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By Electronic Mail

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Re: Sur-Reply to Energy Fuels' Reply to Our Comments on Proposed Amendment No. 10 to the Radioactive Materials License for the White Mesa Uranium Mill

Dear Mr. Howard:

There's a claim in Energy Fuels' response to our comments on the proposed licensing action for the White Mesa mill that sounds a motif. The company asserts that our comments were "*incorrect* to state that Mill tailings are 'wastes.'"[1] And yet, in 2006, the author of that allegation wrote that "[t]he predominant waste generated by uranium mills on an ongoing basis are the mill tailings themselves…."[2]

There are other U-turns and inconsistencies in the company's response. Energy Fuels flip-flops on whether alternate feeds are wastes,[3] for example, and faults us for making an "inflammatory" statement when we were directly quoting the company's founder, George Glasier.[4]

[1] Energy Fuels, Response to Public Comments, p. 99 (Sep. 25, 2020) ("EFR's Resp.") (emphasis added).

[2] David C. Frydenlund, "Waste Streams, Disposal, and Clean-up Issues Associated with Uranium Mining and Milling," Rocky Mtn. Mineral Law Found., p. 7-14 (Apr. 27, 2006) attached as Exhibit 28.

[3] *Compare* EFR's Resp. at 99 *with* Ex. 28 at 7-18.

[4] *Compare* EFR's Resp. at 97 *with* Stephane A. Malin, The Price of Nuclear Power: Uranium Communities & Envtl. Justice, 96 (2015).

The core problem with all of this isn't so much that the company sometimes tripped over its own words in its haste to disagree with us, but that in so doing, it often neglected to engage sincerely with our arguments. It didn't offer any legal reasoning, for example, to support its claim that the Division lacks the discretion to reject the applications to process the Silmet and Moffat Tunnel materials.[5] And it didn't seriously contend with the evidence showing that the Silmet material will not be "[i]mported *solely* for the purposes of recycling and not for waste management or disposal…."[6] Instead, Energy Fuels asserted only that the material "will be processed" and the company's purpose is "therefore" solely to recycle the material,[7] even though the material also will be disposed of at the mill, and indeed, Energy Fuels admits that it would not import the material *at all* if it could not discard the post-processing waste at the mill.

All told, the company's responses to our arguments give no reason for us to amend any of the requests we made in our comments, and we reiterate those requests here.

Thank you for the opportunity to submit this sur-reply. We are grateful for the Division's extra effort to solicit and consider the public's views and develop a more thorough record.

I. Energy Fuels' response sidesteps our argument for denying the alternate-feed applications.

Our comments stressed that the Division has the legal authority to reject Energy Fuels' alternate-feed applications if it finds that they are "inimical to the health and safety of the public."[8] We urged the Division to make that finding on the grounds that the pollution of Utah's environment and communities from processing the Silmet and Moffat Tunnel materials wouldn't occur if the market for nuclear fuel, rather than waste disposal, controlled whether these materials were sent to White Mesa, run through the mill, and forever buried there.[9] Because the mill was not placed atop White Mesa to serve as an indefinitely running landfill for the world's radioactive wastes, we believe it is "inimical to the health and safety of the public" to burden Utah's environment and communities with pollution that wouldn't happen if Energy Fuels could not sell its clients this waste-disposal service.

Our argument here has a great deal to do with process. It's our view—and we don't believe it's an especially controversial one—that only with a clear statutory

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[5] EFR's Resp. at 109.

[6] 10 C.F.R. § 110.2 (emphasis added).

[7] EFR's Resp. at 114.

[8] Grand Canyon Trust, et al., Comments on Proposed Amendment No. 10 to the Radioactive Materials License for the White Mesa Uranium Mill, pp. 12–15 (July 10, 2020) ("Trust, et al., Comments").

[9] *Id.*

authorization and only after a thorough public discourse should there be a decision about what places in this country will be blighted by a landfill that accepts radioactive wastes from around the globe for disposal. True enough, the mill was chosen, with some public process, in the late 1970s as a disposal site for radioactive uranium-milling wastes produced over a period projected to last until about 1995.[10] But it's not true that it was chosen as a place for an industrial operation that processes other business's radioactive wastes *endlessly*. And that transformation in Energy Fuels' business perpetuates harms—like dirtying the air, plaguing the roads with massive trucks, and killing wildlife—that wouldn't occur if the mill operated for its useful life as a supplier of yellowcake and was reclaimed.[11]

Rather than respond directly to this point, a good share of Energy Fuels' response is devoted to arguments that the mill provides jobs and that recovering uranium from alternate feeds is environmentally beneficial.[12] The core problem with these arguments is that alternate-feed milling began without a public lawmaking process in which these supposed benefits of Energy Fuels' alternate-feed business were found to outweigh the harms. Instead, Energy Fuels *unilaterally* decided that existing federal law could be stretched to allow it to undertake its alternate-feed business, and a handful of Commissioners and Nuclear Regulatory Commission staff ultimately consented to that idea, without undertaking a rulemaking, let alone seeking clarification from Congress about whether the laws Congress passed were intended to allow for uranium milling to transform in this way.

The balance of Energy Fuels' response mostly addresses arguments we did not raise. Energy Fuels begins by asserting that "DWMRC is bound to follow federal law on the definition of what is ore, and therefore what is 11e.(2) byproduct,"

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[10] *See* Trust, et al., Comments at n.6 (collecting citations).

[11] Energy Fuels asks us to demonstrate that processing alternate feeds kills wildlife. *See* EFR's Resp. at 109. Our point was that alternate feeds enable the mill to run when it wouldn't otherwise, and that the mill's operations kill wildlife. Trust, et al., Comments at 13. On this score, Energy Fuels' records show that its employees often see birds on the mill's waste pits and sometimes pull deer out of the mill's waste pits. *See, e.g.*, Energy Fuels' tailings system inspection records for March–April 2009, September–October 2009, January–May 2010, November 2010, January 2011, March–June 2011, October–November 2011 (records available upon request). We admit that we cannot prove that these animals thereafter perished, just as Energy Fuels cannot prove that animals have not sunk to the bottom of the waste pits. But we have heard second-hand reports that mill employees have retrieved dead birds from the pits, and our judgment tells us that over the course of four decades, some animals who drank from or took a dip in the mill's highly acidic waste solutions didn't survive the experience. After all, Energy Fuels has long insisted that it takes measures to shoo wildlife away from the waste pits, a practice that would be anomalous if the pits weren't a danger to those animals. *See, e.g.*, Letter from J. Hamrick re: Wildlife in Tailings Area (Sep. 21, 1990), attached as Exhibit 29.

[12] EFR's Resp. 107–109.

claiming that these definitions "have long been resolved beyond legal dispute."[13] The company then discusses the history of litigation involving Energy Fuels and the State of Utah before the Nuclear Regulatory Commission, and concludes with the observation that "[t]he issues raised by the commenter are an attempt to re-litigate issues already resolved by NRC and the courts and binding on DWMRC." This line of argument is off base.

We didn't argue in our comments that alternate feeds are not "ore," nor did we claim that the ensuing wastes are not byproduct material.[14] It's true that the question of how to interpret those terms has been litigated in the past, and while we disagree with the result, we elected not to dispute it in our comments.

Our argument, instead, is that, regardless of the definitions of "ore" and "byproduct material," the Division retains power under Utah state law to deny Energy Fuels' applications to process the Silmet and Moffat Tunnel materials. Put differently, even if we concede for the sake of argument that those materials are "ore" and that the wastes from processing those materials are "byproduct material" within the meaning of the Atomic Energy Act, the Division is not bound by federal law to allow Energy Fuels to process them. Rather, the Division has the power to reject the applications, at a minimum, on the grounds that allowing the company to process these wastes so that they may be discarded at the mill is "inimical to the health and safety of the public."[15]

Energy Fuels addresses this legal standard only briefly, contending that "DWMRC found that the Silmet material is comparable to other materials and therefore is <u>not</u> 'inimical to the health and safety of the public.'"[16] Yet whether or not it is true that the Silmet material is comparable to "other materials," it doesn't follow logically that processing it is not inimical to the health and safety of the public, nor does it address our core argument: that the health and safety risks of milling the Silmet and Moffat Tunnel material wouldn't occur *at all* if Energy Fuels was confined to operating like a traditional, conventional uranium mill, as was contemplated when the mill was originally built on White Mesa. Put differently, it's simply not true, contrary to what Energy Fuels has implied,[17] that Energy Fuels would go mine 2,000 tons of native uranium ore on the Colorado Plateau if it couldn't import and process the Silmet material, for today's market price for yellowcake wouldn't justify the mining expense.

In truth, disallowing Energy Fuels from earning fees to process other business's radioactive wastes would prevent a sizable share of the pollution caused by

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[13] EFR's Resp. at 106.

[14] Trust, et al., Comments at 12–15.

[15] *See* Utah Admin. Code R313-22-33(1)(d).

[16] EFR's Resp. at 109.

[17] EFR's Resp. at 115.

the mill. According to Energy Fuels, about *half* of its yellowcake business in the past two decades has come from processing "uranium-bearing materials" other than native uranium ore.[18] While the company hasn't said what share of those feeds (if any) may have been justifiable to process based solely on the value of the yellowcake they yielded, we suspect most of this segment of the company's business—and the radiation and other pollution it occasions—would never have occurred if the mill were operating only as a conventional uranium mill, as originally planned.

No legal impediment bars the Division from finding that it is inimical to the health and safety of the public to allow Energy Fuels to use the White Mesa mill as a waste-disposal facility for alternate feeds like the Silmet and Moffat Tunnel wastes. We urge the Division to make that finding in this licensing action.

II. The Commission's regulations require Energy Fuels to obtain a specific-import license for the Silmet material.

A. Energy Fuels' argument that the Silmet material is source material and therefore cannot "contain" source material is unsound and should be rejected.

Energy Fuels contends that, if the Division licenses the company to process the Silmet material, "the entire mass" of the material will become source material and therefore cannot be a material that "contains" or is "contaminated" with source material, as is required for it to qualify as "radioactive waste."[19] The Division should reject this argument.

Source material is defined to include two things: (1) natural or depleted uranium or thorium; or (2) ores containing more than 0.05% uranium or thorium.[20] Energy Fuels' argument focuses solely on the second half of this definition. But under that definition's first half, the natural reading of the term "radioactive waste" includes any material that contains or is contaminated with uranium or thorium.[21] Indeed, it is common for the Commission's regulations to refer to materials, substances, equipment, devices, commodities, and products that "contain" source material, a phrasing that invariably means that the substance at issue contains uranium or thorium.[22]

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[18] EFR's Resp. at 127.

[19] *Id.* at 113.

[20] 10 C.F.R. § 110.2 ("Source material").

[21] *Id.* (defining "radioactive waste" as "any material that contains or is contaminated with source … material that by its possession would require a specific radioactive materials license…").

[22] *See, e.g.*, 10 C.F.R. §§ 40.13(c)(2), 171.16(d), 40.52, 140.13b, 40.22, 51.68, 170.11, 170.2, 150.15(a)(6), and 150.17(d)(4).

There is no disputing that the Silmet material contains uranium.[23] And that aspect of the Commission's definition of "radioactive waste" is therefore satisfied. Since the same is true of the remaining criteria for a material to qualify as a "radioactive waste,"[24] the only question is whether the recycling exclusion applies.

B. The recycling exclusion does not apply.

As we argued in our comments, the recycling exclusion does not allow Energy Fuels to import the Silmet material using a general license, for the company's purpose is not "solely" to recycle that material.[25]

On this point, Energy Fuels makes no argument beyond its ipse dixit: "the material will be processed for its source material content," Energy Fuels asserts, "and will *therefore* be imported solely for the purposes of recycling and not for waste management or disposal," adding that "there is a market for the recycled uranium."[26]

This assertion doesn't respond to the argument we laid out. It does not follow logically that, merely because Energy Fuels will process the Silmet material for its source material content, the company's *sole reason* for importing the material is to recycle it rather than dispose of it. The crux of our argument—which Energy Fuels disregards—is that the evidence shows overwhelmingly that the reason for importing the Silmet material is to provide a waste-disposal service to Silmet.[27] This is evident from the economics of the deal with Silmet, from the small fraction and value of the material that can be "recycled" and sold, and from how Silmet and the Republic of Estonia have handled the material.[28]

While these circumstances align precisely with behavior that the Commission warned could amount to "sham recycling,"[29] Energy Fuels claims that "[t]he law is clear that processing an ore at a licensed uranium mill for the recovery of uranium is

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[23] *See* Silmet Application at 6.

[24] It's indisputable that possessing the Silmet material "would require a specific radioactive materials license...." 10 C.F.R. § 110.2 ("Radioactive waste"). Energy Fuels itself argues that its purpose for importing the material is to "recycle" it by processing it through the White Mesa mill. *See, e.g.*, EFR's Resp. at 93 (referring to the plans for the Silmet material as "one small recycling project"). And it is beyond question that processing the Silmet material will generate "radioactive material for disposal in … a disposal area as defined in Appendix A to 10 CFR part 40." 10 C.F.R. § 110.2.

[25] Trust, et al., Comments at 18–21.

[26] EFR's Resp. at 114 (emphasis added).

[27] Trust, et al., Comments at 18–21.

[28] *Id.*

[29] *See* "Export and Import of Nuclear Equipment and Material," 75 Fed. Reg. 44,072, 44,076 (July 28, 2010).

not a 'sham,' regardless of the economics of processing."[30] Yet the company offers no citation for where that "clear" legal proposition can be found. We imagine the company is thinking of the Commission's ruling in *In re Int'l Uranium (USA) Corp.*, 51 NRC 9 (2000). But as we pointed out in our comments,[31] the statutory text that the Commission interpreted in that appeal differs in a crucial way from the text of the Commission's import regulations. The legal question for domestically sourced alternate-feeds is whether they will be processed *primarily* for their source material content; the question for foreign-sourced alternate feeds is whether they will be imported *solely* for the purpose of recycling.[32] It consequently does not follow from the Commission's ruling in *In re Int'l Uranium (USA) Corp.*, that an "alternate feed" may be imported into the United States to be processed and discarded "regardless of the economics."[33]

Indeed, Energy Fuels admits that it would not import the Silmet material into the United States if it could not discard the resulting waste at the White Mesa mill, no doubt *because of* "the economics."[34] We submit that this concession demonstrates that the company's purpose is not "solely" to recycle the material, but instead to dispose of it at the mill. That being so, the recycling exclusion does not apply, and the Commission's rules forbid Energy Fuels from importing the Silmet material using a general license.

C. The Commission's 1998 licensing action for the Cameco materials is not relevant.

Energy Fuels' response again stresses that the Commission in 1998 authorized the company to import materials from Canada using a general-import license, reasoning that the Commission's rules back then allowed Energy Fuels to import anything it was licensed to possess and process.[35]

But again, this argument does not control the legal analysis that applies today.[36] In 1998, the Commission's general-import license also forbade the importation of "radioactive waste," but the definition of radioactive waste was significantly different than it is today, and in particular, did not address at all the subject of recycling.[37] In 2010, the Commission revised the definition of "radioactive

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[30] EFR's Resp. at 113–114.

[31] Trust, et al., Comments at 17–18.

[32] *Id.*

[33] EFR's Resp. at 114.

[34] *Id.* at 115 ("The commenter's suggestion that the tailings from this recycling be returned to Estonia is absurd and would defeat the purpose of recycling, by eliminating recycling as a viable option to Silmet.").

[35] 10 C.F.R. § 110.27(a) (1998).

[36] Trust, et al., Comments at 18.

[37] 10 C.F.R. § 110.2 (1998) ("Radioactive waste").

waste" and adopted the recycling exclusion that remains codified today.[38] As a result, the Commission's analysis of its import rules in 1998 does not answer the question of how the recycling exclusion applies.

This conclusion is not changed by the e-mail from Commission staff that Energy Fuels appended to its response as Attachment C, for that e-mail provides no discussion of the facts and no analysis of the applicable law.[39] On the subject of radioactive waste, the e-mail offers only the conclusory statement that "[t]he alternative feed is not radioactive waste, as defined in Part 110."[40]

Neither the Commission nor Energy Fuels have set out any legal analysis of the requirement that the Silmet material be imported "solely" for recycling, nor have they presented a case for concluding that the evidence shows this requirement to be satisfied. On the contrary, the evidence shows the opposite: Energy Fuels will not import the Silmet material *solely* for the purpose of recycling, but rather to dispose of it at the mill. As a result, if the Division approves Energy Fuels' request to possess and process the Silmet material, its approval should be contingent on Energy Fuels' acquisition of a specific-import license.

D. The balance of Energy Fuels' response has no bearing on the legal analysis for determining whether a specific import license is required.

In addressing our argument that a specific-import license is required, Energy Fuels devotes the rest of its response to asserting that we don't "understand recycling," and that processing the Silmet material is beneficial to the environment.[41] We disagree, but think it suffices to point out in response that these issues are irrelevant to the legal analysis of whether the Silmet material may be imported using a general-import license.

III. Energy Fuels' claim that mill tailings are not "wastes" is diametrically opposed to its prior statements.

In our comments, we urged the Division to revise its assertion that "11(e)(2) byproduct" material is not "waste."[42] By definition, it is waste: "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content."[43] It should not be a controversial idea that the mill tailings that will be spread over about 300 acres and buried for eternity in southeastern Utah is waste.

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[38] 75 Fed. Reg. at 44,076.

[39] *See* EFR's Resp. at Attachment C.

[40] *Id.*

[41] EFR's Resp. at 114–115.

[42] Trust, et al., Comments at 22.

[43] 42 U.S.C. § 2014(e)(2).

Energy Fuels disagrees, arguing that "[u]ranium mill tailings are not wastes…."[44] But its position today is diametrically opposed to its past statements. In 2006, the author of Energy Fuels' comments explained that: "[t]he predominant waste generated by uranium mills on an ongoing basis *are the mill tailings themselves*…."[45] It's perplexing, to say the least, to be accused of making an "incorrect" assertion by the person whose very words we are merely repeating. [46]

Energy Fuels' about-face on this issue seems to be driven by the idea that the company sometimes makes yellowcake or recovers vanadium from some of the tailings in the mill's "tailings management system," and (we infer) that the company thus reasons that tailings are perpetually reused rather than permanently discarded.[47] This argument has no merit.

It is true that Energy Fuels has sometimes processed some fraction of the mill's tailings, but nearly all the re-processed tailings are then put right back into the mill's pits, and it is there that those wastes are meant to remain until the end of time. That *some fraction* of the content of *some* of the pits might be run through the mill again sometime in the future doesn't mean that tailings, writ large, aren't waste. At the very least, we have no doubt that Energy Fuels has no plans to disinter the tailings in Cells 2 and 3 to run them through the mill again. And it is consequently beyond question that the contents of those cells are wastes that have been discarded into the environment.

The truth is that "[t]he predominant waste generated by uranium mills on an ongoing basis are the mill tailings themselves…."[48] Our comments simply ask the Division to acknowledge that point so that the public isn't misled about what 11(e)(2) byproduct materials are.

IV. Energy Fuels' quarrel with our statement of facts is hyperbolic and sometimes contradicts its own prior statements.

A good share of Energy Fuels' response to our comments is directed to a squabble, not about what the facts are, but about how we presented them.[49] Though the company claimed that we made statements that are "patently false," "incorrect," and "generally not true,"[50] it didn't back those claims up, particularly not with

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[44] EFR's Resp. at 99.

[45] Ex. 28 at 7-14.

[46] EFR's Resp. at 99 (claiming that "it is incorrect to state that Mill tailings are 'wastes.'").

[47] *See* EFR's Resp. at 99; 96 (contending that an "impoundment" is something that "materials are placed into to store, reuse or evaporate").

[48] Ex. 28 at 7-14.

[49] *See* EFR's Resp. at 92–101.

[50] *Id.* at 94, 96, 97

citations or other evidence to gainsay our account of the facts.

Energy Fuels argues, for example, that it was "patently false" for us to observe that "[n]o description of the mill's operation appears in any of the documents on which the Division is seeking comment." To ostensibly prove up this allegation, the company then points to a "timeline of controls and license renewal events" from a 2018 public participation summary for a different licensing action.[51] Since that is not one of the documents "on which the Division is seeking comment," there was nothing "patently false" about what we said. Indeed, we think it's unremarkable for the public to put into the record background about the mill that, for whatever reason, was otherwise omitted.

The company also disputes our observations about groundwater contamination at the mill by asserting that the contamination is not from releases from its "tailings management system."[52] And yet, our comments asserted only that Energy Fuels' *business* has fouled the groundwater beneath the mill,[53] a statement whose accuracy Energy Fuels confirms when it points out that "[t]he chloroform plume appears to have resulted from the operation of a temporary laboratory facility that was located at the site prior to and during the construction of the Mill, and from septic drain fields that were used for laboratory and sanitary wastes prior to construction of the Mill's tailings cells."[54]

Energy Fuels similarly criticizes us for asserting that the mill, at its inception, was expected to process "low-grade" ore for about 15 years.[55] And yet this is precisely how Energy Fuels' described the plan for the mill to the Nuclear Regulatory Commission,[56] and how the Commission portrayed that plan to the public in the environmental impact statement published in 1979 to determine whether to issue a license for the mill's operation.[57] If this was not in fact the plan for the mill, then the public-facing documents prepared for the purpose of determining whether to issue a license were intentionally misleading.

While much of the disagreement on these points has only minor bearing on

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[51] EFR's Resp. at 94.

[52] *Id.* at 100.

[53] Trust, et al., Comments at 9.

[54] EFR's Resp. at 100.

[55] *Id.* at 97–98.

[56] Trust, et al., Comments, Ex. 4 at 1-2 ("The mill is planned to have a 2,000 tons-per-day capacity and a projected life of 15 years."); *id.* at 10-1 (referring generally to the uranium ore to be processed at the mill as "low grade ore").

[57] Trust, et al., Comments, Ex. 2 at 10-21 (describing average projected ore grades of 0.125% as "low grade"); 1-1 (describing projected project lifetime as 15 years); *id.* at 3-18 (chart showing that "mill operation ends" at the end of year 15); 3-12, 3-15, 4-3, 10-9, 10-11, 10-13 (describing design features intended for 15 years' of use).

the decisions facing the Division, two especially important observations emerge.

First, it reveals that Energy Fuels' arguments today sometimes contradict its past statements. The company's claim that tailings are not "wastes" is but one example. Energy Fuels also now argues that "[a]lternate feed materials are valuable ores and are not wastes, any more than conventional ore are wastes before they are processed."[58] And yet, in the 2006 paper we discussed above, the author of Energy Fuels' response to our comments listed "alternate feed materials," under the heading "Wastes Accepted by Mills from Third Parties," having introduced the subject with the observation that: "uranium mills can accept other types of materials, which may be wastes in the hands of the generator of the materials, thereby helping to solve the gernator's waste management problems."[59] Another paper by the same author for the Waste Management Symposia in 2002 is devoted wholly to explaining how "mixed wastes" can be disposed of at uranium mills by processing them as "alternate feeds."[60]

Another example surfaces in the company's many complaints[61] that our comments contain "misleading, inflammatory, and speculative language": The statement that the mill was once sold for "almost nothing" isn't our phrasing, but a direct quote from the company's founder, George Glasier.[62]

In each of these examples, the company has in effect asserted that its own prior statements were incorrect, misleading, or inflammatory. And in each instance, when the company wasn't battling our comments and had no incentive to be mealy-mouthed, the company's past statements *agreed* with our comments. We think this is a good indication that our characterization of these now-disputed issues is the better one.

Second, the fact that the company is displeased by our effort to talk about the mill in an everyday way, without using the bureaucratese it prefers, shows that word choice matters in public-facing discussions about the mill. Energy Fuels is piqued, for example, that we often use the word "pit" instead of "impoundment," arguing that the word pit is "patently incorrect and inflammatory."[63] Yet we imagine most people would guess an "impoundment" is the place where you retrieve your car after parking it illegally. And while we don't dispute that the definition of "pit" that

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[58] EFR's Resp. at 99.

[59] Ex. 28 at 7-18 (emphasis added).

[60] David C. Frydenlund, "Accepting Mixed Waste as Alternate Feed Material for Processing and Disposal at a Licensed Uranium Mill (Feb. 2002) attached as Exhibit 30.

[61] *See* EFR's Resp. at 94, 96–98, 101.

[62] Stephane A. Malin, The Price of Nuclear Power: Uranium Communities and Environmental Justice, 96 (2015) (quoting George Glasier).

[63] EFR's Resp. at 96.

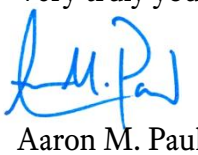
Energy Fuels cites[64] captures *one sense* of the word's meaning, so too does the definition in our dictionary, which says that "pit" means "a large hole in the ground."[65] It's an overstatement, to say the least, for Energy Fuels to insist that it's "patently incorrect and inflammatory" for us to describe a 40-plus-acre cavity in the earth where the mill's waste is deposited as "a large hole in the ground."

Using code words like "impoundment" instead of "pit" and "byproduct" instead of "waste" sanitizes a business that's off-putting to many people when you talk about it in a normal way. Put differently, our narrative about the mill is only so "inflammatory" as Energy Fuels' is anodyne.

V. Conclusion

We are grateful for the opportunity to reply to Energy Fuels' comments on the proposed license amendments. Please don't hesitate to reach out with any question about our comments or to discuss any matters we've raised.

Very truly yours,



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[64] *Id.*

[65] New Oxford Am. Dictionary, 1333 (3d Ed. 2010).

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Enclosures

Exhibit 28

WASTE STREAMS, DISPOSAL, AND CLEAN-UP ISSUES ASSOCIATED WITH URANIUM MINING AND MILLING

By

David C. Frydenlund
Vice President and General Counsel
International Uranium Corporation
Denver, Colorado

Paper 7

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WASTE STREAMS, DISPOSAL AND CLEAN-UP ISSUES ASSOCIATED WITH URANIUM MINING AND MILLING

ROCKY MOUNTAIN MINERAL LAW FOUNDATION

Special Institute on Uranium Exploration and Development

April 27-28, 2006

David C. Frydenlund
Vice President and General Counsel
International Uranium (USA) Corporation

1. INTRODUCTION

This paper will focus on waste streams, disposal and clean-up issues and other regulatory requirements applicable to uranium mining and milling in the United States. Facility design features and operating standards will also be addressed because they play a role in the wastes and effluents generated from uranium mining and milling and in the disposal, clean-up and management of those wastes and effluents. As this paper will focus on uranium mining and milling, it will not address any issues associated with other stages of the nuclear fuel cycle.

Mining and milling in general is subject to regulation by a number of agencies, such as the applicable State agencies responsible for mining and water quality, the United States Bureau of Land Management ("BLM"), the United States Environmental Protection Agency ("EPA") and the Mine Safety and Health Administration ("MSHA") to name a few. However, one of the unique features of uranium mining and milling is that in addition to those agencies, some, but not all, aspects of uranium mining and milling are also regulated by the United States Nuclear Regulatory Commission ("NRC" or the "Commission") under the Atomic Energy Act of 1954,[1] as amended by the Uranium Mill Tailings Radiation Control Act of 1978 ("UMTRCA")[2] (the Atomic Energy Act of 1954 as amended is referred to in this paper as the "AEA"). In some cases, the AEA requirements supersede or replace the requirements of other agencies; in other cases they co-exist with the requirements of those agencies.

Understanding where AEA jurisdiction lies relative to the jurisdiction of other agencies is therefore paramount to an understanding of the regulatory requirements applicable to uranium mining and milling. In order to set the stage for this understanding, some key AEA definitions will be reviewed, as well as some of the main areas where AEA jurisdiction supersedes that of other agencies. This paper will then address waste

[1] *See* 42 U.S.C 2011 *et seq.*
[2] *See* 42 U.S.C. 7901 *et seq.*

streams, disposal and clean-up issues and other regulatory requirements applicable to uranium milling, conventional uranium mining and *in situ* leach ("ISL") uranium recovery, the three main types of operations comprising the uranium mining and milling industry.

2. REVIEW OF KEY AEA DEFINITIONS

The following is a brief discussion of some of the key AEA definitions and concepts and how they define AEA jurisdiction.

2.1. AEA Jurisdiction

2.1.1. General

Under the AEA, the NRC has jurisdiction over source material, special nuclear material and by-product material as well as the development, use and control of atomic energy. It is therefore important to determine if any aspects of a uranium mining or milling operation fall within any of these definitions and are hence subject to AEA jurisdiction.

2.1.2. Source Material

Source material is regulated under Chapter 7 of the AEA and the regulations under 10 CFR Part 40, including Appendix A thereto ("Appendix A").

Source material is defined in 10 CFR 40.4 as (1) uranium or thorium or any combination thereof in any chemical or physical form or (2) ores which contain by weight 0.05% or more of uranium, thorium or any combination thereof. Source material does not include special nuclear material.[3]

What this means is that if uranium or thorium exists in an ore or waste in concentrations less than 0.05%, then just the uranium or thorium itself is source material, and the remainder of the ore or waste is not source material. However, if an *ore* contains 0.05% or more uranium or thorium, then the entire volume or mass of ore is considered source material. If a *waste* contains 0.05% or greater uranium or thorium, then, because it is not an *ore*, just the uranium or thorium itself is source material and the remainder of the volume or mass of waste is not source material. However, if the *waste* becomes an *ore*, say, if the waste is being reprocessed for the recovery of uranium as an alternate feed material at a uranium mill (see Section 4.5.1 below), the entire volume or mass of the waste becomes source material. This is important when determining which agencies have jurisdiction over the ore or waste.

[3] The definition of source material in Section 11 of the AEA (42 U.S.C. 2014) is broader and contemplates the authority of the Commission under Section 61 of the AEA (42 U.S.C. 2091) to determine any other material to be source material. The Commission has not determined any material other than uranium and thorium to be source material.

Section 62 of the AEA[4] provides that a person must obtain a source material license for the possession of source material after removal from its place of deposit in nature, except that licenses shall not be required for quantities of source material which, in the opinion of the Commission, are unimportant.[5] The regulations at 10 CFR 40.13 list a number of circumstances which the Commission considers to be unimportant quantities of source material, and hence do not require a source material license. The two most important of these circumstances relative to uranium mining and milling are the following:

a) A person may receive, possess, use transfer or deliver source material in any chemical mixture, compound, solution, or alloy in which the source material is by weight less than 0.05%;[6] and

b) A person may receive, possess, use or transfer unrefined and unprocessed ore containing source material, provided that such person shall not refine or process such ore.[7]

As will be discussed in more detail below, uranium mills and ISL recovery facilities (which also refine or process uranium ore) require source material licenses while conventional uranium mines do not (because they deal with unrefined and unprocessed ores and they do not refine or process such ores).

2.1.3. Special Nuclear Materials

Special nuclear materials are regulated under Chapters 5 and 6 of the AEA and the regulations at 10 CFR Part 70. Special nuclear materials are defined in Section 11 of the AEA as (1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of Section 51 of the AEA determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material.[8]

Section 57 of the AEA[9] and 10 CFR 70.3 provide that no person may transfer or receive in interstate commerce, transfer, deliver, acquire, own, possess, receive possession of or title to, or import into or export from the United States any special nuclear materials, without a license.

Unlike source material, there is no "unimportant" or unregulated quantity or concentration of special nuclear material.

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[4] *See* 42 U.S.C. 2092.
[5] *See* 42 U.S.C. 2091.
[6] *See* 10 CFR 40.13(a). This unimportant quantity is increased to 0.25% uranium and/or thorium in rare earth metals and compounds, mixtures and products. 10 CFR 40.13(c)(1)(vi).
[7] *See* 10 CFR 40.13 (b).
[8] *See* 42 U.S.C. 2014.
[9] *See* 42 U.S.C. 2077.

Special nuclear materials are generally man-made and are not found in natural ores. As a result, uranium mines and mills are not licensed to deal with special nuclear materials. Special nuclear materials are fissionable and are associated with higher stages of the nuclear fuel cycle and are therefore not relevant to this paper.

2.1.4. Byproduct Material

Byproduct material is regulated under Chapter 8 of the AEA and the regulations at 10 CFR Part 40, including Appendix A thereto. Byproduct material is defined in Section 11 of the AEA[10] as:

> (1) any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material (referred to as 11e.(1) byproduct material), and
>
> (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content (referred to as "11e.(2) byproduct material").

Two additional categories of byproduct material, 11e.(3) and 11e.(4) byproduct material, have recently been added by virtue of Section 659 (e) of the Energy Policy Act of 2005.[11] These definitions give NRC authority over certain discrete sources of naturally occurring and accelerator-produced radioactive material ("NARM") and naturally occurring radioactive materials ("NORM"). NORM is a subset of NARM. These categories of byproduct material were added to give NRC authority to regulate discrete sources of NARM and NORM that could potentially pose a security threat. Non-discrete sources of NORM, such as contaminated soils from commercial oil and gas production and geothermal power production, certain sludges from water treatment facilities and diffuse forms of NARM, are not covered by these new categories of byproduct material, and are generally not subject to AEA jurisdiction.

For purposes of uranium mining and milling, the key category of byproduct material is 11e.(2) byproduct material. These are the tailings and wastes generated from the extraction of uranium from ores. 11e.(1) byproduct material is generated from higher stages of the nuclear fuel cycle and is generally not relevant to uranium mining and milling.

Section 81 of the AEA[12] and 10 CFR 40.3 provide that no person may receive title to, own, receive, possess, use, transfer, provide for long-term care, deliver or dispose of byproduct material without a license. As will be discussed in more detail below, uranium mills and ISL uranium recovery facilities require 11e.(2) byproduct material licenses, while conventional uranium mines do not.

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[10] *See* 42 U.S.C. 2014(e).
[11] *See* H.R.-213 (Public Law 109-58).
[12] *See* 42 U.S.C. 2111.

Unlike source material, there is no "unimportant" or unregulated quantity or concentration of byproduct material

2.1.5. Long Term Custodian

One unique feature of the regulatory scheme for uranium mill tailings is that Section 83 of the AEA[13] requires that, prior to license termination, title to uranium mill tailings (11e.(2) byproduct material) must be transferred to the United States Department of Energy ("DOE") or the State in which the activity occurred, if the State so elects[14], for custody and long term care. 10 CFR 40.28 provides a general license to DOE or the State for that purpose.

2.1.6. Low Level Radioactive Waste

Various categories of wastes from AEA-licensed facilities, containing source material, special nuclear material and 11e.(1) byproduct material in relatively low concentrations (referred to as low level radioactive waste ("LLRW")) must be disposed of in a facility licensed under 10 CFR Part 61.[15] Under the Low level Waste Policy Act, as amended ("LLWPA")[16], a system of regional compacts ("Compacts") was established to oversee disposal of LLRW generated within each Compact.

2.1.7. The Regulations at 10 CFR Part 20

The regulations at 10 CFR Part 20 set out the standards for protection against radiation that are applicable to licensees under the AEA.

2.1.8. Agreement States

Under Section 274 (b) of the AEA[17], the Commission has the authority to enter into an agreement with a State (an "Agreement State") to discontinue NRC's authority over source material, 11e.(1) and 11e.(2) byproduct material and special nuclear material in quantities not sufficient to form a critical mass. The States of Utah, Washington, Colorado and Texas are some of the States that are currently Agreement States.

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[13] *See* 42 U.S.C. 2113.

[14] To date, no State has expressed any interest in taking title to such sites, and as a practical matter, it is unlikely that this situation will change in the foreseeable future. Therefore, for the sake of convenience throughout the remainder of this paper we will refer only to the transfer of title to DOE as the long term custodian.

[15] LLRW is defined in 10 CFR 61.2 as having the same meaning as in the Low-Level Waste Policy Act, that is, radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in Section 11e.(2) of the AEA (uranium or thorium tailings and waste). *See also* the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101 *et seq*), specifically Section 2(16).

[16] *See* 42 U.S.C. 2021b *et seq*.

[17] *See* 42 U.S.C. 2021.

2.1.9. Limits to AEA Authority

The authority of NRC and Agreement States under the AEA is limited to the radionuclides contained in source material, special nuclear material and byproduct material. For example, although NRC has recently been given some authority over discrete sources of radium in the new definitions of 11e.(3) and 11e.(4) byproduct material, the regulation of radium in NORM generally does not fall within the jurisdiction of NRC.[18]

2.2. Source, Special Nuclear Materials and Byproduct Materials Exempt From EPA Jurisdiction

2.2.1. RCRA

EPA regulates "hazardous wastes" under the Resource Conservation and Recovery Act ("RCRA").[19] Hazardous wastes can be either characteristic hazardous wastes (i.e., ignitable, corrosive, toxic or reactive) or listed hazardous wastes (i.e., listed under 40 CFR 271.30-33, or under comparable State law provisions). However, only "solid wastes" may be regulated as "hazardous waste" under RCRA.[20]

Source material, special nuclear material and byproduct material are expressly excluded from the definition of "solid waste." Under RCRA, the term "solid waste" does not include source, special nuclear or byproduct material as defined by the AEA.[21]

Consequently, since source material, special nuclear material and byproduct material are not "solid waste," they cannot be classified as "hazardous waste.". Therefore, source material, special nuclear material and byproduct material are not subject to regulation by EPA or an EPA-authorized State pursuant to RCRA. This is because the AEA provides a comparable regulatory regime of its own. For example, as discussed in more detail in Section 3.4 below, the AEA provides a comprehensive regulatory scheme for the regulation of the radiological and non-radiological aspects of byproduct material by the Commission in accordance with standards set by EPA. There is therefore no need for dual jurisdiction by EPA over source material, special nuclear material or byproduct material.

Having said this, however, if a *waste* is a mixture of source material, special nuclear material or byproduct material, on the one hand, and RCRA listed or characteristic waste on the other hand, then the waste would be considered a "mixed waste" and would be

[18] Since radium is a daughter product of uranium, the AEA does apply to radium to the extent it is a part of source material or 11e.(2) byproduct material, but not generally if it is not associated with source material, special nuclear material or byproduct material.
[19] *See* 42 U.S.C. 6901 *et seq.*
[20] *See* 42 U.S.C. 6903(5); 40 CFR 261.3.
[21] *See* 42 U.S.C. 6903(270; *see also* 40 CFR 261.4(a)(4).

subject to dual jurisdiction by EPA and the Commission under RCRA and the AEA, respectively.[22]

2.2.2. TSCA

Source material, special nuclear material and byproduct material are also excluded from the definition of "chemical substances" under the Toxic Substances Control Act[23] ("TSCA"), which regulates toxic substances such as polychlorinated biphenyls ("PCB"s) and asbestos. As a result, source material, special nuclear material and byproduct material are not subject to regulation under TSCA. Again, given the AEA's comprehensive program for the regulation of source material, special nuclear material and byproduct material, there is no need for dual jurisdiction by EPA under TSCA.

3. CATEGORIES OF URANIUM MILLS AND TAILINGS SITES

3.1. Enactment of UMTRCA

Prior to the enactment of UMTRCA in 1978, uranium mill tailings, *per se*, were not regulated under the AEA.[24] This resulted in a number of problems, most notably a lack of controls on the siting and design of uranium mill tailings impoundments, resulting in contamination of the surrounding environment in a number of cases, and the lack of institutional controls on uranium mill tailings after termination of the license or abandonment of the site. This resulted in public access to abandoned radioactive mill tailings, and in some cases use of such tailings sands as building materials in house foundations etc. In 1978, Congress addressed these problems with the enactment of UMTRCA.

By enacting UMTRCA, Congress intended to create a comprehensive system for regulating the tailings and related wastes resulting from processing ore for its source material content. Congress expressed two purposes for UMTRCA. First, to assess and remediate inactive mill tailings sites that were contaminated with uranium mill tailings and related wastes but that were not subject to an active NRC license at the time of enactment of UMTRCA, and second to regulate the management and disposition of uranium mill tailings and related wastes at active mill tailings sites (i.e., sites subject to active licenses at the time of enactment of UMTRCA).[25] To meet these two objectives, Congress created an integrated, two-part regulatory scheme, under which tailings at

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[22] However, as will be discussed in Section 4.5.1 below, if the *waste* were to be processed as an alternate feed material at a uranium mill for the recovery of uranium, and if it contained 0.05% or greater source material, then the *waste* would become a source material *ore* and the entire *ore* would be considered source material and would be exempt from RCRA. And, since this *ore* would be processed primarily for the recovery of uranium, the resulting tailings would be 11e.(2) byproduct material. As a result, jurisdiction over the processing and disposal of the *ore* would be solely with the Commission under the AEA.

[23] *See* 15 U.S.C. 2601 *et seq.*

[24] Prior to the enactment of UMTRCA, NRC regulated uranium mills through source material licenses. However, in most cases uranium mill tailings contained less than 0.05% source material and were therefore considered an unimportant quantity and not licensable as source material.

[25] *See* 42 U.S.C. 7901.

inactive sites are addressed primarily under Title I of UMTRCA and tailings at active sites are addressed primarily under Title II.

3.2. Title I Sites

Title I of UMTRCA was intended to provide for the remediation and regulation of tailings and wastes associated with uranium processing activities that had occurred at inactive and abandoned milling sites. In Title I, Congress listed 22 inactive milling sites to be evaluated and remediated by DOE and directed DOE to identify, evaluate and, if necessary, remediate any additional inactive milling sites, as well as sites in the vicinity of inactive milling sites that were contaminated with tailings and wastes from the milling activities.[26]. Some examples of remediated Title I sites are the uranium milling facilities in Grand Junction and Durango, Colorado, Salt Lake City, Green River and Monticello, Utah, Ambrosia Lake, New Mexico, Riverton, Wyoming and Tuba City Arizona.

Title I gives authority to DOE to remediate "residual radioactive materials" at abandoned uranium mill sites. Residual radioactive materials are defined in 42 U.S.C. Section 7911(7) to encompass 11e.(2) byproduct material as well as "other waste (which the Secretary [of DOE] determines to be radioactive) at a processing site which relate to such processing, including any residual stock of unprocessed ores or low-grade materials." Residual radioactive materials are defined more broadly than 11e.(2) byproduct material in order to include a wider range of wastes that might be found at abandoned milling sites and vicinity properties.

DOE has the authority and responsibility under Title I to remediate all residual radioactive material at such properties. In some cases, where impacts to the environment have been minimal, DOE has secured the materials in place. In other circumstances, DOE has relocated the tailings and other residual radioactive materials to new dedicated disposal sites that meet the siting, design and long term stability requirements specified in 10 CFR Part 40, Appendix A.

While most Title I sites have been remediated using one of these two methods, UMTRCA permits the direct disposal of residual radioactive material from Title I sites at licensed Title II facilities.[27] While active uranium mill tailings facilities could therefore be utilized for Title I clean up activities, the Title I program is essentially completed at this time.[28]

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[26] *See* 42 U.S.C. 7911(6); 7912.

[27] *See* 42 U.S.C. 7918(a)(1).

[28] Indeed, Section 112.(a)(1) of UMTRCA provides that the authority of DOE to perform remedial action under Title I of UMTRCA shall terminate on September 30, 1998, with the exception of groundwater restoration activities at Title I sites, and clean up of the Monticello tailings in Utah, which has been completed at this time.

3.3. FUSRAP Sites

The DOE's Formerly Utilized Sites Remedial Action Program (the "FUSRAP Program") is aimed at remediating sites contaminated as a result of activities associated with the Manhattan Engineering District and the Atomic Energy Commission (the precursor to the NRC) as part of the nation's early atomic energy program. The FUSRAP Program is now administered by the United States Army Corps of Engineers ("USACE").

While some FUSRAP sites are characterized by wastes and residuals contaminated with special nuclear material, 11e.(1) byproduct material, depleted uranium and thorium and radium wastes, the largest volume of FUSRAP wastes have been uranium mill tailings and associated, soils, environmental media and building debris from facilities that were historically used to concentrate natural uranium.

The mill tailings and related wastes present at these historic uranium milling FUSRAP sites are essentially identical to the residual radioactive materials found at Title I sites. However, a FUSRAP site would be addressed under the FUSRAP program rather than under the Title I program either because the site was not abandoned and therefore would not have been a likely candidate for inclusion within the Title I program, or the site was owned or controlled by the government and hence expressly excluded from the Title I program.[29]

One would think that these types of historic uranium milling FUSRAP wastes should meet the definition of 11e.(2) byproduct material or residual radioactive material and hence be subject to AEA jurisdiction. However, by a letter dated March 2, 1998,[30] NRC staff has taken the position that the Commission cannot exercise jurisdiction over most of these FUSRAP materials because NRC does not have the authority to regulate as 11e.(2) byproduct material or residual radioactive material tailings or wastes that were generated prior to the enactment of UMTRCA in 1978, unless those tailings or wastes were generated pursuant to an NRC-issued license.

Prior to NRC staff taking this position, these types of FUSRAP materials were directly disposed of as 11e.(2) byproduct material in a facility in Utah licensed for the direct disposal of 11e.(2) byproduct material. These materials can no longer be directly disposed of in such a facility as 11e.(2) byproduct material, but must be disposed of either as hazardous waste in a RCRA Subtitle C facility or a NORM facility, if the concentrations of radionuclides are low enough to meet the acceptance criteria at such facilities, or, if the materials contain recoverable concentrations of uranium, reprocessed as alternate feed material at a licensed uranium mill (see Section 4.5.1 below). In some circumstances, FUSRAP sites have been remediated in place, and have not involved excavation of soils and disposal at an offsite facility.

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[29] *See* 42 U.S.C. 7911(6).

[30] Letter from Robert L. Fonner, Special Counsel for Fuel Cycle and Safeguards Regulations, NRC, to Ann Wright, Counsel, HTRW Center of Expertise, USACE (March 2, 1998).

3.4. Title II Sites

As mentioned above, Congress created Title II of UMTRCA to regulate the management and disposition of uranium mill tailings and related wastes at active mill tailings sites (i.e., sites subject to active licenses). Specifically, UMTRCA amended the AEA by adding the definition of 11e.(2) byproduct material[31], by adding Section 83 of the AEA[32], which requires that mill tailings sites must be transferred to the DOE (or a willing State) for long-term custody and maintenance, and by adding Sections 84[33] and 275[34] of the AEA, which give the Commission broad authority to regulate the radiological and non-radiological aspects of mill tailings sites, in accordance with general standards promulgated by the EPA and specific regulatory requirements established by the Commission.

In 1980, the Commission promulgated its 10 CFR Part 40, Appendix A Criteria[35], based upon the findings in its Final Generic Environmental Impact Statement On Uranium Milling set forth in NUREG-0706.[36] Appendix A establishes a program for mill tailings management by setting Criteria for siting and disposal of mill tailings impoundments, controlling erosion and stabilizing tailings, limiting radioactive effluents from uranium mills and mill tailings, controlling seepage of both radiological and non-radiological toxic materials into groundwater, adopting the same groundwater protection criteria established by EPA for RCRA Subtitle C facilities, providing financial assurance for meeting disposal costs and long-term monitoring, and meeting UMTRCA's long-term custodianship requirements for tailings disposal sites.

In 1983, EPA issued its general standards for Title I sites[37] and Title II sites.[38] In 1985, the Commission amended its earlier 1980 Criteria to conform them to EPA's generally applicable standards, [39] although many of the Appendix A Criteria remained unchanged.

There are currently two operating uranium mills in the United States, the White Mesa Mill near Blanding Utah, and the Cotter Mill in Canon City, Colorado. The Sweetwater Mill in Wyoming is on standby, and the Shootering Canyon Mill in Ticaboo, Utah is in the re-permitting process. There are also a number of Title II mill sites that are in the process of reclamation, and one 11e.(2) byproduct material commercial disposal facility in Clive, Utah.

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[31] *See* 42 U.S.C. 2014.
[32] *See* 42 U.S.C. 2113.
[33] *See* 42 U.S.C. 2114.
[34] *See* 42 U.S.C. 2022.
[35] 45 Fed. Reg. 65,521 (1980).
[36] NUREG-0706, Final Generic Environmental Impact Statement on Uranium Milling, (September, 1980).
[37] 48 Fed. Reg. 590 (1983) (codified at 40 CFR 192.00-.23).
[38] 48 Fed. Reg. 45,926 (1983) (codified at 40 CFR 192.30-.43).
[39] 50 Fed. Reg. 41,852 (1985).

4. ACTIVE URANIUM MILLS (TITLE II FACILITIES)

Uranium mills create their own wastes which they must deal with in accordance with applicable regulations. In addition, uranium mills can accept wastes from other facilities, thereby helping to deal with the waste management issues of those other facilities. This Section will first address the siting and design criteria for active uranium mills, as well as the operational standards, the wastes generated and the clean-up standards. It will then address the various types of wastes that uranium mills can accept from other facilities.

4.1. Design Criteria, Siting And Permitting for Uranium Mills

4.1.1. Siting

The siting criteria for uranium mills are set out in Criteria 1 of 10 CFR Part 40, Appendix A, which states that "The general goal or broad objective in siting and design decisions is permanent isolation of tailings and associated contaminants by minimizing disturbance and dispersion by natural forces, and to do so without ongoing maintenance." Criterion 1 goes on to state that the following site features which will contribute to such a goal or objective must be considered in selecting among alternative tailings disposal sites or judging the adequacy of existing tailings sites:

- Remoteness from populated areas;
- Hydrogeologic and other natural conditions as they contribute to continued immobilization and isolation of contaminants from groundwater sources; and
- Potential for minimizing erosion, disturbance, and dispersion by natural forces over the long term.

The Criterion emphasizes that in the selection of disposal sites, primary emphasis must be given to isolation of tailings or wastes, a matter having long term impacts, as opposed to consideration only of short-term convenience or benefits, such a s minimization of transportation or land acquisition costs. Finally, the Criterion provides that while isolation of tailings will be a function of both site and engineering design, overriding consideration must be given to siting features given the long-term conditions of the site.

4.1.2. Uranium Mill Tailings Impoundments Design Criteria

The design criteria for 11e.(2) byproduct impoundments are set out in Appendix A, most notably in Criteria 3 (which provides that below grade disposal is preferred), Criterion 4 (which sets out site and design criteria), Criterion 5A (which specifies criteria for tailings impoundment liners), Criterion 5E (which specifies requirements for leak detection systems and dewatering systems) and Criterion 6 (which provides for the design life standard).

At the time of enactment of UMTRCA, the design standard for active uranium mill tailings impoundments was typically a single synthetic liner (Criterion 5A), with a leak detection system beneath the liner (Criterion 5E) designed to detect major failures should

they occur, and a dewatering system or "slimes drain" above the synthetic liner to dewater the tailings prior to closure of the impoundment (Criterion 5E). Over the years technology has improved, and tailings impoundments constructed in the late 1980s also incorporated a clay liner beneath the leak detection system and synthetic liner. As an example of a current tailings impoundment design standard, the State of Utah, which is an Agreement State, is requiring a design similar to that required for RCRA Subtitle C Hazardous Waste facilities. That is, two synthetic liners underlain by a clay liner, with a leak detection system between the two synthetic liners, and a slimes drain above the liner system.[40]

The other notable design criterion is Criterion 6, which requires that 11e.(2) byproduct material impoundments must be designed to provide reasonable assurance of control of radiological hazards to (i) be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years, and (ii) limit releases of radon-222 from uranium byproduct materials to the atmosphere so as not to exceed an average release rate of 20 $pCi/m^2/s$ to the extent practicable throughout the effective design life.[41]

4.1.3. Permitting Requires EIS And Extensive Evaluations

As can be expected, permitting of a uranium mill will require a full environmental impact statement under the National Environmental Policy Act ("NEPA").[42]

4.1.4. Siting Of New Uranium Mill Unlikely –Toll Milling An Option.

It should be evident from the foregoing that permitting a new uranium mill is not an easy matter. Siting criteria are strict, which will limit the types of sites that will be suitable. The design criteria are strict, especially the requirement that uranium mill tailings impoundments must be constructed to what is, in effect, a 1,000 year design standard, without active maintenance.

The result is that there are few licensed uranium mills and not likely to be too many more in the foreseeable future. Fortunately the existing uranium mills have relatively large capacity and have historically entered into toll milling or ore-purchase arrangements with independent uranium mines. It has not been uncommon for uranium ores to be transported several hundred miles from a mine to a uranium mill. This has allowed the permitting and development of many smaller uranium mines throughout the Colorado Plateau that may not otherwise have been feasible.

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[40] It should be noted that these design standards are applicable to active uranium mill tailings cells, which receive tailings solids and solutions. Different design criteria may apply to 11e.(2) direct disposal facilities, which typically receive dry tailings only.

[41] By comparison, the design standard for a Part 61 LLRW facility requires 100 years of active institutional controls and for Class C wastes protection for 500 years, and RCRA disposal cells are designed with a regulatory oversight horizon of approximately 30 years.

[42] *See* 42 U.S.C. 4321 *et seq.*

4.2. Operating Standards For Uranium Mills

4.2.1. 10 CFR Part 20

The regulations at 10 CFR Part 20 set out the standards for protection against radiation for all types of licenses issued under the AEA, including source material licenses and byproduct material licenses. These regulations address both occupational standards, i.e., standards applicable to workers at the licensed facility, and standards applicable to members of the public who may be exposed to radiation emanating from the licensed facility.

For workers, the regulations in 10 CFR Part 20 address radiation exposure from various different radionuclides, which in the case of uranium mills is mainly from uranium and its daughters (thorium-230, radium-226 and lead-210). The regulations also address the different pathways of exposure -- inhalation of radon and its daughters, ingestion and inhalation of air particulate (radioactive dust), and exposure to gamma radiation. Measurements of these types of radiation are required at various locations throughout the mill site, and records are required to be kept of the amount of time each worker spends in each area throughout the year. The maximum time-weighted exposure from all of these pathways combined for an adult worker cannot exceed 5 rem (5,000 mrem) per year.[43] However, under 10 C.F.R 20.1101, each licensee is also required to use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable ("ALARA"). ALARA goals are typically set at 25% of the regulatory standards, or, in the case of adult workers, 1.25 rem (1,250 mrem) per year.[44]

10 CFR 20.1301 provides that each licensee shall conduct operations so that the total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (100 mrem) in a year, exclusive of the dose contributions from background. Radon, air particulate and gamma emanations from the site are measured at regular intervals to ensure that this standard is satisfied. In addition, 10 CFR 20.1101(d) provides that to implement the ALARA requirements, the exposure to members of the public from air particulate, excluding radon and its daughters, should not exceed 0.01 rem (10 mrem) per year.

4.2.2. Clean Air Act Requirements

In addition to the requirements of 10 CFR Part 20, uranium mills must also comply with Clean Air Act national emission standards for hazardous air pollutants ("NESHAPS"). The requirements for operating (i.e., active) uranium mills are set forth in 40 CFR Part

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[43] *See* 10 CFR 20.1201.

[44] These ALARA goals are typically set by the licensee, with the concurrence of NRC, based on the recommendations set out in NRC Regulatory Guide 8.31, *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable*, Revision 1, May 2002 (see in particular Sections 3.3(2), 4.2 and 4.3),

61, Subpart W, and require that the radon flux from the Mill's tailings impoundments cannot exceed 20 $pCi/m^2/s$. Measurements or radon flux from the mill's tailings impoundments must be taken annually.

The regulations under 40 CFR Part 70 provide for the establishment of comprehensive State air quality permitting systems consistent with the requirements of title V of the Clean Air Act[45] These permits will require the mill facility to comply with the radon flux standards set out in 40 CFR Part 61, Subpart W as well as the air particulate (PM10) and other non-radionuclide standards set by EPA under the Clean Air Act for such things as stationary sources and mobile equipment.

4.2.3. Monitoring Of Any Impacts To Groundwater

Criterion 7A of 10 CFR Part 40, Appendix A requires that a uranium mill establish a groundwater detection monitoring program to ensure that any hazardous constituents entering the groundwater do not exceed the specific concentration limits set out in Criterion 5C in the uppermost aquifer beyond the point of compliance during the compliance period. The list of hazardous constituents is set out in Criterion 13 and includes the full list imposed by EPA under 40 CFR Part 192, which is the full suite of hazardous chemicals applicable to groundwater protection at RCRA Subtitle C facilities. It should be noted that some Agreement States, such as Utah, will have their own groundwater protection regulations, that may be stricter than the NRC program set forth in Appendix A. In the case of Utah, the groundwater protection program for a uranium mill tailings facility is implemented through a specific groundwater discharge permit for the facility.[46]

The primary standard for groundwater protection is the design standard for mill tailings impoundments set out in Criterion 5A of Appendix A. The groundwater monitoring program is considered a secondary standard.

In practice, groundwater monitoring at uranium mills is conducted on a quarterly or semi-annual basis, or a combination of the two, for a number of constituents from the list set out in Criterion 13 (or under the State's groundwater protection program), that are considered to be good indicator parameters for potential tailings cell leakage (i.e., constituents that are considered to be prevalent in the tailings and mobile in groundwater) in a number of monitoring wells at the site. Monitoring results are recorded and reported to NRC (or the Agreement State) on a periodic basis.

4.3. Wastes Generated by Mills On An Ongoing Basis

The predominant waste generated by uranium mills on an ongoing basis are the mill tailings themselves, which are 11e.(2) byproduct materials and are required to be placed in tailings impoundments at the Mill site that are designed to meet the Criteria in 10 CFR Part 40, Appendix A.

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[45] *See* 42 U.S.C. 7401 *et seq.*

[46] This is a misnomer, as most uranium mills are designed as non-discharge facilities for liquid effluents.

In addition, all other wastes created at the Mill that are incidental to Mill operations, such as office trash, fluorescent light bulbs, laboratory chemicals etc. are also considered to be 11e.(2) byproduct material and must be disposed of in the Mill's tailings impoundments on an ongoing basis.

4.4. Clean Up Standards For Uranium Mills

4.4.1. Responsibility For And Manner Of Clean Up

UMTRCA mandated that all Title I sites (uranium or thorium mill tailings facilities that were abandoned at the time of enactment of UMTRCA) would be remediated by DOE, with the State in which the facility was located responsible for 10% of the costs of clean up and DOE responsible for the remainder.[47] UMTRCA also amended the AEA to require that all Title II facilities (i.e., active mills) will comply with the decontamination, decommissioning, and reclamation standards prescribed by the Commission[48] and to require that such facilities post reclamation bonds or surety[49].

Responsibility for reclamation rests with the licensee. Appendix A Criterion 6A requires the adoption of a Commission-approved reclamation plan for the site, Criterion 9 requires that financial surety must be established to fund the cost of reclamation in accordance with such plan, and Criterion 11 requires that each licensee include in its financial surety an amount equivalent to $250,000 (1978 dollars) to cover the costs of long-term surveillance by the long-term government custodian (DOE).

4.4.2. Surface

As mentioned in Section 4.4.1 above, the uranium mill licensee will have to prepare a reclamation plan at the outset, as required by 10 CFR Part 40, Appendix A, Criterion 9, that addresses the decontamination and decommissioning of the mill and mill site and reclamation of any tailings or waste disposal areas.

Reclamation plans for uranium mills typically require that upon closure, all mill buildings, unsalvageable equipment, contaminated soils (impacted by Mill operations within the Mill site itself as well as surrounding areas that may be impacted by windblown radioactive dusts from milling operations) etc be deposited in the tailings cells and the tailings cells capped in place.[50]

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[47] *See* 42 U.S.C. 7917.
[48] *See* 42 U.S.C. 2113.
[49] *See* 42 U.S.C. 2201.
[50] In special circumstances, such as existed with the uranium mill tailings site in Moab, Utah, conditions at a Title II site may not allow for permanent disposal of all Mill wastes on site. The Moab tailings, some 13 million tons in total, are the remnants of the Atlas uranium mill that was licensed at the time UMTRCA was enacted and is therefore a Title II site. The Mill was constructed in the 1950s, before the enactment of UMTRCA, is located on the banks of the Colorado River and the tailings impoundment is not lined. The Mill buildings were demolished and placed into the tailings impoundment and a temporary cap was placed on the tailings. However, tailings solutions are leaking into the Colorado River. Some concerns have been

Appendix A, Criterion 6(6) sets the standard for determining when all impacted areas, other than the tailings impoundments have been adequately cleaned up. Criterion 6(6) provides that byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures, must not result in a total effective dose equivalent (TEDE) exceeding the dose from cleanup of radium contaminated soil to the benchmark standard of 5pCi/g concentration of radium in the surface 15 cm (6 in) and 15 pCi/g concentration of radium in the subsurface, and must be at levels which are ALARA. If more than one residual radionuclide is present, the sum of the ratios for each radionuclide of concentration present to the concentration limit will not exceed "1" (unity). Further details on the NRC's approach to evaluating reclamation plans and release criteria for uranium mill sites, including the manner of modeling the release standard set out in Criterion 6(6), are contained in NUREG-1620, Rev 1, *Standard Review Plan for the Review of a Reclamation plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978*, Final Report, June 2003 ("NUREG-1620").

Affected soils and facilities at uranium mill sites will have residual concentrations of uranium, thorium-230, radium-226 and lead-210. What this standard means is that a dose calculation must be made taking into account the combined dose from each of these radionuclides. This combined dose can not exceed the dose from radium resulting from applying the benchmark standard for radium, were the site contaminated by radium alone. In fact, in order to satisfy the additional requirement that the combined total effective dose be ALARA, NRC notes in NUREG-1620 that "in recent practice at mill sites, the as low as is reasonably achievable principle is implemented by removing about 2 more inches [5 cm] of soil than is estimated to achieve the radium standard (reduce any possible excess or borderline contamination). At mills, it is generally cheaper to remove more soil than to do sampling and testing that may indicate failure and require additional soil removal with additional testing."[51]

4.4.3. Groundwater

As discussed above, each uranium mill is required to have a groundwater monitoring program. If the facility has been designed in accordance with the Criteria set out in 10 CFR Part 40, Appendix A and everything goes as planned, there will be no contamination to groundwater at the time of site reclamation. However, if there is contamination, Appendix A Criterion 5B(5) provides that at the point of compliance, the concentration of a hazardous constituent must not exceed the greater of NRC-approved background and

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raised as to the stability of the tailings pile, even if capped in accordance with 10 CFR Part 40, Appendix A criteria, in the event of a flood of the Colorado River. A debate had persisted for a number of years over whether or not to cap the pile in place or to move the pile to another location. In the midst of this debate, Atlas went into bankruptcy, and the reclamation surety was inadequate to accomplish either of these objectives. After much debate, Congress committed to fund the relocation of the pile to a location distant from the river. This special act of Congress achieved a similar result as if the site had been a Title I site (although the State of Utah is not required to fund 10% of the clean-up, as required under Section 107. (a) of UMTRCA for Title I sites (*See* 42 U.S.C. 7917)).

[51] See NUREG-1620, Appendix H, Section H2.2.3 (5).

the concentration limit set out in Criterion 5C or an alternate concentration limit ("ACL"). Criterion 5B(6) provides that where it is not practically achievable at a site to reduce groundwater contamination to background or to the limits established by NRC in Criterion 5C, ACLs that present no significant hazard may be proposed by licensees for Commission consideration. The Commission will establish a site specific ACL for a hazardous constituent if it finds that the proposed limit is ALARA, after considering practicable corrective actions, and that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the ACL is not exceeded.

Criterion 5D provides that the licensee shall continue corrective action measures to the extent necessary to achieve and maintain compliance with the groundwater standard. The Commission will determine when the licensee may terminate corrective action measures based on data from the groundwater monitoring program and other information that provide reasonable assurance that the groundwater protection standard will not be exceeded.

4.4.4. License Termination

Section 83.7 of the AEA[52] and 10 CFR Part 40, Appendix A Criterion 11E provide that material and land transferred to the long term custodian must be transferred without cost to the long-term custodian other than administrative and legal costs incurred in carrying out such transfer. Criterion 12 provides that the final disposition of tailings, residual radioactive material, or wastes at milling sites should be such that ongoing active maintenance is not necessary to preserve isolation.

In order to cover the costs of long-term surveillance, Criterion 10 requires that a minimum charge of $250,000 (1978 dollars) must be paid by each mill operator to the general treasury of the Unites States or to an appropriate State agency prior to the termination of a uranium mill license. The Criterion goes on to provide that if site surveillance or control requirements at a particular site are determined, on the basis of a site-specific evaluation, to be significantly greater than those specified in Criterion 12 (e.g., if fencing is determined to be necessary), variance in funding requirements may be specified by the Commission.

In most cases if there is a groundwater contamination problem, the problem must be remediated prior to license termination, or an ACL must be obtained, thereby solving the problem. In some circumstances DOE may agree to take some additional actions after it takes title to the site, such as additional monitoring, if not onerous and provided adequate funding is provided.

Upon NRC being satisfied that all regulatory requirements have been met and the site is reclaimed in a manner that satisfies all applicable standards, the mill's license will be terminated upon transfer of the tailings to DOE. 10 CFR 40.28 provides a general license in favor of the long-term custodian for custody of and long-term care of the tailings

[52] *See* 42 U.S.C. 2113.

impoundments and any surrounding lands transferred to it. [53] The surrounding areas not transferred to DOE would generally be free-released.

4.5. Wastes Accepted by Mills From Third Parties

Typically, the predominant materials accepted by uranium mills are uranium ores, or in the case of Colorado Plateau mines, uranium/vanadium ores, which are processed for the recovery of uranium, alone or together with vanadium. As discussed above, the tailings from this processing are considered 11e.(2) byproduct material and are disposed of permanently on site in the mill's tailings impoundments.

However, uranium mills can accept other types of materials, which may be wastes in the hands of the generator of the materials, thereby helping to solve the gernator's waste management problems.

4.5.1. Alternate Feed Materials

Alternate feed materials are uranium bearing materials, other than "conventional ores," that can be processed at a uranium mill for the recovery of uranium. Examples of alternate feed materials are uranium-bearing residues from other uranium processing facilities or other metal processing facilities, as well as environmental media (primarily soils) contaminated with natural uranium, or any other material that contains recoverable concentrations of natural uranium.

Uranium mills are licensed to process conventionally mined ores for the recovery of uranium and, in some cases, uranium and vanadium. When these licenses are granted, they are based on the assumption that conventional ores will be processed. Because alternate feed materials could have different physical, chemical and radiological characteristics than conventional ores, specific license amendments to allow for the processing of each alternate feed material must be obtained. This allows NRC (or the Agreement State) to ensure that receipt and processing of the materials and disposal of the resulting tailings in the mill's tailings impoundment will not give rise to any significant incremental public health, safety or environmental impacts over and above normal conventional ore processing.

Prior to 1995, applications for alternate feed license amendments were made and license amendments were granted on an ad hoc basis[54] In 1995, NRC adopted its Alternate Feed

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[53] In circumstances where the facility has a groundwater contamination plume, additional lands may be acquired by the licensee in order to bound the plume. In these circumstances these additional lands would be transferred along with the capped tailings impoundments, to DOE.

[54] For example, NRC amended the source material license held by Rio Algom's uranium mill in Lisbon, Utah several times between 1982 and 1987 to enable the mill to receive processing wastes from a uranium hexafluoride conversion facility, a niobium-tantalum recovery facility, and an yttrium-lanthanides recovery facility. *See* 57 Fed. Reg. 20520, 20531 (1992).

Guidance[55] to establish a set of criteria to be used in determining whether a proposed alternate feed material can be processed at a licensed uranium mill. The Guidance established four criteria that must be satisfied before a proposed alternate feed material may be processed at a licensed uranium mill. First, processing the alternate feed material (and disposal of the resulting tailings and wastes) must conform with the requirements of 10 CFR Part 40, Appendix A. Second, the alternate feed material must qualify as an "ore", which is defined broadly as "a natural or native matter that may be mined and treated for the extraction of any of its constituents or any other matter from which source material is extracted in a licensed uranium or thorium mill." Third, the alternate feed material must not contain any "listed" hazardous wastes (i.e., any wastes listed under 40 CFR 271.30-33 or under comparable State law provisions) or any residues that constitute hazardous waste from any wastewater treatment process.[56] However, alternate feed materials exhibiting only a characteristic of hazardous waste (ignitable, corrosive, reactive, toxic) are acceptable. Finally, the alternate feed material must be processed primarily for its source material content. The phrase "processed primarily for its source material content" was interpreted by the Commission in *In the Matter of International Uranium Corporation (Receipt of Materials from Tonawanda, New York)* CLI-00-01 (Feb. 10, 2000) to mean that it must be reasonable to expect that the material will in fact be processed at a licensed uranium mill and that uranium will be recovered, regardless of the economics of the transaction.

One of the primary objectives of the Alternate Feed Guidance is to ensure that the resulting tailings from processing the feed material will be 11e.(2) byproduct material and will qualify for transfer to DOE upon license termination. Hence, the material must be an "ore" that is "processed primarily for the recovery of source material," two key components of the definition of 11e.(2) byproduct material.

The requirement that the alternate feed material not contain any listed hazardous wastes was added to the Alternate Feed Guidance to protect against the risk of dual EPA/NRC jurisdiction over the resulting tailings. Such dual jurisdiction could jeopardize the ultimate transfer of the tailings to DOE.[57]

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[55] *See Final Position and Guidance on the Use of Uranium Mill Feed Materials Other than Natural Ores*, 60 Fed. Reg. 49296 (September 25, 1995), as amended by *Regulatory Issue Summary* 2000-23 (Nov. 2000) (*Interim Position and Guidance on the Use of Uranium Mill Feed Material Other than Natural Ores*).

[56] However, the *Interim Position and Guidance on the Use of Uranium Mill Feed Material Other than Natural Ores*, indicates that materials containing listed hazardous waste may be licensed as alternate feed material with approval from EPA or an EPA-authorized State.

[57] However, subsequent to the date of publication of the Alternate Feed Guidance, NRC staff recognized (see the *Technical Evaluation Report Request to Receive and Process Molycorp Site Material* issued by NRC on December 3, 2001) that any alternate feed material that meets the requirements specified in the Alternate Feed Guidance must be an *ore* and that, if the alternate feed material contains 0.05% or greater source material, the entire alternate feed material *ore* must be source material under the definition of source material in 10 CFR 40.4 (see the discussion in Section 2.1.2 above). As a result, any such alternate feed material should be exempt from RCRA under 40 CFR 2611.4(a)(4). While NRC only considered the question of characteristic hazardous wastes in that particular Technical Evaluation Report, the logic should apply equally well to listed hazardous wastes. At this time, however, the Alternate Feed Guidance has not been amended to recognize that alternate feed materials containing 0.05% or greater source material may contain listed hazardous wastes, without the need to obtain EPA approval. As a result, until such time as

In developing its Alternate Feed Guidance, NRC also recognized that the physical, chemical, and radiological characteristics of alternate feed materials may vary widely in comparison to conventional ores. Thus, the guidance requires a licensee to ensure that processing an alternate feed material, and disposing of the resulting tailings and wastes in the mill's tailings impoundment, will not compromise a mill's ability to comply with the regulatory requirements contained in 10 CFR Part 40, Appendix A.[58] What this means is that the receipt and processing of the alternate feed material must fit within the design and environmental assumptions in the facility's license.

If an alternate feed material satisfies the requirements set out in the Alternate Feed Guidance, NRC will issue a license amendment permitting receipt and processing of the material at the uranium mill. The alternate feed material will become an ore that will be processed primarily for the recovery of uranium and the resulting tailings will therefore be classified as 11e.(2) byproduct material. Provided these conditions are satisfied, it does not matter if the material is originally classified as LLRW, mixed waste, NORM, Technically Enhanced NORM ("TENORM"), 11e.(2) byproduct material or pre-1978 11e.(2) byproduct material. Once approved for processing, the alternate feed material will become uranium *ore*, and the tailings will be 11e.(2) byproduct material. In this way, uranium mills can convert materials that may be classified as *wastes* at other facilities into a valuable *ore* with the resulting tailings being permanently disposed of in the mill's tailings impoundments as 11e.(2) byproduct material. In most cases, the alternative for the generator of the waste would be direct disposal in an LLRW, mixed waste or NORM disposal facility.[59]

4.5.2. 11e.(2) Byproduct Materials From ISL Recovery Facilities

As discussed in detail in Section 6.1 below, ISL recovery facilities effectively process uranium ores primarily for the recovery of uranium and thereby create wastes that are classified as 11e.(2) byproduct material. However, one of the main distinctions between an ISL recovery facility and a uranium mill is that ISL recovery facilities do not have mill tailings impoundments for the permanent disposal of the 11e.(2) byproduct material wastes they create. ISL recovery facilities must therefore enter into agreements with

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the Alternate Feed Guidance may be amended, licensees must either demonstrate that the alternate feed material does not contain listed hazardous wastes, or obtain EPA approval.

[58] *See* 60 Fed. Reg. at 49,296.

[59] As an example of the types of alternate feed materials that have been processed at uranium mills, International Uranium (USA) Corporation's White Mesa uranium mill located near Blanding, Utah, has obtained 14 license amendments to date to process 17 different alternate feed materials. The alternate feed materials have included residues from uranium conversion facilities, residues from tantalum-niobium metal producers, lead-sulfide sludges from a metals producer, residues from rare-earth producers, 11e.(2) byproduct material from other facilities, pre-1978 11e.(2) byproduct material from FUSRAP sites, LLRW and mixed wastes containing characteristic hazardous wastes. Some have contained high concentrations of uranium and others relatively low concentrations. In total, the White Mesa Mill has processed over 300,000 tons of alternate feed materials, and has recovered over 1.2 million pounds of uranium from those materials.

uranium mills or other facilities with 11e.(2) byproduct material disposal impoundments,[60] in order to dispose of their wastes.

Uranium mill licenses will typically permit the direct disposal of 11.e(2) byproduct materials from ISL facilities into the mill's tailings impoundments.

4.5.3. Direct Disposal of 11e.(2) Byproduct Material From Facilities Other Than ISL Facilities.

Uranium mills have applied for and received license amendments to allow for the direct disposal of 11e.(2) byproduct materials from facilities other than ISL facilities. These approvals are granted by NRC or an Agreement State, without the need to seek the other approvals applicable to the direct disposal of non-11e.(2) byproduct materials in mill tailings facilities (see Section 4.5.4 below). However, individual States may impose additional requirements and restrictions on the ability of uranium mills to become commercial disposal facilities (see for example Utah Radiation Control Act 19-3-105).

4.5.4. Direct Disposal of Non-11e.(2) Byproduct Material

There are a number of types of wastes that are not 11e.(2) byproduct material but have been proposed as candidates for direct disposal into uranium mill tailings impoundments. These materials, referred to as "Non-11e.(2) byproduct materials", are similar physically, chemically and radioactively to 11e.(2) byproduct materials. The high costs of disposal of these types of mateials in LLRW and other disposal facilities has prompted generators of these wastes to view uranium mill tailings impoundments as an attractive alternative for disposal.

Examples of these types of wastes are:

a) Some FUSRAP materials, including pre-1978 11e.(2) byproduct material, that are not considered to be 11e.(2) byproduct material;

b) Some forms of NARM wastes and most forms of NORM wastes. Most NARM and NORM wastes are the result of activities not regulated under the AEA;[61]

c) Sludges or residues generated during treatment of mine water containing suspended or dissolved source material. These sludges or residues do not directly result from the extraction or concentration of uranium or thorium from

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[60] 11e.(2) byproduct material (or any material mixed with 11e.(2) byproduct material) can only be disposed of in a facility licensed under the AEA to receive 11e.(2) byproduct materials. These would be operating uranium mills, uranium mills in the process of reclamation but which have not yet capped their tailings impoundments, and one commercial disposal facility in Utah that has an 11e.(2) disposal cell that is licensed to accept dry 11e.(2) byproduct materials from other facilities.

[61] The new definitions of 11e.(3) and 11e.(4) byproduct material (see the discussion in Section 2.1.4 above) give NRC jurisdiction over some discrete forms of NARM and NORM, but these new definitions are limited in scope.

ore processed primarily for its source material content and, therefore, are not considered to be 11e.(2) byproduct material;

d) Certain mixed wastes containing AEA-regulated materials and RCRA listed or characteristic hazardous wastes that have similar physical, chemical and radioactive characteristics as 11e.(2) byproduct material;

e) Mildly contaminated soils and debris from nuclear power plant decommissioning;

f) Depleted uranium and materials containing or contaminated with depleted uranium;

g) Process wastes from facilities that extracted uranium as a side-stream or secondary operation to another mineral extraction process which is the primary operation. These wastes are similar physically and chemically to 11e.(2) byproduct materials;[62]

h) Process wastes from other metal or rare earth producers that contain uranium or thorium;[63] and

i) Certain wastes containing thorium contamination.

Recognizing that many of these materials have similar physical, chemical and radioactive characteristics as 11e.(2) byproduct material, and should be capable of direct disposal in a uranium mill tailings impoundment, NRC staff developed a guidance, the "Non-11e.(2) Byproduct Disposal Guidance",[64] that sets out criteria for such disposal. In developing this Guidance, NRC staff had two main objectives. First, to ensure that there would be no significant incremental public health, safety or environmental impacts associated with direct disposal of these materials into uranium mill tailings impoundments. Second, to ensure that direct disposal activities would not result in dual or multiple jurisdiction over the tailings impoundment, which might complicate the eventual transfer of the mill tailings to DOE, or may result in DOE refusing to accept the tailings impoundment to the extent they contain materials other than 11e(2) byproduct materials.

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[62]Because a secondary side-stream uranium or thorium recovery operation results in the concentration of source material, a source material license is required by the operator. However, since the ores are being processed primarily for the recovery of another metal and not for the source material, the resulting tailings or wastes are not 11e.(2) byproduct material, so an 11e.(2) byproduct material license is not required for the operator.

[63] Because these ores are not processed for uranium, the process wastes are not 11e.(2) byproduct material. However, as discussed in Section 2.1.2 above, if such tailings or wastes contain 0.05% or greater source material, the tailings will require licensing as source material.

[64] U.S. Nuclear Regulatory Commission, *Final Revised Guidance on Disposal of Non-Atomic Energy Act of 1954, Section 11e.(2) Byproduct Material in Tailings Impoundments* (August 15, 1995), as amended by *Regulatory Issue Summary* 2000-23 (Nov. 2000) (*Interim Guidance on Disposal of Non-Atomic Energy Act of 1954, Section 11e.(2) Byproduct Material in Tailings Impoundments*).

As a result, the Guidance provides that a mill licensee may apply for a license amendment authorizing the direct disposal of non-11e.(2) byproduct materials in the mill's tailings impoundments if, in addition to establishing that the material has similar radiological characteristics as 11e.(2) byproduct material, that there will be no significant environmental impacts from the disposal and that the disposal will not compromise the reclamation of the tailings impoundments, the following approvals are required:

- Necessary approvals of other affected regulators (e.g., the EPA or State) for material containing listed hazardous wastes or any other material regulated by another Federal agency or State because of environmental or safety considerations;
- Approval of the Regional Low-Level Waste Compact in whose jurisdiction the waste originates as well as approval by the Compact in whose jurisdiction the disposal site is located, for material which otherwise would fall under Compact jurisdiction;
- Approval of the long term government custodian (DOE or the State) that it will take title to the mill tailings after closure; and
- If the tailings impoundment is located in an Agreement State with LLRW licensing authority, the State must take the appropriate action to exempt the non-11e.(2) byproduct material from regulation as LLRW.

In addition, the Guidance provides that special nuclear material and Section 11e.(1) byproduct material waste should not be considered as candidates for disposal in a uranium mill tailings impoundment without compelling reasons to the contrary.

Unfortunately, because of the need to obtain these approvals, the Guidance is generally considered to be prohibitive. To date, few, if any, mill tailings licensees have made an application to receive non-11e.(2) byproduct materials under this Guidance.[65]

It should be noted that many non-11e.(2) byproduct materials that contain recoverable concentrations of natural uranium are candidates for processing as alternate feed materials at uranium mills. By processing the materials as alternate feed materials for the recovery of uranium, the resulting tailings and wastes would become 11e.(2) byproduct material and could be disposed of in the Mill's tailings impoundments without the need to obtain the approvals required for direct disposal of the materials.

4.6. Other milling

From a technical and environmental point of view, uranium mills can be used to extract metals, other than uranium, from ores or alternate feed materials. If the ore or alternate feed material is being processed at a licensed uranium mill for the recovery of uranium

[65] The National Mining Association and Fuel Cycle Facilities Forum have submitted to NRC a *White Paper on Direct Disposal of Non-11e.(2) Byproduct Materials in Uranium Mill Tailings Impoundments* (May 2006), which proposes amendments to the Guidance by setting some generic acceptance criteria for such materials, thereby resulting in the elimination of the requirement to obtain some of these approvals, and making the Guidance more workable.

and the other metal is being recovered as a co-product, then the entire tailings from that process would be considered 11e.(2) byproduct material. Examples of this are Colorado Plateau ores that have been processed for both uranium and vanadium, and alternate feed materials that have been processed for both uranium and tantalum. In both of these cases the resulting tailings have been 11e.(2) byproduct material.

However, if the ore or alternate feed material does not contain recoverable quantities of uranium, and is processed at a uranium mill for the recovery of the other metal alone, then the resulting tailings would not be 11e.(2) byproduct material. This would result in multiple jurisdictional issues similar to those arising from the direct disposal of non-11e.(2) byproduct material. For example, the alternate feed material may contain RCRA listed or characteristic hazardous wastes or the milling process itself may create its own RCRA hazardous wastes, in either case subject to EPA jurisdiction. This would become more problematic if the tailings from processing the non-11e.(2) materials were commingled with the mill's existing tailings, thereby resulting in dual jurisdiction over the tailings. These dual jurisdiction issues would have to be addressed before this type of activity could occur at a uranium mill.[66]

5. CONVENTIONAL URANIUM MINES

5.1. Conventional Uranium Mining Not Subject to AEA Jurisdiction

5.1.1. Ores not Source Material

As mentioned in Section 2.1.2 above, Section 62 of the AEA[67] and 10 CFR 40.3 only require a license for the ownership, possession or use of source material "after removal from its place of deposit in nature." Therefore, uranium ores while in the ground are not subject to licensing under the AEA. In addition, under its authority under Section 62 of the AEA, and as set out in 10 CFR 40.13 (b), the Commission has determined that any person is exempt from the regulations in 10 CFR Part 40 and from the licensing requirements of Section 62 of the AEA to the extent that such person receives, possesses, uses, or transfers unrefined and unprocessed ore containing source material; provided, that, except as authorized in a specific license, such person shall not refine or process such ore.

What this means is that conventional mining of uranium ore and transporting the ore to a uranium mill are not subject to regulation or licensing under the AEA. However, once the ore is received at a licensed uranium mill, where it will be processed, it becomes subject to AEA jurisdiction as source material.

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[66] These issues may not be insurmountable, and may involve similar steps as those set out in the non-11e.(2) disposal guidance.

[67] *See* 42 U.S.C. 2092.

5.1.2. *Mine Wastes Not 11e.(2) Byproduct Material*

Furthermore, because the definition of 11e.(2) byproduct material is defined specifically as the tailings or wastes from the processing of any ore primarily for the recovery of source material, and because conventional uranium mines are not considered to be "processing" ores for the recovery of source material, no wastes at conventional uranium mines are 11e.(2) byproduct material. As a result, an 11e.(2) byproduct material license is not required for a conventional uranium mine.

5.2. Jurisdiction Over Conventional Uranium Mining

As demonstrated above, NRC (or the Agreement State) does not have jurisdiction over conventional uranium mining. However, jurisdiction over conventional uranium mining can fall under a number of other regulatory authorities, as described below.

5.2.1. *State and Federal Agencies*

Conventional uranium mining is subject to all of the State and federal agencies typically involved in other types of mining, such as the State Departments of Mining and Water Quality or the equivalent, the BLM under 43 CFR 3809, EPA and MSHA and other State and Federal agencies. Which of these agencies will be involved and to what extent will depend on the specific circumstances of the mine, but will not generally be dependent on the fact that the mine is a uranium mine rather than any other type of mine.

5.2.2. *EPA*

EPA can have jurisdiction over conventional uranium mining activities in a number of ways:

a) RCRA. Because the wastes generated by conventional uranium mining activity are not 11e.(2) byproduct material, they are not excluded from the definition of "solid waste" under RCRA and therefore can be hazardous wastes. Examples of hazardous wastes that may be found at conventional uranium mine sites are cleaning solvents, degreasers, used oil, nickel/cadmium in batteries, etc. These will require disposal off site at a facility licensed to receive such materials. This is no different than for any other conventional mining activity. Since beneficiation and processing activities are not conducted at conventional uranium mines, the Bevill exemption would not be applicable.

b) TSCA. Again, because the wastes generated by conventional uranium mining activity are not 11e.(2) byproduct material, they are not excluded from the definition of "chemical substances" under TSCA. As a result things such as PCBs from transformers used at the mine, PCB-laden fluorescent light bulbs, etc would have to be managed and disposed of in accordance with TSCA and its applicable regulations. This is no different than for any other conventional mining activity.

c) Clean Water Act. As with any other mining operation, a uranium mine that must discharge mine water will be subject to the requirements of the Clean Water Act. These requirements are discussed in more detail in Section 5.3.3 below.

d) Clean Air Act. 40 CFR Part 61 Subpart B sets out national emission standards for radon emissions from underground uranium mines. These standards are discussed in more detail in Section 5.3.2 below.

5.2.3. MSHA

MSHA has jurisdiction overccupational safety in conventional uranium mines, under the Federal Mine Safety and Health Act of 1977.[68] The applicable regulations are set out at 30 CFR Parts 1 through 104.

The regulations at 30 CFR Part 57 address safety and health standards for underground metal and nonmetal mines. Of these regulations the regulations at 30 C.F.R 57.5037 through 57.5047 address the measurement and recording of radon daughter and gamma levels in underground uranium mines and set standards for maximum permissible levels and other related protections. These are discussed in more detail in Section 5.3.1 below.

5.2.4. Other

Other regulations may apply to uranium mines just as they may apply to other metal mines, depending on the circumstances and the host State.

5.3. Operational Standards

5.3.1. Radon And Gamma In Mines And Management Of Exposure To Workers

Radiation safety for workers in underground mines falls under the jurisdiction of MSHA. The applicable regulations are at 30 CFR 57.5037 – 57.5047. For underground uranium mines, radon daughter concentrations must be monitored at least every two weeks, unless radon daughters are found to be in excess of 0.3 Working Levels ("WL")[69], in which case the frequency of monitoring must increase to weekly.[70]

The annual exposure limit to radon daughters is set at 4 Working Level Months ("WLM") in any calendar year.[71] The regulations also provide for record keeping of each

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[68] *See* 30 U.S.C. 801.

[69] A Working Level ("WL") is defined in 30 CFR 57.2 as any combination of the short-lived radon daughters in one liter of air that will result in ultimate emission of 1.3E+5 MeV (million electron volts) of potential alpha energy. Exposure to these radon daughters over a period of time is expressed in terms of "working level months" (WLM). Inhalation of air containing a radon daughter concentration of 1 WL for 173 hours results in an exposure of 1 WLM.

[70] *See* 30 CFR 57.5037 (a) (1).

[71] Continuous exposure to 0.3 WL over an entire working year (173 hours per month over 12 months) will result in the maximum allowable exposure of 4 WLM.

worker's time in the various areas of the mine and the radon daughter concentrations in the various areas of the mine,[72] as well as requirements for the use of respiratory protection in any areas exceeding 1.0WL.[73]

MSHA has also set standards for exposure to gamma radiation in underground uranium mines. 30 CFR 57.5047 provides that gamma radiation surveys shall be conducted annually in all underground mines where radioactive ores are mined. Where average gamma radiation measurements are in excess of 2.0 milliroentgens per hour in the working place, gamma radiation dosimeters shall be provided for all persons affected. Records of cumulative individual gamma radiation exposure shall be kept. Annual individual gamma radiation exposure shall not exceed 5 rems (5,000 mrem).[74]

5.3.2. Radon Emanations From Underground Uranium Mines

The regulations under the Clean Air Act[75] set out national emission standards for radon emissions from underground uranium mines in 40 CFR Part 61 Subpart B. Those regulations are administered by EPA (or an EPA-authorized State) and apply to uranium mines that have mined, will mine or are designed to mine over 100,000 tons of ore during the life of the mine or had or will have an annual ore production rate greater than 10,000 tons (unless it can be demonstrated to EPA that the mine will not exceed total ore production of 100,000 tons during the life of the mine.)[76]

The standard is set in 40 CFR 61.22, which provides that the emissions of radon-222 to the ambient air from an underground uranium mine shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/y. Compliance with this standard must be calculated annually by use of an EPA-approved model and the results reported to EPA (or the EPA-authorized State).[77]

5.3.3. Possible Need For NPDES Discharge Permit Or The Equivalent

If the mine discharges water, it may be necessary to obtain an NPDES Permit, or the equivalent State-issued permit, under the Clean Water Act. The NPDES program requires permits for the discharge of "pollutants" from any "point source" into "waters of the United States." This includes discharge of contaminated mine waters, and covers radionuclides as well as other metals and pollutants.

5.3.4. Groundwater Protection

States will regulate any impacts to groundwater from conventional mining operations, including any impacts from elevated levels of radionuclides. For example, Section 3.1.7

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[72] *See* 30 CFR 57.5040.
[73] *See* 30 CFR 57.5044.
[74] *See* 30 CFR 57.5047 (d).
[75] *See* 42 U.S.C. 7401.
[76] *See* 40 CFR 61.20.
[77] *See* 40 CFR 61.23, 61.24.

of the Colorado Hard Rock/Metal Mining rules and regulations provides that operations that may affect groundwater quality shall comply with all State-wide groundwater quality standards established by the Water Quality Control Commission. Similarly, groundwater monitoring wells may be required around evaporation ponds as a condition of issuance or renewal of an NPDES permit, or the equivalent.

5.3.5. Other Matters

Individual States may have other applicable requirements. For example, the Colorado Division of Minerals and Geology ("DMG") can determine that a mine is a Designated Mining Operation (a "DMO") if it is a mining operation at which "toxic or acidic chemicals used in extractive metallurgical processing are present on site or acid- or toxic-forming materials will be exposed or disturbed as a result of mining operations."[78] If a mine is determined to be a DMO, the most significant result is the requirement that it submit an environmental protection plan (an "EPP"). The EPP must identify the methods the operator will utilize for the protection of human health, wildlife, property and the environment from the potential toxic- or acid-forming material or acid mine drainage associated with the operations. The EPP must be submitted to the DMG for review, and after a public hearing, a decision must be made by DMG.

5.4. Reclamation

5.4.1. Responsibility For And Manner Of Clean Up

It is the responsibility of the mine permit holder to reclaim the mine site prior to permit termination. Any permit or 43 CFR 3809 Plan of Operations approval issued today will require the applicant to provide a mine reclamation plan for approval and to post a mine bond or other form of surety to cover the costs of reclamation. Because conventional uranium mines do not create 11e.(2) byproduct material, DOE will have no responsibility for taking title to the reclaimed mine site or any of the wastes generated at the site.

Mine reclamation plans will typically require that any hazardous substances, such as used engine oils, on site chemicals and other hazardous wastes and PCB-laden transformers and other toxic wastes be recycled or disposed of at an offsite disposal facility licensed to accept such wastes. The mine facilities and equipment that cannot be salvaged and removed from the site will typically be required to be buried with and covered by waste rock or, in some cases, put back into the mine. Radioactive waste rock or low grade ores on surface are usually placed above ground in dumps (along with unsalvageable building debris and equipment) and covered with a dry cover system and then contoured to meet erosion control requirements and re-vegetated. In some circumstances, such waste rock and low grade ore may be placed back into the mine. Upon completion of reclamation, all mine openings will be plugged and sealed off. In any circumstance where equipment, debris, waste rock or ore is put back into the mine, attention must be given to ensuring that such activity does not contribute to groundwater or surface water contamination. Sludges from NPDES treatment or settling ponds, which may contain elevated levels of

[78] *See* Colorado Revised Statutes 34-32-112.5.

radionuclides, are not considered to be 11e.(2) byproduct material and cannot be disposed of in uranium mill tailings impoundments as 11e.(2) byproduct material.[79] The current practice for dealing with these sludges varies from mine to mine, depending on permit conditions.

5.4.2. Radiological Standards For Reclamation

There are currently no regulatory standards in most States for the clean up of radionuclides at conventional uranium mine sites, other than through groundwater and Clean Air Act requirements. As mentioned above, NRC does not have jurisdiction under the AEA.

EPA's Radiation Protection Division is reviewing the current hazards associated with uranium mining TENORM,[80] and, based on this review will make a determination on what further steps may be necessary for the purpose of radiation protection from this source of waste material. EPA has indicated that waste materials that are or could be classified as TENORM from conventional uranium mining include overburden, un-reclaimed, sub-economic ores (protore), "barren" rock, and drill cuttings.[81]

6. IN-SITU LEACH URANIUM RECOVERY FACILITIES

6.1. How ISL Mining is Performed

ISL mining is a technique that involves separating uranium from ore, without removing the ore from the ground. Rather than using surface or underground excavation techniques, ISL facilities use subsurface wellfields to bring the uranium to the surface for production. Each wellfield is usually composed of a number of patterns which involve the installation of injection wells and production wells in the ore zone. Each pattern will consist of a number of injection wells to inject a solution known as lixiviant into the mineralized zone. This lixiviant typically consists of groundwater containing dissolved oxygen and carbon dioxide. At the same time, a single production well located at the center of the injection well pattern will draw the lixiviant through the ore body. By continuously injecting lixiviant and drawing it through the ore body, the uranium is oxidized and dissolved into the solution and is brought to the surface. An ISL facility will typically have a number of these injection well/production well patterns throughout the ore body.

Once brought to surface, the "pregnant" solution is run through ion exchange (IX) units, which cause the uranium in solution to attach to resins, thereby removing the uranium

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[79] However, such sludges may be candidates for processing at uranium mills as alternate feed materials, or candidates for direct disposal at uranium mills under the Non-11e.(2) Byproduct Disposal Guidance.

[80] Materials with radioactive elements as they occur in nature, such as uranium, are referred to by EPA as NORM. When these materials have been processed, or beneficiated, or disturbed in any way that increases the potential for human and/or environmental exposure, they are referred to by EPA as technologically enhanced NORM, or TENORM. Uranium TENORM includes the succession of radioactive decay progeny of the parent uranium.

[81] *See* www.epa.gov/radiation/tenorm/uranium_waste.htm.

from solution. The barren lixiviant is then pumped back through injection wells into the wellfield and the process repeats itself on a continuous basis. When fully loaded, the IX resins are transferred to a processing facility where the uranium is stripped from the resins. The stripped resins are then returned to the IX columns for reuse. The strip solution is then treated with ammonia in order to precipitate the uranium. The precipitated uranium is then dewatered and dried, resulting in the production of U_3O_8, or "yellowcake." These processing facilities are similar to the back end of a conventional uranium mill. That is, they do not involve crushing, milling or leaching of ore or separating leached solutions from solids, as would be found at the front end of a conventional uranium mill, but they do involve the remaining steps in the milling process of stripping, precipitation, dewatering and drying to produce yellowcake. Each ISL recovery facility may have several wellfields that utilize one such processing facility. Smaller ISL facilities may enter into commercial arrangements with other ISL facilities or a conventional uranium mill to ship their IX resins to those other facilities for stripping, precipitation, dewatering and drying.

6.2. Wastes Generated From ISL Mining

The ISL mining process generates a number of waste streams.

6.2.1. Bleed Solution

In order to create a cone of depression, or pressure sink, that prevents production fluids from leaving the mining zone, and to bring fresh water into the mining zone to reduce the build up of contaminants in the lixiviant, slightly more water is removed from the ore zone than is injected. This net withdrawal of solutions from the well field is referred to as "bleed solution" and often contains high levels of radium.

6.2.2. Liquid Process Effluents

Resin stripping and yellowcake precipitation and de-watering activities also generate wastewater.

6.2.3. Restoration Waters

When uranium recovery operations cease at a wellfield, existing wells are used to sweep contaminated water out of the ore zone, thereby letting native groundwater flow in to replace the contaminated water. The contaminated water is referred to as "restoration water".

6.2.4. Discrete Surface Wastes

Discrete surface wastes generated by ISL facilities include discarded piping, discarded IX resins and other chemicals, construction material and equipment that can not be decontaminated and salvaged, as well as contaminated soils that must be removed in order to meet free release criteria. Other such wastes are sludges from treatment of bleed

solutions, liquid process effluents and restoration waters. These solutions often contain high levels of radium and are treated to remove the radium using a barium-radium sulfate precipitation method. The resulting precipitates are removed from the solutions in settling ponds or by filtration. This process results in radium-contaminated sludges. The treated water is then discharged to holding ponds and from there it may be disposed of through land application, deep well injection, solar evaporation or some combination of the foregoing, as discussed in Section 6.5.2 below.

6.3. Jurisdictional Issues

6.3.1. ISL Recovery Facilities Require Source Material and Byproduct Material Licenses

Although ISL recovery facilities are involved in mining, NRC treats them differently than conventional uranium mines, which are not under NRC jurisdiction. There are two reasons for this. First, unlike conventional uranium mines, ISL facilities actually refine and process the ore to create yellowcake and therefore require a source material license under the AEA.

Secondly, because ISL facilities concentrate uranium from ores processed primarily for their source material content, any wastes or tailings from such processing fall within the definition of 11e.(2) byproduct material.[82] In fact, in its regulations, NRC has defined byproduct material to mean "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, *including discrete surface wastes resulting from uranium solution extraction processes.*"[83] What this means is that ISL facilities also require an 11e.(2) byproduct material license.

6.3.2. All Liquid Effluents 11e.(2) Byproduct Material

Historically, NRC has made a distinction between bleed solutions and liquid process effluents and their corresponding treatment sludges, on the one hand, and restoration waters and their corresponding treatment sludges, on the other hand. Bleed solutions and liquid process effluents and their treatment sludges were considered to be 11e.(2) byproduct material because they are a part of the uranium recovery operations. In contrast, restoration waters and their treatment sludges are associated with clean-up activities and not with the recovery of uranium, and were considered not to be 11e.(2) byproduct material. However, the Commission changed its position on this in 2000. NRC now classifies all liquid effluents at ISL uranium recovery facilities as 11e.(2) byproduct material. NRC takes the position that any waste water generated during or after the uranium extraction phase of site operations, and all evaporation pond sludges derived from such waste waters, would be classified as 11e.(2) byproduct material. NRC

[82] *See* 42 U.S.C. 2014.
[83] *See* 10 CFR 40.4. Emphasis added.

makes no legal distinction among the waste waters produced at different stages in a facility's life cycle.[84]

6.3.3. Jurisdiction Over Subsurface Activities

NRC is of the view that "the potential interaction with groundwater is so integrally related to the above-ground processing (which [NRC does]) license) as to be properly the subject of license conditions . . ."[85] Hence, the Commission's legal staff has asserted that in addition to having jurisdiction over the above surface concentrating and processing activities, NRC also has jurisdiction over the subsurface aspects of ISL mining.

As a result, NRC imposes conditions on ISL operations to ensure that groundwater quality is maintained during licensed activities and that actions are taken to ensure the restoration of groundwater quality before the license is terminated. NRC has set standards for groundwater restoration at ISL facilities as follows.[86] The primary goal of a restoration program is to return the water quality within the exploited production zone and any affected aquifers to pre-operation (baseline) water quality conditions. However, ISL operations may cause permanent changes in water quality within the exploited production zone, because the *in situ* leach extraction process relies on changing the chemistry in the production zone to remove the uranium. The licensee may therefore propose returning the water quality to its pre-operational class of use (e.g., drinking water, livestock, agricultural, of limited use) as a secondary restoration standard. If a constituent cannot technically or economically be restored to its secondary standard within the exploited production zone, a licensee must demonstrate that leaving the constituent at the higher concentration (an ACL) would not be a threat to public health and safety or the environment or produce an unacceptable degradation to the water use of adjacent groundwater resources.

However, while NRC assumes jurisdiction over underground aspects of ISL mining and can impose license conditions relating to underground activities in order to protect public health and the environment, the depleted ore is not considered to be 11e.(2) byproduct material. The regulatory definition of byproduct material in 10 CFR 40.3 provides that "[u]nderground ore bodies depleted by such solution extraction operations do not constitute "byproduct material" within this definition."

6.3.4. Dual Jurisdiction – Need For EPA UIC Permit and Aquifer Exemption

NRC's position that it has jurisdiction over groundwater restoration at ISL facilities, while at the same time conceding that depleted ore bodies at ISL facilities are not 11e.(2) byproduct material, results in dual jurisdictional problems. In addition to being required

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[84] *See* Staff Requirements Memorandum for SECY-99-013, July 26, 2000.

[85] Memorandum from Howard K. Shapar, Executive Legal Director, NRC, to Chairman Ahearne, NRC re: OELD Legal Opinion on Two Questions Relating to Operation of the Uranium Mill Tailings Radiation Control Act of 1978, Attachment A (Apr. 28, 1980).

[86] *See* NUREG-1569 *Standard Review Plan for In Situ Leach Uranium Extraction License Applications,* Final Report, June 2003. ("NUREG-1569").

to obtain a source material and 11e.(2) byproduct material license from NRC (or the Agreement State), licensees must also obtain an Underground Injection Control (UIC) Permit from EPA or an EPA-authorized State under EPA's UIC program, promulgated under Part C of the Safe Drinking Water Act.[87] The UIC program is intended to protect underground waters from contamination and prohibit the movement of any contaminant into an underground source of drinking water. Underground injection, such as is the case with ISL mining, is permitted so long as minimum prescribed requirements are satisfied to prevent the migration of injection fluids to underground sources of drinking water. Under 40 CFR 146.04, the EPA or EPA-authorized State is authorized to designate aquifers or portions thereof as exempt if, "It cannot now and will not in the future serve as a source of drinking water because:

> It is mineral, hydrocarbon or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible.

In order to obtain a UIC permit, the licensee must obtain an aquifer exemption for the aquifer or portion thereof that will be affected by ISL operations. In order to approve an aquifer exemption, EPA or an EPA-authorized State must find that the aquifer does not currently and will not in the future serve as a source of drinking water.[88] One way to support such a finding is to determine that the aquifer or portion thereof contains minerals that are expected to be commercially producible.[89]

While the EPA aquifer exemption effectively removes that portion of the aquifer from any future consideration for groundwater protection, the NRC groundwater protection provisions are still in effect for the aquifer adjacent to the exempted area. This is the primary concern of the NRC. It should be noted that the EPA-authorized State may impose its own groundwater restoration requirements for the adjacent (non-exempt) aquifer that may be different from the NRC requirements.

NRC has recognized the problems associated with dual jurisdiction over groundwater at ISL facilities and has attempted to negotiate Memoranda of Understanding with non-Agreement States, giving non-Agreement States with equivalent groundwater protection programs paramountcy over groundwater remediation at ISL facilities. To date, however, this has not been successful, as NRC has not been able to conclude that the applicable States have had equivalent programs.[90] This matter and other matters relating to the regulation of ISL facilities is currently the subject of a Part 41 rulemaking specifically tailored to groundwater protection programs at ISL facilities. The NRC staff has been directed by the Commission to focus on eliminating dual regulation by the NRC and EPA of groundwater protection. In order to accomplish this, NRC will retain its jurisdiction

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[87] *See generally* 42 U.S.C. 300(f) *et seq.*
[88] *See* 40 CFR 146.4(a) and (c).
[89] *See* 40 CFR 146.4(b)(1).
[90] *See* SECY-05-0123.

over the wellfield and groundwater under its AEA authority, but will defer active regulation of groundwater protection programs to the EPA or the EPA-authorized State through EPA's UIC permit program.[91]

6.4. Licensing Process

As should be evident from the foregoing, the licensing process for an ISL uranium facility will typically be considerably more involved than the licensing process for a conventional uranium mine. This is because source material and 11e.(2) byproduct material licenses will need to be obtained from NRC (or an Agreement State), which will involve many of the considerations required for a conventional uranium mill. In addition, a UIC permit and an aquifer exemption will be required from EPA (or an EPA-approved State) and other mining approvals will be required. The result is that the licensing process for an ISL uranium facility has typically taken 5 to 7 years from start to finish, and could take longer. In contrast, the time frame for permitting a conventional uranium mine has typically been closer to one to two years.

6.5. Operational Standards

6.5.1. Radon, Gamma And Air Particulate Levels At The Facility And Management Of Exposure To Workers.

As an ISL facility is an AEA licensed facility and performs many of the same operations as a conventional uranium mill, e.g., concentrating, precipitating, dewatering and drying yellowcake, all of the provisions of 10 CFR Part 20 described in Section 4.2.1 above for conventional uranium mills for the protection of workers and the public will apply to ISL facilities. This will result in similar types of radiation monitoring and exposure standards as for conventional uranium mills.

However, because ISL facilities do not have tailings impoundments, they are not subject to the radon flux measurement requirements of 40 CFR Part 61, Subpart W.

6.5.2. Management of Waste Solutions

As discussed in Section 6.2 above, ISL facilities will generate bleed solutions, liquid process wastes and restoration water wastes. All of these are considered to be 11e.(2) byproduct material by NRC, as are the sludges that result from their treatment.

These waste solutions can be managed in a number of ways.

a) Onsite Evaporation

Such solutions may be placed in surface impoundments and left to evaporate. Surface impoundments must be constructed in accordance with the design criteria in 10 CFR Part

[91] *See* SRM –COMJSM-06-0001, March 24, 2006.

40, Appendix A, and monitoring requirements must be established to detect any migration of contaminants to the ground water.[92]

b) Release to Surface Waters

EPA, in accordance with 40 CFR 440.34, does not allow new ISL facilities to discharge process waste water to navigable waters. For existing licensees, however, such wastes may be released to surface waters if the requirements of 10 CFR 20.1302(b)(2) are satisfied and the licensee can also demonstrate that doses are maintained ALARA.[93] In addition, other State and Federal permits may be required, such as an NPDES permit or the equivalent.

c) Land Applications

For the land application of process waste water, the licensee must meet the regulatory provisions in 10 CFR 20.2002 and demonstrate that doses are maintained ALARA and within the dose limits in 10 CFR 20.1301. The licensee must also comply with NRC regulatory provisions for decommissioning. This means that the licensee must address whether the proposed land applications methodologies will comply with the clean up standard set out in Appendix A, Criterion 6(6) at the time of decommissioning.[94] In addition, any other required State and federal agency permits must be obtained in accordance with 10 CFR 20.2007.

d) Deep-Well Injection

Disposal of liquid waste from process water by injection in deep wells must meet the regulatory provisions in 10 CFR 20.2002 and demonstrate that doses are ALARA and within the dose limits in 10 CFR 20.1301. In addition, licensees must also comply with NRC regulatory provisions for decommissioning.

Furthermore, licensees must obtain any other permits required for such disposal, including in particular a UIC permit under 40 CFR Part 146 from EPA or an EPA-authorized State.

6.6. Responsibility For And Manner Of Clean Up

As with a uranium mill, ISL uranium facilities must submit a reclamation plan for approval as part of the licensing process. The licensee must post a reclamation bond or other form of surety with NRC (or the Agreement State) to cover the cost of reclamation in accordance with the approved reclamation plan. The amount of the surety must be reviewed each year and adjusted to reflect any changes in the costs of reclamation.

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[92] *See* NUREG-1569, p. 6-12.
[93] *See* NUREG-1569, p 6-12.
[94] *See* NUREG-1569, p. 6-13.

All surface wastes at an ISL facility, such as buildings and equipment that can not be decontaminated and salvaged, piping, sludges from treatment of waste waters and restoration waters, evaporation pond liners and contaminated soils in and around the site, are considered to be 11e.(2) byproduct material.[95] However, an ISL facility will not have an 11e.(2) tailings impoundment in which to dispose of these wastes.[96] Instead, ISL facilities must enter into agreements with uranium mills or facilities with 11e.(2) disposal cells in order to dispose of these wastes upon reclamation of the ISL site.[97]

Such wastes must be removed from the site and disposed of at an offsite facility licensed to accept 11e.(2) byproduct material. Reclamation will be complete when all such materials are removed from the site and the site meets the free release criteria in 10 CFR Part 40, Appendix A, Criterion 6(6).[98] This is the same free release standard as for conventional uranium mills, discussed in Section 4.4.2 above.

As mentioned in Sections 6.5.2(c) and (d) above, licensees must also demonstrate that any land application or deep-well injection of process waste waters from the ISL facility will comply with Appendix A, Criterion 6(6) at the time of decommissioning.[99]

Finally, any groundwater contamination problems will have to be remediated, as discussed in Section 6.3.3 above.

As ISL facilities will dispose of all of their 11e.(2) byproduct material offsite at a licensed facility, and any 11e.(2) byproduct material contamination remaining will meet the free release standards in Appendix A, Criterion 6(6), the facility will not be transferred to DOE upon license termination.

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[95] It should be noted that, because the wastes generated from ISL operations are 11e.(2) byproduct material, they are exempt from RCRA and TSCA (see the discussion in Section 2.2 above). This is similar to uranium mills, but in contrast to conventional uranium mines where certain wastes are not exempted from the requirements of RCRA and TSCA and require special handling on reclamation of the site and during ongoing operations.

[96] Appendix A, Criterion 2 provides that to avoid proliferation of small waste disposal sites and thereby reduce perpetual surveillance obligations, byproduct material from *in situ* extraction operations, such as residues from solution evaporation or contaminated control processes, and wastes from small remote above ground extraction operations must be disposed of at existing large mill tailings disposal sites; unless, considering the nature of the wastes and the costs and environmental impacts of transporting the wastes to a large disposal site, such offsite disposal is demonstrated to be impracticable or the advantages of onsite burial clearly outweigh the benefits of reducing the perpetual surveillance obligations.

[97] Section 4.2.3 (6) of NUREG-1569 provides that an applicant for an ISL license must have an approved waste disposal agreement for 11e.(2) byproduct material disposal at an NRC or Agreement State licensed disposal facility. This agreement must be maintained on site. The applicant must commit to notify NRC in writing within 7 days if this agreement expires or is terminated and must submit a new agreement for NRC approval within 90 days of the expiration of termination (failure to comply with this license condition will result in a prohibition from future lixivient injection).

[98] Appendix H, Section H1.0 of NUREG-1620 provides that "in 10 CFR 40.4, byproduct material is defined as the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Uranium milling is defined as any activity resulting in byproduct material. Therefore, 10 CFR Part 40, Appendix A, applies to *in situ* leach, heap leach, and ion-exchange facilities that produce byproduct material, as well as to conventional uranium and thorium mills."

[99] *See* NUREG-1569 paragraphs 6.1.3 (12) and (13).

7. APPLICATION OF AEA TO NON-URANIUM MINING ACTIVITIES

Regulation under the AEA can apply to other types of facilities in certain circumstances.

7.1. Side Stream Uranium Recovery Facilities

Some minerals, such as copper and molybdenum are found in nature along with uranium. In some circumstances a producer of another metal such as copper may find it commercially attractive to also concentrate uranium as a side-stream recovery operation. In those circumstances, the operation would require a source material license under the AEA, because source material would be concentrated. As a result, a number of the radiation protection measures required for uranium mills and ISL facilities would be required.

However, because the ores are being processed primarily for the other metal and the recovery of uranium is just a side-stream or secondary operation, the tailings from the uranium recovery operation would not be considered to be 11e.(2) byproduct material. In such a circumstance, the tailings from the uranium side-stream recovery operation could be commingled with the tailings from the primary metals operation.

7.2. Tailings of Other Metals Producers Licensable as Source Material

In other circumstances a producer of another metal or rare earth product may process ores that contain uranium and/or thorium but it is not commercially viable to attempt to recover the uranium or thorium. In those cases the uranium and/or thorium would become part of the tailings from the other metal processing. Again, since the ores are not processed primarily for source material (and in this case not processed at all for source material) the resulting tailings and waste from the processing would not be categorized as 11e.(2) byproduct material.

However, if, as a result of processing for the other metal the resulting tailings contain 0.05% or greater source material (uranium and/or thorium), then the tailings would be considered to contain source material and would be subject to licensing as source material under the AEA. This becomes a waste issue for the metals producer. As discussed in Section 4.5.1 above, these wastes and tailings may be candidates for processing as an alternate feed material at a uranium mill.

7.3. Products of Other Metals Producers Licensed as Source Material

It is possible that a producer of a metal other than uranium or thorium or of a rare earth metal or mixture or other product may not have uranium and/or thorium in its tailings in excess of 0.05%. However, the producer could have uranium and/or thorium in its metal, rare earth or other product. Rare earth metals or mixtures may contain up to 0.25%

uranium and/or thorium without the need for a source material license.[100] In all other cases, the product or metal must contain less than 0.05% uranium and/or thorium to avoid the requirement to obtain a source material license.[101]

[100] 0.25% source material by weight in rare earth metals or mixtures is considered to be an "unimportant quantity" in 10 CFR 40.13 (c)(1)(vi).

[101] By virtue of the determination of the Commission in 10 CFR 40.13 (a) that such a concentration of source material is an "unimportant quantity."

Exhibit 29

WHITE MESA MILL • P.O. BOX 669 • BLANDING, UTAH 84511

To [Name] Distribution List

Division

Location White Mesa

Area

Date September 21, 1990

Originating Dept. J. S. Hamrick

Area

Answering Letter Date

Subject Wildlife in the Tailings Area

Copy to

R. E. Bartlett
L. R. Bowers
L. C. Coldiron
Central File
W. G. Bennett
S. L. Christensen
M. A. Spillman

It has been my experience and observation that every effort to encourage waterfowl to leave the tailings area has been expended by all concerned. This is the season for migration for many of these birds, and we should be especially on alert for any waterfowl or wildlife in the tailings area. If birds are observed, use every reasonable method to get them to leave. Community concern has been expressed in this area, and we have an obligation to protect these animals to the best of our abilities. As has been pointed out by the game warden, any actions other than encouraging them to leave must include the State Fish and Game personnel. Please review this memo with all personnel that may be in the tailings area, keeping in mind that anyone who observes waterfowl in the area should take immediate action. If you have any questions, my extension is 48.

John S. Hamrick
Site Environmental Coordinator

Exhibit 30

ACCEPTING MIXED WASTE AS ALTERNATE FEED MATERIAL FOR PROCESSING AND DISPOSAL AT A LICENSED URANIUM MILL

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ABSTRACT

Certain categories of mixed wastes that contain recoverable amounts of natural uranium can be processed for the recovery of valuable uranium, alone or together with other metals, at licensed uranium mills, and the resulting tailings permanently disposed of as 11e.(2) byproduct material in the mill's tailings impoundment, as an alternative to treatment and/or direct disposal at a mixed waste disposal facility.

This paper discusses the regulatory background applicable to hazardous wastes, mixed wastes and uranium mills and, in particular, NRC's Alternate Feed Guidance under which alternate feed materials that contain certain types of mixed wastes may be processed and disposed of at uranium mills. The paper discusses the way in which the Alternate Feed Guidance has been interpreted in the past with respect to processing mixed wastes and the significance of recent changes in NRC's interpretation of the Alternate Feed Guidance that sets the stage for a broader range of mixed waste materials to be processed as alternate feed materials.

The paper also reviews the legal rationale and policy reasons why materials that would otherwise have to be treated and/or disposed of as mixed waste, at a mixed waste disposal facility, are exempt from RCRA when reprocessed as alternate feed material at a uranium mill and become subject to the sole jurisdiction of NRC, and some of the reasons why processing mixed wastes as alternate feed materials at uranium mills is preferable to direct disposal.

Finally, the paper concludes with a discussion of the specific acceptance, characterization and certification requirements applicable to alternate feed materials and mixed wastes at International Uranium (USA) Corporation's White Mesa Mill, which has been the most active uranium mill in the processing of alternate feed materials under the Alternate Feed Guidance.

INTRODUCTION

Under U.S. rules, mixed waste is waste that contains hazardous constituents regulated under the Resource Conservation and Recovery Act ("RCRA") and radioactive constituents regulated under the Atomic Energy Act ("AEA"), as amended, and is hence subject to dual jurisdiction by the Environmental Protection Agency ("EPA") (or the equivalent State authority) and the Nuclear Regulatory Commission ("NRC") (or the equivalent State authority) or the Department of Energy ("DOE")[1].

Thus far, there have been limited disposal options for mixed waste, with the result that large quantities of such wastes (particularly DOE wastes) have had to be exempted from RCRA storage limitations. As a result, disposition of mixed waste has posed a difficult regulatory conundrum that neither generators nor regulators have been able to solve effectively to date.

In light of this substantial regulatory uncertainty, it is useful to know that certain mixed wastes can be processed at a licensed uranium mill as alternate feed material under NRC's "Final Position and Guidance on the Use of Uranium Mill Feed Material Other Than Natural Ores" (the "Alternate Feed Guidance")[2] for the recovery of contained natural uranium, and the resulting tailings and wastes, including the RCRA constituents, disposed of permanently in the mill's tailings impoundment as 11e.(2) byproduct material, typically at much less cost than direct disposal at a mixed waste disposal facility. As 11e.(2) byproduct material, the wastes are not mixed wastes and are regulated solely by NRC, thereby eliminating dual EPA/NRC jurisdiction.

This paper will briefly discuss the regulatory background applicable to hazardous wastes, mixed wastes and uranium mills and, in particular, the Alternate Feed Guidance under which alternate feed materials that contain mixed wastes may be processed and disposed of at uranium mills. The paper will discuss the way in which the Alternate Feed Guidance has been interpreted in the past with respect to processing mixed wastes and the significance of recent changes in NRC's interpretation of the Alternate Feed Guidance that sets the stage for a broader range of mixed waste materials to be processed as alternate feed materials.

REGULATORY BACKGROUND

Regulation of Hazardous Wastes

Hazardous wastes are regulated by EPA (or the equivalent state authority)[3] under RCRA. If a material is a "solid waste," as defined in 40 C.F.R. § 261.2, it may be classified as either a *characteristic* hazardous waste, as defined in 40 C.F.R. §§ 261.20-24, or a *listed* hazardous waste, as defined in 40 C.F.R. §§ 261.30-33. Generally, a *characteristic* hazardous waste is a solid waste that exhibits one of the *characteristic*s of toxicity, ignitability, corrosivity or reactivity, and *listed* hazardous wastes are solid wastes that are enumerated on any one of a number of specified lists of chemicals and metals, or that resulted from any one of a number of specifically *listed* processes.

Unless specifically exempted, *characteristic* and *listed* hazardous wastes must generally be disposed of in a facility that is regulated under 40 C.F.R. Part 264 (a "RCRA Subtitle C" facility), and is hence subject to the jurisdiction of EPA.

There are a number of exemptions from these requirements, most notably, the *Bevill* exemption, which exempts extraction, beneficiation and certain mineral processing wastes from regulation under RCRA in certain circumstances; the ability to obtain a "contained out" determination where environmental media such as soils or sediments contain *listed* hazardous wastes at *de minimus* levels; the "recycling" exemption, which exempts materials that exhibit a hazardous *characteristic* but are reclaimed to recover a valuable material in accordance with RCRA guidelines; and the *source material* exemption. The recycling exemption and the *source material* exemption will be discussed in more detail below.

Regulation of Uranium Mills

Under the AEA, NRC (or the equivalent state authority[4]) has sole jurisdiction over the regulation of *source material* (i.e., uranium and thorium), special nuclear material and byproduct material (which includes uranium recovery tailings and wastes, i.e., 11e.(2) byproduct material). As uranium mills process *source material ore*s for the recovery of *source material,* and in so doing create and dispose of 11e.(2) byproduct material, uranium mills and their operations are primarily subject to regulation by NRC under the AEA, as amended by the Uranium Mill Tailings Radiation Control Act ("UMTRCA"). UMTRCA requires NRC to conform its requirements with applicable EPA environmental standards for uranium mill tailings. Uranium mills are also subject to the requirements of Clean Air Act radon emission limits, and typically air quality permits issued by the state in which the mill is located.

The AEA, as amended by UMTRCA, gives NRC wide-ranging authority to regulate the disposal of 11e.(2) byproduct material. EPA and NRC regulations, developed under UMTRCA, provide a unique and extremely protective regime of controls to limit releases of radionuclides and *non*-radiological (e.g., hazardous) materials into the environment. In addition, when uranium mills are finally decommissioned and tailings are stabilized, NRC regulations require "passive" control systems, paid for by the licensee, which will provide *reasonable assurance* that potential radiological and *non*-radiological hazards will be controlled for a minimum of 200, and to the extent practicable, 1,000 years, without "active" (i.e., ongoing) maintenance. Finally, UMTRCA requires transfer of the tailings impoundments and any other property required for the disposal of byproduct material, along with associated long-term care funds, to DOE or the State where located for perpetual care. As a practical matter, this means that the U.S.Government, through DOE, will become an NRC licensee for each uranium mill site in perpetuity, and will have the funds provided by the mill licensee for long term surveillance and any necessary long-term care. Each operating mill must maintain an NRC-approved financial surety arrangement, adequate to cover the estimated costs, as accomplished by a third party, for decommissioning and decontamination of the mill and the mill site, reclamation of any tailings or waste disposal areas, ground-water restoration as warranted, and long-term surveillance.

NRC's Alternate Feed Guidance

Under a uranium mill's NRC license, the mill is licensed to process natural uranium *ore*s. In 1995, NRC issued the Alternate Feed Guidance. Alternate feeds consist of uranium-bearing residues from uranium processing facilities or other metal processing facilities, as well as environmental media (soils) contaminated with natural uranium. Under the Alternate Feed Guidance, NRC permits licensees to process alternate feed materials in uranium mills if the following three conditions are satisfied:

- The alternate feed material meets the NRC definition of "*ore*," which is " a natural or native matter that may be mined and treated for the extraction of any of its constituents *or any other matter from which source material [i.e., uranium or thorium] is extracted in a licensed uranium or thorium mill"* [emphasis added]. This includes 11e.(2) byproduct material from other facilities, and other processing wastes from *ore*s which have previously been beneficiated for other minerals (i.e., refined or processed ores).

- The proposed alternate feed material does not contain any RCRA *listed* hazardous wastes. However, potential alternate feed materials that exhibit only a *characteristic* of RCRA hazardous waste may be processed as alternate feed materials at uranium mills.

- The alternate feed material must be processed *"primarily"* for its *source material* content. This has recently been interpreted by NRC to mean that the material is actually processed at the uranium mill for the recovery of uranium (alone or in combination with other metals) and it is reasonable to expect that uranium will be recovered. There is no minimum amount of uranium that must be recovered, nor is there any requirement that the value of the uranium recovered must exceed the cost of processing or any processing or recycling/disposal fee

Currently, NRC policy requires that a specific license amendment must be obtained for processing each proposed alternate feed material. If a proposed alternate feed material satisfies these three conditions, then, upon application by the licensee, NRC will issue an amendment to the license permitting processing of such materials as *ore*, with the resultant wastes, including tailings, being classified as 11e.(2) byproduct material. 11e.(2) byproduct material is subject to the federal regulatory framework described above under the heading "Regulation of Uranium Mills."

Regulation of Mixed Wastes

As stated above, mixed wastes are wastes that contain hazardous wastes regulated under RCRA and radionuclides regulated under the AEA. As such, they are subject to dual jurisdiction by EPA and NRC. There are a limited number of facilities in the United States that are licensed to treat and dispose of mixed waste.

As is evident from the foregoing discussion, however, any waste that, were it to be disposed of would be classified as a mixed waste, because it contains *characteristic*

hazardous wastes[5] together with natural uranium, alone or together with natural thorium and their respective progeny[6], may be processed as an alternate feed material at a uranium mill if it is reasonable to expect that uranium can be extracted from the materials[7]. The resulting tailings would be disposed of permanently in the mill's tailings impoundment as 11e.(2) byproduct material.

The ability to process these types of mixed wastes as alternate feed materials at a licensed uranium mill and recycle a valuable energy resource provides an alternative to more costly disposal of these types of mixed wastes at mixed waste treatment and disposal facilities.

HISTORICAL APPLICATION OF ALTERNATE FEED GUIDANCE TO PERMIT THE PROCESSING AND DISPOSAL OF MIXED WASTE

While a few alternate feed materials were processed by uranium mills in the 1980's, the primary processor of alternate feed materials since the beginning of the 1990's has been International Uranium (USA) Corporation's ("IUC's") White Mesa Mill, located near Blanding Utah

Since 1994, the White Mesa Mill has received 14 license amendments to process alternate feed materials. The White Mesa Mill is the only facility to have received amendments from NRC under the Alternate Feed Guidance to receive and process alternate feed materials. To date, IUC has not been denied a license amendment request to process alternate feed materials.

Several of these alternate feed materials have exhibited *characteristic*s of RCRA hazardous wastes. One of these alternate feeds, the Cotter Concentrate, was actually classified as mixed waste at the Nevada Test Site, due to its RCRA *characteristic*s, but was reclassified as an alternate feed material and processed at the White Mesa Mill for the recovery of uranium.

Until January 2001, EPA and the State of Utah Department of Environmental Quality ("UDEQ"), which has RCRA authority in the State of Utah, did not question the ability of uranium mills to process alternate feed materials that contain RCRA *characteristic* wastes under the Alternate Feed Guidance. The agencies relied implicitly on the RCRA recycling exemption that is available to exempt a RCRA *characteristic* waste from regulation under RCRA if it is legitimately recycled in accordance with RCRA guidance. However, no independent analysis under RCRA was ever performed to determine whether or not the RCRA recycling guidance actually applied to exempt any particular alternate feed material from the RCRA requirements. It appears that each agency implicitly accepted the concept that if a material is approved by NRC for processing at a uranium mill for the recovery of uranium, it must be considered to be legitimately recycled under the RCRA Guidance such that it is exempt from RCRA.

RECENT APPLICATION OF ALTERNATE FEED GUIDANCE TO PERMIT THE PROCESSING AND DISPOSAL OF MIXED WASTE

In December 2000, IUC filed an application to amend its NRC license to allow the White Mesa Mill to receive and process certain waste materials from a rare earth producer as alternate feed material pursuant to the Alternate Feed Guidance.

The materials consisted of approximately 17,750 tons of lead sulfide sludge containing uranium. The materials, which resulted from the extraction of lanthanides and other rare earth materials, were stored in ponds at the generator's facility. The materials were estimated to have an average uranium content of approximately 0.15%. The lead content in the materials was a natural component of the *ore* (similar to many *ore*s processed by IUC) and was at levels such that the materials might not have passed EPA's Toxicity Characteristic Leaching Procedure ("TCLP"). Consequently, unless exempted from RCRA, the materials potentially could have been subject to regulation as a RCRA *characteristic* hazardous waste. The materials did not however, contain any *listed* hazardous waste as defined in RCRA.

In a letter received by NRC on February 12, 2001, EPA headquarters expressed concerns regarding IUC's application. Specifically, EPA advised NRC that according to EPA's Region 9 Office, the materials were regulated under RCRA as a *characteristic* hazardous waste and had been classified by the State of California as such.[8] EPA further stated that it is "unclear whether RCRA jurisdiction would apply to some components of the waste after it is licensed as a *source material*," and, in particular, questioned IUC's analysis, as stated in the license amendment request, that once NRC has determined the waste to be deemed *source material* it could be removed from the generator's facility as a "recycled mineral waste." In the letter, EPA requested that NRC meet with EPA to clarify this point and to work with EPA to reach a consensus on the issue. In a follow-up letter received by NRC on April 5, 2001, EPA advised NRC that the determination as to whether the materials were hazardous waste required resolution of several issues, including whether the materials in question were "solid wastes." EPA noted that generally materials are not classified as "solid wastes" when they are legitimately reclaimed, and therefore such materials are not considered hazardous wastes under Subtitle C of RCRA. The letter further stated that EPA had authorized the State of California and the State of Utah to implement their State RCRA programs in lieu of the Federal RCRA program and that NRC should obtain the views of California, Utah and Nevada (through which the materials were to be transported) on this matter. In discussions with the State of Utah Division of Solid and Hazardous Waste ("UDSHW"), UDSHW advised IUC that it interpreted the April 5, 2001 EPA letter as EPA deferring to the State with respect to whether the processing of the materials as an alternate feed material would be exempt from RCRA. UDSHW advised IUC that, based on the letter from EPA, UDSHW would apply standard RCRA guidance to determine whether or not the materials would be legitimately "recycled" at the White Mesa Mill, and hence exempt from RCRA pursuant to 40 C.F.R. § 261.2(e).

In response, IUC argued that the primary issue was not whether the materials would be "recycled" and, therefore, would not be hazardous waste, but rather whether the materials were *source material ore* and hence were not solid waste and, therefore, not regulated under RCRA.

Specifically, IUC argued that only "solid wastes" may be regulated as "hazardous waste" under RCRA. *See* 42 U.S.C. § 6903(5); 40 C.F.R. § 261.3. *Source material* is expressly excluded from the definition of "solid waste." RCRA provides that the term "solid waste" does not include:

> source, special nuclear or byproduct material as defined by the Atomic Energy Act of 1954, as amended, (68 Stat. 923) [42 U.S.C. §§ 2011 *et seq.*].

42 U.S.C. § 6903(27); *see also* 40 C.F.R. § 261.4(a)(4). Consequently, since *source material* is not a "solid waste," it cannot be classified as "hazardous waste." Therefore, *source material* is not subject to regulation by EPA or an authorized state pursuant to RCRA.

Since RCRA must rely on the AEA definition of *source material*, an understanding of what qualifies as "*source material*" under the AEA was critical to IUC's argument. *See* 42 U.S.C. § 6903(27); 40 C.F.R. § 261.4(a)(4). The term *source material* is defined to mean:

> (1) uranium, thorium, or any other material which is determined by the Commission pursuant to the provisions of section 61 to be *source material*; or (2) *ores* containing one or more of the foregoing materials, in such concentration as the Commission may by regulation determine from time to time.

42 U.S.C. § 2014z *(emphasis added)*. NRC has determined that licensable or licensed *source material ore* must contain at least 0.05% uranium and/or thorium. *See* 10 C.F.R. § 40.4. Thus, any material that satisfies NRC's definition of *ore* and contains 0.05% or greater uranium is *source material* and, therefore, is excluded from regulation under RCRA.

As discussed above, in order to be approved for processing at a uranium mill under the Alternate Feed Guidance, an alternate feed material must be an *ore*. Therefore, an alternate feed material with a uranium content of 0.05% or greater is *source material ore,* and, for the reasons stated above, such *source material ore* is exempt from regulation under RCRA.

Based on this logic, and because the lead sulphide sludge material contained in excess of 0.05% uranium, it was unnecessary to engage in a RCRA recycling analysis with respect to the materials. IUC argued that upon issuance by NRC of an alternate feed material license amendment to IUC to process the materials as *source material ore* at the White

Mesa Mill, and the materials were destined for processing at the White Mesa Mill pursuant to that amendment, neither EPA nor a state with delegated RCRA authority had jurisdiction over the materials under RCRA.

NRC and EPA accepted these arguments, and NRC issued the license amendment on this basis.

SIGNIFICANCE OF THE RECENT NRC DECISION ON THE PROCESSING OF MIXED WASTES AS ALTERNATE FEED MATERIALS

NRC's recent position on this issue is significant for three reasons. First, it makes it absolutely clear that any alternate feed material that exhibits *characteristic*s of RCRA hazardous waste and contains at least 0.05% uranium and/or thorium can be processed at a uranium mill for the recovery of uranium, without any need to refer to RCRA recycling guidance. The alternate feed materials are *source material ore* and are exempt from RCRA.

Second, while not applicable in the case of the lead sulphide sludge materials discussed above, which had an expected average concentration of greater than 0.05% uranium, and hence not yet specifically addressed by NRC, alternate feed materials containing less than 0.05% uranium should also be considered alternate feed *ores* and hence exempt from RCRA for different reasons. Any alternate feed material that is approved by NRC for processing at a uranium mill, regardless of its concentration of uranium, must be an *ore* that is subject to AEA jurisdiction. As such it should be considered to be a primary raw material feedstock for AEA and RCRA purposes, cease to become a solid waste and therefore cease to be regulated under RCRA. This argument, while consistent with NRC's position on alternate feed materials that contain in excess of 0.05% uranium or greater, has not yet been specifically addressed by NRC.

Third, there is no reason why the foregoing analysis and conclusions should apply only to RCRA *characteristic* wastes and not to RCRA *listed* wastes, as listed hazardous wastes are not necessarily more hazardous than characteristic hazardous wastes. Whether or not the alternate feed materials contain 0.05% or greater uranium, in which case they are *source material ore* under the AEA, or they contain less than 0.05% uranium and are exempt from RCRA because they are *ores* and are not solid wastes, the exemption from RCRA should apply equally to *listed* hazardous wastes as to RCRA *characteristic* hazardous wastes because once processed and the uranium removed the resulting 11e.(2) byproduct material is exempt from RCRA regulations.[9]

At this time, NRC has not addressed the question of whether or not RCRA *listed* hazardous wastes should be treated the same as RCRA *characteristic* wastes under the Alternate Feed Guidance. It should be noted, however, that to the extent an alternate feed material that either exhibits RCRA *characteristic*s or contains RCRA *listed* hazardous wastes is exempt from RCRA, NRC in approving the license amendment for the alternate feed material will ensure that adequate safeguards exist at the uranium mill to ensure that public health, safety and the environment are protected.

POLICY RATIONALE FOR EXCLUDING ALTERNATE FEED MATERIALS FROM RCRA JURISDICTION

Congress gave NRC the authority to regulate both the radiological and *non*-radiological aspects of *source material ore* processing and the resulting byproduct material, in conformity with standards set by EPA. In Section 84 of the AEA, Congress directed NRC to regulate both the *radiological and nonradiological* components of mill tailings in conformance with the manner in which EPA manages hazardous waste under RCRA. Specifically, EPA promulgated standards that NRC relied on when promulgating its 10 C.F.R. Part 40, Appendix A criteria. However, unlike the EPA standards, NRC criteria include additional protections and slight variations to address the unique issues associated with the presence of radionuclides in *source material ore* and byproduct material. The AEA, as amended by UMTRCA, requires NRC to regulate wastes from processing *source material* based on standards that provide equivalent protection to EPA standards, and, as a result, no permit is required under the Solid Waste Disposal Act for the "processing, possessing, transfer, or disposal of byproduct material." Section 275 b.(2).

NRC, not EPA, is charged with active implementation and enforcement of UMTRCA-generated requirements including ensuring that the standards providing equivalent protection to RCRA, set forth at 40 C.F.R. Part 192, Subpart D, are applied "during and following processing of uranium ores." 40 C.F.R. § 192.30. Similarly, the applicable surface impoundment design standards and groundwater protection requirements for Subtitle C facilities are incorporated into 10 C.F.R. Part 40 Appendix A, which include the requirements applicable to mill tailings impoundments and the operations of uranium mills generally. *See* 40 C.F.R. § 192.32. For example, since the long-lived nature of radionuclides pose an additional potential threat beyond mere *characteristic* waste, the Appendix A criteria, incorporating the 40 C.F.R. Part 192, Subpart D standards, have unique features such as passive controls for 1,000 years through an engineered encapsulation system and a mandatory governmental custodian licensed in perpetuity by NRC, which provide additional protection above and beyond that provided by a state of the art RCRA impoundment.

Congress in adopting the AEA, as amended by UMTRCA, delegated to NRC exclusive jurisdiction over AEA definitions for *source material* and 11e.(2) byproduct material. Had it been intended that EPA should have jurisdiction over these materials, either of which could and both of which frequently do contain hazardous constituents, Congress would not have exempted them from RCRA and provided that where there is a conflict between AEA and RCRA, RCRA yields.[10] Therefore, it is only proper that alternate feed material, which NRC determines to be *source material ore,* is exempt from regulation as hazardous waste under RCRA. If NRC did not assert its sole authority over these materials, it could result in an entangled web of dual jurisdiction of the very kind Congress intended to avoid.

From the standpoint of environmental protection, RCRA recycling management requirements are duplicative of NRC's license amendment process and could lead to confusion or conflicts as a result of the application of two similar, yet distinctly different, regulatory programs.[11] The ultimate objective of the RCRA analysis is the same as the

analysis NRC performs under the AEA when evaluating whether to approve an alternate feed license amendment—to evaluate whether materials proposed for recycling/processing will indeed be recycled/processed to produce a valuable product (*i.e.* yellow cake) and to assure that all wastes generated will not avoid appropriate regulatory controls, and will be used and managed in a manner that is protective of human health and the environment.

ADVANTAGES OF PROCESSING MIXED WASTES AS ALTERNATE FEED MATERIALS VERSUS DIRECT DISPOSAL

Mixed waste that contains recoverable amounts of natural uranium, alone or together with other recoverable metals may be recycled for the uranium content and other metals. These resources would otherwise be wasted were the mixed wastes to be directly disposed of (either with or without stabilization treatment). In some circumstances, the recovery of such resources can offset or eliminate the costs associated with disposal.

To the extent that uranium is extracted from the materials, not only are energy resources preserved, but the wastes that will ultimately be disposed of will be less radioactive than they would otherwise be, which reduces further long term concerns about potential impacts to the environment.

From a regulatory standpoint, as discussed above, the conversion of mixed wastes into 11e.(2) byproduct material will result in the maximum amount of protection to the generator from long term liabilities. EPA and NRC regulations, developed under UMTRCA, provide a unique and extremely protective regime of controls to limit releases of radionuclides and *non*-radiological (e.g., hazardous) materials into the environment. In addition, as noted above, when uranium mills are finally decommissioned and tailings stabilized, the "passive" control systems and mandatory perpetual governmental custodian will provide control and protection for 1,000 years.

CHARACTERIZATION, CERTIFICATION AND ACCEPTANCE OF ALTERNATE FEED MATERIALS CONTAINING *CHARACTERISTIC* HAZARDOUS WASTES

General

As is evident from the foregoing discussions, uranium mills such as IUC's White Mesa Mill, can currently accept mixed wastes that contain *characteristic* hazardous wastes for processing as alternate feed materials.[12] In order to determine whether or not a proposed mixed waste is acceptable for processing at a uranium mill it is therefore necessary to determine if the waste qualifies as an alternate feed material that may be processed at the mill.

The following sections summarize the relevant characterization, certification and acceptance procedures for materials that are proposed for processing at IUC's White Mesa Mill as alternate feed materials. Any mixed waste that satisfies these procedures and requirements may be processed and disposed of at the White Mesa Mill.

IUC's Acceptance Procedures for Alternate Feed Materials

IUC's alternate feed recycling and disposal program involves the general procedures illustrated in Table I.

Table I. IUC's Acceptance Procedures for Alternate Feed Materials

Step 1:	Determine if material meets Feed Acceptance Criteria through initial screening/characterization. See FACTS described below under the heading "Characterization – IUC's Feed Acceptanceteria Criteria for Alternate Feed Materials."
Step 2:	Complete any further site or material characterization if required and complete Radioactive Materials Profile Record ("RMPR") described below under the heading "Certification."
Step 3	Conduct initial scoping process testwork.
Step 4	Finalize commercial arrangements.
Step 5:	Apply for routine license amendment. Typical required information includes: • Site and material history • Radiochemical data • Material composition and volume • Hazardous constituent data • Transportation/logistics • Special health/safety handling requirements
Step 6:	Arrange transport of material to White Mesa Mill.

Characterization -- IUC's Feed Acceptance Criteria for Alternate Feed Materials

In addition to compliance with applicable federal and state laws, IUC is required to operate the White Mesa Mill in compliance with the conditions of its NRC License and in conformance with the environmental parameters that formed the technical basis for that License. In order to ensure that alternate feed materials conform to the environmental assumptions included in the White Mesa Mill's License, IUC applies Feed Acceptance Criteria and Tests ("FACTS") to alternate feeds. IUC's FACTS include Content and Volume Requirements, Physical Requirements, Analytical Requirements, and General Acceptance Requirements. A copy of IUC's FACTS is available on IUC's web site at www.intluranium.com.

While reference should be made to the FACTS for all specific detailed acceptance criteria, generally IUC can accept and process alternate feed materials that satisfy the following requirements:

Radionuclides

- Materials containing natural uranium in any form and associated daughter products
- From relatively low grade FUSRAP type material to very high grade materials - IUC has handled material grading over 40% U_3O_8
- Classification of material, whether 11e(2), pre-1978 11e(2), LLRW, NORM or TENORM does not matter if it otherwise satisfies the Alternate Feed
- Guidance. The tailings from the processing of the alternate feed materials will always be 11e.(2) byproduct material
- Must contain recoverable amounts of uranium. What constitutes "recoverable amounts" of uranium must be determined on a case-by-case basis. The White Mesa Mill has processed alternate feed materials in the 0.01% U_3O_8 (0.0085% U) range and would consider materials that contain lower levels of uranium if the circumstances warrant.
- Can contain Thorium 232 and its daughter products, so long as it contains recoverable amounts of uranium
- Cannot accept depleted uranium, special nuclear materials or transuranics[13]

Mixed Waste

- Mixed waste that contains *characteristic*s of hazardous waste is generally acceptable.
- Currently cannot accept *listed* RCRA hazardous waste[14]

Acceptable Physical *Characteristic*s:

- Any non-gaseous form, e.g. soil, *ore*, sands, slag, liquid, slurry are acceptable
- White Mesa Mill can accommodate a large range of particle sizes and any moisture content
- White Mesa Mill can accommodate most forms of debris that are consequential to excavation activities (cement, asphalt, timbers, etc.)

Other Recoverable Metals

- Other metals such as vanadium, tantalum, niobium, titanium, zirconium, and scandium can be recovered in certain circumstances in conjunction with uranium processing

Certification

If the proposed alternate feed material meets the FACTS, the generator of the materials must certify to the characterization of the materials by completing and executing a Radioactive Materials Profile Record ("RMPR"), a copy of which is available on IUC's web site at www.intluranium.com, which includes a certification as to the accuracy of the information contained therein.

CONCLUSION

Mixed wastes that contain recoverable amounts of natural uranium and that meet the acceptance criteria discussed in this paper can be processed for the recovery of valuable uranium, alone or together with other metals, at licensed uranium mills, and the resulting tailings permanently disposed of as 11e.(2) byproduct material in the mill's tailings impoundment.

Recycling of wastes in this manner can be accomplished at costs to the generator that are less than have traditionally been charged by mixed waste disposal facilities, and in a manner that provides maximum protection to the environment and that minimizes any potential long term liability to the generator.

FOOTNOTES

[1] DOE has self-regulatory authority under the AEA and, indeed it has by far the largest volume of mixed waste. However, for convenience sake, references in this paper are primarily to NRC regulatory authority, as uranium mills are NRC (or the equivalent state authority) licensees.

[2] See Final Position and Guidance on the Use of Uranium Mill Feed Materials Other than Natural Ores, 60 Fed. Reg. 49296 (September 25, 1995), as amended by Regulatory Issue Summary 2000-03 (Nov. 2000) (Interim Position and Guidance on the Use of Uranium Mill Feed Material Other than Natural Ores).

[3] EPA can delegate authority to approved states for primacy under statutes such as the Clean Air Act and RCRA. For convenience, all references to EPA in this paper will include states with such delegated authority.

[4] Under Section 274 of the AEA, a state can elect to assume the responsibilities of NRC in a number of areas, including the regulation of uranium mills and mill tailings, by becoming an "Agreement State" in those areas. For convenience, all references to NRC in this paper will include Agreement States.

[5] At the present time, alternate feed materials may only contain RCRA *characteristic* hazardous wastes. However, recent pronouncements by NRC logically would lead to the conclusion that any type of RCRA hazardous wastes may be processed as alternate feed materials, it they otherwise meet the requirements applicable to alternate feed materials. See the discussion below under the headings "Recent Application of Alternate Feed Guidance to Permit the Processing and Disposal of Mixed Waste" and "Significance of the Recent NRC Decision on the Processing of Mixed Wastes as Alternate Feed Materials."

[6] At this time, uranium mills are not licensed to receive any materials that contain special nuclear materials or transuranics. However, the National Mining Association ("NMA") and the Fuel Cycle Facilities Forum ("FCFF") are preparing submissions to NRC aimed at allowing uranium mills to accept de minimus levels of these types of materials. These submissions are currently under discussion between NRC, NMA and FCFF.

[7] As discussed above, so long as the alternate feed material will be processed at the uranium mill and it is reasonable to expect that uranium will be recovered from the processing, the materials will be acceptable feed materials. It is irrelevant whether or not the value of the uranium recovered justifies the cost of processing or whether or not a recycling/disposal fee is paid to the mill by the generator of the waste.

[8] IUC understands that while the State of California had previously classified a lead precipitate stored in drums at the generator's facility as hazardous waste, it had never asserted jurisdiction over the lead sulfide sludge that was stored in the ponds. Moreover, under EPA guidance, 54 Fed. Reg. 36597 (September 1, 1989), because the lead sulfide sludge materials had not been actively managed since the mid-1980's, IUC understands that they were not subject to regulation as hazardous wastes.

[9] Prior to a uranium mill accepting alternate feed materials that contain listed hazardous wastes, NRC would have to amend its Alternate Feed Guidance to reflect this legal conclusion. No such amendment has been made by NRC to date.

[10] Congress has made it clear that, in the event of a conflict between RCRA and the AEA, RCRA requirements must yield. RCRA § 6905(a) provides that:

> Nothing in this chapter shall be construed to apply to (or to authorize any State, interstate, or local authority to regulate) any activity or substance which is subject to … the Atomic Energy Act of 1954 except to the extent that such application (or regulation) is not inconsistent with the requirements of such Acts.

[11]For example, RCRA recycling guidance considers economics as a factor (although acknowledging that all mineral recovery recycling does not necessarily have to be profitable to be legitimate). NRC however, as explained *supra*, has determined that the economics of uranium recovery at a uranium mill are irrelevant to valid recycling as long as uranium can reasonably be expected to be (or is) extracted at a mill.

[12]As discussed above, the recent pronouncements by NRC logically would lead to the conclusion that NRC should amend its Alternate Feed Guidance to allow the processing of alternate feed materials that contain *listed* hazardous wastes. No such amendment has been made to date.

[13] See note 6 *Supra*

[14] See note 5 *Supra*.