some information in terms of how you can provide comments and we'll extend the meeting by an hour or longer as necessary, as long as we're able to stay, to ensure you have ample opportunity to provide your comments. Thank you.

MR. SUBER: And the information you have here on the slide shows you one -- well, actually two ways to submit comments. I'd like to make the point that this meeting that we're having tonight is being transcribed, so all of the comments that you give orally will be transcribed and will be treated by the NRC with the same weight that we treat written comments.

Now, written comments can be submitted by mail to this address, or if you'd prefer, you can also email written comments to our email address. Now this information is also included on a handout that's on a table right outside this room, so if you don't have a pen or you don't want to write it down, that's fine, because you can get the information right outside the

room.

(Mr. Charley translates in Navajo)

MR. SUBER: Okay. Now this is contact information and this is also available on the slide outside the room.

(Mr. Charley translates in Navajo)

MR. SUBER: And we've also set up a web page that has information about the GEIS process, and also this -- I don't want to be redundant, but this is also on the slide that you can receive on the table outside the room.

(Mr. Charley translates in Navajo)

MR. SUBER: Okay. And that concludes my presentation. I'd once again like to thank you for your patience, and thank you for coming out tonight and I look forward to your comments.

And I'd just like to say as Lance is walking up, that your comments are important to us. As you've already seen, they have affected the way we are conducting the review in the GEIS process. We've extended the comment period. We're issuing EAs for public comment, so your comments have been heard and they are important to us. And I'd just like to thank you for your attention.

MR. RAKOVAN: Thanks, guys. And again, I

apologize to all those who think that we took too long in doing that. I've got the public meeting feedback forms right here, if you want to fill it out and give it to me, I'd be more than happy to take your comments. This is one of the few meetings that we've ever done with a translator and we are learning. So I apologize that it took so long to get to this point.

We're going to go ahead and go to the comment period. Perry, as long as you're okay with continuing to translate, do you want to give a shot at maybe summarizing the speakers once they come up and speak? Does that sound okay? Okay.

Again, given the amount of time that we have, I'm going to ask that people be concise. We do want your comments, we do want to hear from you, but I have quite a few speakers signed up to speak and we're going to try to stay as long as possible, so hopefully we can have a chance to get everybody up here.

What I'm going to do is I'm just going to start going through the cards. I'll probably read two or three names at a time, just to give you an idea of who to expect. Once you come up to the mic, if you could please identify yourself and any group or organization that you're with if that's appropriate.

And basically the floor is yours.

Specifically as we went through in our presentations, we are looking for comments on what we should take into account in terms of the Generic Environmental Impact Statement.

So having said that, let's start out with George Arthur from the Navajo Nation Council.

MR. ARTHUR: Well, good evening everybody that's here. I am glad that the general public has a great interest in this discussion, and I appreciate again, your presence here and showing your interest.

I'd also like to thank the panel here for coming to this area. Oftentimes only a handful of people get the chance to visit you in the Washington area.

My name is George Arthur. I am presently serving on the Navajo Nation Council. I sit with the Natural Resources Committee, as their chairman. And just real quick, our questions and comments.

First of all, I want to ask the Commission in what shape or form do you have provisions that you can assure my people, the Native American people, that the sincerity of protecting religious sites in your generic EIS? Where in your discussion do you have that provision? And if you can assure the Navajo people and Native American that have symbolic,

religious symbols in these areas, primarily as we discuss now the Mount Taylor area; that is part of our sacred mountains.

Second is that a few years ago during the Clinton administration, there was an executive order that was issued and as far as I know, it hasn't been rescinded, that all cabinet branches have trust responsibility. And I'm sure as NRC, that you are answerable to some form of cabinet level review.

So in -- maybe in that instance, I don't know whether or not you also are charged with trust responsibility for Navajo people and Native American in general. With that scenario, do you played out that role?

And my conclusion question, I'm sure you are aware that the Navajo Nation Council has established and has a position in reference to these additional development in respect to uranium mining and processing. That is Navajo Nation's position, and it's not going to be altered from that. Thank you.

(Applause)

MR. RAKOVAN: Thank you, sir.

Perry, do you want to do some translation or --

(Mr. Charley questions in Navajo)

MR. RAKOVAN: Okay. It doesn't look like -- okay.

Then the next few speakers; David Ulibarri, Cibola County Manager, and following him Joe Murrietta from City of Grants. David Ulibarri from Cibola County Manager. Okay.

Joe Murrietta from the City of Grants.

MR. MURRIETTA: Good evening. My name is Joe Murrietta and I'm the mayor of the City of Grants, New Mexico.

And I'm here tonight to let you know that as a lifelong citizen of the Grants area, which in a few months will be 60 years, and I only bring it up to your -- for your information because I want to let you know that I am personally familiar with over 50 -- over -- with a majority of my citizens in the Grants area, and also in reality, I'm probably related to a good percentage of them.

But with that in mind, I'm here tonight to express the City of Grants' support for the development of the uranium recovery industry, which was illustrated with the passage of a resolution support of this industry by the Grants City Council unanimously late last year. With that in mind, the -- my citizens are -- understand the industry because of

our past experience with the industry.

We eagerly anticipate the development of this industry in the next few years because we all -- we recognize the economic benefit from this industry, the potential for growth within our communities. And also that we understand that, and fully realize that we need a dependable, productive alternative fuel source which will provide fuel and power for our nation -- and the entire world as a matter of fact, and will lessen the dependence which we have now on foreign fuels, which -- and which are -- I think we all are -- recognize at this time.

Again, I'd like to say the City of Grants wholeheartedly supports the development of the uranium recovery industry.

Thank you.

(Applause)

MR. RAKOVAN: Thank you, sir.

Next, we'll go to Danny Charley, Jay Charley, and then Rick Van Horn.

MR. CHARLEY: Hello everyone, and good evening NRC. My name is Danny Charley, and I'm an allottee. And I have uranium in my land and I'm confident in saying that property rights to which the greatest interest in the development of uranium.

What is at stake here? Economic development and hundreds of jobs that the people can have that they don't have right now. Not only that, economic development. In Crownpoint area, people are, you know, they're desperately in need of jobs. Crownpoint can grow the surrounding areas. The towns can grow. And it can bring a lot of money into our communities and into our towns.

As citizens who drink water, we also have concerns regarding protection of our local environment, including drinking water. Both these issues are extremely important to all of us allottees. We're not just looking at the money. My land can help a lot of people get jobs. There's people running around, groups that are against uranium. They're not going to give us jobs, but my land will. My land will give several hundred people jobs and provide food to their families.

My understanding is that NRC will evaluate recent U.S. uranium operations Generic Environmental Impact Statement. Using this information, NRC will weigh the potential impacts associated with such proposed operations and will use this information to make new uranium operations safer. And if we can just understand that.

Allottees, all of us allottees, strongly support the preparation of this Generic Environmental Impact Statement, and we believe that the Nuclear Regulatory Commission's effort is in the best interests of all Navajos, and not only the allottees.

In closing, let me say that ENDAUM, uranium -- they're saying that uranium is dangerous, that ENDAUM has nothing to lose by opposing uranium development. Us allottees do.

We are offered an opportunity to have the Federal Government prepare a neutral ground base study to evaluate safety. Why do some people oppose this study? I do not want to see this opportunity wasted at this time, when the recovery of uranium presents a chance to improve the livelihood of a lot of people that can have jobs. A lot of men and women out there are wishing that they can have a job. Instead of going to food stamp offices and selling burritos at flea markets, you know, they can have a check. The recovery of uranium presents a chance to improve the livelihood of Navajo families, escape their poor financial conditions. Why not let us all work together and do this? Thank you.

MR. RAKOVAN: And we're going to go next to Jay Charley, then Rick VanHorn, and then George

Byers.

MR. CHARLEY: Good evening everybody. My name is Jay Charley. Just real quick, I had a question. You guys are going to do this study, right? And you guys are just here to see what we want you guys to focus on or if we miss any of the areas that you guys need to focus on, is that what you guys are here for? Right?

MR. RAKOVAN: I'll give a yes.

MR. CHARLEY: So you're not here to see whether or not uranium mining is bad or not, you're just here to say what we should focus on, what is our concerns, what we need you guys to focus on; is that what you guys are here for? Is that the main reason why you're here?

MR. RAKOVAN: That's the main reason why we're here. And I don't want to get into a Q and A with you, because we're here mostly to listen to you. And since I'm the facilitator, any of these gentlemen can probably go and answer your question in back, but we want to leave the microphone open for comments, so --

MR. CHARLEY: That's just what I wanted to know. I mean, I just didn't want this to turn into, you know, whether or not -- I think we're losing the

focus here. You guys are here to listen to what we need you guys to focus on, not whether or not the uranium mine should go through. Yes, I believe it should, but I believe that, you know, instead of taking off in one direction that we need to focus on what you guys are here for. I don't know if you guys think the same way, or -- but you guys are here for that reason.

MR. FLANDERS: I just want to say that we're here to listen tonight, and I -- and we'll listen to all comments. Again, the focus of tonight's meeting, as we stated earlier the purpose was to receive comments on the scope of the Generic Environmental Impact Statement, but we're here to listen, and we'll listen to all comments.

MR. CHARLEY: Okay. That's all I wanted to just say is I was getting confused on whether or not, you know, but you guys are going to do the study, right? And you're just here to listen on what we want you guys to focus on? All right. Thank you.

MR. RAKOVAN: Rick VanHorn, please.

MR. VANHORN: My name is Rick VanHorn. I'm the COO for Uranium Resources/HRI. As you know, we have been working to the Church Rock facility for over 20 years. We have our EIS completed. It was

completed --

MR. RAKOVAN: If you want to move the mike around, please.

MR. VANHORN: We have completed our EIS, it was completed in 1997. We have an NRC license to operate at Church Rock and Crownpoint.

We believe that the GEIS process will provide an unbiased review of the past 30 years of ISL mining. Our company has been in ISL for - well, sometime in 1977. We also -- we think it'll identify and put to rest misconceptions that exist about the industry. We believe it'll also identify areas of concern. This is good for all of us.

The one thing it will not do is it will not allow us to gloss over site-specific issues, but rather it's going to highlight them, so we can pay attention to them.

And based on all that, Uranium Resources and HRI support your process with GEIS and look forward to the results. Thank you.

MR. RAKOVAN: Thank you. I'd like to thank all the speakers so far for coming up here, staying to the point, staying concise, and introducing yourself so we can make sure that we know who's speaking on the transcript.

Our next three speakers, I have George Byers, Cal Curley and Larry King.

Mr. Byers? And careful of the cords, please.

MR. BYERS: Thank you. I'm George Byers with Neutron Energy. Our company controls about 30 million pounds or more of historic uranium resources, most of which are on the east side of Mount Taylor, most of which are conventional minable, but some of which have ISL potential.

And I want to thank you and commend you for listening in Albuquerque. You heard a couple of things. You heard people say we want another public meeting and you're holding it. You heard the confusion about whether or not a generic EIS would be the only thing. And you went to great lengths tonight to explain that there is going to be additional assessment.

Our company, all the other companies that I know of, are doing our site evaluations now, our data gathering on the basis that we most likely are going to have to do in the EIS, and we're prepared to do that. We're prepared to take that step.

The location that our company has its uranium resources are on two land grants, Juan Tafoya

and Cebolleta on the east side of Mount Taylor. The people that live there have lived there for many generations, for about 400 years. They have been ranchers, they have been farmers, they have used the water, and they understand what uranium mining has meant to them because they've done this in the past. They've done it safely, and they're prepared to do it again. They know that one of the benefits they're going to get is going to be royalty payments that they are going to receive. They're going to get scholarship money which is already beginning. The royalty payments come upon production, and they are already preparing to -- how do we improve irrigation systems, waste water systems, domestic water systems, transfer stations. They're already looking at ways to use that uranium royalty money to benefit them and their people. They're fortunate. They may not understand, but they are prepared to do what the -- probably the best conservation president we had said. That was Teddy Roosevelt. He said, "Do what you can with what you have, where you are."

The people at Cebolleta and Juan Tafoya have uranium, they're prepared to do the best with it. Thank you.

MR. RAKOVAN: Cal Curley.

MR. CURLEY: (Speaks in Navajo) I'm going to talk in Navajo and then we can interpret in English. Just kidding.

Good evening, everyone. My name is Cal Curley and I'm with Congressman Tom Udall's office here in Gallup, and I am here to read Congressman Udall's statement:

"Dear Commissioners, thank you for the opportunity to contribute to this discussion. As you know, we have a troubled history with uranium mining in Navajo country, and this is an important issue for us.

"Sixty years ago, government engineers came to Navajo country to begin mining uranium for a new weapon that the world was just coming to know and fear. They spoke of defending the nation, and they promised economic benefits to the Navajo people, but they did not mention the brutal health and environmental effects of mining radioactive materials. By the 1980's, the damage done by uranium mining was all too apparent. Hundreds of families had lost their loved ones and breadwinners to the efforts of mining.

"With loved ones dying young from lung cancer and other radiation-related diseases, the

Navajo people filed suit to demand compensation. My father, Stuart Udall, got the first court case calling for justice for Navajo miners, a paramount case I had the opportunity to work on with him.

"His work and the efforts of Navajo activists led to the passage of the Radiation Exposure Act (RECA). Today, the Federal Government still has not found the financial resources to fully fund RECA. The Navajos struggled to receive compensation they deserved. Sadly some seemed more interested in expanding uranium mining than cleaning up the mess left behind by uranium industries.

"As the NRC works quickly to streamline their approval process for more uranium mining, you must ensure that the errors of the past are not repeated. Navajo land is a brutal reminder of what can happen when planners allow zeal for mining to cloud their judgment. Too often, attempts to simplify environmental protection measures deny local communities their opportunity to affect the approval process for new mines.

"In New Mexico, uranium mines have been located near some of the most vulnerable communities in the state. The Federal Government has the duty to protect these communities from harm, and the NRC

should not limit the ability of community members to protect themselves from potentially ill-advised mining projects.

"For example, the Navajo Nation has passed legislation banning uranium extraction and processing on tribal lands. The NRC should respect sovereign right to reject these potentially dangerous activities. Any future mining raises particular concerns.

"As you know, water is a precious resource in New Mexico, and future mining has the potential to compromise the water supply to tens of thousands of New Mexicans.

"In Wyoming, the NRC certified water as restored, despite a uranium level 100 times higher than the EPA considers safe.

"For the NRC -- before the NRC rushes to approve new mines, it should address safety concerns and standards related to any future mining and ensure that local communities have the opportunity to protect water supplies during the mining approval process. As you develop your proposal, I ask you to remember that the environmental impact statement is not just another piece of red tape. It is a crucial defense against the kind of irresponsibility that has

already led to the death of too many Navajo miners, and to the poisoning of some of the most beautiful land in our nation.

“This is about our lives, our land, our communities. On behalf of the Navajo people and all of those who have been and will be affected by uranium mining, I urge you to be cautious and I look forward to working with you to protect the citizens of New Mexico and the nation. Sincerely, Tom Udall, a member of Congress."

Thank you for your time.

MR. RAKOVAN: Thank you. Next three speakers, I have Larry King, Stephen Etsitty, and James Martinez.

Mr. King.

MR. KING: Good evening, everybody. My name is Larry King and I live in Church Rock chapter area and HRI is proposing an in situ leach mining right in my own backyard, about a thousand feet away.

And number one, the community of Church Rock is opposed to any new type of mining company moving into our community. There are still a lot of contaminants still left behind from previous mining. That needs to be addressed first before it can be even considered letting applicants, new mining

to process their applications.

And to get to the point of what the meeting is about tonight, the GEIS I think should not even be an issue at all because it's only from what I read in the papers, it's to speed up the process of issuing a license to mining companies, just to make some people in Washington, to make their job a lot easier and quicker. This GEIS should not even be an issue right now.

Each EIS should be taken and reviewed, piece-by-piece, for each mining company. These proposed mine sites and geographic locations are not the same from New Mexico or to Wyoming. So these EIS, to me, should be taken by locations, not with this Generic Environment Impact Statement. To me it's discrimination against the native America people.

We practice our native traditional -- I'm a traditional person. I believe in my traditional values. I value the Mother Earth as sacred and the plants that are around the area, the water we hold sacred. Gallup is always in the paper saying that the water in the Gallup area is going to be scarce in about ten years if nothing is done. What if that happens? The Navajo people have to rely on a lot of

these outlying areas where there's watering points. Crownpoint chapter has a watering point, and Crownpoint community has a few thousand people, but there's several outlying communities that rely on this watering point, from Lake Valley, from Toreon, from Smith Lake. What if these waters, the aquifers are contaminated? Where are you guys going to get your water?

So I'm also proud to say -- I just became an heir to some allotments, several allotment, a lot of land, so all allottees are not for uranium mining. I'm against uranium mining. Thank you.

MR. RAKOVAN: Thank you, sir.

Stephen Etsitty.

MR. ETSITTY: My name is Stephen Etsitty. I'm the executive director for the Navajo Nation's Environmental Protection Agency. NNEPA requires meaningful public involvement, especially for individuals in communities who may be directly and indirectly impacted by a proposed action. It's my hope that the result of this scoping process is the realization that the no-action alternative is the preferred alternative, meaning that no action would be to not build or license potential uranium milling facilities, and that under this alternative the NRC

would not approve future license applications.

In this process, NRC shall not assume that conditions are the same or similar in all western states where past, current, or proposed ISL mining and milling developments are occurring or likely to occur. NRC's proposed GEIS shall not limit public -- meaningful public participation, nor limit the ability to identify significant issues, nor limit the analysis of direct, indirect, or cumulative effects.

The proposed GEIS shall not increase the likelihood that a private individual or developer forego the process of a site-specific environmental review and documentation for a proposed ISL mining and milling license application.

As was explained earlier, the GEIS potentially shortens the need for process and implies to some extent that local government decisions and/or authorities that limit or prohibit ISL mining and milling may not be acknowledged or considered by the NRC. It was stated earlier that important land use laws that should be deemed to be important is the Navajo Nation's Diné Natural Resources Protection Act of 2005 which prohibits uranium development.

The Navajo government submits that there is no other political geographical area in the United

States and perhaps the world that has suffered and continues to suffer from the environmental impacts of past uranium mining and processing to the same extent as the Navajo Nation.

There is no guarantee that the proposed GEIS will improve NRC's efficiency. In addition, there is no guarantee that NRC will respond adequately to environmental consequences of new uranium development.

Therefore the Navajo Nation respectfully requests the NRC to provide the Nation and the public with any examples of aquifers utilized for ISL mining where the post-ISL mining condition of the aquifer is as good as the pre-ISL mining conditions. Let me wrap up here.

The uranium legacy on the Navajo Nation goes back approximately 90 years, and the legacy consists of approximately 1,349 abandoned uranium mines, four former uranium military processing facilities known as UMTRCA sites, and two known ISL pilot projects located on free land surrounded by Navajo Nation trust land. Together these sites are the sources of known and potentially hazardous substance releases, and today more than one-third of our 110 Navajo communities and a growing population

of young and elderly are living with varied and significant health impacts from past uranium development.

During the '80s, the Navajo Nation began conducting radiological surveys of abandoned uranium mines, waste ore piles, uranium military sites, transfer and haul roads, and homes that were constructed with some of these waste uranium ore material.

In 1993, the Navajo Nation testified in hearings before Congress and requested assistance to assess and mitigate adverse environmental and human health impacts attributed to historical uranium mining and milling activities.

Since then, the U.S. Government's response has been sporadic, and the Navajo Nation's efforts have resulted in the identification of additional contaminated sites which have yet to be addressed.

The Navajo Nation has also determined that the NRC and the Atomic Energy Commission approved waste management practices, for example the disposal of mill tailings at the two mine shafts at northeast Church Rock mine near Pine Hill, New Mexico, which posed potential adverse impacts to ground water resources.

Although NRC's decisions may have been coordinated with state agencies in New Mexico, there was no available documentation to indicate that NRC formally consulted with the Navajo Nation on a government-to-government basis.

Formal consultations were also lacking with the Atomic Energy Commission's decisions to exclude mill waste for proper disposal, which was -- has been discovered by the Navajo Nation on adjacent vicinity property at a former Rare Metals of America uranium milling facility near Tuba City, Arizona.

So the U.S. Government has yet to completely verify, assess, or mitigate ongoing hazardous substance releases throughout the Navajo Nation from the last wave or uranium development. How is it possible that the NRC's proposed GEIS appropriately address all these impacts, cumulative impacts, sufficiently to justify issuance of future leases or licenses for renewed uranium development?

How would NRC's proposed GEIS appropriately address abandoned uranium mining and milling impacts within adjacent state jurisdictions?

The states of Arizona, Utah, and New Mexico have not formally proposed an agreeable approach to assess the -- to assess and mitigate hazardous

substance releases from state lands that are adversely impacting the Navajo Nation.

How will NRC's proposed GEIS acknowledge, assess, and mitigate the unique history of the Navajo Nation's uranium legacy? Our current conditions and the impacts from the last wave of uranium development are neither well understood nor predictable.

What assurances do we have that new uranium development will not adversely impact human health and the environment on the Navajo Nation?

How will NRC's proposed GEIS address potential cumulative impacts, which may include impacts from both past and new -- actually which should include impacts from both past and new uranium development activities.

The renewed interest in uranium resources is driven by current uranium prices, and NRC is proposing to expedite the NEPA process with the proposed GEIS, which has the likely potential to exacerbate existing and devastating conditions on the Navajo Nation.

So formal consultation and the proposed GEIS must acknowledge the existing impacts to the Navajo people from past uranium development, current Navajo law, which prohibits new uranium development

until the legacy of adverse and devastating impacts have been completely addressed by the U.S. Government. Thank you very much.

MR. RAKOVAN: Thank you for your comments.

The next three speakers, James Martinez, Benjamin House, and Chee Smith, Jr.

MR. MARTINEZ: My name is James Martinez. I am here on behalf of myself, my family, Puerta Villa Land Grant Corporation, which I am an heir to.

I attended the NRC hearing on August 9th in Albuquerque. I had the opportunity to listen to all the representatives speaking, and I am concerned about some that made -- who spoke and referred to Mount Taylor as their mountain.

As me -- as I am second generation heir to the Land Grant which is also Mount Taylor, I want to also make it clear and state that Mount Taylor is my mountain too.

Over 30 years ago, uranium mining began in our community. We have a mine and shaft -- a mine, shaft, and mill in the midst of our Land Grant, and mining was done safely during that time. We have never had any issues on our land being harmed and not being able to provide our crops and water for our livestock and our own personal use. We continue to

raise livestock, develop our lands with crops, and maintain our water hand-in-hand with uranium mining.

And also, we also already are benefiting from the mining with the scholarships that are being offered to my children and the Land Grant children. We are already starting to teach our children.

And also I want to say that I have a lot of health problems, and I wish I could blame it on the uranium. My family has a lot of health problems, and I wish I could blame it on the uranium. That way the doctors could pinpoint it right away.

And everybody is scared about the uranium, I don't know why. You know, it's going to generate a lot of jobs for a lot of people here, and also for my people. The money that we're going to generate, hopefully we could maybe get the mine back that we lost like Laguna did. Laguna made a lot of money with the uranium, and they bought a lot of land back that they had lost. And hopefully my people can do the same.

I just want to thank you all for listening to me.

(Applause)

MR. RAKOVAN: Benjamin House.

MR. HOUSE: My name is Benjamin House, an

allottee and president of the Eastern Navajo Allotees' Association.

In his new book, The Age of Turbulence, Alan Greenspan makes it clear that the Iraq war was largely about oil.

My point is that energy is so necessary in modern society that we will send our sons and daughters to war to fight for it because we do not have sufficient oil here in the States. This is not acceptable.

We must develop alternatives to this poor and largely Arabic dependence to oil. One widely acceptable solution is nuclear energy. It is clean and we have the fuel right here at home. Yet there are many who would have nuclear power plants fueled by foreign uranium.

Currently the country that is increasing its uranium production the fastest is Kazakhstan, another Arabic society. Does it make sense for the United States to reduce our dependence on Arabic oil by developing nuclear power only to increase on (sic) dependence on Arabic uranium, uranium that we can again go to war for some day?

So here is my request to the NRC, with haste, conduct the Generic Environmental Impact

Statement as a matter of energy security.

Two, make concrete recommendation that will allow safe development of the country's uranium resources.

Three, evaluate the national security implications of continued foreign reliance on oil and potentially uranium.

Finally, if uranium recovery is not safe, just say so. But if it is safe, also say so. And in the GEIS alternative, let us compare the safety of domestic uranium development with the safety of going to war for energy security. Thank you.

(Applause)

MR. RAKOVAN: Chee Smith, Jr.

MR. SMITH: Good evening, ladies and gentlemen, NRC Commission, and staff. My name is Chee Smith, Jr. I'm a former chapter president for Power State chapter, which is about 35 miles east of Crownpoint and Eastern Navajo Agency. I also sit on the board of ENDAUM.

In the year 2001, ENDAUM traveled to Rockville, Maryland to testify before the NRC Commission to oppose the grant of license to HRI to mine in the Crownpoint area and Church Rock area. Two sites are proposed in Crownpoint, and two sites

are proposed in Church Rock.

As we all know, water is a precious commodity. No matter what you put in the water, water cannot be restored to its original state. We all know that.

People from Wilos Lake travel to Crownpoint 35 miles every day with four or five barrels, 50 gallon barrels in their trucks, hauling water for cooking, for washing, for their livestock. And that takes a toll on their vehicles. So what I'm saying is if the ISL method goes through, people might be -- would have to get water from somewhere outside of the Navajo Reservation. And along with -- I agree with the mission of the NRC where they are to protect the public health and safety and the environment. And I think I'm talking about the lives of our people.

The one question or concern that I have falls under the historical and cultural resources. Mount Taylor is one of our four sacred mountains. Our people use it, they go up there to gather herbs, they do their prayers up there, and they respect the wildlife that's up there, but they use the eagle feathers for their ceremonies. So we who respect Mother Earth -- and we intend to keep the earth as God has created it for us to respect it. Thank you

very much.

(Applause)

MR. RAKOVAN: Thank you, sir.

The next three speakers I have Art Gebeau, Rhilla Vasquez and Jay Tonny Bowman.

Art Gebeau.

MR. GEBEAU: I'll try to be brief. I believe the previous speakers have pretty well addressed everything. My name is Art Gebeau. I'm a citizen in the Milan area, and next month it'll be 50 years, so I've been here a little while.

I was in the uranium mining and milling industry for 36 years, from 1957 'til 1993, so I have some acquaintanceship with what we're talking about tonight.

Now I'm a member of a group known as the Blue Water Valley Downstream Alliance. We're a group of homeowners who live in the vicinity of the Homestake Mill. Many of these people lived there long before the mill was there. I did not; I came there in '78 to live at that point.

The Homestake Mill started up in '58. Within three years, pollution was discovered in the ground water outside of the mill property. This was reported by the United States Public Health Service

as there were no other regulatory agencies doing anything then. After that, things kept on and by the mid to late '70s, the pollution was probably a half-mile outside of the mill boundary. The alluvial aquifer and the three upper bedrock aquifers were all involved by that time.

The NRC and the EPA and the company have been diligently working on this problem since about that time, and through their great efforts, now the pollution is about three miles outside the boundary of that mill. They think -- they say they're doing good because some of the monitored wells, the pollution levels are lower, but they sure as heck have encompassed a lot more area. My house is in that area. Now they say gee, Homestake is not to blame for all of this because there's something coming at them from upstream, upstream being where two other mills previously were and a bunch of mines.

So they've given Homestake what's called alternate concentration limits. This is a nice way of saying you're not going to meet drinking water standards so we'll just raise up the floor that you've got to meet. And by the way people, don't use your wells. Don't drink the water. Don't feed your livestock with it. Don't raise gardens with it. You

probably shouldn't even shower in it. Go find you some water. And that's what the folks in Crownpoint are saying could happen to them. Go find you some water.

I want to thank you all for your diligent efforts on the water situation on the Homestake Mill. Thank you.

(Applause)

MR. RAKOVAN: Rhilla Vasquez.

MS. VASQUEZ: Hello, I'm Rhilla Vasquez and like Art says, I'm with the Blue Water Valley Down Stream Alliance. And our wells are contaminated.

As far as NRC goes, I've had questions at previous meetings. We had a meeting at Grants on the 18th.

UNIDENTIFIED SPEAKER: Can't hear you.

MS. VASQUEZ: We had a meeting at Grants on September 18th. Mr. Von Till couldn't answer my questions.

As far as the GEIS study goes, I -- at this point I don't see what it's going to do. You haven't done anything to help clean up the community as it is. You say you're going to use all your data and all your research. We've asked for research over the last 30 years, but NRC tells us there's no

insufficient data. Well how can you set a standard if there's no insufficient data to back up your standards? So what we're asking for is a little bit of help in trying to clean up the mess.

As far as uranium recovery, you people need to think hard and fast. Thank you.

(Applause)

MR. RAKOVAN: Mr. Bowman.

MR. BOWMAN: (Speaks in Navajo) Loud audience. My name is Jay Tonny Bowman. I'm from Twin Lakes, New Mexico, about 15 miles from -- north of here. I'd like to thank U.S. NRC for bringing this hearing to this community. It is enlightening. Do you hear me? I guess I can hear myself or -- it is isn't -- why I say it is enlightening is, this is the first time that I'm hearing this kind of a meeting.

I'm going to speak on the political response to the oppositions to mining and recovery in the uranium in this area. I have heard the Navajo Nation President Joe Shirley express opposition to development of uranium through radio and newspapers. The local uranium supply is on the Navajo allotment land. Joe Shirley expressed that there will be no uranium exploration, mining, recovery on the Navajo

and Navajo allotment land. I believe this is -- interferes with Navajo private property and owners intending to utilize their property in lawful and profitable manner. Opposition mostly beyond -- opposition must prove beyond a reasonable doubt that the -- through technical, scientific, medical, and other scientific datas.

On the other hand, President Joe Shirley should assist the Navajo allottees to market their uranium properties to the maximum extent of possibility, not hinder their wishes for business development and opportunities. I'm going to make this comment in non-technical aspect of uranium activities and development, so therefore I fully support uranium development here.

I would request that NRC grant private companies their license to recover uranium in and around Crownpoint and other places for profit, other opportunities which would give the people opportunity to engage in much needed employment. If you oppose this kind of development and opportunity and employment, what are your arguments?

I don't have a job now. What are the opportunities that you can make available for the people, for the kids who I see walking on the road,

hitchhiking somewhere. They don't have enough education. They have nothing to look forward to, but all I hear now is opposition, opposition, opposition from Joe Shirley. Why don't they help the people here and come up with solutions for the disease that they claim that uranium brings, the disease that the -- the air and the environment. Find solutions, not say don't do something that the people should engage in. It's their property and I heard it mentioned that somebody was here for 60 years. Look, we've been here for thousands and thousands of years on this continent, and so what -- we need opportunities. Give us opportunities. If you have better solutions, let's hear it, not negative obstruction. Thank you.

(Applause)

MR. RAKOVAN: I'm going to continue to go through the speakers -- through the cards more or less in the order that I was given them. Our next three speakers I have are Chuck Wade, Teddy Nez, and Derrith Watchman-Moore.

Chuck Wade.

MR. WADE: My name is -- can you hear me back there? Because you can't really tell from here. My name is Chuck Wade. I'm a retired general contractor from here in Gallup, and I have been

studying alternative energy for many years. What I'd like for you to know that uranium is not an alternative energy.

(Applause)

MR. WADE: Uranium is finite, and that any rate of use of uranium at some point in time, it's going to be totally depleted off this earth. Then what are we going to do to make electricity? I have a suggestion. Let's not use fuel to make electricity. It's absolutely not necessary.

And what I mean by that is there are methods and I have one in my hand here, is a provisional patent application for a heat amplification process that takes no incoming fuel and puts out lots of energy. And I will explain that very, very easily. Take normal electricity and start -- and put it into an infrared light bulb. That light bulb will turn it in -- turn the electricity into heat. That heat goes into a nano-sized particle. That particle will be -- will start self-resonating and will take in 18 times more energy than you put in. And that's -- then it will not only take it in, then it will reradiate it out.

Therefore you put in one part of energy, you get out 18 parts of energy. You can take two of

three of those parts of energy that comes out, run it back in, and heat that light bulb and this whole process becomes a self-powering generator. Why I say all this is, we're up here talking about a little bitty in situ mining process that will help a few people here, that will help and hinder and hurt many more people, but it will have almost no effect to the people of this world. What we need to do is solve our energy, our fuel for energy problem. And this heat amplification process will do that. What I would encourage you to do, for the Navajo Nation and even HRI, to go together and engineer, manufacture, and put this heat amplification process into industry. That way these processes and unit can go throughout the world and help the people of the world, put jobs here on the Navajo Nation. I see a lot of good. And I absolutely cannot see any good of having in situ mining going into our water tables in this arid land.

Let me explain just a little bit what -- how uranium does energy, or becomes electricity I should say. What uranium does it creates heat, very, very efficiently. That heat boils water to make steam to turn a turbine and the only thing that turbine does, folks, is make a -- it goes round and

round and it creates a rotating magnetic flux. Not one part of that uranium goes down the -- because that rotating magnetic flux has the energy of the vacuum which is a -- absolutely the energy of the universe at its disposal. This energy from the vacuum goes into that rotating magnetic flux, is consolidated, and comes out of that flux as usable photons, then it goes into the wire and we use it. There is absolutely nothing in uranium that is used to make electricity per se.

I'm sure there's lots of questions and I won't take anymore of your time, and I'd be happy to work with the Navajo Nation and HRI or anyone else that wants to solve our fuel for energy problem. Thank you.

(Applause)

MR. RAKOVAN: Teddy Nez.

I have a feeling that's going to happen a few more times before this meeting is over.

MR. NEZ: I'm the next to trip on the extension cord. My name is Teddy Nez. I live at Red Water Pond Road between the two abandoned mines, United Nuclear and Kerr-McGee mining.

And I've been -- my family's been living there for eight generations. You can calculate that.

And that -- I'll talk about the license issue. And then talk about contamination on the ground, air, plants, sunlight, health, human health.

So I've been living in that area for -- 1968 and then I went to Vietnam, far from our country, then came back and then developed post-traumatic syndrome on that site, and then I had to live with the abandoned uranium mine post-traumatic syndrome, so health issue.

I need to address that to the NRC and then we need to have the health, our health issue, I have cancer; I'm living it. I live in it everyday. And then I have to go through the post-traumatic syndrome with the uranium and then with the -- as a Vietnam veteran, I have to go through with that, living with the contaminated water. Our water is already contaminated, and then on the -- some of the regulations, some of the standards that you have, I would make a request to have that like -- if the water is contaminated, it should be a hundred percent cured, instead of 40, 60, or any of the given factors. So illness, we're living with it. We have people that have cancers, so we have five individuals that we have cancer. So as far as the license issue, I would say no to it. Thank you.

(Applause)

MR. RAKOVAN: Derrith Watchman-Moore.

MS. WATCHMAN-MOORE: Good evening. My name is Derrith Watchman-Moore, and I'm representing the State of New Mexico and the Office of the Governor, Governor Bill Richardson, as well as the New Mexico Environment Department. And I have a letter written by the Governor to Chairman Dale E. Klein of the U.S. Regulatory -- Nuclear Regulatory Commission, and his letter is dated July 31st. And I want to note for the record that the Governor did receive a response from Chairman Klein on September 12th. And I want to submit that particular letter for the record and if you have access, you can, you know, make sure that that letter is in the record.

But I want to preface the Governor's letter first by saying the State of New Mexico wants to applaud the NRC this evening for coming to the community where the action is going to take place. But we also want to say that we, as government, have to do a little better. And you're getting there and -- but you're not close.

I also want to add that it's unfortunate that the NRC did not consult, communicate, invite, or even allow participation by the State of New Mexico

where most of this activity is going to be occurring in the U.S., when you even had the idea of a GEIS. And we would have told you that that particular process is probably not a good one because you're going to end up doing an EIS for every site anyway. So you're not saving any money at all.

And if you were to conduct a cost benefit analysis, your cost benefit analysis will tell you that your proposed EGI -- or GEIS process is not going to save you any money.

And the Governor acknowledges that your goal is efficiency and I believe he talked about cost and time. The State of New Mexico also considers efficiency something that we consider in government decisions, but we also consider the community wishes. And so we are getting better at understanding the community needs.

So I want to read a couple of comments from the letter and I won't read it in detail because I understand this particular letter was also read for the record -- into the record at the Albuquerque meeting.

But the Governor says that he shares your goal of efficiency and governmental oversight, but however in this case he believes that your attempt at

efficiency will negatively impact the ability of New Mexico citizens to participate in the NRC licensing processes for individual facilities.

He also says that there is nothing generic about the concerns that many New Mexicos have -- New Mexicans have with proposals to open or start new uranium mining and milling operations in their communities. The Governor states that New Mexico citizens have the right to full involvement in decisions, and that New Mexico citizens have a problem with a proposal of a Generic Environmental Impact Statement -- okay, I have to read this again, that the NRC's GEIS proposal is contrary to the State of New Mexico's public participation permitting process. And that given the concerns of New Mexico citizens and their concern about public participation in this particular process, that the Governor asks that you eliminate the EGIS (sic) process and that you are respectful to the sovereign Native American tribes in Pueblos and the general public, particularly in this particular part of the State.

The Governor states that the -- New Mexico must be assured that the public is given a robust opportunity to participate in the decisions and that all environmental, water, resource, and public --

potential public health issues are thoroughly examined for each operation.

And given that we're far into this process, I would add that the primary area that you should be concerned about, and given that there are many, many significant cultural sites and concerns regarding protection of sacred sites, and given the fact that there are environmental justice concerns, that you'll find that these particular concerns and issues will take you straight to the EIS process.

In conclusion, the Governor wants to be assured that the public to review individual Environmental Impact Statements for proposed uranium mines and mills in New Mexico are on a case-by-case basis and that the only way to get there again is through an Environmental Impact Statement for each particular site. Thank you.

(Applause)

MR. RAKOVAN: Thank you.

The next three speakers that I have are Annie Sorrell, Michael Daly, and Eric Jantz.

Annie Sorrell.

MS. SORRELL: Good evening. (Speaks in Navajo) Well just by listening, a lot of us are living out in the past. You know some of us want to

go forward. We want to see what we can establish. We want to see what improvement we can make. Too much of this way back 1968, those years are gone. That's why our government doesn't get anywhere, it's because they live in the past. They go back, go back and forth. We need to go forward.

I'm for uranium mine. I'm allottee, I have a land. Our parents have given us land in Crownpoint and in Smith Lake, and I'd like to see Crownpoint as a city, a town. I'll always say that I want a big motel there. I want a big restaurant because we have a lot of tours that goes to Chaco Canyon. And we need these places, you know, established. I'd really like to see some improvement on the reservation.

Our chapter places are the only thing that lightens up is the Bashas. That's the town Mr. MacDonald established and what more has been established this year -- for the next -- for the last eight years as far as I know? What are we doing? Where are we going? Do you ever think of your grandchildren, your children? They need jobs. They need to improve themselves in the housing. A lot of these houses are built, the rents are too high because our children are not working. And our grandchildren are coming up. I think we should think

again, and I'm in favor of uranium mines. Not that I want the money. We need businesses. We need auto sales. We need a lot of things that we can enjoy while we're here.

You talk about a lot about these sacred places, and it looks like we're pulling Mount Taylor with the Mexican people. They're my people, yes. And the Navajo, we are pulling them. We're pulling it this way. And the Hopis took our land, they said something about regaining our land. Maybe when we get our uranium we'll buy our land that's been given away. Watching our leaders just -- you know, the lands that were stolen from them.

I'm in favor of a lot of improvements on the reservation and I'd like to see it. A lot of us are middle age and we're grandmas and you know, our -- my parents have -- are both gone, but you know we want to do what we can while we're here. And that's why a lot of our children are off reservation. They have jobs back there because there wasn't -- the jobs weren't available and then the pay was really bad.

So some of you are leaders here like George. And the rest of you, please think again. Think tomorrow. We need the best for our children. We need to concentrate in helping the children with

drugs, alcohol, and meth, whatever it is. That's what we need to concentrate on, I think, other than uranium. Not all people are gone with uranium. There was tuberculosis. I know when I was a little girl, you know, I herd sheep and I always say that we herd sheep near Wilson and Cindy's place (phonetic) and you could just see dust. And I'll always say that we just blew dust away from Cactus and Edith (phonetic). And then if we see ponds when we're thirsty, we just blow all the bugs away and drink water.

What are we afraid of? We need to get away from this being afraid and do something about it. I'm in favor of uranium and I'm glad these people are supporting us.

(Applause)

MR. RAKOVAN: Michael Daly.

MR. DALY: Thank you. Good evening, NRC staff and ladies and gentlemen. My name is Michael Daly. I'm outgoing chairman of McKinley County Water Board. The county commission appointed us several years to go -- to look into issues related to water and to advise them in those matters in a way that might be beneficial to them.

One of the things we looked at was the

mining by H -- the proposed mining by HRI at Crownpoint and Church Rock. And the way we did that, we asked HRI to come in and give a presentation, and then we asked ENDAUM and the Southwest Research and Information Center through ENDAUM to come and speak to us so we could evaluate it. What we received from HRI was a technical presentation, and parenthetically while I'm talking about a technical presentation, Mr. Michalak, I really appreciated your presentation. It's obvious that you understand the subject and you could also communicate it very clearly. Thank you. But -- I liked it. I'm sorry.

But anyway, what we received from HRI was a pretty clear technical presentation and it sounded good to us.

When an ENDAUM representative came to us, what we got was a very heartfelt visceral reaction to any kind of mining. We didn't hear a technical argument against the in situ leach mining. What we heard was about all the past mining problems that we've been hearing about tonight. And Southwest Research and Information Center did not come to our board. They did come to the Gallup water board, however.

What we did then is we investigated --

there's a final EIS for HRI's proposals at Church Rock and Crownpoint, and there were appeals made by the Southwest Research Information Center and by ENDAUM, technical presentations, and we got the hearing reports and read those. And based on that, we concluded that there is -- that the mining operation won't impair the water.

The conclusion here in a short paragraph: "After a review of the materials provided, an investigation into the assertions made by those opposing in situ leach mining, we discovered no evidence that would suggest that the mining operation will impair our water supply."

And there's one other thing here. I want you to know that the people on the water board are all volunteers and we have a broad spectrum. We're not yes-men for the uranium industry and I mean, we just -- we had had a broad view from both sides. And -- but we did come together on this issue.

The other thing, and I think it's more like a recommendation, I'm not sure the environment department is going to be in charge, but we did also recommend that there be frequent split sampling at the monitor wells to be sure that the material is contained, the mining operation is contained in the

area it's intended. You can have excursions, they do go off. And HRI proposal is to mine $100 million worth of uranium a year. If they can mine $100 million uranium a year, I think we could probably have weekly or monthly split sampling and it wouldn't break anybody's back and be safe. Thank you.

(Applause)

MR. RAKOVAN: Eric Santz (sic).

MR. JANTZ: Jantz.

MR. RAKOVAN: Jantz, sorry.

MR. JANTZ: Not a problem.

MR. RAKOVAN: I thought it started with an S. I apologize.

MR. JANTZ: It's okay. Hi, my name is Eric Jantz. I'm a staff attorney with the New Mexico Environmental Law Center. I represent a number of organizations who are submitting written comments on the proposed GEIS, among them Eastern Navajo Diné Against Uranium Mining, Blue Water Valley Down Stream Alliance, Southwest Research and Information Center, and the Haak'u Water Office of the Acoma Pueblo.

And tonight I'm actually speaking on behalf of, for the most part, Haak'u Water Office of the Acoma Pueblo. The folks from ENDAUM and Blue Water Valley have done a great job of giving their concerns

about proposed uranium mining, as well as the legacy of past uranium mining.

One thing I do want to correct that was made in the NRC presentation at the beginning of this meeting is the impression that ground water can be restored after ISL mining. There's never been a commercial ISL mine in the United States that's restored ground water to its pre-mining condition. It hasn't happened.

I have in my hand a report by the U.S. Geological Survey prepared for the NRC about ground water restoration. The -- one of the examples they give of a successful restoration is the Highland, Wyoming, the Highland Oil Field, a project in Wyoming. The original baseline water quality for uranium, which is a poison; it, if ingested, will result in kidney failure and damage, was .05 (sic) milligrams of water per liter. After restoration, after restoration, it was 3.53 milligrams per liter of water, from 0.5 to 3.53 of this kidney toxicant, and that was considered a successful restoration by the NRC. So I just want to let the folks out here know that that's what restoration means to the Nuclear Regulatory Commission.

In terms of the GEIS process, it's

unfortunate that the NRC has represented that it takes public comment into account. At the Albuquerque meeting, a representative from Haak'u Water stood up before a crowd of 250 so people and asked for a tribal consultation on this GEIS. That hasn't been done. I'm here to ask for that again. A tribal consultation was absolutely not done in the context of whether or not a GEAS -- GEIS should be prepared. And tribal consultation, at least with Acoma Pueblo, has not occurred to date.

As trustee, as a federal trustee for tribes, the Nuclear Regulatory Commission, as an agency of the Federal Government, has an obligation to consult with tribal governments. Tribal governments aren't a member of the public, they are governments. Government-to-government consultation is necessary and should commence at the as soon as possible date. Thank you for your time. (Speaks Navajo)

(Applause)

MR. RAKOVAN: I'd like to thank everyone who has spoken tonight and, you know, thank you for keeping with our time so we can get through. I've got a number of people that we're going to get through so we're going to just keep on going.

The next three speakers that I have are Jerry Pohl, Terry Fletcher, and Rose Marie Cocchini.

Jerry Pohl.

MR. POHL: Good evening, ladies and gentlemen. My name is Jerry Pohl. I'm here to represent the Cebolleta Land Grant. I want to thank you -- all you guys for being here and I respect all you guys' thoughts. And as leaders of your people, I know you've got concerns for them, but I also want you guys to respect my thoughts.

I've lived in the Cebolleta Land Grant for many generations, I have come back from the colonial times, my people have been there for just about ever. We live on the east side of Mount Taylor. We used to own 200,000 acres of the mountain on the inside and the Alpy Ranch, the Elkins Ranch, even part of the Flowing B (phonetic) Ranch and the Puerta Villa Land Grant. That all belonged to the Cebolleta Land Grant.

We have had mining in the past in the Cebolleta Land Grant. It never hurt our water. It always produced good jobs for us. In fact, most of the people have stayed in the Cebolleta area because of the mines, because they didn't have to go out and look for jobs. The mines can do a lot of good things

for the people. It's governed right. With today's technology I think they can even do a lot better. So don't be afraid of it, don't be afraid of uranium.

I myself have worked ten years in the underground mining. I also have worked in the reclamation of Anaconda Mine. In this respect, I know I can represent a few miners and the mill workers that are anxious and willing to go back to work. I want to thank you all.

(Applause)

MR. RAKOVAN: Terry Fletcher.

MR. FLETCHER: Good evening, ladies and gentlemen. My name is Terry Fletcher and I'm the president of the New Mexico Mining Association. One of our functions is education of the public and government officials.

The World Health Organization has commented the greatest threat to the health and welfare of rural people is poverty.

Mining can be conducted in a sustainable and environmentally sound manner. We support the GEIS. This allows mining companies to prepare a robust EIS. It allows NRC to concentrate its expertise and experience on the site-specific aspects of each and every site.

I was going to speak to you a little bit tonight about energy independence for our nation, but Mr. House did a wonderful job, so I'm not going to repeat that. But I do want to point out that we're all feeling the impact of higher natural gas prices and gasoline at $3 a gallon. Gasoline, we're only dependent on 60 percent of our oil resources outside of the United States. Nuclear power is a given source. Whether we like it or not, it's going to be a mix for the future. Today we only achieve four percent of that from domestic supply. How would we like to be 96 percent dependent on the rest of the world for one of major sources of energy. So energy independence, local jobs, the swift and concise actions from the NRC; we support the GEIS. Thank you.

(Applause)

MR. RAKOVAN: Rose Marie Cocchini.

MS. COCCHINI: Good evening everyone, and also members of the Nuclear Regulatory Commission. Welcome, and thank you for your presentation.

I'm Sister Rose Marie Cocchini and I'm presently serving as coordinator of the Office of Peace, Justice, and Creations Stewardship for the Diocese of Gallup. And perhaps I'm stepping back

with a different perspective, but I think it's a very important perspective, especially for people of faith. And we have many different religions and traditions represented here, but we all share a deep concern for life.

And so I'd like to just begin by sharing the quote from Chief Blackout, who said and reminded us decades ago that we belong to the earth. We do not own the earth. The earth does not belong to us. And it's very obvious that our human life is very dependent upon everything that the earth provides for us. We're all totally dependent on the biosystems of earth.

Yet somehow our western civilization has proceeded and continued to regard the earth as a natural resource to be exploited and used for development and for economic profit. And at this time I think most of us are growing in an awareness that our earth is very limited, and we're seeing it with global warming. We understand that the whole earth is going to suffer as a result from rising seas, from the continuing drought here in the southwest, which will only continue and worsen.

And so as we look at this and we reflect on it, that we all share in one web of life, regardless

of our cultural, ethnic and racial backgrounds. If we truly come to that from a religious perspective, then we know that our personal and individual choices are affecting each and every one in our community of life. And that's all living beings, our fellow kin, creatures, the life and the beauty of the southwest, the earth around us.

In learning of this challenge of this possible resumption of uranium mining in the Diocese of Gallup, Bishop Donald Pollot responded by issuing a pastoral statement and the title is "God's Sacred Gift of Water." And he addressed this to all people of faith. And his intent was to place this discussion in a broader context, and that context for people of faith is one of relationship with our creator and the relationship we have with all God's creation. So you may bear with me with some of the traditions of this concept or this idea that we are one family under one creator, that the creation is God's self-revelatory gift to each of us, and it's a revelation of God's love and care.

All of us, each and every human being is created in the image and likeness of our creator. We are all one, brothers and sisters in this family. These are very basic fundamental beliefs for people

who hold religion important and faith and spirituality in their daily living. And so we are each entrusted with the sacred vocation to somehow share and mirror this love for each other, for God's creation, and for all the community of life. And not just for ourselves, but for our future generations. We learned this from our Native Americans brothers and sisters. It's the seventh generation, how will they be impacted.

So in this particular pastoral statement, the Bishop presents the idea that when life-sustaining waters are threatened, we're all challenged then to go deeper and to somehow understand that we need to respect and protect water as God's sacred gift. It's not a natural resource to use and misuse and contaminate because it will bring us more economic profit.

So we're being challenged about renewable energy. What are the possibilities? Where's the solar energy and the hydro energy, the wind energy, where are the alternative energy technologies that our scientists, our very talented scientists and technologies could help us open up for the future.

The -- also in this statement, it is reminded that numerous scientific and medical experts

have warned that invasive and experimental in situ leach uranium mining technology would invade and as we have heard already, irreversibly contaminate vital water reserves in the aquifers, pollute soil, air. We've heard this and we see evidence, those of us who have traveled to these former uranium sites.

So there's no scientific evidence, as was presented by Eric Jantz from the New Mexico Environmental Law Center, no scientific evidence that uranium-contaminated waters have ever been restored to pre-operation standards.

So the Bishop asks us to look at this. What about the contamination and destruction of vital water reserves? What does that mean for us? For our communities? For all life in our region? And nothing is more precious than what sustains life, the bio regions. We know that.

So the pastoral statement invites us in our public policy making, and our discussions with our officials and those who represent agencies to focus directly on environmental issues at stake, safeguarding vital water reserves for present and future generations. What is the common good for all in the communities involved, which by necessity includes the good of the earth and the earth's living

systems. Without water there is no life.

And so for those of us who have the religious perspective and that spiritual, moral, ethical, environmental justice principles are at the core of our faith journey, our life journey, these are very serious considerations. So we join you all in looking at these challenges, but now is the time, here is the place, and we are the stewards of God's sacred creation. Thank you.

(Applause)

MR. RAKOVAN: From my card count, it looks like we're winding down to the last, like half dozen or so speakers, so we'll keep on moving.

Melvin Capitan, Jr., Susan and Juan Elizondo.

Melvin Capitan, Jr., please.

MR. CAPITAN: Good evening or goodnight, NRC representative. I'm Melvin Capitan, Jr. and I'm a Navajo and a geologist for HRI.

I strongly support the preparation of the Generic Environmental Impact Statement. I understand your concerns and issue on underground drinking water. I work with the Navajo Nation Environmental Protection Agency under the underground injection control CIE for six years, and then worked for the

BIA for another five years. I'm also a resident of the Greater Aneth oil field, have lived with exploration and production of oil and gas most of my life. I'm aware of the pros and cons of the industry.

My recommendation is that the in situ recovery ISL method is the best method due to the safety and cleanness of the operation and development, because I'm the guy in charge of the geology of the operation.

It is my belief that if we don't pursue with the GEIS, the residents of Crownpoint and Church Rock will lose out on economic benefit.

There have been statements still, as I said in Albuquerque, many in regard to annihilation and genocide of the Navajo people, but if you look at Crownpoint and Church Rock today, the population of those communities seem to have tripled. I see more homes. How will these growth -- growing communities sustain themselves without the resources that money could provide for them.

Finally I'd like to ask the Navajo Nation Council delegates and the president and vice president, come on, my own people, can't not work together. We need to sit down with some -- bring in

-- back the young people like myself back to the reservation, hire us on to resolve all these issues. That's a solution right there. But it's been the past. The past is still with us and I don't like that at all. So I encourage the Navajo Nation to step up. Thank you.

(Applause)

MR. RAKOVAN: Susan and Juan Elizondo. Susan and Juan Elizondo. Okay.

I apologize, but I know I'm going to slaughter this one because I'm having a difficult time reading it. Sarah Nemio-Adeky. If you could please introduce yourself, because I apologize, but I can't make out the name.

After her we'll go to Chris Kenny and Phil Harrison.

MS. NEMIO-ADEKY: Good evening. It's actually -- they can call me Adeky which is Japan, it's Japanese, and sometimes it's Adeky but it's actually Adeky. Sara Nemio-Adeky. That's my name.

MR. RAKOVAN: Thank you.

MS. NEMIO-ADEKY: Good evening, members of the NRC.

UNIDENTIFIED SPEAKER: We can't hear you.

MS. NEMIO-ADEKY: Okay. I just mentioned

who I am, addressing myself properly here. I'm a Navajo, a member of the Eastern Navajo Agency. I'm also an allottee of the -- within the Eastern Navajo Agency. I'm here to talk about what is happening within our Eastern Navajo Agency communities.

I've been working in that area for the last two and a half years and have come on a one-to-one basis with our community members out there. We have many, many cases of where our people are suffering from the legacy in one way or another. And I think not only if -- until we come on a one-to-one basis with our people, will we find what is really happening out there.

I know that we are in an economical distress time within our nation, but we have to look at what we have and the resources that we have right here in our own areas and where our people are dwelling. There's a lot of rich resources there, and whether it's on the subsurface -- in the subsurface area or in the surface area. And our people cherish that, and they don't want to see any more unforeseen, unpleasant things that will happen to them because they don't know, they don't know what's coming down on them. They don't understand the in situ leach mining like a lot of the technical people understand.

They don't know what is going to happen to them. We hear testimonies. We hear oil history coming from them, and they are very saddened by what is happening.

So as you look at the -- your Generic Environmental Impact Statement and how you're going to develop that, I just heard just this evening that one of the requirement is the bio assay program that the mining companies have to implement. I think it's just proper to properly -- it's proper to go beyond that and go to the communities and give them the full health studies too. I think they need to be assured that what their health state is like, because this is what is lacking there. They don't know what is happening to them. There are health assessments going on. There's some data gathering going on, but that is not enough. It goes beyond that for our Navajo people. There's many things that have happened, and I think we can go down the line. A lot of it has been mentioned, but the Navajo Nation we kept saying our president, Joe Shirley, he only validated the law.

The Navajo Nation Council, a majority has voted to ban uranium mining and processing. And the -- to this day, the support is still there with the

Navajo Nation Council. And that should be upheld by outside agencies, including the mining companies, as well as our neighboring tribes, Acoma Pueblo, Laguna Pueblo, and all inter-Pueblo council have also passed resolution opposing any new uranium resource development that is going to happen near their sites.

I'm from Cebolla County. I live in Cebolla County and that's where my voting is at. And my home chapter, Ramah Navajo chapter is the only chapter in Cebolla County, and they have the resolution opposing uranium mining.

And it's only the City of Grants, a very few people that are in support of uranium mining.

We hold and cherish our sacred mountain, Mount Taylor, and we have a Navajo history and culture committee that have endorsed the resolution that they will come forth and they will -- in their own language to say that it's improper and it's also a -- it's improper for mining companies to go in and start digging.

Right now we have abandoned mines. We have holes in the earth that go somewhere, and we could hear our mother earth just moaning right there. She's still hurting. And that's what I know, 'cause I go out there and I look and we do ground truthing,

and we come across these places, and we investigate in our own ways as to what happened. And it saddens our hearts to see that.

And it just so happens that your comment period ends on October the 31st. And my brother here, Perry Charley, said that's the day that the day that the Little Chube saw something about Little Chube. But you know that's the day that I would say for Halloween, that's the day that people celebrate evil. And in our language we would say (speaks Navajo). And maybe this is rightful. You know it's wrong, it's wrong to be -- start celebrating the in situ leach mining and processing and supporting it, because that's the day of, and the way we see it as Navajo people, it's celebrating evil. And maybe that's where it will end up. Thank you.

(Applause)

MR. RAKOVAN: Thank you for your comments.

Chris Kenny.

MR. KENNY: Short people here. This feels strange. I'd like to request in the future in your meetings that you allow the speaker to be able to address the people here, as well as people out here, somehow. I think it could be possible.

I wanted to start by just voicing my

support for a few of the speakers that I have heard, Larry King, absolutely, Stephen I believe his last name is Edison, absolutely. If Governor Richardson said what I think he did, you'll find out my support for that later. Eric Jantz, absolutely.

I -- so that I don't need to say what those people said. My feeling is what we in this country, maybe especially, but all other the world, have a belief, an inherent belief in the infallibility of our own goodness, and that we couldn't possibly do anything bad.

And I just want to say that my name is Chris Kenny, and I forgot to say that. And I'm a scientist like you people, and I can tell, I can look into your faces and see that you are very genuine in what you do, you're very competent, you're given a challenge, you go after it in the best possible way. And if I were in charge of this task, I couldn't possibly imagine doing it any better than you have demonstrated and which you're going to be doing for the next two years.

However, it does seem like humans are capable of doing things that surprise themselves. If for example we had done an environmental impact study on the initial holocaust to the Navajo in the 1800s,

I'm sure they were people just like you on the committees in Washington to look at that, and the decision to control the Navajo problem basically was coming from people who saw land they wanted and wanted to get it. And the solution was to assassinate a few million Navajo and put the rest on a reservation, a concentration camp. There's always a justification with well-meaning people who are heavily religious, who are doing what they think is best, but it often is not in their own backyards and not with their own relatives and not with their own people. And we have another example of this going on here.

These people will not live here and they have conveniently chosen the people who live here to be the sufferers if something goes wrong, not themselves.

If we had done an environmental impact study on what would happen to Vietnam -- it's just impossible to imagine how good people can go so wrong. But they do, so we have to keep watch over ourselves.

Every single person in this room I would guess is currently contributing to the holocaust in Iraq every April 15th. You know where your money is

going. It's going to kill those people. Do you stop yourselves? No, because you have an inherent belief in the goodness of this country and the goodness of yourselves. And that the allegiance and the service of God and country is your protection system. You can't serve your God and country, because God does not favor a particular country or a particular culture and certainly does not consider the Navajo to be expendable.

I would say you already have your answer. You've had it for years now. The Navajo clearly said no. Why do another study? Because you're paid to do it and you have a job. Find another job.

(Applause)

MR. KENNY: And I'm sure you can do a good job in other areas where your true beliefs can be in action and know that you're doing the right thing. You're very smart people.

Now, I would encourage, and I want to mention Chuck Wade here in a particular kind of way. He mentions using a renewable resource. Uranium is like oil; it will come to an end. What do we have? Why I am wearing this T-shirt? We have renewable, sustainable energy, plentiful. It's cheap. Just because we have 30 new nuclear plants being approved

in Texas does not mean they have to come here and as a afterthought, figure out how to get the uranium.

We just say no, no. I say no now, you say no, we fire these people. No study. Use their salaries to build a solar plant for our city and we'll have a lot of money left over. Thank you.

(Applause)

MR. RAKOVAN: Suddenly I'm glad that I'm the facilitator of this meeting.

(Laughter)

MR. RAKOVAN: Having said that, we've got three more speakers that I have signed up to speak tonight. Phil Harrison, Leona Morgan, and Linda Evers.

If we could we please have Phil Harrison.

MR. HARRISON: I need to lower this a bit here. The uranium made me short.

Good evening ladies and gentlemen. My name is Phil Harrison and I'm from Red Valley co-chapter. And I -- it's my first term on the Navajo Nation Council and I sit on the resource committee. I wanted to speak on the issue, being a concerned citizen and a concerned leader.

I have dealt with uranium for -- since the 1950s. I grew up in the mining camps and I lost my

father to lung cancer. And I also worked in the mines too, and went through some health problems. And I lost many relatives in the Community of Cove (phonetic) and the Community of Red Valley.

If you experience these health problems and the destruction of our mother earth and contamination in our water, contamination in the vegetation, the air that we breathe, what life that we have, you would know what you're talking about. If you were never exposed to any kind of genocide or radiation exposure, then if you don't live in the impacted areas, then you wouldn't care. You wouldn't know what will come of it.

I have experienced this firsthand, and this is my first time that I actually -- going on record, but I spent 27 years of my life. I been to the military, and came back on the hardship discharge because of my father was dying; I had to help my family. The uranium had denied my education, and I had to cut short of my military career. And I lobbied for 27 years to, along with Tom Udahl, Congressman Udahl, and Stewart Udahl, and by the way, I had really enjoined the statement that Congressman Udahl delivered. Thank you very much, Congressman Udahl. And he had helped us. And he had seen this

and spent many hours on the road meeting with people, meeting with congressional people, and seeing that we're starting another trend of uranium mining, which is not good for us, not good for us.

And I sat back there and having people talk about saying that this is good for all of us. What do you mean by that? As leaders, we have to take care of our younger generation, we have to take care of our elderly. And that's how I took my oath in January. As leaders, you don't poison your people, you don't bring harm to your relatives, to your children. This is really outrageous. If they can make bombs with uranium, we are fragile. Just imagine what they will do.

Money is not the answer. To me I think this is greed, ignorance, and the nuclear field cycle as you know, ends up back in the Native American country. You mine, you mill, you burn, where does the ashes go. It goes back to the Native Americans' territory. And that is how I describe nuclear field cycle.

So I do not support this and I will stand by what the 40th council has passed, the Natural Resource Protection Act, that ban uranium mining or any kind of technology until, as our honorable

president says, that until they find a cure for cancer. So that's something that I will support while I sit on the council.

And by the way, talking about Halloween, if you see that word there GIS, that -- half of that word means crazy. If you finish it, add some more letters to it, it will be crazy. Thank you.

(Applause)

MR. RAKOVAN: Leona Morgan. Leona Morgan.

MS. MORGAN: Right here.

MR. RAKOVAN: Okay, I see her. Thanks.

MS. MORGAN: (Speaks in Navajo) Hello, my name is Leona Morgan. I am the lead organizer of the organization ENDAUM Eastern Navajo Diné Against Uranium workers -- I mean against uranium mining, not uranium workers. It's been a long night.

I have some print for -- to submit to the NRC. I'd just like to make my commentary on all the things that were said tonight and on the Generic Environmental Impact Statement.

As a community organization, ENDAUM is concerned with the quality of life of Diné people. We are also concerned for our future generations. And as a community organizer, I have been trained in working with grassroots people, and one of the things

that we observed in our Navajo people is the lack of education. Yes, there's poverty, there's other issues. And I understand that there's individuals that are concerned for the benefit of their own family because they need to know that there is job security, there's economic development so that when their kids go to school, they'd have jobs to come home to. That is a concern, and so I'm going to address that in a minute, but I just wanted to point out that we are all concerned for the best things that we want for our people. And so right now I believe that if there was more education on the effects, both negative and positive, if we can look at the cost benefit analysis and see that there is the benefit for a short time that is a little bit of fuel for some people that are not on the reservation, it's a little bit of energy through the nuclear fuel chain that we just heard about, and it's also a little bit of economic development for our people, but only for a short time.

If you think about the uranium industry, the reason why it ended and all the other things that have happened, we've seen this before and it's a process that we need to re-examine because it ended for a reason and we're going to go through the same

thing again if we don't learn our lesson.

And so part of the thing I'm stressing about education is that there are risks, there are risks that will affect our future generations beyond my lifetime, beyond my children's lifetime. If the uranium -- if the half-life of uranium is longer than any of our lives, we will not see the total effects that it is causing our people. And so there's just one thing I wanted to point out that the effects are much longer that we even can imagine.

But I want to talk a little bit about the job, economic development. If we are able as Navajo people to create our own industries, we can find better solutions. Someone was commenting about better solutions and alternate sources of energy. There are excellent abundant sources of energy in this region that are wind and solar, so I'd like to stress to the NRC, and to all the people here tonight, that we should as Navajo people look into the industries of wind and solar, because we can develop these ourselves and we don't have to allow other companies to come in and benefit from our resources.

And so that's one thing that we should consider as the U.S. -- one of the countries that

uses the most energy in the world, when our population is growing, that's just going to increase our need for energy, and uranium is just going to pollute our land even more. So we need to find energy sources that will last as much as our energy needs are growing.

And so the other thing I wanted to address about the Generic Environmental Impact Statement is that EIS, they should be -- an EIS is made to be site-specific. So we need -- each site needs to be examined and have its own individual EIS. And that needs to be presented to each community, meaning if it's in a chapter area, it's appropriate to address the chapter and to do tribal consultation.

I know at the Albuquerque meeting of the NRC, Robert Tookey presented a resolution from the all Indian Pueblo Council, which is a representative of all the 19 pueblos in the state of New Mexico, and they signed a resolution that has been submitted to the NRC at the last meeting in Albuquerque.

And so tonight what I want to submit to you, the NRC, and to point out to the people listening is that the Navajo tribe has had a ban on uranium through our Diné Natural Resources Protection Act of 2005, and so I have a copy of that right here

that I'd like to submit. I'm sure you have several copies, but this is just to add to the record.

So right here what I have also is a packet of all the resolutions signed by different communities dating back to 2003. There are several groups, chapters, Church Rock chapter, Crownpoint chapter, that have all signed resolutions opposing uranium mining.

There are also letters from our different Navajo Nation leadership, including -- going all the way back to President Zaw and Shirley, and right here I want to represent -- I want to present this which I'd like to call the past, present, and future, the past being all the resolutions signed, the present being the -- our current ban, Navajo Nation ban that I'd like to stress to ask the NRC to please respect the sovereignty of the Navajo people. When we make a law in our country, in Navajo Indian country, that pertains to everything within it. And that includes independent Indian communities such as Church Rock and Crownpoint.

(Applause)

MS. MORGAN: And so unfortunately one of the sites that is currently under, I guess, under

attack is Mount Taylor, and so as a community organization, we are also concerned about our sacred sites. As Diné people, it is explained -- it's try -- it's almost explained in the fundamental law, but unless you speak and understand our tradition, the fundamental law in its written form is just a description of what the belief is of the Navajo people, which defines our, in western words, our religion.

It is not a religion, it is a way of life, but as Americans, our First Amendment Right is to the freedom of any religion of our choosing. And as Navajo people, this is a religion that has existed since time immemorial. And so as a sacred site, Mount Taylor is inherently important in our community -- in our people's philosophy that there are teachings that go way back that explain that when things happen to our sacred sites, things that are negative or a long time ago we refer to a lot of these as monsters such as poverty and laziness and all these things. We knew of them as monsters and so currently uranium is a new kind of monster. It's something that is plaguing our people and it's destroying the health and it's also creating this false economy.

If HRI and other companies are coming in asking to use our resources, it's only to benefit themselves. And the economy will only go to benefit the people in the offices and the cities that are wherever the energy is going, not our own Diné people.

And so I'd just like to present this other article. It says, "The Luke Chapter Considers Just Transition." Just transition is -- it's an energy development between the Navajo and the Hopi with the State of California to promote and to increase the production of wind and solar power. And so here -- these are all the documents and so someone else was asking for proof. There's a book I have right here that everyone, I'm sure you've seen, has lots of proof about the scientific documentation against uranium mining and why it's bad for our people.

And so I'd just like to thank the NRC for holding additional meetings and for extending the commentary period. And so I'd like to thank you for that.

And lastly I'd just like to reiterate that we would like tribal consultation, not just for Navajo, for all the tribes in affected areas in every state, and so federally-recognized tribes. And to go

to all the communities.

And also that as Diné people, when there are negative effects to our natural world, it affects us as people. And so that's when things start to happen to our mentality and the stories that go with it; there's disease, there's growing substance abuse, all of these things. There are effects of -- that were taught to us in our traditions.

And so again I'd just like to say thank you. Thank you for your time and (speaks Navajo).

(Applause)

MR. RAKOVAN: The final card that I have is Linda Evers.

MS. EVERS: I'll keep it short. It's almost morning again. We are with Post 71 Uranium Committee. We have been doing an involuntary survey on safety guidelines and health problems and safety meetings that people had to work with in the previous uranium boom. We're trying to get compensation extended up 'til 1990 to include all the people that were over-radiated and were never informed.

For one thing that I would like to make a point is, Mayor Marietta out of Grants has turned a blind eye and a deaf ear to our people and our predicaments and our health problems. And he does

not speak for Grants and Milan when it comes to saying that they support uranium mining.

(Applause)

MS. EVERS: There is a big constituent that does not support it at all because we're sick and dying in our 30s and 40s, and it's from radiation overexposure, lack of safety equipment. I saw in your presentation that you talked a lot about safety training. Safety training and safety equipment are two different things. You could be trained all you want but unless you're properly protected, you're still overly radiated.

You've heard over and over again there's no way to reclaim water once it's toxic. I live in Art Gebeau's neighborhood. The EPA came out and tested my well. My well was a little contaminated, so instead of telling me it was contaminated, they raised the numbers and told me I could consume the water. When I took a jar of water to the EPA's office and set it on his desk and told him you drink it first, he put on a rubber glove and carried it out of his office.

So we have good reason to not trust the NRA (sic), we have good reason not to trust the EPA, and you're not going to convince us with a little study.

You're going to have to step up, you're going to have to put up. I know uranium is a renewable, reusable energy. Our point is, is we shouldn't have to sacrifice one more life to get uranium out of the ground. Thank you for your time.

MR. RAKOVAN: Thank you.

Scott, did you want to close things out?

MR. FLANDERS: I just want to say in closing I want to thank all of you for coming out for the meeting. I know it's been a long meeting and I appreciate you staying until the end to provide your comments. All your comments will be taken into consideration as we prepare the draft Generic Environmental Impact Statement and we will be back out as Greg said before when we actually have a draft for you to provide comments to us on that as well.

Again, we appreciate you for your time and attention. Thank you very much.

(Whereupon the above-entitled matter was concluded at 11:01 p.m.)

Transcript and slides of the September 27, 2007 Scoping Meeting in Gallup, New Mexico will be made available on the U. S. Nuclear Regulatory Commission's website

The specific Accession Number was unavailable at the time this document was finalized.

http://www.nrc.gov/materials/fuel-cycle-fac/licensing/geis.html#scoping-comments

Appendix B

Examples of Regulatory Approvals for Completed Restoration Projects

September 20, 2006

Ms. Donna L. Wichers
General Manager
COGEMA Mining, Inc.
935 Pendell Boulevard
P.O. Box 730
Mills, WY 82644

SUBJECT: REVIEW OF COGEMA MINING, INC., IRIGARAY MINE RESTORATION REPORT, PRODUCTION UNITS 1 THROUGH 9, SOURCE MATERIALS LICENSE SUA-1341 (TAC LU0137)

Dear Ms. Wichers:

By letter dated November 7, 2005, to the U.S. Nuclear Regulatory Commission (NRC), COGEMA Mining, Inc. (COGEMA), submitted a mine restoration report for Irigaray Mine, production units 1 through 9. COGEMA submitted this information to fulfill License Condition (LC) 10.16 of Source Materials License SUA-1341 that requires COGEMA to conduct ground-water restoration and postrestoration monitoring as described in Section 6.1 of the approved license application.

COGEMA submitted information that included the mine restoration report as well as the results of the Wyoming Department of Environmental Quality's (WDEQ) review of that report. In a letter dated November 1, 2005, Mr. Richard Chancellor, Administrator of the WDEQ Land Quality Division, noted that WDEQ determined that ground water in Irigaray Mine production units 1 through 9 has been restored, as a whole, to its premining class of use. The WDEQ concluded that although ground water has not returned to baseline conditions, ground-water quality within the wellfield, based on the mean concentrations, will not endanger the class of use. The WDEQ also concluded that residual contaminant concentrations will not exceed U.S. Environmental Protection Agency maximum contaminant levels for the ground water outside the aquifer exemption boundary. Accordingly, WDEQ determined that the wells within the wellfield may be abandoned as described in the reclamation plan.

The NRC staff has completed its review of the ground-water restoration, stability, and monitoring information provided by COGEMA. The NRC staff concurs with the WDEQ that qround water has been restored, as a whole, to its premining class of use. Although the licensee has not met the NRC primary or background restoration standards in LC 10.16, the NRC staff concludes that COGEMA has restored ground water to the NRC secondary standards or premining use category as required in LC 10.16. Therefore, with this approval, COGEMA can begin decommissioning wells in Irigaray Mine production units 1 through 9.

The enclosed technical evaluation report (TER) provides the staff's detailed review of the Irigaray Mine restoration information.

If you have any questions regarding this letter or the enclosed TER, please contact Mr. Ron Linton, the Project Manager for COGEMA license SUA-1341, at (301) 415-7777, or via email, to RCL1@nrc.gov.

In accordance with Title 10, Section 2.390, "Public Inspections, Exemption, Requests for Withholding," of the *Code of Federal Regulations* (10 CFR 2.390) and the NRC's Rules of Practice, the agency will electronically provide a copy of this letter for public inspection in the NRC Public Document Room or from the Publicly Available Records component of the NRC's Agencywide Documents Access and Management System, which is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/

Gary S. Janosko, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No.: 040-8502
License No.: SUA-1341

Enclosure: Technical Evaluation Report

cc: R. Chancellor, WDEQ-LQD
S. Ingle, WDEQ-LQD
J. Corra, WDEQ-LQD

The enclosed technical evaluation report (TER) provides the staff's detailed review of the Irigaray Mine restoration information.

If you have any questions regarding this letter or the enclosed TER, please contact Mr. Ron Linton, the Project Manager for COGEMA license SUA-1341, at (301) 415-7777, or via email, to RCL1@nrc.gov.

In accordance with Title 10, Section 2.390, "Public Inspections, Exemption, Requests for Withholding," of the *Code of Federal Regulations* (10 CFR 2.390) and the NRC's Rules of Practice, the agency will electronically provide a copy of this letter for public inspection in the NRC Public Document Room or from the Publicly Available Records component of the NRC's Agencywide Documents Access and Management System, which is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/

Gary S. Janosko, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No.: 040-8502
License No.: SUA-1341

Enclosure: Technical Evaluation Report

cc: R. Chancellor, WDEQ-LQD
S. Ingle, WDEQ-LQD
J. Corra, WDEQ-LQD

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February 12, 2003

Michael L. Griffin
Manager of Environmental and Regulatory Affairs
Crow Butte Resources, Inc.
86 Crow Butte Road
Post Office Box 169
Crawford, NE 69339-0169

SUBJECT: LICENSE AMENDMENT 15, CROW BUTTE RESOURCES *IN SITU* LEACH FACILITY, LICENSE NO. SUA-1534, WELLFIELD #1 RESTORATION ACCEPTANCE (TAC NO. L52491)

Dear Mr. Griffin:

Staff concludes the data submitted in the October 11, 2002, Additional Stability Monitoring Data (CBR, 2002A) demonstrates that restoration of Wellfield Unit 1 is acceptable and has resulted in constituent levels that will remain below levels protective of human health and the environment, in accordance with 10 CFR 40.31(h) and 10 CFR Part 40, Appendix A, Criterion 5F.

License Condition 10.3C has been changed to reflect the change in the Wellfield Restoration Plan as applied to other Wellfields to comply with the performance based criteria for stabilization, transmitted by letter dated January 30, 2003, which includes stability monitoring beyond the six-month period, as necessary, to continue until no increasing concentration trends are exhibited.

Additionally, the staff is making an administrative change deleting License Condition 9.6 which is more restrictive than the requirements set forth in Reg. Guide 8.31, which is required to be followed in License Condition 9.12.

The staff has concluded that this license amendment meets the requirements in 10 CFR 51.22(c)(11) for a categorical exclusion because (i) there is no significant change in the types or significant increase in the amounts of any effluents; (ii) there is no significant increase in additional or cumulative occupational radiation exposure; (iii) there is no significant construction impact; and (iv) there is no significant increase in the potential for, or consequences from radiological accidents. Therefore, neither an environmental assessment nor an environmental impact statement is required.

These changes to Materials License SUA-1534 were discussed between you and Mr. John Lusher, the NRC Project Manager for the Crow Butte facility, on January 30, 2003. If you have any questions concerning this letter or the enclosure, please contact Mr. Lusher at (301) 415-7694 or by e-mail to JHL@nrc.gov.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

Daniel M. Gillen, Chief Fuel Cycle Facilities Branch Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards

M. Griffin 2
February 12, 2003

Docket No. 40-8943 License No. SUA-1534

Enclosure: Technical Evaluation Report
Materials License SUA-1534, Amendment 15

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OFC FCFB FCFB OGC FCFB FCFB

NAME JLusher* BGarrett* M. Schwartz*
via email

GJanosko* DGillen

DATE 02/04/03 02/05/03 02/11/03 02/12/03 02/12/03
*see previous concurrence **OFFICIAL RECORD COPY**

TECHNICAL EVALUATION REPORT

DATE: January 30, 2003

DOCKET NO.: 40-8943

LICENSE NO.: SUA-1534

FACILITY: Crow Butte Resources *In Situ* Leach Uranium Project, Chadron, Nebraska

PROJECT MANGER: John H. Lusher

TECHNICAL REVIEWER: Michael C. Layton, Hydrogeologist

SUMMARY AND CONCLUSIONS: Staff concludes the data submitted in the October 11, 2002 Additional Stability Monitoring Data (CBR, 2002A) demonstrates that restoration activities in Wellfield Unit 1, have resulted in constituent levels that will remain below levels protective of human health and the environment, in accordance with 10 CFR 40.31(h) and Criterion 5F, 10 CFR Part 40, Appendix A. Staff recommends amending Materials License SUA-1534 to show that restoration of Wellfield Unit 1 is complete. Staff also recommends that the licensee seek a license amendment to make the stability monitoring performance oriented, continuing until no increasing concentration trends are exhibited, rather than restricting the monitoring period to no longer than six months.

DESCRIPTION OF AMENDMENT REQUESTS: By letter dated October 11, 2002, (CBR, 2002A), the licensee submitted supplemental ground-water monitoring data collected in Wellfield Unit 1 to

demonstrate the stability of the ground-water restoration efforts. These data were collected and submitted in accordance with the licensee's proposed monitoring plan dated June 28, 2002 (CBR, 2002B), which NRC accepted by letter dated August 2, 2002, (NRC, 2002). The licensee is requesting approval of restoration completion for Unit 1, based on the recently submitted data.

The licensee must demonstrate that the proposed request meets the general requirements of 10 CFR Part 40, specifically 10 CFR 40.31(h) and 10 CFR Part 40, Appendix A, Criterion 5F, as described in Section 6.1.3 (5), "Standard Review Plan for *In Situ* Leach Uranium Extraction License Applications" (SRP), NUREG-1569 Rev. 1 (NRC, 2002B).

EVALUATION: Staff completed its review of the approval request for the completion of ground-water restoration in Unit 1, as presented in Crow Butte's "Mine Unit 1 Restoration Report," and supplemental documents (CBR, 2000B; CBR, 2000C; CBR, 2001; CBR, 2002A, and CBR, 2002B). The submitted data show that ground-water quality has been restored to the baseline concentrations or the secondary restoration standards established by license condition 10.3C, SUA-1534.

Staff previously denied the request for wellfield restoration approval for Unit 1, based on insufficient data to demonstrate stability of the restored concentrations for several constituents. Staff's analysis indicates that concentrations of ammonium, iron, radium-226, selenium, total dissolved solids, and uranium show strongly increasing concentration trends over the stability monitoring period (NRC, 2002A).

The licensee conducted additional confirmatory monitoring in several Unit 1 monitoring wells, in accordance with the June 28, 2002 (CBR, 2002B) proposed monitoring plan as agreed upon by the NRC by letter dated August 2, 2002 (NRC, 2002B). The data provided by the licensee by letter dated October 11, 2002 (CBR, 2002A) shows that concentrations of ammonium, radium-226, selenium, total dissolved solids, and uranium have remained stable and below regulatory limits during four consecutive sampling episodes collected at least two weeks apart.

Iron concentrations over the same period have shown a continued increase, and at one point, exceeded the State's water quality standard of 0.30 mg/L. Iron is often measured to indicate general quality and aesthetic character of water. It is sometimes used to describe the hardness of ground water and is considered a secondary water quality parameter, which does not impact public health. Staff considers that the increasing iron concentrations exhibited in Unit 1 are likely the result of reducing geochemical conditions continuing to be re-established after restoration completion. The staff does not consider this increasing trend to be an impact to human health or the environment.

As previously concluded, staff's analysis and findings strongly indicate that the six-month period for stability monitoring at this site required by CBR's Underground Injection Control Permit, is insufficient to assure stability for all monitored constituents. Many constituents reached stability within a relatively short time; however, increasing concentrations for several constituents persist at the end of, and presumably beyond, the six-month stability period. Accordingly, CBR has made a commitment in its January 30, 2003 Groundwater Restoration Plan, Revision 2, to continue stability monitoring beyond the six-month period as necessary. Stability monitoring will conclude, instead, when stabilization samples show that restoration goals on a mine unit average for monitored constituents are met and there is an absence of significant increasing trends.

RECOMMENDATIONS:

Staff recommends approval for the completion of Unit 1 ground-water restoration.

Staff also recommends that the licensee seek a license amendment to make the stability monitoring performance oriented, continuing until no increasing concentration trends are exhibited, rather than restricting the monitoring period to no longer than six months.

ENVIRONMENTAL REVIEW:

The staff has determined that the following have been met:

1. The Environmental Assessment for Renewal of Source Material License No. SUA-1534, Crow Butte Resources, Incorporated, Crow Butte Uranium Project, Dawes County Nebraska, February 1998, encompasses this licensing action; additionally,
I. There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite;
II. There is no significant increase in individual or cumulative occupational radiation exposure;
III. There is no significant construction impact; and
IV. There is no significant increase in the potential for or occurrences from radiological accidents.

The staff has concluded that this license amendment meets the requirements in 10 CFR 51.22(c)(11) for a categorical exclusion. Therefore, neither an environmental assessment nor an environmental impact statement is required.

COORDINATION AND CONSULTATION: This technical review and the proposed license amendment were discussed and coordinated with Louis Carson, III, of NRC's Region IV Inspection Program, and David Miesbach, Under Ground Injection Control Program Coordinator, for the Nebraska Department of Environmental Quality, on January 27, 2003, which regulates the Crow Butte Resources facility under its Underground Injection Control Program, delegated from the U.S. Environmental Protection Agency. No unresolved concerns were identified through the course of this coordination.

REFERENCES:

Code of Federal Regulations (CFR), Title 10, Chapter I - Nuclear Regulatory Commission, Parts 2 , 40, and 51, revised as of January 1, 2002.

CBR (Crow Butte Resource, Inc.). 2002A. Additional Stability Monitoring Data for Mine Unit 1 Groundwater Restoration Crow Butte Uranium Project. Report attached to Letter from Michael Griffin, Crow Butte Resources to Daniel M. Gillen, Uranium Recovery Branch, NRC, dated October 11, 2002, Accession Number ML022980095.

CBR (Crow Butte Resource, Inc.). 2002B. Denial, Mine Unit 1 Groundwater restoration Source Materials License SUA-1534 Docket Number 40-8963. Letter and attachments from Fletcher Newton to Martin J. Virgilio, Director NMSS/NRC, dated June 28, 2002. Accession Number ML021990509.

NRC (U.S. Nuclear Regulatory Commission). 2002A. Denial, Wellfield Unit 1 Ground-Water Restoration Approval, Crow Butte Resources In Situ Leach Facility, License No. SUA- 1534 (TAC No. L52376). Letter and Attachments from Melvyn Leach to Michael L. Griffin dated March 29, 2002. Accession Number ML020930087.

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NRC FORM 374 U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and the applicable parts of Title 10, Code of Federal Regulations, Chapter I, Parts 19, 20, 30, 31, 32, 33, 34, 35, 36, 39, 40, 51, 70, and 71, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee

1. Crow Butte Resources, Inc.

3. License Number SUA-1534, Amendment 15

2. 274 Union Blvd. Suite 310 4. Expiration Date February 28, 2008
Lakewood, Colorado, 80228 5. Docket No. 40-8943
[Applicable Amendments: 6, 10] Reference No.

6. Byproduct Source, and/or 7. Chemical and/or Physical 8. Maximum amount that Licensee
Special Nuclear Material Form May Possess at Any One Time

Under This License
a.. Natural Uranium Any a. Unlimited

b. Byproduct material Unspecified b. Quantity generated under
as defined in Operations authorized by
10 CFR 40.4 this license

SECTION 9: **Administrative Conditions**

9.1 Authorized place of use shall be the licensee's Crow Butte uranium recovery and processing facilities in
Dawes County, Nebraska.

9.2 All written notices and reports to NRC required under this license shall be addressed to the Chief, Fuel
Cycle Licensing Branch, c/o Document Control Desk, Division of Fuel Cycle Safety and Safeguards,
Office of Nuclear Materials Safety and Safeguards, U. S. Nuclear Regulatory Commission, 11545 Rockville Pike, Two White Flint North, Rockville, MD 20852-2738.

Required telephone notification shall be made to the NRC Operations Center at (301) 816-5100, unless otherwise specified in license conditions.

[Applicable Amendment: 7, 12]

9.3 The licensee shall conduct operations in accordance with the commitments, representations, and
statements contained in the license application dated December 1995, as amended by submittals dated
April 1, June 25, July 28, October 31, 1997, January 14, 2000, September 12, 2001, April 19, 2002, and
September 25, 2002, which are hereby incorporated by reference, except where superseded by license
conditions below.

Whenever the word "will" or “shall” is used in the above referenced documents, it shall denote a requirement.

[Applicable Amendment: 11, 12, 14]

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9.4 Change, Test and Experiment License Condition

A) The licensee may, without obtaining a license amendment pursuant to § 40.44, and subject to conditions specified in (b) of this condition:

I make changes in the facility as described in the license application (as updated),

ii make changes in the procedures as described in the license application (as updated), and

iii conduct test or experiments not described in the license application (as updated).

B) The licensee shall obtain a license amendment pursuant to § 40.44 prior to implementing a proposed change, test or experiment if the change, test, or experiment would:

i Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);

ii Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);

iii Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);

iv Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);

v Create a possibility for an accident of a different type than any previously evaluated in the license application (as updated);

vi Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);

vii Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or technical evaluation reports (TERs) or other analysis and evaluations for license amendments.

viii For purposes of this paragraph as applied to this license, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments thereof.

C) Additionally the licensee must obtain a license amendment unless the change, test, or experiment is consistent with the NRC conclusions, or the basis of, or analysis leading to, the conclusions of actions, designs, or design configurations analyzed and selected in the site or facility Safety Evaluation Report, TER, and EIS or EA. This would include all supplements and amendments, and TERs, EAs, EISs issued with amendments to this license.

D) The licensee's determinations concerning (b) and (c) of this condition, shall be made by a Safety and Environmental Review Panel (SERP). The SERP shall consist of a minimum of three individuals. One member of the SERP shall have expertise in management (e.g., Plant Manager) and shall be

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responsible for financial approval for changes; one member shall have expertise in operations and/or construction and shall have responsibility for implementing any operational changes; and, one member shall be the radiation safety officer (RSO) or equivalent, with the responsibility of assuring changes conform to radiation safety and environmental requirements. Additional members may be included in the SERP as appropriate, to address technical aspects such as groundwater, hydrology, surface-water hydrology, specific earth sciences, and other technical disciplines. Temporary members or permanent members, other than the three above-specified individuals, may be consultants.

E) The licensee shall maintain records of any changes made pursuant to this condition until license termination. These records shall include written safety and environmental evaluations made by the SERP that provide the basis for determining changes are in compliance with (b) of

this condition. The licensee shall furnish, in an annual report to the NRC, a description of such changes, test, or experiments, including a summary of the safety and environmental evaluation of each. In addition, the licensee shall annually submit to the NRC changed pages, which shall include both a change indicator for the area changed, e.g. a bold line vertically drawn in the margin adjacent to the portion actually changed, and a page change identification (date of change or change number or both), to the operations plan and reclamation plan of the approved license application (as updated) to reflect changes made under this condition.

[Applicable Amendment 12]

9.5 The licensee shall maintain an NRC-approved financial surety arrangement, consistent with 10 CFR 40,
Appendix A, Criterion 9, adequate to cover the estimated reclamation and closure costs, if accomplished by a third party, for all existing operations and any planned expansions or operational
changes for the upcoming year. Reclamation includes all cited activities and groundwater restoration,
as well as off-site disposal of all 11e.(2) byproduct material.

Within three months of NRC approval of a revised closure plan and cost estimate, the licensee shall submit for NRC review and approval, a proposed revision to the financial surety arrangement if estimated costs in the newly approved site closure plan exceed the amount covered in the existing financial surety. The revised surety shall then be in effect within three months of written NRC approval.

Annual updates to the surety amount, required by 10 CFR 40, Appendix A, Criterion 9, shall be provided to NRC by October 1 of each year. If NRC has not approved a proposed revision 30 days prior to the expiration date of the existing surety arrangement, the licensee shall extend the existing arrangement, prior to expiration, for one year. Along with each proposed revision or annual update of the surety, the licensee shall submit supporting documentation showing a breakdown of the costs and the basis for the cost estimates with adjustments for inflation, maintenance of a minimum 15 percent contingency, changes in engineering plans, activities performed, and any other conditions affecting estimated costs for site closure.

At least 90 days prior to beginning construction associated with any planned expansion or operational change which was not included in the annual surety update, the licensee shall provide for NRC approval an updated surety to cover the expansion or change.

The licensee shall also provide NRC with copies of surety-related correspondence submitted to the State of Nebraska, a copy of the State's surety review, and the final approved surety arrangement. The licensee also must ensure that the surety, where authorized to be held by the State, identifies the NRC-related portion of the surety and covers the above-ground decommissioning and decontamination, the cost of offsite disposal, soil and water sample analyses, and groundwater restoration associated with the site. The basis for the cost estimate is the NRC-approved site closure plan or the

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NRC-approved revisions to the plan. Reclamation/decommissioning plan, cost estimates, and annual updates should follow the outline in Appendix E to NUREG-1569 (NRC, 1997), entitled "Recommended Outline for Site-Specific *In Situ* Leach Facility Reclamation and Stabilization Cost Estimates."

Crow Butte Resources, Inc.'s currently approved surety instrument, an Irrevocable Standby Letter of Credit issued by the Royal Bank Of Canada (New York Branch), in favor of the State of Nebraska, shall be continuously maintained in the sum total amount of no less than $12,816,973.00 for the purpose of complying with 10 CFR 40, Appendix A, Criterion 9, until a replacement is authorized by both the State of Nebraska and NRC.

[Applicable Amendments: 1, 2, 5, 9, 12, 14]

9.6 [Deleted by Amendment No. 15]

9.7 The licensee shall dispose of 11e.(2) byproduct material from the Crow Butte Facility at a site licensed by NRC or an NRC Agreement State to receive 11e.(2) byproduct material. The licensee's approved waste disposal agreement must be maintained on-site. In the event the agreement expires or is terminated, the licensee shall notify NRC in writing, in accordance with License Condition 9.2, within 7 days after the date of expiration or termination. A new agreement shall be submitted for NRC approval within 90 days after expiration or termination unless further delay is justified, or the licensee will be prohibited from further lixiviant injection.

9.8 Release of equipment, materials, or packages from the restricted area shall be in accordance with the NRC guidance document entitled "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated May 1987, or suitable alternative procedures approved by NRC prior to any such release.

9.9 Before engaging in any construction activity not previously assessed by NRC, the licensee shall complete a cultural resource inventory. All construction associated with the proposed development will be completed in compliance with the National Historic Preservation Act of 1966 (as amended)

and its implementing regulations (36 CFR Part 800), and the Archaeological Resources Protection Act of 1979 (as amended) and its implementing regulations (43 CFR Part 7).

In order to ensure that no unapproved disturbance of cultural resources occurs, any work resulting in the discovery of previously unknown cultural artifacts shall cease. The artifacts shall be inventoried and evaluated in accordance with 36 CFR Part 800, and no disturbance shall occur until the licensee has received authorization from NRC to proceed.

Prior to any developmental activity in the immediate vicinity of the six “potentially eligible” sites identified in Section 2.4 of the approved license application, the licensee shall provide documentation of its coordination with the Nebraska State Historical Society to NRC.

9.10 The licensee shall conduct operations within the permit area boundaries shown in Figure 1.3-1 of the approved license application, as amended by the submittal dated July 28, 1997.

9.11 The licensee is hereby exempted from the requirements of Section 20.1902(e) of 10 CFR Part 20 for areas within the facility, provided that all entrances to the facility are conspicuously posted in accordance with Section 20.1902(e) and with the words, "**ANY AREA WITHIN THIS FACILITY MAY CONTAIN RADIOACTIVE MATERIAL.”**

9.12 The licensee shall follow the guidance set forth in U.S. Nuclear Regulatory Commission, Regulatory Guides 8.22, “Bioassay at Uranium Recovery Facilities,” 8.30, “Health Physics Surveys in Uranium Recovery Facilities,” and 8.31, “Information Relevant to Ensuring that Occupational Radiation Exposure at Uranium Recovery Facilities will be As Low As is Reasonably Achievable (ALARA),” or NRC-approved equivalent.

9.13 [DELETED by Amendment No. 12]

9.14 [DELETED by Amendment No. 4]

SECTION 10: **Operations, Controls, Limits, and Restrictions**

10.1 The licensee shall use a lixiviant composed of native groundwater, with added sodium carbonate/bicarbonate and oxygen or hydrogen peroxide, as described in the approved license application.

10.2 The licensee shall construct all wells in accordance with methods described in Section 3.1.2 of the approved license application.

Mechanical integrity tests shall be performed on each injection and production well before the wells are utilized and on wells that have been serviced with equipment or procedures that could damage the well casing. Additionally, each well shall be retested at least once each five (5) years it is in use. The integrity test shall pressurize the well to 125 percent of the maximum operating pressure and shall maintain 90 percent of this pressure for 20 minutes to pass the test. A single point resistance test may be used only in conjunction with another approved well integrity testing method. If any well casing failing the integrity test cannot be repaired, the well shall be plugged and abandoned.

10.3 The licensee shall establish pre-operational baseline groundwater quality data for all well field units.
Baseline water quality sampling shall provide representative pre-operational groundwater quality data
and restoration criteria as described in the approved license application.

The data shall consist, at a minimum, of the following sampling and analyses:

A. Three samples shall be collected from production and injection wells at a minimum density of one production or injection well per 4 acres. These samples shall be collected at least 14 days apart.

B. The samples shall be analyzed for ammonia, arsenic, barium, cadmium, calcium, chloride, copper, fluoride, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, nitrate, pH, potassium, radium-226, selenium, sodium, sulfate, total carbonate, total dissolved solids, uranium, vanadium, and zinc.

C. Groundwater restoration goals shall be established on a parameter-by-parameter basis for the constituents identified in License Condition 10.3B. The primary goal of restoration shall be on a parameter-by-parameter basis to return the average well field unit concentration to baseline conditions. The secondary goal of groundwater restoration shall be on a parameter-by-parameter basis to return the average well field unit concentration to the numerical class-of-use standards established by the Nebraska Department of Environmental Quality, as described in section 6.1.3 of the approved license application. The licensee shall conduct groundwater restoration activities in accordance with the groundwater restoration plan submitted by letter dated January 30, 2003.

[Applicable Amendment: 11, 15]

10.4 The licensee shall establish upper control limits (UCLs) in designated upper aquifer and perimeter monitoring wells before lixiviant is injected in each well field unit. The UCLs shall be established by collecting and analyzing groundwater samples from those designated wells according to the following criteria:

A. Three samples shall be collected from each designated monitoring well at a minimum density of: 1) one upper aquifer monitoring well per 5 acres of well field area, and 2) all perimeter monitoring wells. These samples shall be collected at least 14 days apart. The results of these analyses shall constitute the baseline for each designated well.

B. The samples shall be analyzed for the following indicator parameters: chloride, sodium, sulfate, conductivity, and total alkalinity.

C. The UCLs shall be calculated for each indicator parameter, in each monitoring well, as equal to 20 percent above the maximum concentration measured for that parameter, among the three baseline samples. For those indicator parameters with baseline concentrations that average 50 mg/L or less, the UCL for that parameter may be calculated as equal to 20 percent above the maximum baseline concentration, the baseline average plus 5 standard deviations, or the baseline average plus 15 mg/L.

[Applicable Amendments: 8, 10]

10.5 The plant throughput shall not exceed a maximum flow rate of 5000 gallons per minute, excluding
restoration flow. Annual yellowcake production shall not exceed 2 million pounds.

10.6 Each of the R&D evaporation ponds shall have at least 0.9 meters (3 feet) of freeboard. Each of the
commercial evaporation ponds shall have at least 1.5 meters (5 feet) of freeboard.

Additionally, the licensee shall maintain, at all times, sufficient reserve capacity in the evaporation pond system to enable transferring the contents of a pond to the other ponds. In the event of a leak and subsequent transfer of liquid, freeboard requirements shall be suspended during the repair period.

10.7 All liquid effluents from process buildings and other process waste streams, with the exception of sanitary wastes, shall be returned to the process circuit; discharged to the solar evaporation ponds; disposed by land irrigation in accordance with the licensee's proposal submitted on August 3, 1988, as modified by its submittal on June 7, 1993; or deep well injected in accordance with the licensee's report submitted on August 24, 1993, as modified by submittals dated December 7, 1995, April 3, 1996, and September 12, 2000.

[Applicable Amendment: 7]

10.8 The licensee shall maintain effluent control systems as specified in Sections 4.1 and 5.7.1.1 of the
approved license application, with the following exceptions:

A. If any of the yellowcake emission control equipment fails to operate within specifications set forth in the standard operating procedures, the drying and packaging room shall immediately be closed-in as an airborne radiation area and heating operations shall be switched to cooldown, or packaging operations shall be temporarily suspended. Packaging operations shall not be resumed until the vacuum system is operational to draw air into the system.

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B. The licensee shall, during all periods of yellowcake drying operations, assure that the negative pressure specified in the standard operating procedures for the dryer heating chamber is maintained. This shall be accomplished by either (1) performing and documenting checks of air pressure differential approximately every four hours during operation, or (2) installing instrumentation which will signal an audible alarm if the water flow or air pressure differential falls below the recommended levels. If an audible alarm is used, its operation shall be checked and documented at the beginning and end of each drying cycle when the differential pressure is lowered.

10.9 [DELETED by Amendment No. 12]

10.10 In-plant radiological monitoring for airborne uranium and radon daughters shall be conducted at the locations shown in Figure 5.7-1 in the approved license application.

10.11 [DELETED by Amendment No. 12]

10.12 [DELETED by Amendment No. 12]

10.13 [DELETED by Amendment No. 12]

10.14 The licensee shall maintain an area within the restricted area boundary for temporary storage of contaminated materials. All contaminated wastes and evaporation pond residues shall be disposed at a radioactive waste disposal site licensed to accept 11e.(2) byproduct material.

10.15 The licensee shall construct evaporation ponds 2 and 5 in accordance with the engineering design report dated April 27, 1988, as modified by the submittals dated May 11, and July 16, 1992. In addition, the ponds shall be constructed as follows:

A. Fill material shall be classified as a silty sand material in accordance with the Unified Soil Classification System.

B. Quality control of the fill shall be performed in accordance with the guidance provided for radon barrier materials in the NRC “Staff Technical Position on Testing and Inspection Plans during Construction of DOE’s Remedial Action at Inactive Uranium Mill Tailing Sites” (January 1989).

C. As-built drawings of the constructed ponds shall be submitted to NRC within 3 months of the completion of construction of each pond.

10.16 Production zone monitor wells drilled after April, 1999, shall be spaced no greater than 300 feet from a well field unit and no greater than 400 feet between the wells.

SECTION 11: **Monitoring, Recording, and Bookkeeping Requirements**

11.1 Flow rates on each injection and recovery well, and manifold pressures on the entire system, shall be measured and recorded daily. During wellfield operations, injection pressures shall not exceed the integrity test pressure at the injection well heads.

11.2 All designated perimeter and upper aquifer monitor wells shall be sampled and tested no more than 14 days apart, except in the event of the situations identified in the licensee's submittal dated March 19, 1998. If a designated monitor well is not sampled within 14 days of a previous sampling event, the reasons for the postponement of sampling shall be documented. Sampling shall not be postponed for greater than five days.

If two UCLs are exceeded in a well or if a single UCL is exceeded by 20 percent, the licensee shall take a confirming water sample within 48 hours after the results of the first analyses are received and analyze the sample for the indicator parameters. If the second sample does not indicate an exceedance, a third sample shall be taken and analyzed in a similar manner with 48 hours after the second set of samples was acquired. If neither the second nor the third sample indicate an exceedance, the first sample shall be considered in error.

If either the second or third sample confirms that a UCL(s) has been exceeded, the well in question shall be placed on excursion status. Upon confirmation of an excursion, the licensee shall notify NRC in accordance with License Condition 12.2, implement corrective action, and increase the sampling frequency for the indicator parameters at the excursion well to once every seven (7) days. Corrective actions for confirmed excursions may be, but are not limited to, those described in Section 5.7.8.1 of the approved license application. An excursion is considered concluded when the concentrations of the indicator parameters are below the concentration levels defining an excursion for three (3) consecutive weekly samples.

[Applicable Amendment: 1, 12]

11.3 The licensee shall establish and conduct an effluent and environmental monitoring program in accordance with the program submitted by letter dated March 18, 1999.

[Applicable Amendment: 3]

11.4 The licensee shall perform and document inspections in accordance with the February 5, 1996, revision to its Evaporation Pond Onsite Inspection Program.

Any time 6 inches or more of fluid is detected in a commercial pond standpipe, it shall be analyzed for specific conductance. If the water quality is degraded beyond the action level, the water shall be further sampled and analyzed for chloride, alkalinity, sodium, and sulfate. Any time

6 inches or more of fluid is detected an R&D pond standpipe, it shall be analyzed for specific conductance, chloride, alkalinity, sodium, and sulfate.

Upon verification of a liner leak, the licensee shall notify NRC in accordance with License Condition 12.2, lower the fluid level by transferring the pond's contents to an alternate cell, and undertake repairs, as needed. Water quality in the affected standpipe shall be analyzed for the five parameters listed above once every 7 days during the leak period and once every 7 days for at least 14 days following repairs.

11.5 [DELETED by Amendment No. 12]

11.6 The results of the following activities, operations, or actions shall be documented: sampling; analyses; surveys and monitoring; survey/monitoring equipment calibration results; reports on audits and inspections; all meetings and training courses required by this license; and any subsequent reviews, investigations, or corrective actions. Unless otherwise specified in the NRC regulations, all such documentation shall be maintained for a period of at least five (5) years.

11.7 [DELETED by Amendment No. 12]

11.8 Any time uranium in a worker's urine specimen exceeds 15 micrograms per liter (ug/l), the annual ALARA audit will indicating what corrective actions were considered or performed.

11.9 Any time a uranium action level of 35 ug/l for two consecutive urine specimens or 130 ug/l for any one specimen is reached or exceeded, the licensee shall provide documentation within 30 days to the NRC indicating what corrective actions have been performed.

SECTION 12.0 **Reporting Requirements**

12.1 Effluent and environmental monitoring program results submitted in accordance with 10 CFR 40.65 shall be reported in the format shown Table 3 of Regulatory Guide 4.14, (Rev 1) entitled, "Sample Format for Reporting Monitoring Data." These reports also shall include injection rates, recovery rates, and injection manifold pressures.

12.2 Spills, Pond Leaks, Leaks, Excursions, and Incident/Event Reporting

Until license termination, the licensee shall maintain documentation on unplanned release of source or 11e.(2) by product materials (including extraction solutions) and process chemicals. Documented information shall include, but not be limited to: date, volume, total activity of each radionuclide released, radiological survey results, soil sample results (if taken), corrective actions, results of post remediation surveys (if taken), and a map showing the spill location and the impacted area.

The licensee shall have procedures which will evaluate the consequences of the spill or incident/event against 10 CFR 20, Subpart "M," and 10 CFR 40.60 reporting criteria. If the criteria are met, then report to the NRC Operations Center as required.

If the licensee is required to report any spills, pond leaks, excursions of source, 11e.(2) by product material, and process chemicals that may have an impact on the environment, or any other incidents/events to State or Federal Agencies, a notification shall be made to the NRC Headquarters Project Manager (PM) by telephone or electronic mail (e-mail) within 48 hours of the event. This notification shall be followed, within thirty (30) days of the notification, by submittal of a written report to NRC Headquarters PM as per License Condition 9.2, detailing the conditions

leading to the spill, pond leak, excursion or incident/event, corrective actions taken, and results achieved.

[Applicable Amendment 12]

12.3 [DELETED by Amendment No. 12]

12.4 [DELETED by Amendment No. 13]

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12.5 The licensee shall submit a detailed decommissioning plan to NRC for review and approval at least
12 months prior to the planned final shutdown of well field extraction operations.

12.6 [Deleted by Amendment 12}

12.7 [Deleted by Amendment 12]

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/ Dated: __2/12/03______________

Daniel M. Gillen, Chief Fuel Cycle Facilities Branch Division of Fuel Cycle Safety and Safeguards Office of Nuclear Material Safety and Safeguards