THE EVOLVING REGULATION OF URANIUM RECOVERY OPERATIONS IN THE UNITED STATES: INNOVATIVE APPROACHES ARE NECESSARY FOR COST EFFECTIVE REGULATORY OVERSIGHT

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Abstract

The U.S. domestic uranium industry is at a crossroads. Historic low prices for uranium, combined with stringent and often irrational regulatory requirements, pose a very real threat to the industry's continued viability. The Nuclear Regulatory Commission has taken a number of innovative steps to reform and rationalize its regulatory program. However, if the domestic uranium recovery industry is to remain viable, additional steps toward innovation and reform are needed, and effective implementation of reforms adopted by the Commission is essential.

1. INTRODUCTION

The past decade has seen major transformations in the uranium recovery (UR) sector around the world. Flooding of the world market with inexpensive uranium has resulted in the price of uranium at very near an all-time low. Even though the price of uranium has fallen, regulatory oversight of the UR sector has not slackened (especially in the "developed" nations) and, as a result, economic pressures on uranium producers due to the costs associated with regulatory compliance have intensified. Perhaps no uranium producers have been as significantly affected as UR operations in the United States.

In order to address the excessive regulatory burden that has been created in the U.S. as a result of piecemeal regulatory decisions, the U.S. Nuclear Regulatory Commission (NRC), the Federal agency charged with day-to-day regulation of nuclear materials under the Atomic Energy Act of 1954 (AEA),[1] has undertaken, at industry's urging, a strategic review of the applicable regulatory regime, with assistance and input from the regulated community and other stakeholders. The goal is to develop a more efficient, cost-effective and adequately protective regulatory program that is not burdened by undue complexity and inconsistent interpretations.

There is no question that the governing statutes -- in particular the AEA – provide NRC with the flexibility needed to fashion a more coherent, responsive and efficient regulatory regime for UR operations. It is unclear at the time of this paper's creation, however, whether NRC will take advantage of the opportunity provided by its strategic review to implement innovative and forward thinking approaches to UR regulation. Bureaucratic inertia, encouraged by vocal public opposition from anti-nuclear groups, could merely reinforce the *status quo* (i.e., an expensive and somewhat random collection of regulations, guidance and

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practices that hinders resolution of the complex regulatory issues confronting UR licensees). This paper suggests that new and innovative approaches can lessen the regulatory burden on the UR sector in the U.S., giving it the chance again to be viable in the global marketplace, without compromising protection of public health, safety or the environment. Moreover, as this paper suggests, the implementation of innovations and changes within and outside of the U.S. may inure to the benefit of uranium producers and other fuel-cycle facilities around the globe.

Our analysis begins with a brief overview of the regulatory framework governing UR operations in the U.S. That discussion (Section II), provides a basic overview of the important regulatory requirements governing siting, operations and site closure. Section III discusses recent developments and innovative proposals in the areas of UR regulation addressed in Section II.

2. OVERVIEW OF THE REGULATION OF URANIUM RECOVERY OPERATIONS

The AEA provides NRC with jurisdiction to implement and enforce regulations for three classes of nuclear fuel cycle radioactive materials: source material, special nuclear material, and byproduct material. *Source material* is uranium and thorium that can be used to create nuclear fuel, but that has not yet been enriched and therefore, is not fissionable. *Special nuclear material* is plutonium and enriched uranium that can be used as nuclear fuel. *Byproduct material* encompasses both 11e.(1) byproduct material, which is material created from nuclear reactions, and 11e.(2) byproduct material, which consists of tailings and other wastes that are created when uranium ores are milled primarily for their source material content.

The AEA and NRC's implementing regulations generally prohibit persons from transferring, delivering, receiving, possessing, importing, or exporting any source material, special nuclear material, or byproduct material unless authorized by an NRC license. NRC is directed under the AEA to designate what constitutes "unimportant quantities" of source material for which no licenses shall be required, and NRC is authorized to exempt certain classes or quantities of special nuclear material and byproduct material or uses or users of those materials from license requirements.

With regard to the regulation of UR, the Atomic Energy Commission (AEC) (the predecessor of NRC), historically took the position that while it had jurisdiction under the AEA over uranium as source material, it was without jurisdiction to regulate uranium mining[2] and uranium mill tailings.[3] NRC continues to take the position that it does not have authority to regulate uranium mining, except *in situ leach* (ISL) mining (which will be discussed in Section III). With regard to mill tailings, Congress and NRC realized in the late 1970s that NRC's AEA authority was inadequate to address all of the complex environmental and public health issues associated with uranium mill tailings. Congress remedied this deficiency by enacting the Uranium Mill Tailings and Radiation Control Act of 1978, (UMTRCA), which amended the AEA. In UMTRCA, Congress afforded NRC broad authority to regulate all aspects of the management and disposition of uranium mill tailings and related wastes generated at NRC licensed uranium mills. Specifically, UMTRCA gave NRC jurisdiction over "11e.(2) byproduct material" which the statute defined to encompass *all* wastes, both *radioactive* and *nonradioactive (i.e., hazardous)*, resulting from the processing of uranium ore *primarily* for its source material content.[4]

NRC is not the only Federal agency with responsibilities for mill tailings and related wastes under UMTRCA. The U.S. Environmental Protection Agency (EPA) promulgates *generally applicable* standards for the protection of public health, safety, and the environment from potential radiological and *non*-radiological hazards at uranium mill tailings sites.[5] NRC implements those standards at "active" sites under Title II of UMTRCA, and the U.S. Department of Energy (DOE) implements them at "inactive" or abandoned sites under Title I of UMTRCA.[6] The standards developed by EPA for *non*-radiological hazards are required to be as protective of human health and the environment as comparable standards established under the hazardous waste law administered by EPA (the Resource Conservation and Recovery Act (RCRA)).

Finally, under the AEA, NRC lacks authority to regulate naturally occurring radioactive materials (NORM) that are not generated at AEA licensed facilities. Although these materials contain the same naturally occurring radionuclides, they do not satisfy the *legal definitions* of *source material* or *11e.(2) byproduct material*, and therefore, they are not subject to NRC's jurisdiction. Federal and State regulators have expressed growing concern over the potential public health and environmental risks posed by NORM as it is ubiquitous in the environment and can pose similar potential hazards as source or 11e.(2) byproduct material. Various forms of NORM include naturally occurring and accelerator-produced radioactive materials (NARM) and technologically enhanced NORM (TENORM), which results from industrial activities involving petroleum, natural gas, geothermal energy, water treatment and mining.[7] Several States, including Texas and Louisiana, have promulgated regulations governing NORM; and the Conference of Radiation Control Program Directors (CRCPD) has published Model State TENORM regulations.[8]

3. RECENT REGULATORY DEVELOPMENTS AND INNOVATIONS

3.1. NRC's Adoption of A "Risk Informed" Regulatory Approach

In 1994, NRC Staff proposed [9] and in 1995, NRC established a policy -- the 1995 Probabilistic Risk Assessment (PRA) Policy Statement -- that requires, to the extent practicable, that probabilistic risk insights be incorporated into all nuclear regulatory activities, including UR regulation. According to NRC, PRA methods have been applied successfully in several regulatory activities and have proved to be a valuable complement to traditional deterministic engineering approaches."[10]

By way of background, NRC has generally regulated the possession and use of AEA licensed nuclear materials based on a deterministic approach. In short, deterministic approaches to regulation:

> consider a set of challenges to safety and specify how those challenges should be mitigated . . . The deterministic approach establishes requirements for use of materials and for engineering margin and quality assurance in design, manufacture, construction, and operation of nuclear facilities.[11]

NRC's regulatory requirements have been intended to ensure that a licensed facility is designed, constructed and operated in a manner consistent with the AEA and without undue risk to human health, safety, and the environment. Traditionally, deterministic criteria were meant to ensure that safety systems capable of preventing and/or mitigating failures (*a.k.a.* design basis events) were utilized. Although the deterministic approach employs elements of

probability, the *risk-informed* approach to regulation that is now being utilized by NRC enhances and extends the traditional deterministic approach discussed above. It does so by:

> (a) Allowing consideration of a broader set of potential challenges to safety, (b) providing a logical means for prioritizing these challenges based on likelihood and risk significance, and (c) allowing consideration of a broader set of resources to defend against these challenges.[12]

A risk-informed approach considers risk insights, operating experience, and engineering judgment and allows NRC and the regulated community to focus on those areas that have been of greatest potential significance to public health and safety. Perhaps most importantly, where appropriate, a risk informed approach may be used to reduce unnecessary conservatism that results in regulatory overkill and provides negligible public health protection benefits.

3.1.1. Risk Informed, Performance Based Regulatory Approach

In addition to following a risk-informed approach to regulation, NRC has layered onto that approach the adoption of *performance-based* standards. Generally speaking, a performance based approach establishes standards of performance that must be achieved by a regulated entity, while allowing flexibility as to the methods the entity may employ to achieve those standards. NRC has articulated four key elements to its approach to performance-based regulation:

> (1) There are measurable parameters to monitor acceptable plant and licensee performance; (2) objective performance criteria are established to assess performance; (3) there is licensee flexibility to determine how to meet established performance criteria; and (4) failure to meet a performance criterion must not result in unacceptable consequences.[13]

A *risk informed, performance based* approach to regulation uses risk insights and deterministic analyses and performance history to develop parameters for monitoring the performance of a regulated entity, as well as for developing criteria for performance assessment. The use of a risk informed, performance based approach theoretically results in NRC focusing on specific areas of greatest concern as the primary means of regulatory oversight. The approach is intended to permit the licensee enhanced flexibility in complying with regulatory requirements while at the same time focusing regulator and licensee resources on those areas of greatest potential significance to human health and the environment.[14]

3.2. Regulatory Developments Concerning Siting/Licensing of UR Facilities

3.2.1. 10 C.F.R. Part 2, Subpart L

Disputes concerning the siting of conventional uranium mills and ISL mines typically are governed by NRC's *informal* hearing procedures set forth in 10 C.F.R. Part 2, Subpart L.[15] The AEA requires that NRC afford "interested persons" upon request, a "hearing," in any proceeding granting suspending, revoking, or amending a license involving source, byproduct, and special nuclear materials. In 1989, NRC codified the "informal" "Subpart L" hearing process, specifying that written presentations are generally sufficient to fulfill the "hearing" requirement of the AEA, particularly where the potential public health risks as with UR operations are less significant than with reactors.[16] Under Subpart L, the Presiding Officer

makes his determination based solely on a "hearing file" compiled by NRC Staff and on written presentations by the parties. At bottom, the informal Subpart L hearing is intended to elicit information and resolve issues primarily through inquiry by the Presiding Officer rather than through adversarial confrontation between the parties. Accordingly, the Presiding Officer has a great deal of discretion in controlling the manner in which the issues raised by the parties are presented and reviewed. Unfortunately, both NRC Presiding Officers and the Commission itself have allowed abuse of this process by Intervenors, who are often permitted to file multiple redundant and voluminous pleadings, resulting in substantial delays and expense, thus essentially negating the purposes and intended benefits of a streamlined *informal* Subpart L hearing procedure.

3.2.2. Environmental Justice

One particular area that has received a great deal of attention with respect to the siting of uranium recovery facilities is *environmental justice (EJ)*. The National Environmental Policy Act (NEPA), creates a "broad national commitment to protecting and promoting environmental quality."[17] NEPA is primarily a procedural statute requiring federal agencies to develop an environmental impact statement (EIS) for all major actions that "significantly affect[] the quality of the human environment."[18] The principal goals of the Final Environmental Impact Statement (FEIS) are to require agencies to take a "hard look" at environmental consequences of a proposed action and, "by making relevant analysis openly available, to permit the public a role in the agency decision making process."[19] The EIS should provide a sufficient discussion of the relevant issues to enable the agency to make a reasoned decision.[20] Importantly, however, NEPA does not require agencies to select the most environmentally benign option.[21] In addition, "NEPA does not require agencies to assess every impact or effect on the environment."[22] *EJ* is a relatively new concept pertaining to the potential effects of major federal actions on certain sub-populations that has recently been incorporated into the NEPA process of many agencies.

Executive Order 12898 ("EO"), *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*,[23] provides that "each Federal agency[24] shall make achieving EJ part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.[25] The President's memorandum accompanying the EO states that "each Federal agency shall analyze the environmental effects, including human health, economic, and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the [NEPA]."[26] The EO goes on to state that:

> Each Federal agency shall conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin.[27]

Finally, and most importantly, the EO states in relevant part:

> This order is intended only to improve the internal management of the executive branch and is not intended to, *nor does it create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by a party against the United States, its agencies, its officers, or any person.* This order shall not be construed to create any right to judicial review involving the compliance or noncompliance of the United States, it agencies, its officers, or any other person with this order.[28]

Although the EO is not generally applicable to independent regulatory agencies like the NRC, NRC has indicated that it "would endeavor to carry out the measures set forth in the Executive Order, and accompanying memorandum" in its "efforts to fulfill the requirements of [NEPA] as an integral part of NRC's licensing process." Despite the apparently clear limits on *EJ* considerations in NRC's NEPA analyses, the issue has had substantial negative impacts on the efficiency of NRC licensing actions involving siting determinations.[29]

3.2.3. The Case of Hydro Resources

The most recent and noteworthy case involving the siting of a uranium mill or mining operation involves Hydro Resources, Inc.'s (HRI's) proposed ISL uranium mine near Crownpoint, New Mexico. In 1988, HRI applied to the NRC for a general license to construct and operate ISL uranium mining facilities near the town of Church Rock, New Mexico, which is primarily inhabited by native American members of the Navajo Nation.[30] After completing a Final EIS (FEIS) and a Safety Evaluation Report (January 5, 1998), NRC Staff issued a source material license to HRI permitting the company to construct and operate ISL mining facilities on an incremental basis: (i.e., well field by well field) over a twenty-year period.

Immediately after issuance of the license to HRI, the Eastern Navajo Dine' Against Uranium Mining (ENDAUM), the Southwest Research and Information Center ("SRIC"), and others filed motions to intervene and requests for hearing raising a multitude of technical issues and challenges to the licensing process and the FEIS including *EJ*. In response to the motions, a Presiding Officer was appointed to conduct an *informal* hearing pursuant to Subpart L. The record in the case includes more than 50,000 pages of documents and more than 10,000 pages of pleadings and supporting materials. The "informal" Subpart L hearing has been ongoing for more than two years at a cost to the licensee of more than $500,000. The entire licensing process for HRI, including the FEIS, has totaled more than $10 million. The *EJ* issue has yet to be resolved by the Commission even though the location of the uranium deposits, and thus the site for the ISL facility, is not under HRI's control. All of this to license the lowest risk type of facility in the entire nuclear fuel cycle.

Similarly, *EJ* played a major role in another drawn out licensing proceeding at NRC involving siting a proposed enrichment facility that led to the proposed licensee withdrawing its application. In that case, *Louisiana Energy Services, L.P.* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87 (1998) ("LES"), the applicant spent more than seven years and $34 million in what turned out to be a futile attempt to site its facility. As these examples suggest, risk-informed, performance based licensing and streamlined hearing processes may provide merely illusory benefits, particularly when disputes arise. When Staff regulators are unnecessarily conservative and Presiding Officers and the Commission lose control of the review and hearing process, even the wisest and best intentioned regulatory policies can be eviscerated.

3.3. Regulatory Developments and Innovations Concerning UR Operations

3.3.1. NRC's and EPA's Regulation of In situ *Leach Mining*

The most significant development in uranium mining and milling operations recently has been the abandonment of conventional surface and underground mining techniques in favor of ISL mining. ISL mining, which has been practiced for over three decades and currently is the primary extraction technology for commercial uranium production in the United States, provides a safe and cost-effective method of recovering uranium contained within a minable, confined aquifer system. In the ISL process, lixiviant solution, consisting of groundwater containing dissolved oxygen and carbon dioxide, is injected into the ore zone through injection wells. Uranium in the ore zone dissolves in the lixiviant, and this "pregnant" lixiviant is then drawn to the surface via a *production* well. At the surface, the pregnant lixiviant is passed through an ion exchange (IX) unit, which removes the uranium from solution. The "barren" lixiviant, which has been stripped of uranium, is then reinjected into the ore zone to complete the circuit. As NRC legal Staff has noted, ISL mining does not involve crushing or grinding of any ore, nor does it produce mill tailings; for these and other reasons, the "potential for environmental impacts due to in situ uranium mining appears to be minor."[31] This is because, although ISL mining accomplishes the same end result as conventional mining, *i.e.,* bringing uranium to the surface for beneficiation and processing, it does so in a very different manner.

In April of 1998, the National Mining Association submitted a paper to NRC entitled *Recommendations for a Coordinated Approach to Regulating the Uranium Recovery Industry* (the "White Paper"). In this White Paper, and in subsequent correspondence with NRC, the UR industry outlined its concern that NRC's regulation of ISL wellfield activities exceeds the scope of the Commission's authority under the AEA and is redundant of existing regulatory regimes. With respect to the first point, industry noted that NRC's jurisdiction under the AEA is material-based, meaning that the Commission's authority extends only to source, special nuclear and byproduct material. Industry argued that, when the relevant statutory definitions are applied faithfully and in a manner consistent with prior NRC guidance, it becomes evident that none of the materials involved in ISL wellfield activities are subject to regulation as source, special nuclear, or byproduct material. For example, industry argued that, with respect to wellfield *production* activities, the dissolved uranium carried in pregnant lixiviant solution was unrefined and unprocessed and would not be "removed from its place in nature" until the uranium is stripped from the lixiviant in the IX unit. Under the relevant statutory and regulatory provisions, uranium ore that is unprocessed and uranium that has not been removed from its place in nature is exempt from regulation as source material.[32] Moreover, the AEA expressly provides that there *shall be* no licenses required for quantities of source material that are deemed to be unimportant (i.e., less than 0.05% uranium under NRC's current interpretation). Wellfield production fluids prior to reaching the IX process contain "unimportant quantities" of uranium and should therefore be excluded from regulation.

Similarly, industry argued that none of the materials involved in ISL wellfield *restoration activities* fall within the purview of NRC's jurisdiction under the AEA. For example, NRC's regulations make clear that underground ore bodies depleted from ISL mining are not regulated as byproduct material for purposes of the AEA.[33] Similarly, the Commission had in the past taken the position that groundwater and related sludge wastes from wellfield restoration are also excluded from regulation as byproduct material, because they constitute "mining wastes" which are subject to State, not NRC, regulation.[34] Since none of the materials involved in either wellfield production or wellfield restoration is subject to NRC

regulation under the AEA, industry argued, NRC has no legitimate basis upon which to exercise jurisdiction over ISL wellfield activities.

In addition to the lack of jurisdiction, industry argued to the Commission that NRC regulation of wellfield production and restoration activities is redundant and unnecessary because those same activities are regulated by the Environmental Protection Agency under the Safe Drinking Water Act (SDWA) and by the individual States, through their mining laws and delegated SDWA authority. As was pointed out to the Commission, such dual regulation leads to duplicative and sometimes conflicting regulatory requirements. At a minimum, this kind of duplicative regulation has the effect of increasing the costs and undermining the efficiencies associated with ISL mining. A more pernicious effect of dual regulation can be delayed site restoration and closure, as ISL producers struggle to reconcile disparate regulatory requirements imposed by multiple regulatory agencies.

Just recently, the Commission responded to the concerns raised by industry regarding NRC's regulation of ISL wellfield activities, by voting on a plan to "improve the efficiency" of ISL regulation.[35] Despite this stated objective, the plan approved by the Commission appears to take a step backwards in terms of rationalizing regulation of ISL operations in the United States. Instead of acknowledging its lack of jurisdiction over wellfield materials, the Commission voted to assert an *expanded* authority over wellfield materials. In particular, NRC had in the past agreed that restoration fluids are not subject to regulation under the AEA as 11e.(2) byproduct material. However, under the plan just approved by the Commission, *all* liquid wastes produced as a result of wellfield production and restoration activities – including restoration fluids – will be considered by NRC to be 11e.(2) byproduct material and subject to the Commission's jurisdiction. Consequently, under the plan approved by the Commission, ISL wellfield activities will continue to be subject to the inefficiencies of dual, and sometimes conflicting, State and Federal regulation (although the Commission has directed staff to engage in "discussions" with EPA and relevant states, regarding the extent to which EPA and State groundwater regulations may obviate the need for NRC regulations).[36]

3.3.2. Disposal of Non-11e.(2) Materials

A second regulatory development in the area of UR mining and milling operations involves the use of conventional mill tailings facilities for disposal of other *similar* types of wastes that do not qualify as 11e.(2) byproduct material. The potential benefits of allowing existing mill tailings disposal facilities to be used for the disposal of other similar kinds of wastes are enormous. In the United States, available disposal capacity for high volume, low activity radioactive wastes is quite limited, and this scarcity of disposal capacity is likely to continue into the foreseeable future. In part this lack of disposal capacity can be traced to the failure of past legislation (notably the Low Level Radioactive Waste Policy Act (LLRWPA)) to result in the licensing of new low level radioactive waste (LLRW) disposal facilities, as intended. Consequently, as the few remaining licensed LLRW disposal facilities close or restrict their operations, the price of commercial disposal at LLRW disposal sites has become exorbitant, particularly for high volume wastes. Consequently, sites with large volumes of low activity wastes (such as radioactively contaminated soil or debris), in particular, have not been able to dispose of those wastes at such licensed LLRW facilities. As a result, the only viable alternative for some of these sites has become on-site disposal -- which necessarily results in a proliferation of disposal sites, or in delays in decommissioning as sites wait for new disposal capacity to come on line. Both outcomes are contrary to sound environmental management principles.

Utilizing existing uranium mill tailings facilities for the disposal of other similar types of low activity radioactive wastes makes eminent good sense for a number of reasons: (i) these existing impoundments offer large amounts of *existing* disposal capacity; (ii) materials eligible for disposal at tailings facilities, such as mineral processing wastes, construction scrap, and mine water sludges are large volume, low-level wastes that are physically, chemically, and radiologically similar to 11e.(2) byproduct material and therefore would not pose any potential hazards beyond those evaluated for the 11e.(2) disposal license; and (iii) such wastes, when disposed of in a tailings impoundment, would be subject to stringent, ongoing and long-term oversight with regard to both potential radiological and *non-radiological* hazards, and this superior degree of protection would be achieved without the creation of new disposal sites. In addition, the large volume and relatively inexpensive disposal capacity provided by existing mill tailings sites would help drive down the costs of disposing of low activity wastes, thereby encouraging generators of low activity waste (such as facilities undergoing decommissioning) to dispose of their wastes promptly.

In 1995, NRC issued a regulatory policy regarding the use of mill tailings facilities for the disposal of *non*-11e.(2) waste (the "*Non*-11e.(2) Policy").[37] This policy establishes a set of nine criteria that must be satisfied before a given waste material can be approved for disposal in a uranium mill tailings facility. A key objective of the policy is to ensure that mill tailings disposal facilities do not become subject to dual regulation as a result of commingling 11e.(2) byproduct material and *non*-11e.(2) wastes. To prevent such dual regulation the *Non*-11e.(2) Policy excludes certain types of materials from disposal in tailings facilities – notably NORM, special nuclear material, 11e.(1) byproduct material, and materials subject to regulation under other Federal statutes. In addition, the Policy imposes numerous other requirements on licensees seeking to dispose of *non*-11e.(2) wastes, such as the requirement to obtain prior approval from the DOE or the State in which the facility is located and from the appropriate Regional Low Level Waste Compact, and the requirement to obtain a waiver from NRC's regulations governing the disposal of LLRW. Although well-intentioned, as a practical matter, NRC's *Non*-11e.(2) Policy imposes so many burdensome requirements on licensees as to make it extremely difficult, if not impossible, to dispose of *non*-11e.(2) byproduct material in uranium mill tailings piles.

In its White Paper, NMA suggested a number of changes to NRC's *Non*-11e.(2) Policy in order to make the policy more accessible and thereby open the door to the benefits associated with expanded use of tailings facilities for the disposal of *non*-11e.(2) low activity wastes. For example, NMA urged NRC to develop generic risk-based criteria to be used to assess whether a particular material could be disposed of in a uranium mill tailings facility, instead of requiring case-by-case evaluation of every waste stream proposed for disposal. In addition, industry suggested that NRC expand the list of materials eligible for disposal under the policy (for example, to allow the disposal of NORM and mixed waste provided that such waste is sufficiently similar to 11e.(2) byproduct material). The White Paper also suggested that NRC explore the possibility of utilizing memoranda of understanding (MOUs) with other Federal and State regulatory authorities to eliminate concerns regarding dual or overlapping regulation of mill tailings facilities used for the disposal of *non*-11e.(2) material.

Very recently the Commission voted to retain the 1995 *Non*-11e.(2) Policy with a few modifications. Specifically, the Commission directed its Staff to pursue a generic exemption from NRC's LLRW regulations for wastes that are approved for disposal in an 11e.(2) disposal facility. In addition, the Commission directed the Staff to eliminate the exclusion of NORM wastes and wastes regulated under other Federal statutes (i.e., to allow their disposal in mill tailings facilities), provided that such materials are radiologically, physically and

chemically similar to and compatible with the 11e.(2) byproduct material already present at the mill tailings facility. These modifications represent a step in the right direction with respect to simplifying the *Non*-11e.(2) Policy and making it more accessible for a wider variety of waste materials. However, even with these modifications, the numerous requirements remaining as part of the Policy – including the requirement for prior approval by other Federal and State regulators as well as approval from the relevant interstate LLRW disposal compacts and the long term governmental custodian -- still present a formidable barrier to utilizing mill tailings facilities to dispose of wastes other than 11e.(2) byproduct material. Moreover, a statement made by the Commission Chairman to the effect that licensees who take advantage of the *Non*-11e.(2) Policy must be "prepared to accept the consequences of dual regulation"[38] is inconsistent with NRC's previously-articulated goal of *avoiding* dual regulation and is likely to discourage licensees of uranium mill tailings facilities from accepting *non*-11e.(2) wastes for disposal, despite the substantial benefits associated with such a disposal option.

3.3.3. Processing Alternate Feeds

A third innovation in the area of UR operations involves the processing of *non-traditional ores* or "*alternate feeds*" in conventional uranium mills. Because these alternate feeds are often considered "wastes" by the facilities that generate them, the availability of uranium mills to process those feeds provides a unique opportunity to *recycle* those wastes in order to recover valuable uranium (and other materials) and to dispose of the residual tailings as 11e.(2) byproduct material.

Processing of "alternate feed" material is governed by NRC's August 15, 1995 "Final Position and Guidance on the Use of Uranium Mill Feed Material Other Than Natural Ores" (the "Alternate Feed Policy").[39] Under this policy, NRC permits licensees to process alternate feed materials in uranium mills, provided that three conditions are satisfied. First, the alternate feed material must qualify as "ore." NRC has defined "ore" broadly to encompass any "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.*"[40] This definition clearly is broad enough to encompass ores which have previously been beneficiated for uranium or other minerals, and which are outside of the initial processor's legal or technical ability to process further, provided that source material is extracted from the ore in a licensed uranium or thorium mill.

Second, in order to qualify as alternate feed, the material cannot contain a *listed* hazardous waste subject to regulation by EPA under RCRA.[41] This restriction, which is intended to avoid dual regulation by NRC and EPA (or a delegated State), does not apply to feed material that exhibits only *"characteristics"* of hazardous waste, since such material is exempt from regulation as hazardous waste under RCRA when recycled.[42]

Third, the alternate feed material must be processed "*primarily* for its source-material content." Opponents of alternate feed processing have used this criterion as a basis for attacking plans to process alternate feeds for a fee, claiming that in such circumstances an alternate feed is not processed "primarily" for its source material content if fees collected to process the feed exceed the value of the uranium that is recovered. However, the Commission soundly rejected this theory in recent litigation on the issue.[43] As a result of that litigation, the Commission ordered its Staff to reconsider the tests that were employed under the Alternate Feed Policy to determine whether a feed is processed *primarily* for its source material content. Specifically, the Commission ruled that the economic viability of the uranium recovery, in and

of itself, is not the determining factor in judging whether a feed is being processed "primarily" for its source material content. Basing its decision on the language of the AEA and its legislative history, the Commission indicated that if more than a negligible amount of uranium is recovered through the processing of an alternate feed in a licensed uranium mill then the mill is processing the feed *primarily* for its source material content. The Commission's decision avoids concerns about so-called "sham processing" (processing that is undertaken to change the regulatory definition of a waste stream) and allows UR mills to process a broad stream of wastes in order to recover uranium while also receiving a recycling and/or disposal fee for this processing.

As indicated, an important feature of alternate feed processing is that the tailings and other wastes that result from such processing are regulated as 11e.(2) byproduct material. This is important since 11e.(2) material is subject to stringent controls that include a 1,000 year impoundment design requirement as well as perpetual monitoring and surveillance and a mandatory governmental custodian. Thus, potential long-term contingent (i.e., Superfund) liability for the initial generator of the alternate feed is effectively eliminated once that feed is processed at the mill and the residual tailings/wastes disposed of in the mill tailings impoundment. At the same time, because of the fees they are allowed to charge, it is economically feasible for uranium mills to process this alternate feed at a time when conventional (natural) ores cannot be economically processed. Thus, processing alternate feeds may keep valuable milling and disposal capacity available until the price of uranium rebounds.

One firm that has employed the alternate feed guidance and has been licensed by NRC to process alternate feed materials for its uranium content is International Uranium (USA) Corporation, (IUC). IUC has processed mill tailings and other "waste materials" for their uranium content at its mill located in White Mesa, Utah. By processing alternate feed materials at its mill, IUC is able to recover substantial quantities of uranium and, in some cases, other valuable metals from materials that might otherwise be discarded as "wastes." In 1998 alone, the White Mesa Mill recovered over 600,000 pounds of uranium from alternate feedstocks. If the Commission's decision had not supported the recycling option offered by the White Mesa Mill, these alternate feedstocks would have been disposed of, the valuable mineral content of these materials would have been lost, and the mill would likely have had to shut down.

3.4. Regulatory Developments Concerning Mill Site Closure

3.4.1. The Employment of Alternate Concentration Limits

Perhaps the most significant development in the mine and mill site closure context is the employment of alternate concentration limits (ACLs) in the remediation of contaminated groundwater. Groundwater contamination, not surface stabilization, at both ISL mining sites and conventional milling sites is proving to be most costly and technically complex issue in the site closure context. In short, compliance with impracticable groundwater remediation standards (often based on tap water standards) has proven to be too costly and, in many cases, unachievable. Therefore, alternatives to strict limits are needed to permit cost-effective final site closures to occur. These alternatives are available under the applicable Federal regulations.

NRC's regulations at 10 C.F.R. Part 40, Appendix A require that groundwater protection programs for Title II uranium mill tailings sites include the following four elements:

1. A list of site-specific hazardous constituents;
2. A groundwater concentration limit for each of these hazardous constituents, which must not exceed:[44]

   (1) NRC-approved background concentration of constituent in the groundwater;

   (2) EPA's maximum concentration limit (MCL) for the constituent if an MCL is available and higher than the background level; or

   (3) An *Alternate Concentration Limit* approved by NRC.
3. A compliance location where the concentration limits must be met (*i.e.*, point of compliance [POC]); and
4. A time period during which compliance is required.

An ACL is a licensee-proposed *site-specific*, *risk-based* alternative to either the background level or the MCL that would otherwise apply to a specific groundwater contaminant. Two criteria must be satisfied for NRC to approve an ACL:[45] (1) the hazardous constituent that is the subject of the ACL must not pose a substantial present nor potential hazard to human health or the environment as long as the ACL is not exceeded;[46] **and** (2) the proposed ACL value must be *as low as is reasonably achievable* (ALARA), after considering practicable corrective actions. The ACL is based on a concentration at the POC that over the 1,000 year post-closure regulatory horizon will provide *reasonable assurance* that public health will be adequately protected.

Thus, when approved by NRC, an ACL gives the licensee flexibility to remediate contaminated groundwater to a level that provides adequate protection of public health and safety, in a manner that is reasonably achievable.

3.4.2. Licensee-Proposed "Alternatives"

ACLs are a specific example of NRC's use of regulatory flexibility that is *written into the statute* with respect to the regulation of UR site closure and the disposition of uranium mill tailings and related wastes. This statutory flexibility permits licensees to propose site-specific alternatives to the generic standards adopted by NRC or EPA, so long as those alternatives provide an equivalent degree of protection of human health and the environment. This flexibility is built into the law in Section 84 of the AEA, which provides that:

> In the case of sites at which ores are processed primarily for their source material content or which are used for the disposal of byproduct material as defined in section 11e.(2), a licensee may propose alternatives to specific requirements adopted and enforced by the Commission under this Act. Such alternative proposals may take into account local or regional conditions, including geology, topography, hydrology and meteorology. The Commission may treat such alternatives as satisfying Commission requirements if the Commission determines that such 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 . . . which is

> equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose and any final standards promulgated by the Administrator of the Environmental Protection Agency in accordance with section 275.[47]

Thus, the governing statute provides NRC and the regulated community with a powerful tool that can be used to fashion site-specific standards and requirements that are protective of human health and the environment and that are more practicable or otherwise better suited to the specific circumstances facing a licensee than the generic standards and requirements that would otherwise apply. In order to avail themselves of this statutory based flexibility and to overcome regulatory inertia that inherently disfavors innovation, however, licensees must be creative and, where necessary, assertive when dealing with NRC.

4. CONCLUSIONS

In the broadest sense, NRC's regulatory focus for the UR industry seems pointed in the right direction. In particular, the Commission's strategic reexamination of its UR program and its adoption of risk-informed, performance-based approaches to regulation hold out the promise of a more rational and efficient regulatory environment for UR licensees. However, when one looks beyond the Commission's broad policy positions and examines specific regulatory policies and positions, the Commission's record is decidedly mixed. Rational and innovative policies that are not effectively implemented, or that are even ignored in practice, are failing to yield the anticipated benefits touted by the Commission.

This is a time of great uncertainty for the U.S. uranium recovery industry. If that industry is to remain viable, NRC must continue along the path of implementing innovative and flexible approaches to UR regulation. Licensees, too, must be prepared to think creatively and to aggressively advocate innovative approaches to the Commission.

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[1] 42 U.S.C. § 2011, *et seq.*

[2] NRC, *Final Generic Environmental Impact Statement on Uranium Milling*, NUREG-0706 (September 1980) vol. 1 at A-94.

[3] *See* Kerr McGee v. U.S. Nuclear Regulatory Comm'n, 903 F.2d 1, 3 (D.C. Cir. 1990), where the court recognized:
As early as 1960, however, the AEC had concluded that because these mill tailings generally could not be classified as source material . . . they lay outside the AEC's statutory licensing authority and therefore beyond its regulatory reach.

[4] *See* 57 Fed. Reg. 20,525-26 (1992).

[5] 42 U.S.C. §§ 7901-7942 (1998).

[6] 42 U.S.C. § 2021(d).

[7] 22 Envt'l L. Rep. (Envtl. L. Inst.) 10052.

[8] *See* 33 LAC Chap. 14 (June 1992); 25 TAC 289.127, TCR pt. 46 (July 1993); and Suggested State Regulations for Control of Regulation, Vol. I, pt. N, "Regulation and Licensing of Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM), April 1999.

[9] NRC SECY-94-218, *Proposed Policy Statement on the Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities* (1994) and NRC SECY-94-219, *Proposed Agency-Wide Implementation Plan for Probabalistic Risk Assessment* (1994).

[10] *Id.*

[11] *Id.*

[12] *Id.*

[13] *Id.*

[14] In this regard the performance based regulatory criteria applicable to uranium mills that were developed by NRC in the 1980s were ahead of their time, reflecting the Commission's understanding that site-specific circumstances would significantly affect regulatory oversight at any given mill. *See* 10 C.F.R. Part 40, Appendix A.

[15] 10 C.F.R. §§ 2.1201-2.1263.

[16] *See* 54 Fed. Reg. 8269 (Feb, 28, 1989). Less formal hearing processes were utilized by the NRC for nuclear material licensing proceedings prior to the adoption of Subpart L, however, the procedures were not codified in NRC's regulations. *See Kerr-McGee Corp. (West Chicago Rate Earths Facility),* CLI-82-2, 15 NRC 232 (1982), aff'd sub nom.

[17] *Louisiana Energy Services, L.P.* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87 (1998) ("LES"), *citing, Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 348 (1989).

[18] *See* 42 U.S.C. § 4332(2)(C).

[19] *LES* at 87, *citing Robertson*, 490 U.S. at 349-50.

[20] *Natural Resources Defense Council, Inc. v. Hodel*, 865 F,2d 288, 294 (D.C. Cir. 1988).

[21] *LES* at 88, *citing Robertson*, 490 U.S. at 350 ("If the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh environmental costs.").

[22] *Metropolitan Edison Co. v. People Against Nuclear Energy*, 460 U.S. 766, 772 (1983).

[23] 3 C.F.R. § 859 (1995),

[24] For the purposes of the EO, "Federal agency" is defined as any agency on the Working Group, and such other agencies as are designated by the President of the United States, that conducts any Federal program or activity that substantially affects human health or the environment. Independent agencies, like NRC, are requested to comply with the order pursuant to the EO. See EO at 6-604.

[25] EO 12898, 59 Fed. Reg. 7629 (Feb. 16, 1994), codified at 3 C.F.R. § 859 (1995).

[26] Memorandum for the Heads of All Departments and Agencies, (accompanying EO) (Feb. 11, 1994), 30 Weekly Comp. Pres. Doc. 279 (Feb. 14, 1994).

[27] EO at 2-2 (emphasis added).

[28] EO at 6-609; 59 Fed. Reg. at 7633

[29] Letter from Ivan Selin, Commissioner NRC to President William Jefferson Clinton (March 31, 1994); *see also* Letter from Hugh L. Thompson, Jr. NRC Member Environmental Justice Working Group to Carol Browner, Chair, Environmental Justice IAWG (March 24, 1995); U.S. Nuclear Regulatory Commission Environmental Justice Strategy (March 1995).

[30] Application for Materials License, ACN No. 8805200339, (April 13, 1988).

[31] R.S. Popielak and J. Siegel, "Economic and Environmental Implications of Leakage Upon *In Situ* Uranium Mining," *Mining Engineering* 800, 804 (Aug. 1987). Moreover, the low hazard associated with the ISL technique suggests that "[t]he concept of natural ground-water quality restoration may have particular merit in uranium leaching. It is believed that, under the proper circumstances, most of the objectionable elements that have been introduced or mobilized during leaching will be removed by reprecipitation, ion exchange, adsorption, or reduction . . .." Geraghty & Miller, "Ground-Water Elements of In Situ Leach Mining of Uranium," at 76 (Aug. 1978).

[32] 42 U.S.C. § 2092; 10 C.F.R. § 40.13.

[33] *See* 40 C.F.R. § 40.4.

[34] *See Staff Technical Position on Effluent Disposal at Uranium Recovery Facilities* (April 1995) at 5; SECY-99-013 at 2.

[35] Commission Voting Record on SECY-99-0013 *Recommendations on Ways to Improve the Efficiency of NRC Regulation at In Situ Leach Uranium Recovery Operations* (July 26, 2000).

[36] The threat of dual regulation of ISL wellfield activities could be blunted if NRC were to assert that its regulatory authority over both the radiological and non-radiological components of byproduct material is exclusive, so that individual States would be preempted from superimposing their own regulatory regimes on ISL wellfield activities that are already regulated by NRC. Thus far, however, NRC has shown little inclination to assert such exclusive authority over 11e.(2) byproduct material. In the mean time, it appears that, even at the highest levels of NRC, the ramifications of overlapping jurisdiction are not appreciated. For example, the Commission's decision to regulate ISL restoration fluids as if they were 11e.(2) byproduct material may cause ISL licensees to be in violation of their EPA Clean Water Act (CWA) permits, which prohibit the discharge of ISL *production* wastes.

[37] 60 Fed. Reg. 49,296 (Sept. 22, 1995).

[38] *Commissioner Comments on SECY-99-0012*, Comments of Chairman Meserve (Attached to Commission Voting Record on SECY-99-0012 (July 26, 2000)) available at www.nrc.gov/NRC/COMMISSION/VOTE/1999-012vtr.html .

[39] 60 Fed. Reg. 49,296-7 (Sept. 22, 1995).

[40] 57 Fed. Reg. 20525, 20532 (1992) (emphasis added).
[41] "Listed" hazardous wastes consist of a finite number of specific wastes that are listed in EPA's regulations. A listed waste should be distinguished from a "characteristic" waste, which is *any* solid wastes that displays one or more hazardous characteristics as defined in the regulations. *See* 40 C.F.R. § 261.3(a).
[42] *See* 40 C.F.R. § 261.2(c)(3).
[43] *In the Matter of International Uranium (USA) Corporation*, Docket No. 40-8681-MLA-4, CLI-00-01 (Feb. 10, 2000).
[44] 10 C.F.R. Part 40, Appendix A, Criterion 5B(5).
[45] 10 C.F.R. Part 40, Appendix A, Criterion 5B(6).
[46] In making the *present and potential hazard* finding, NRC will consider the following 19 factors, which can be grouped in two categories:
(1) Those concerning potential adverse effects on groundwater quality:
Physical and chemical characteristics of the waste in the licensed site, including its potential for migration; (b) Hydrogeological characteristics of the facility and surrounding land; (c) Quantity of groundwater and the direction and rate of groundwater flow; (d) Proximity and withdrawal rates of groundwater users; (e) Current and potential future uses of groundwater in the area; (f) Existing quality of groundwater; (g) Potential health risks posed by human exposure to waste constituents; (h) Potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and (i) Persistence and permanence of potential adverse effects.
(2) Those concerning potential adverse effects on hydraulically connected surface water quality: (a) Volume and physical and chemical characteristics of waste in the licensed site; (b) Hydrogeological characteristics of the facility and surrounding land; (c) Quantity and quality of groundwater and the direction and rate of groundwater flow; (d) Patterns of rainfall in the region; (e) Proximity of the licensed site to surface waters; (f) Current and future uses of surface waters in the area and any water quality standards established for those surface waters; (g) Existing quality of surface water; (h) Potential health risks posed by human exposure to waste constituents; (I) Potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and (j) Persistence and permanence of potential adverse effects.
All the factors listed above may not be applicable at specific sites. Where this is the case, an ACL application must specify the factors that do not apply and explain why those factors were not addressed in the application.
[47] 42 U.S.C. § 2114(c). Under the statute, Agreement States (States that regulate in lieu of NRC, pursuant to agreements between the State and the NRC) are provided with similar latitude to accept licensee proposed alternatives. *See* 42 U.S.C. § 2021(o).