HARDROCK MINING: ISSUES RELATING TO ABANDONED MINE LANDS AND URANIUM MINING

Energy and Natural Resources Committee
United States Senate

Statement of the National Mining Association
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Good morning, Mr. Chairman and members of the Committee. My name is Fletcher Newton, and I am the Executive Vice President of Corporate and Strategic Affairs for Uranium One, Inc. Uranium One is a publicly traded company 90% of whose shareholders are American investors. We are developing new uranium mines in the United States, Australia, and South Africa and own interests in existing mines in Kazakhstan. Our U.S. production will be primarily in Texas and Wyoming and exclusively use solution mining to recover uranium. We expect to see our first production from Texas at the end of this year, with production from Wyoming coming on line in 2010. I am testifying today on behalf of the National Mining Association (NMA). NMA appreciates the opportunity to testify before the Committee on this issue of great importance to the domestic mining industry. NMA members support reform of the Mining Law and look forward to working with the Committee to try to resolve this issue during this Congress.

NMA is the principal representative of the producers of most of America's coal, metals, industrial and agricultural minerals; the manufacturers of mining and mineral processing machinery, equipment and supplies; and the engineering and consulting firms, financial institutions and other firms that serve our nation's mining industry. Our association and our members, which employ or support 170,000 high-wage jobs, have a significant interest in the exploration for, and development of, minerals on federal lands. The public lands in the Western states are an important source of minerals, metal production and reserves for the nation's security and well-being. Mining on federal lands provides for high-wage employment, vitality of communities, and for the future of this critical industry.

NMA is committed to the development of a fair, predictable and efficient national minerals policy through amendments to the Mining Law of 1872. Because the vitality of the modern American economy is firmly rooted in the ready availability of metals and minerals that are essential to our way of life and our national security, our efforts in the end should result in a mining law that:

- Secures a fair return to the government in the form of a net income production payment for minerals produced from new mining claims on federal lands;
- Establishes an abandoned mine lands clean-up fund financed with revenue generated from a net income production payment; and
- Provides the certainty needed for private investment in mining activities on federal lands by ensuring security of title and tenure from the time of claim location through mine reclamation and closure.

Uranium Mining is Appropriately Governed by the Mining Law

Extraction of uranium on federal lands is conducted similarly to extraction for other hardrock minerals governed by the Mining Law. As with other types of hardrock mining there are several methods for extraction of uranium, such as underground uranium mining, open pit mining and in situ recovery. The type of mining undertaken depends on a number of factors including the nature of the deposit and grade of ore. Underground uranium mining is in principle no different than any other hard rock mining and other ores are often mined in association (e.g., copper, gold, silver). In open pit mining, overburden is removed by drilling and blasting to expose the ore body which is mined by blasting and excavation via loaders and dump trucks. In situ recovery is performed by pumping liquids down through injection wells placed on one side of the deposit of uranium, through the deposit, and up through recovery wells on the opposing side of the deposit.

Current Environmental Scheme Governing Uranium Mining on Federal Lands

The potential impacts from uranium mining on federal lands are substantially similar to those from other hardrock mining and the existing regulatory scheme adequately protects federal lands from all types of hardrock mining. Mining on public lands, **including uranium mining**, is a pervasively regulated enterprise with a vast range of federal, state, and local environmental laws and regulations governing mineral exploration, development, operation, closure and reclamation. Under current law, companies that engage in hardrock mining and related activities on the public lands are subject to a comprehensive framework of federal and State environmental, ecological, and reclamation laws and regulations to ensure that operations are fully protective of public health and safety, the environment, and wildlife including:

- Specific mining environmental standards administered by the Bureau of Land Management (BLM) and the Forest Service, the federal surface land management agencies, and supplemented by state laws;
- All major applicable federal environmental laws such as the National Environmental Policy Act (NEPA), the Clean Air Act (CAA), the Clean Water Act (CWA), the Solid Waste Disposal Act (SWDA), the Resource Conservation and Recovery Act (RCRA), Superfund, the Safe Drinking Water Act (SDWA), the Toxic Substances Control Act (TSCA) and many others;

- Wildlife protection statutes administered by the Department of the Interior and/or States such as the Endangered Species Act.
- Comprehensive Western State laws and regulations dealing with the protection of groundwater quality and quantity, both for operations and closure, the management and disposal of solid waste, and the reclamation of mining sites, which typically focus on the establishment of post-mining habitat for wildlife.

As seen by the number of approvals and permits the typical mining operation on federal lands must obtain before commencing construction, mining is heavily and thoroughly regulated. Depending on a project's complexity, the environmental assessment and permitting process can take upwards of a decade to complete. Typical environmental permits and approvals include:

- A plan of operations from the BLM or Forest Service, requiring a reclamation plan, closure plan, and cultural resources plan. The plan of operations is scrutinized under NEPA, usually requiring the preparation of an environmental impact statement (EIS), which evaluates potential environmental impacts of the mining operation, assesses alternatives and requires the identification of mitigation measures to reduce potentially significant environmental impacts.
- Air quality permits from EPA or state agencies with delegated programs under the CAA.
- Water quality permits from EPA or state agencies with delegated programs under the CWA. Water quality permits can include discharge permits, stormwater management permits and section 404 permits. States also require permits to address potential impacts to ground water, both during operations and closure to protect the reasonably foreseeable beneficial uses of groundwater resources.
- Rights to use or consume water from appropriate state authorities.
- Hazardous waste permits that govern storage, transportation and disposal of laboratory or processing wastes.
- Authorization under the National Historic Preservation Act if cultural or historic resources are present.

These laws and regulations that govern mining on federal lands are "cradle to grave," covering virtually every aspect of mining from exploration through mine reclamation and closure. The National Academy of Sciences (NAS) reviewed the existing federal and state regulatory framework for hardrock mining and concluded that the existing laws were "generally effective" in ensuring environmental protection. *Hardrock Mining on Federal Lands,* National Academy of Sciences, National Academy Press, 1999, p. 89.

Since the NAS study was published, the federal land management agencies have acted to make this effective regulatory program even stronger. For example, BLM and the Forest Service have significantly strengthened their financial guarantee requirements. BLM's regulations now require financial guarantees for all mining and exploration disturbances, no matter how small, before activities can proceed. Both agencies require the financial guarantee to cover the full cost to reclaim the operation, as if the agencies were to contract with a third party to conduct reclamation. In addition, the agencies can now require the establishment of a trust fund or other funding mechanism to ensure the continuation of long-term treatment to achieve water quality standards and for other long-term, post-mining reclamation and maintenance requirements. State-specific regulations require the establishment of financial assurance using a variety of specified forms.

Furthermore, the agencies require periodic review of reclamation funding. BLM has implemented a tracking system under which BLM state directors are required to certify each fiscal year that the reclamation cost estimates for proposed and operating mines have been reviewed and are sufficient to cover the cost of reclamation. Similarly, the Forest Service requires annual review of financial assurances. The improvements in financial assurance requirements, combined with sustained environmental compliance, will ensure that the public will not ultimately become responsible for reclamation of mine sites on federal lands.

The existing comprehensive framework of federal and state environmental and cultural resources laws already regulates all aspects of mining from exploration through mine reclamation and closure. Additional federal regulation is unnecessary, duplicative and unreasonable.

Existing Authorities Adequately Protect Special Places

Access to federal lands for mineral exploration and development is critical to maintain a strong domestic mining industry. Federal lands account for as much as 86 percent of the land area in certain Western states. These same states, rich in minerals, account for 75 percent of our nation’s metals production and will continue to provide a large share of the future metals and hardrock minerals produced in this country.

Efforts to amend the Mining Law must recognize existing authorities to close certain “special places” to mining activity. Congress has closed lands to mining for wilderness, national parks, wildlife refuges, recreation areas, and wild and scenic rivers. Congress also has granted additional authority to the Executive Branch to close federal lands to mining. The Antiquities Act authorizes the president to create national monuments to protect landmarks and objects of historic and scientific interest. Finally, Congress authorized the Secretary of the Interior to close federal lands to mining pursuant to the land withdrawal authority of the Federal Land Policy and Management Act. As a result of these laws and practices, new mining operations are either restricted or banned on more than half of all federally owned public lands. These existing laws and authorities are adequate to protect special areas. New closures of public land, based on vague and subjective criteria without congressional oversight, would arbitrarily impair domestic mineral and economic development.

In addition, the federal land management agencies have land use planning processes to identify natural or cultural resources or environmental and social sensitivities that require special consideration. These planning processes are used to identify areas that need to be withdrawn as well as any terms, conditions, or other special considerations needed to protect other resource values while conducting activities under the operation of the mining laws. Other mechanisms available to federal land management agencies for protecting valuable resources and sensitive areas include use of advisory guidelines to identify categories of resources or lands that deserve special consideration and the adoption of site-specific mitigation measures in a plan of operations to protect cultural values, riparian habitat, springs, seeps, and ephemeral streams that are not otherwise protected by specific laws.

Right to Deny Approval

With the existing tools available to protect special resources and environmentally sensitive areas, there is no need to provide additional federal authority to address where mining claims should be denied on federal lands due to environmental or other concerns. In particular, it is not necessary to give the Secretary of Interior the right to stop a mining project when all environmental and other legal requirements are met. Such authority is simply not needed to protect against unnecessary or undue degradation as the federal land management agencies have other statutory and regulatory means of preventing irreparable harm to significant scientific, cultural, or environmental resource values. The Department of the Interior exercises case-by-case discretion to protect the environment from any unnecessary or undue degradation through the process of approving or rejecting individual mining plans of operations.

Not only is such federal authority unnecessary to protect the environment or special resources, providing such authority creates significant uncertainty regarding ultimate mining project approval. Mining projects will not be able to attract investments if there is no certainty that the project can obtain approval even when the operator complies with all relevant laws and regulations. Investors need to know that a mining project in the United States can obtain approval and proceed unimpeded as long as the operator complies with all relevant laws and regulations. Mining projects—from exploration to extraction to reclamation and closure—are time- and capital-intensive undertakings, requiring years of development before investors realize positive cash flows. Uncertainty in the legal regime applicable to mining projects can chill the climate for capital investments in domestic mining projects and have serious consequences for our economic and national security. If the investments critical for bringing a mine to fruition tend to migrate toward projects planned in other countries, the United States will become even more reliant on foreign sources of minerals.

Growing Reliance on Foreign Sources of Minerals

Despite reserves of 78 important mined minerals, the United States currently attracts only eight percent of worldwide exploration dollars. As a result, our nation is becoming more dependent upon foreign sources to meet our country’s strategic and critical metals and minerals requirements, even for minerals with adequate domestic resources. The 2007 U.S. Geological Survey Minerals Commodity

Summaries reported that America now depends on imports from other countries for 100 percent of 17 mineral commodities and for more than 50 percent of 45 mineral commodities. This increased import dependency is not in our national interest particularly for commodities critical to pending strategic programs such as reducing greenhouse gas emissions or undertaking energy efficiency efforts. Increased import dependency causes a multitude of negative consequences, including aggravation of the U.S. balance of payments, unpredictable price fluctuations, and vulnerability to possible supply disruptions due to political or military instability.

Our over-reliance on foreign supplies is exacerbated by competition from the surging economies of countries such as China and India. As these countries continue to evolve and emerge into the global economy, their consumption rates for mineral resources are ever-increasing; they are growing their economies by employing the same mineral resources that we used to build and maintain our economy. As a result, there exists a much more competitive market for global mineral resources. Even now, some mineral resources that we need in our daily lives are no longer as readily available to the United States.

Uranium is an excellent example of a mineral that the US relies on foreign sources. The United States currently consumes about 56 million pounds of uranium each year, yet we only produce 4 and a half million pounds. We have the worlds largest fleet of reactors (now 104), which operate at the world's highest average capacity factor and produce 20% of our country's electricity. In fact, America's nuclear reactors now produce more electricity than ever before. And we have one of the world's largest resource bases of uranium of any country in the world.

Despite the size of our nuclear fleet, however, we produce less than 10% of our own uranium and import over 90% of what we need to operate our reactors. The price for uranium has recently climbed to an historic high, and yet new U.S. production is still lagging, at least in part because of uncertainty over the regulatory environment for new production here.

Processing of Uranium

Uranium processing, as opposed to uranium mining, is not conducted under the auspices of the Mining Law. Instead, a comprehensive federal program for processing has evolved through the Atomic Energy Act of 1946 (1946 AEA), the Atomic Energy Act of 1954 (1954 AEA) and the Uranium Mill Tailings Radiation Control Act of 1978 and its amendments (UMTRCA). After World War II, in recognition of the significant military importance of uranium, and in recognition of the strategic value of having a secure supply of uranium, Congress passed the 1946 AEA.[1] This act created the Atomic Energy Commission (AEC), the forerunner of Nuclear Regulatory Commission (NRC), and it provided the AEC with substantial powers with respect to uranium.

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[1] Atomic Energy Act of 1946, Pub. L. No. 79-585, 60 Stat. 755 (1946).

At its inception, the AEC recognized that the United States atomic weapons program was almost completely dependent on uranium ores originating in the Belgian Congo. The AEC set out to correct this strategic weakness by developing a domestic uranium producing industry. To accomplish this task, the AEC went to work implementing a policy that would encourage private companies and individuals to explore for uranium and develop any reserves located in the United States. In these efforts, the AEC was fully aware that its most significant obstacle was the high cost associated with the domestic extraction and production of yellowcake.[2] Added to the uncertainties of mineral exploration, these costs were a substantial barrier to domestic mining --particularly in light of the fact that there existed no private market for either uranium ore or processed uranium. Therefore, to provide an incentive to potential prospectors, the AEC developed a program that guaranteed prices for ore production, provided bonuses for the initial production from new mines, and reimbursed producers for transportation costs.[3]

It was not enough, however, just to locate uranium reserves and extract the ore: as the AEC recognized, it would also be important to encourage the development of a domestic uranium milling industry. Accordingly, the AEC set out to encourage the private development of milling facilities, by creating an incentive system in the form of agreements by the AEC to purchase processed uranium on terms that allowed private companies to recover the cost of constructing and operating a mill during the life of the contract.[4] Under this program, uranium mills were privately constructed and operated pursuant to contracts negotiated with the AEC, under which the AEC committed to purchases of uranium concentrate that would effectively return to the mill operator the costs of mill construction and operation plus a reasonable return on investment.

Concerns regarding the potential health and environmental hazards of mill tailings awakened in the late 1960s, however, as information came to light regarding the dispersal of uranium mill tailings in the area of Grand Junction, Colorado. Congress reacted to this information by taking a second look at the scope of AEC's legal authority to regulate uranium mill tailings.

In the early and mid-1970s the AEC (and later NRC)[5] relied upon the combined authorities contained in the AEA and NEPA to impose restrictions on the management and disposition of uranium mill tailings through the issuance of "Regulatory Guides" and "Branch Positions." NRC and Congress soon recognized the inadequacies of the authority claimed by the Commission to regulate mill tailings through NEPA and the AEA; and in response, UMTRCA was passed to grant

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[2] As an example, at that time, the cost of Belgian Congo yellowcake delivered in the United States was \$3.40 per lb., while yellowcake from the Colorado Plateau would cost at least \$20 per lb. to produce. Gray *supra* note 1 at 42.

[3] Gray *supra* note 1 at 42-43.

[4] Final Generic Environmental Impact Statement on Uranium Milling, NUREG-0706 vol. I at 2-1 (September 1980).

[5] In 1974, the AEC was terminated and divided into a promotional and a regulatory agency. The Energy Research and Development Administration, the precursor to the current Department of Energy (DOE) was the promotional agency. The new regulatory agency created was the NRC.

the Commission explicit authority to directly regulate uranium mill tailings and related wastes.

UMTRCA created a two-part regulatory system to deal, comprehensively, with uranium milling operations and, in particular, with the tailings and other wastes generated from those operations. In Title I of UMTRCA, Congress established a program to identify and remediate so-called "inactive" sites; that is, sites at which uranium milling operations had occurred in the past or that contained the tailings or other wastes produced during such milling operations and that were not covered by an existing license. In Title II of the Act, Congress created a program for the regulation of tailings and wastes generated at "active" milling sites; that is, sites with active licenses under the AEA. To implement the provisions of the Act, Congress established a tripartite jurisdictional scheme involving EPA, NRC and the Department of Energy (DOE), each of which have a defined role in the comprehensive national program to regulate uranium mill tailings and related wastes.

Under the program set out in Title I of UMTRCA, DOE is authorized to enter into "cooperative agreements" with states containing inactive sites, for the purpose of remediating those sites. Remedial actions undertaken by DOE under Title I are required to have the Commission's concurrence and to conform with standards developed by EPA for the protection of public health, safety and the environment from the potential radiological and non-radiological hazards associated with tailings and other uranium milling wastes.[6] Following remediation of these inactive sites, title to the tailings and wastes from the sites, and to the land used for their disposal, is to be transferred to DOE with concurrence of the Commission, and the sites are to be maintained by DOE in perpetuity, pursuant to licenses issued by the Commission.[7] In addition, the Commission is authorized under Title I to require that DOE, as the custodian of remediated inactive sites, undertake such monitoring, maintenance and emergency measures as the Commission may deem necessary to protect public health and safety. The Commission can also require DOE to take other actions that the Commission deems necessary to comply with EPA's generally applicable standards for protection against potential radiological and non-radiological hazards associated with uranium mill tailings and related wastes.[8]

The complement to the Title I program is found in Title II of UMTRCA. In Title II Congress granted the Commission expansive authority, along with EPA, to regulate directly all aspects of the management and disposition of uranium mill tailings and related wastes generated at active sites.[9] The centerpiece of this grant of direct

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[6] 42 U.S.C. § 7918 (1994).

[7] 42 U.S.C. § 7914 (1994).

[8] In many respects, the role assigned to DOE under Title I of UMTRCA is akin to that of a super "potentially responsible party" or "PRP" under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. §§ 9601, *et seq*., since DOE is responsible for remediating Title I sites and maintaining them in perpetuity, and the agency is responsible for most of the costs associated with those efforts. Indeed, because of the unique role per-formed by DOE at Title I sites, Congress deemed it appropriate to specifically exclude those sites from the reach of CERCLA. 42 U.S.C. § 9601(22).

[9] Under section 274 of the AEA states can enter into agreements with NRC under which the states assume the authority of the Commission with respect to the regulation of uranium mill tailings and related wastes. Accordingly,

authority was the creation of a new category of AEA-regulated materials. Specifically, by modifying the existing definition of "byproduct" material under the AEA, Congress created "11e.(2) byproduct material," which was defined 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.[10]

This class of material was (and is) unique among the materials regulated under the AEA because it was defined not solely in terms of its radiologic characteristics, but instead was defined broadly enough to encompass "all wastes" -- both radioactive and *non-radioactive* -- resulting from uranium ore processing.[11]

In addition, the legislative history of the Act makes plain Congress' intent that this unique material be regulated under a single, coordinated regulatory regime. As Senator Domenici explained in floor debates on a Senate bill that was substantially similar to the bill eventually enacted as UMTRCA:

> A basic principle of the amendment is the creation of a unified regime for mill tailings so that the various distinct materials which make up a single mill tailings pile need not be subject to fragmented [sic], duplicative and potentially conflicting regulatory activities by different government agencies.[12]

UMTRCA assigned to EPA the authority to promulgate standards of general applicability -- for both the Title I and Title II programs addressing both the radiological and *non-radiological* hazards of uranium mill tailings and related wastes. For the *non-radiological* hazards, these generally applicable standards are to provide protection *equivalent* to that provided by EPA's RCRA standards. At the same time, however, such tailings and wastes, because they are 11e.(2) byproduct material, are specifically exempted from regulation by EPA under RCRA, and permitting authority over 11e.(2) material is deliberately withheld from EPA. Instead, UMTRCA calls upon the Commission to implement and enforce through licensing the generally-applicable standards developed by EPA.[13] Furthermore, Congress directed NRC to *independently* develop specific requirements and criteria applicable to licensees that (1) the Commission deems appropriate to protect against both the potential radiological and *non-radiological* hazards associated with

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reference in this White Paper regarding the authority of the Commission with respect to uranium mill tailings are intended to encompass Agreement states as well.

[10] AEA section 11e.(2)142 U.S.C. § 2014e(2). Previously, "byproduct material" had been defined to mean "any radioactive material (except special nuclear material) yielded or made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear material." This definition has been retained in AEA section 11e.(1).

[11] *See* 57 Fed. Reg. 20,525, 20,526 (1992) ("The definition of byproduct material in section 11e.(2) of the AEA includes all the wastes from the milling process, not just the radioactive components.... The designation of 11e.(2) material contrasts significantly with the situation for source material and other radioactive materials controlled under the authority of the AEA.").

[12] 124 Cong. Rec. 29,776 (Sept. 18, 1978).

[13] 42 U.S.C. § 2022(d).

11e.(2) material; and (ii) that are compatible with EPA's generally-applicable RCRA-based standards.[14]

Thus, by adding a new category to the existing AEA definition of "byproduct material" Congress, in UMTRCA, created a whole new class of regulated materials and expanded EPA's and NRC's jurisdiction *under the AEA* into entirely new areas of regulation (namely, the direct regulation of *non-radiological* materials associated with uranium milling). Based on this definitional change and on the provisions of Sections 84 and 275 of the AEA (which were also added by UMTRCA), Congress incorporated protection against potential *non-radiological* hazards (consistent with that provided by EPA's RCRA standards) into the program for regulating uranium mill tailings and other 11e.(2) materials, without giving EPA any direct permitting authority over Title I sites or Title II licensees.

The Creation of a Regulatory Program for Uranium Mill Tailings

After UMTRCA's enactment, the Commission developed the regulatory program needed to implement its new statutory authority. NRC first issued a Draft Generic Environmental Impact Statement (DGEIS) examining the environmental ramifications of uranium milling activities and possible regulatory standards pertaining to those activities. NRC then published proposed regulations governing uranium milling and mill tailings.[15] NRC's regulations adopted extremely conservative standards for the management and disposal of uranium mill tailings.

In the decade of the 1980s, the various pieces that were required to construct a comprehensive system for regulating UR activities were put into place, and a mature regulatory program for uranium milling operations began to take shape. At the same time, however, the uranium recovery industry began to experience a fundamental shift away from conventional mining and milling.

In 1983, three years after NRC issued its final GEIS and promulgated initial regulations on uranium milling, EPA promulgated its first set of "generally applicable standards."[16] These standards applied only to "inactive" sites (i.e., sites regulated under Title I of UMTRCA that were no longer operated under an active license). Although these types of sites were not addressed in NRC's initial regulations, EPA's inactive site regulations opened a window on some important differences between NRC and EPA, particularly with respect to the establishment of standards for the control of radon emissions from tailings. Thus, for example, in its final inactive sites regulations, EPA concluded that a radon emission standard of 20 pCi/m^2/s was adequately protective of human health and safety, as compared to the 2 pCi/m^2/s standard adopted by NRC. In addition, EPA's regulations did not

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[14] This basic division of authority between EPA and the Commission for the entire nuclear fuel cycle, under which EPA promulgates standards of general applicability and NRC imposes specific requirements consistent with those EPA standards, generally is consistent with the division of authority established under Reorganization Plan No. 3 of 1970, 5 U.S.C. App. at 1551. Under that Plan the functions of the AEC were transferred to EPA, but only to the extent that such functions of the Commission consist of establishing generally applicable standards for the protection of the general environment from radioactive material."

[15] 44 Fed. Reg. 50,015 (1979).

[16] 48 Fed. Reg. 590 (January 5, 1983).

include any specific standards for radon barriers (since, arguably, EPA did not have any authority to impose that sort of design requirement on tailings facilities) although, in its rulemaking materials, EPA 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 pCi/g in the first 15 cm soil horizon and no more than 15 pCi/g in succeeding 15 cm soil layers. In addition, EPA required that disposal systems be designed to provide "reasonable assurance" of achieving the Agency's disposal standard for 1,000 years, but no less that 200 years without reliance on "active" maintenance. Finally, EPA did not, in its inactive sites regulations, establish any generally applicable criteria for groundwater contamination because, in the Agency's view at the time, the risks from groundwater contamination were not sufficiently significant to require the development of such standards. 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 DOE on a site-by-site basis, taking into account various site-specific factors.[17]

Later in 1983, EPA promulgated final regulations for active sites (i.e., sites addressed under Title II of UMTRCA that were operated under active licenses).[18] As with the inactive site standards, EPA's active site regulations require that radon emanation from tailings disposal sites be limited to 20 pCi/m^2/s.[19] The regulations also require that the controls used for tailings disposal provide "reasonable assurance" of achieving this standard for 1,000 years, but not less than 200 years.[20] In addition, like the inactive sites regulations, EPA's active sites provisions also incorporate the 5/15 standard for radium in soil.[21]

Despite these similarities, EPA's active sites regulations deviated from the inactive sites requirements in at least one significant way: by establishing generally applicable groundwater standards that were intended to provide a level of protection equivalent to that provided by EPA's regulations under RCRA.[22] The groundwater standards in EPA's active site regulations, which were directed primarily at potential *non-radiological* contaminants, were divided into a primary standard and a secondary standard. The primary standard is a *design* standard, requiring the installation of a bottom liner under all new tailings impoundments and

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[17] Id. at 599-600.

[18] 48 Fed. Reg. 45,926 (1983).

[19] *Id*. at 45947.

[20] *Id.*

[21] *Id.*

[22] Although the inactive sites regulations promulgated by EPA in 1983 did not include generally-applicable standards for groundwater protection (because, as indicated previously, the Agency believed at the time that the risks from groundwater contamination were not sufficiently significant to require the development of such standards), EPA was subsequently required by the courts to adopt groundwater standards for inactive sites that were comparable to those promulgated for active sites. *See* 60 Fed. Reg. 2854 (1995).

under new extensions of existing impoundments. The secondary standard is a performance standard, requiring that groundwater at the edge of a tailings pile meet background levels or, for certain parameters, the higher of background levels or drinking water standards. In addition, the new active sites regulations allowed for the establishment of alternate concentration limits (ACLs), on a site-specific basis, at the point of compliance (POC) (i.e., the area necessary for disposal), provided that groundwater constituent concentrations protection of public health, safety, and the environment were attained at the point of exposure (POE).

Congress addressed additional concerns about the NRC regulation in 1983 by amending the AEA to modify certain sections that had been added previously by UMTRCA.[23] In particular, section 274 of the Act was amended to provide Agreement states with explicit authority to adopt "alternatives (including, where appropriate, site-specific alternatives) to the requirements adopted and enforced by the Commission" provided that they achieve a level of protection "equivalent to, to the extent practicable, or more stringent than" the level of protection afforded by NRC's standards.[24] Similarly, section 84 of the Act was also amended to allow NRC to approve licensee-proposed alternatives to the requirements adopted by the Commission if the licensee-proposed alternatives provide a level of protection that is "equivalent to, to the extent practicable, or more stringent than" the level of protection afforded by the NRC standards.[25]

In addition, the 1983 amendments to the AEA clarified NRC's responsibilities under AEA section 84(a) by specifically requiring that the Commission consider environmental and economic costs and balance those costs against potential risks when developing standards and requirements for the management of 11e.(2) material.[26] By the end of 1983, EPA had issued standards of general applicability for active uranium mill tailings sites (as well as for inactive sites), and Congress had amended the AEA to provide more flexibility for Agreement states and NRC licensees to achieve the levels of protection required under EPA and NRC regulations without necessarily being bound to the specific requirements set forth in those regulations. In addition, Congress specifically directed NRC and EPA to balance costs against risks when developing regulations and standards governing the management of uranium mill tailings and related wastes.

Under the administrative scheme set out in the statute, NRC's mill tailings regulations were required to conform to EPA's generally applicable standards. However, since NRC had promulgated its mill tailings regulations three years *prior to* EPA's issuance of generally applicable standards (instead of waiting for EPA action before promulgating its regulations), at the time EPA's generally-applicable standards were promulgated they were in conflict with the Commission's regulations. Consequently, NRC was forced to revise its 1980 regulations so that they would conform to EPA's later-issued generally applicable standards.

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[23] Pub. L. No. 97-415, 96 Stat. 2067 (1983).

[24] Id. codified at 42 U.S.C. § 2021(o).

[25] 52 Fed. Reg. 43,553 (1987).

[26] Pub. L. No. 97-415 § 22 (1983).

Although NRC was able to conform its mill tailings regulations to EPA's radon and surface stabilization standards fairly quickly, it took a significantly longer period of time for the Commission to conform its regulations to EPA's groundwater standards. Indeed, although NRC. published an advance notice of proposed rulemaking in November of 1984, it was not until three years later, at the end of 1987, that NRC's final groundwater regulations were promulgated.[27] Those regulations, like the EPA groundwater protection regulations described above, included a design standard and a performance standard. Also like the EPA standard, NRC's performance standard required the licensee to achieve background concentrations, drinking water standards, or an ACL. At around the same time that NRC promulgated its final groundwater standards, the Commission began to require that licensees implement groundwater corrective action programs aimed at ensuring compliance with those standards.

NRC's failure to promulgate final groundwater regulations prior to 1987 created difficulties for some mill operators. By the mid-1980s, unfavorable world market conditions for uranium were beginning to take their toll on conventional uranium milling operations in the United States, causing a general decline in the industry. As a consequence, a number of uranium mills that had been on "standby" status in the United States began to seriously address the closure process. However, final closure was, as a practical matter, impossible until NRC's groundwater regulations were in place. And the closure efforts of some facilities were further delayed by the time required to develop and issue guidance on obtaining ACLs (which, for most facilities, would be essential to satisfying NRC's groundwater standards). NRC did not issue "final" guidance on ACLs until December of 1992 (although the regulated community would have to wait until 1996 for further revised ACL guidance that incorporated risk-based limits).

Another component of NRC's regulatory program to address closure of uranium mill and tailings facilities was put into place in August of 1990, when NRC issued its "Final Staff Technical Position" on the design of erosion protection covers for uranium mill tailings disposal sites. This technical guidance document, intended to assist licensees in designing erosion protection covers satisfying the surface stabilization criteria in NRC's mill tailings regulations, required most licensees to reconsider either proposed or approved surface reclamation plans. Also in 1990, NRC promulgated regulations establishing a general license to DOE for the long-term care, maintenance and monitoring of uranium mill tailings sites following license termination and closure. Under these regulations, DOE is required to submit for NRC approval a Long-Term Surveillance Plan (LTSP) for the site over which it is to assume custody. The LTSP must include a detailed description of DOE's long term monitoring program and it must identify criteria for instituting maintenance or emergency measures.[28]

Further, in 1994, NRC participated in a settlement negotiation between the American Mining Congress (now NMA), EPA, and environmental groups as part of the recision of 40 C.F.R. Part 61, Subpart T. As a result of this negotiation, NRC

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[27] 52 Fed. Reg. 43,553 (1987).

[28] 55 Fed. Reg. 45,591 (1990) *codified at* 10 C.F.R. § 40.28.

revised its mill tailings regulations to require licensees to achieve enforceable "milestones" leading to accelerated placement of radon barriers at *non-operational* (i.e., no longer actively milling or on standby) Title II mill tailings disposal sites.[29] These milestones were included in the settlement agreement to satisfy EPA's and the environmental groups' concerns that the potential threat from radon emissions be addressed by the *prompt* placement of radon barriers over disposal areas.[30]

Finally, in January of 1998, NRC and DOE generated a protocol for the transfer and licensing of mill tailings disposal sites to DOE for long term surveillance and maintenance following site closure and license termination. This "Working Protocol for Long-Term Licensing of Commercial Uranium Mills" sets forth a number of principles that NRC and DOE will follow in affecting the transfer of these sites. For example, the Protocol specifies that NRC will require current licensees to demonstrate that all applicable NRC requirements have been met before the Commission will terminate current licenses. In addition, the Protocol provides that NRC "will not terminate any site-specific license until the site licensee has demonstrated that all issues with state regulatory authorities have been resolved."

Two decades after Congress first provided the Commission with direct authority to regulate uranium mill tailings, there is now in place a comprehensive and mature regulatory program governing UR facilities and uranium mill tailings. Unlike the regulatory program for mill tailings that NRC first put into place in 1980, which focused primarily on radon, the regulatory regime that has developed over the past two decades now covers all aspects of UR facility management, with a particular focus on groundwater issues at both conventional and ISL facilities. At the same time, the fundamental nature of the UR industry has changed dramatically since Congress first enacted UMTRCA. Contrary to NRC staff expectations in 1980, dozens of new conventional mills have *not* come on line since the development of the final GEIS. Further, most conventional mills are no longer engaged in active milling operations or on standby but instead are inactive and working toward final site closure and license termination. Similarly, ISL operations no longer account for only a small fraction of domestic UR, as was the case in 1980. Instead, ISL operations are now the most vital segment of the UR production industry and will continue to generate wastes (albeit small quantities of waste, when compared to the tailings generated by convent ional mining and milling) for years into the future.

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[29] 59 Fed. Reg. 28,220 (1994).

[30] EPA was clearly concerned with prompt placement of radon barriers over tailings piles, the Agency thus indicated that the primary purpose of the settlement was to

> to ensure that owners of uranium mill tailings disposal sites ... bring those piles into compliance with the 20 pCi/m^2s flux standard as expeditiously as practicable considering technological feasibility ... with the goal that all current disposal sites be closed and in compliance with the radon emission standard by the end of 1997, or within seven years of the date on which existing operations and standby sites enter disposal status.

59 Fed. Reg. 36,280, 36,282 (1994).

The *In Situ* Recovery (ISR) Process for Uranium

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.

ISR uranium recovery leaves the underground ore body in place and continuously recirculates 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) 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 assists 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.

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.

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, 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.

Statutory and Regulatory Programs for ISR Uranium Recovery

A robust regulatory program for ISR uranium recovery is in place to assure adequate protection of public health and safety and the environment.

Pursuant to the AEA, as amended by UMTRCA, NRC is the federal agency empowered with the responsibility for regulating ISR uranium recovery operations at the point processing of uranium begins. 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.[31] In total, Appendix A contains thirteen criteria designed to allow licensees to properly locate, operate, and decontaminate and decommission their sites.

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.

To assure safe and effective underground injection throughout the United States, the United States Congress also enacted the SDWA which, in part, authorized establishment of the Underground Injection Control (UIC) program so that injection wells would not endanger current and future underground sources of drinking water (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.[32]

Underground injection is broadly defined as *the process of placing fluids underground in porous formations of rocks through wells or other similar*

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[31] 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.

[32] *See* 42 U.S.C. § 300h(1).

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.[33]

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)[34] 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."[35]

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.[36] Aquifer exemptions are a *mandatory* prerequisite for any ISR project.

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

[34] *See* 42 U.S.C. § 300h(b)(1).

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

[36] 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

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.[37]

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.*

Potential Impacts of ISR Uranium Recovery Are Adequately Addressed

One of the issues most frequently raised by interested stakeholders is the potential impacts to public health and safety from ISR uranium recovery. The extremely low-risk nature of ISR operations can be seen in the potential radiation dose impacts on workers and the public from 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

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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.

[37] *See* 40 CFR § 146.7.

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.[38] 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 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.

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[38] *See* 10 CFR § 20.1003.

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).[39] 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.

Conclusion

The U.S. mining industry has fully embraced the responsibility to conduct its operations in an environmentally and fiscally sound manner. The industry hopes and expects that Mining Law legislation will recognize and honor both its commitments to continuous improvement in our environmental performance and the industry's contribution to our national well-being.

NMA appreciates the opportunity to provide this testimony.

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[39] 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."