



# POLICY ISSUE

## (Notation Vote)

June 28, 2023

SECY-23-0055

FOR: The Commissioners

FROM: Daniel H. Dorman  
Executive Director for Operations

SUBJECT: OPTIONS FOR LICENSING EMERGING TECHNOLOGIES USED FOR  
REMEDICATION OF MINE WASTE

PURPOSE:

This paper responds to the Commission's direction in Staff Requirements Memorandum (SRM) M230126, "Staff Requirements – Strategic Programmatic Overview of the Decommissioning and Low-Level Waste and Nuclear Materials Users Business Lines." The SRM directed U.S. Nuclear Regulatory Commission (NRC) staff to "provide a notation vote paper to the Commission evaluating the advantages and disadvantages of different options for the licensing of emerging technologies used for remediation of mine waste." The SRM also directed NRC staff to "analyze any legal constraints on the options and discuss the viability of alternative statutory and regulatory interpretations."<sup>1</sup> This paper provides an overview of four options and a recommendation for licensing these technologies. This paper does not address any new commitments or resource implications.

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<sup>1</sup> Staff Requirements – Strategic Programmatic Overview of the Decommissioning and Low-Level Waste and Nuclear Materials Users Business Lines" (Feb. 16, 2023) ([ML23047A448](#)).

## SUMMARY:

The NRC does not regulate mining or mine wastes.<sup>2</sup> However, remediation of mine waste may require an NRC license, depending on the remediation activities. One type of remediation that would require an NRC license, as it would involve the concentration or extraction of uranium or thorium, is to separate and isolate the hazardous constituents of the mine waste into a smaller volume and to remove that volume of material from a site. The NRC staff evaluated four options for licensing emerging remediation technologies. These options are: 1) license under the current source and byproduct material framework in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 40, including Appendix A, with exemptions and alternative standards for specific criteria, as appropriate, on a case-by-case basis; 2) license under the source material framework in Part 40 solely under one of two approaches (i.e., a source material license for the site or a source material license for a service provider); 3) create a standardized position in guidance or regulations by which applicants can be exempt from certain Appendix A requirements, and (4) propose a legislative change.

As described below, the staff recommends Option 1 as it is the established, flexible framework with inherent opportunities for risk-informed implementation. If the staff's recommended option is pursued, there would be no legal constraints; no need to reinterpret any statutory provisions, rules, or guidance; and no need to undertake rulemaking. Additionally, the staff (as well as industry and other external stakeholders) would have the opportunity to leverage the knowledge and flexibility of the existing regulatory framework. The NRC used the flexibilities in 10 CFR Part 40 Appendix A to regulate in situ recovery of uranium effectively and efficiently and could do the same for remediation of mine waste. Finally, Option 1 enables the NRC to obtain insights and learn from licensing mine remediation technology and avoid spending time and resources on programmatic changes (e.g., revisions to regulations or guidance) that could have unintended consequences of such changes, especially given the limited number of expected applicants.

## BACKGROUND:

Uranium is a naturally occurring radioactive element that has been mined for a variety of uses, including as fuel for nuclear power reactors. Uranium may also be present in small quantities at mines where other minerals are the main interest. The NRC does not regulate mining (the process by which ore<sup>3</sup> is removed from their place of deposit in nature) or mining waste. However, the NRC does regulate possession of source material as well as the uranium milling process. NRC oversight of the uranium milling process includes the resulting waste, referred to as 11e. (2) byproduct material (byproduct material), at conventional mill sites and in situ recovery sites in certain states once the ore is altered or processed.<sup>4</sup>

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<sup>2</sup> Other Federal and state agencies have roles in regulating the mining industry. See <https://www.epa.gov/smartsectors/mining-sector-information> (last updated 10/27/2022).

<sup>3</sup> The NRC defines ore in guidance 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." [Regulatory Issue Summary \(RIS\) 2000-23, "Recent Changes to Uranium Recovery Policy" \(ML003773008\)](#).

<sup>4</sup> State agencies regulate these activities in Agreement States with Agreements that cover these activities. Currently, the NRC regulates uranium recovery operations in New Mexico and Nebraska. Uranium recovery operations in Colorado, Texas, Utah, Washington, and Wyoming are regulated by State agencies. See <https://www.nrc.gov/materials/uranium-recovery.html> (last updated 3/31/2023). The States of Illinois and Ohio also

During the mining process, overburden<sup>5</sup> is typically removed from the ground to access ore. Overburden has little to no economic value. In addition, subeconomic ore, also referred to as sub-ore, is removed during the mining process. As discussed in the Environmental Protection Agency's (EPA) "National Hardrock Mining Framework,"<sup>6</sup> the distinction between ore and sub-ore is an economic judgment made by the mine owner. Whether ore is sub-ore can change over time, depending on a variety of economic considerations, like the price of the commodity or development of technologies that would lower the cost of removal or processing. Overburden and sub-ore are both mine waste products that are rock or earth-like material. Tailings are another mine waste product and are material that remains after target minerals have been removed from the ore. Unlike the rock-like overburden and sub-ore, tailings are typically finely ground material that are disposed of in engineered systems. Overburden and sub-ore are often stockpiled at the surface. Overburden and sub-ore have been typically regulated at the State level but may fall under EPA jurisdiction in certain situations, such as in and around Tribal areas.<sup>7</sup>

Waste products, such as the overburden, sub-ore, and tailings, at mine sites can present a safety hazard. The safety hazards from mine waste can be physical, chemical, or, in some cases, radiological. Physical hazards can arise from the configuration of the mine waste when it was disposed, based on its location, slope angle, or slope length. Chemical or radiological hazards can arise depending on the geology and minerology of the rock. For example, heavy metals such as selenium, arsenic, cadmium, vanadium, and manganese were found at abandoned uranium mines in Utah.<sup>8</sup> Varying concentrations of uranium, radium, and thorium are also typically present in wastes from uranium mines. With physical changes to the mine waste, like slurring and crushing, the remaining heavy metals and radionuclides may more easily mobilize through wind and water erosion, presenting a threat to groundwater and surface water, which are sometimes used as sources of drinking water, irrigation, and water for livestock. From a radiological dose perspective, the presence of radium-226 in mining wastes, particularly those resulting from uranium mining activities, is the radionuclide of greatest safety significance.<sup>9</sup>

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have authority to regulate 11e.(2) byproduct material, but do not have uranium recovery facilities. See "Agreement Between the United States Nuclear Regulatory Commission and the State of Ohio for Discontinuance of Certain Commission Regulatory Authority and Responsibility Within the State Pursuant to Section 274 of the Atomic Energy Act of 1954, as Amended," available at <https://scp.nrc.gov/special/regs/ohagreements.pdf>; see also "Amendment Number One to the Agreement Between the United States Nuclear Regulatory Commission and the State of Illinois for Discontinuance of Certain Commission Regulatory Authority and Responsibility Within the State Pursuant to Section 274 of the Atomic Energy Act of 1954, as Amended," available at <https://www.nrc.gov/cdn/nmss/pdf/ilagreements.pdf>.

<sup>5</sup> Overburden refers to material of any nature, consolidated or unconsolidated, that overlies a deposit of useful materials or ores, especially those deposits that are mined from the surface by open cuts or open-pit methods. EPA, "Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume 2: Investigation of Potential Health Geographic and Environmental Issues of Abandoned Uranium Mines," Appendix V, "List of Acronyms and Abbreviations and Glossary of Terms" at AV-12 (2007), available at <https://www.epa.gov/sites/default/files/2015-05/documents/402-r-08-005-v2.pdf>.

<sup>6</sup> EPA, "National Hardrock Mining Framework," Appendix A, "Mining Industry Profile" at A-10 (1997), available at [https://www.epa.gov/sites/default/files/2015-10/documents/hardrock\\_mining\\_framework\\_0.pdf](https://www.epa.gov/sites/default/files/2015-10/documents/hardrock_mining_framework_0.pdf).

<sup>7</sup> See <https://www.epa.gov/radiation/tenorm-uranium-mining-residuals> (last updated 2/16/2023).

<sup>8</sup> United States Geological Survey, "Assessment of Nonpoint Source Chemical Loading Potential to Watersheds Containing Uranium Waste Dumps and Human Health Hazards Associated with Uranium Exploration and Mining, Red, White, and Fry Canyons, Southeastern Utah, 2007," available at <https://www.usgs.gov/publications/assessment-nonpoint-source-chemical-loading-potential-watersheds-containing-uranium-0>.

<sup>9</sup> EPA, "Final Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites (40 CFR 192)," Vol. 1. (Oct. 1982).

One potential methodology for remediating mine waste is to separate and isolate uranium and thorium into a smaller volume and then remove that material from a site. The remainder of the material could remain on-site. For the purposes of this paper, the material that would be removed from a site is referred to as “uranium and thorium laden material.” The on-site material is referred to as “residual on-site material.” This paper does not address any potential changes to how the uranium and thorium laden material would be handled once taken offsite either for further processing or disposal at an appropriately licensed facility.

When considering remediation technologies that separate and isolate radiological constituents into a smaller volume of uranium and thorium laden material for removal from the site, the concentration of the radioactive material that remains in the residual on-site material is a key factor in determining the health and safety consequences. Heavy metals and radionuclides have the potential to persist in the residual on-site material after a remedial technology is used. Additionally, further processing of mine waste (e.g., by crushing rock, which increases its surface area) can mobilize potential contaminants. For these reasons, the residual on-site material can also present a threat to groundwater and surface water.

The NRC staff is aware of governmental and private interest in remediating mine waste. The NRC participates in the Abandoned Uranium Mine Waste group, which includes several Federal and State agencies and Tribal representatives. Within this group, there is a federal government initiative, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), to cleanup abandoned uranium mines. This group is especially focused on identifying solutions to clean up the more than 500 abandoned uranium mines on and near the Navajo Nation. In addition to cleanup of uranium mines, the NRC staff is also aware of efforts to clean up other types of mine waste and recover critical minerals.<sup>10</sup> The NRC recognizes that remediation of mine waste may fall within its regulatory purview or that of an Agreement State.<sup>11</sup> In the remainder of this paper, “NRC” is used as a collective short form when discussing the licensing authority of both the NRC and Agreement States.

## DISCUSSION:

Before providing options for licensing emerging technologies used for remediation of mine waste, the following discussion contains a review of the agency’s current statutory and regulatory authority over source material and byproduct material, including the definitions of these terms, and a high-level overview of the regulatory framework in 10 CFR Part 40, including Appendix A.

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<sup>10</sup> See e.g., United States Government Accountability Office, “Critical Minerals: Building on Federal Efforts to Advance Recovery and Substitution Could Help Address Supply Risks,” GAO-22-104824 (June 2022), available at <https://www.gao.gov/assets/gao-22-104824.pdf>. As discussed in the Consolidated Appropriations Act of 2021, a critical mineral is a mineral essential to the economic or national security of the United States, has a supply chain vulnerable to disruption, and serves an essential function in the manufacturing of a product whose absence would have significant consequences for the economic or national security of the United States. Public Law 116-260, Consolidated Appropriations Act of 2021 § 6003, codified in 42 U.S.C. § 17113. The United States Geological Survey maintains a list of critical minerals, which is updated on a regular basis. U.S. Geological Survey, “2022 Final List of Critical Minerals,” 87 Fed. Reg. 10381 (Feb. 24, 2022). Roughly a third of the critical minerals are co-located with uranium and/or thorium. Staff anticipates that interest in remediating mine sites will increase as technology improves and new mineral sources become more limited.

<sup>11</sup> For example, as discussed *infra*, if the remediation activity involves 11.e(2) byproduct material or source material, licensing by the NRC or Agreement State is necessary.

Under Section 62 of the Atomic Energy Act of 1954, as amended (AEA), the NRC's jurisdiction attaches when a person seeks to transfer or receive in interstate commerce, transfer, deliver, receive possession of or title to, import or export from the United States any source material after removal from its place of deposit in nature.<sup>12</sup> Similarly, the NRC's implementing regulations provide that, once the source material is removed from its place of deposit in nature, it becomes subject to the NRC's or Agreement State's jurisdiction and to the respective regulator's licensing requirements, if the person removing the ore seeks to possess, take title to, transfer, or deliver the ore.<sup>13</sup>

The NRC has exempted "unrefined and unprocessed ores," as defined in 10 CFR 40.4,<sup>14</sup> from NRC licensing.<sup>15</sup> In accordance with 10 CFR 40.13(a), source material below the 0.05 weight percent threshold is deemed unimportant and not subject to NRC regulation. As discussed in 10 CFR 40.13(b), a license is not needed to receive, possess, use, or transfer unrefined or unprocessed ore. A license is required for refining or processing ore, including ore that is below the 0.05 weight percent threshold. A license is also required to receive title to, receive, possess, use, transfer, or deliver source material. Source material is defined in the AEA as:

(1) uranium, thorium, or any other material which is determined by the Commission pursuant to the provisions of [Section 61 of the AEA] 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.<sup>16</sup>

Part 40 defines source material as:

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

In addition to the regulatory authority the NRC has over source material, the NRC also has broad regulatory authority over byproduct material. Pursuant to AEA Section 81, "[n]o person may transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, own, possess, import, or export any byproduct material," except as authorized by the NRC.<sup>17</sup> This provision is reflected in the NRC's implementing regulations in 10 CFR 40.3, which states that a person "may not receive title to, own, receive, possess, use, transfer, provide for long-term care, deliver or dispose of byproduct material... unless authorized in a specific or general license issued by the Commission."<sup>18</sup>

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<sup>12</sup> 42 U.S.C. § 2092.

<sup>13</sup> 10 CFR 40.3.

<sup>14</sup> "Unrefined and unprocessed ore" means "ore in its natural form prior to any processing, such as grinding, roasting or beneficiating, or refining. Processing does not include sieving or encapsulation of ore or preparation of samples for laboratory analysis." 10 CFR 40.4.

<sup>15</sup> The statutory basis for the exemption is the AEA Section 62 provision providing "that licenses shall not be required for quantities of source material which, in the opinion of the Commission, are unimportant." 42 U.S.C. § 2092.

<sup>16</sup> § 11z of the AEA, 42 U.S.C. § 2014.z.

<sup>17</sup> 42 U.S.C. § 2111.

<sup>18</sup> The term "byproduct material" as used in Part 40 is limited to Section 11e.(2) byproduct material. 10 CFR 40.4.

When the AEA was first passed, the definition of byproduct material did not encompass uranium mill tailings.<sup>19</sup> In the 1960s and 70s, awareness grew of the public health hazards associated with mill tailings, which were often left behind at former milling sites following the extraction of uranium or thorium from ore. Occasionally, mill tailings were removed from milling sites and used as construction material such as bedding material for pipes or backfill for utility trenches. In 1978, Congress passed the Uranium Mill Tailings Radiation Control Act (UMTRCA), which, among other things, amended the AEA to create a new category of byproduct material to give the NRC statutory authority over mill tailings and close the regulatory gap.

Also pursuant to UMTRCA, the EPA developed generally applicable standards to protect public health, safety, and the environment from the radiological and non-radiological hazards resulting from the processing, possession, transfer, and disposal of byproduct material. The NRC promulgated implementing regulations regarding the licensing and oversight of byproduct material; it also developed Appendix A to Part 40, which contains a set of 13 criteria that ensure proper operation and closure of a uranium mill and safe disposal of the byproduct materials that result from the extraction or concentration of uranium or thorium. The Appendix A criteria are focused on limiting emanation of radon from tailings and protecting groundwater. The NRC staff has been licensing conventional uranium mills and in situ recovery facilities using the framework in 10 CFR Part 40 and Appendix A since the mid-1980s.

The new definition of byproduct material was added to Section 11, paragraph e, subparagraph 2 of the AEA and is frequently referred to as Section 11e.(2) byproduct material. It is defined as: “the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.” 10 CFR 40.4 defines it similarly as:

the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by such solution extraction operations do not constitute ‘byproduct material’ within this definition.

Importantly, under the statutory and regulatory framework, whether material is 11.e(2) byproduct material is not based on the material’s composition, form, or hazards, but how the material came to be. Similarly, “uranium milling” is defined in 10 CFR 40.4 as “any activity that results in the production of byproduct material as defined in [10 CFR Part 40].”

Based on the legislative history of UMTRCA, the definition of 11e.(2) byproduct material is purposefully broad. In early draft legislation, byproduct material was initially defined as “the tailings or wastes produced by the extraction or concentration of uranium or thorium from source material.”<sup>20</sup> Aware that some mills were using feedstock that was less than the 0.05 weight

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<sup>19</sup> NRC Chairman Hendrie discussed this regulatory gap in jurisdiction during the UMTRCA hearings. He explained, “[h]istorically, the NRC and its predecessor agency have not had regulatory jurisdiction over uranium [mill tailings] after mill operations are terminated because the tailings are not themselves licensable material. Regulatory control over tailings is exerted indirectly as part of the Commission’s licensing of ongoing milling operations pursuant to licensing authority over source materials. Therefore, after operations had ceased... and all licensable quantities of source material removed, the regulatory staff had no further role.” Uranium Mill Tailings Control Act of 1978: Hearings on H.R. 11698, H.R. 12229, H.R. 12938, H.R. 12535, H.R. 13049 and H.R. 13650 Before the Subcomm. on Energy and Power of the House Comm. on Interstate and Foreign Commerce, 95th Cong., 2d Sess. 204–07 (1978) (“Hearings”) at 216.

<sup>20</sup> H.R. 13382, 95th Cong., 2d Sess. § 1 (1978).

percent cutoff in the 10 CFR Part 40 definition of source material and the potential for more mills to do so as high-grade ores became scarcer, then NRC Chair, Dr. Hendrie, testified, “Since [milling operations processing low-grade ore] should be covered by any regulatory regime over mill tailings, the Commission would suggest that the definition of byproduct material... be revised to include tailings produced by extraction of uranium or thorium from any ore processed primarily for its source material content.”<sup>21</sup> This revision was incorporated into UMTRCA. Therefore, Congress deliberately broadened the definition to avoid any potential gap in regulation based on a minimum ore grade or uranium or thorium level.

Moreover, the definition of byproduct material adopted was even broader than what the NRC proposed in its testimony, as it includes both “tailings *or wastes produced*” (emphasis added). Congress defined “tailings” in Title I of UMTRCA as “the remaining portion of a metal-bearing ore after some or all of such metal, such as uranium, has been extracted.”<sup>22</sup> EPA adopted this definition of “tailings” in its UMTRCA Title II regulations;<sup>23</sup> NRC regulations do not include a definition of tailings.<sup>24</sup> The term “wastes” is not defined by statute or regulation, and there is little legislative history explaining its addition; but there is some testimony describing “liquid material” or “waste junk material” associated with uranium mills and tailing ponds that may not have otherwise fallen within the definition of byproduct material.

Further, with respect to the definition of byproduct material and congressional intent, the U.S. Court of Appeals for the D.C. Circuit has ruled on what was meant by the terms “from any ore processed primarily for its source material content.” In *Kerr-McGee Chemical Corp. v. US NRC*,<sup>25</sup> the D.C. Circuit Court reviewed a challenge to the Commission’s then interpretation of the definition byproduct material in 11e.(2). The NRC had determined that a pile of tailings from ore first processed for its rare-earth content and then processed for its source material was not byproduct material but source material. The NRC also determined that another pile of tailings from ore first processed for its source material and then processed for its rare-earth content was byproduct material. This distinction was important because the State of Illinois, at that time, assumed regulatory jurisdiction of source material while the NRC retained regulatory jurisdiction of 11e.(2) byproduct material.<sup>26</sup> With the NRC’s initial determination, the two tailings piles would be regulated differently despite having the same chemical characteristics and hazards. At that time, the NRC took the position the term “primarily” to mean “unless the first, chief, or principal purpose for processing a particular batch of ore is to obtain source material, the resulting tailings are not byproduct material.”<sup>27</sup>

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<sup>21</sup> Hearings at 343.

<sup>22</sup> § 101(8) of UMTRCA; 42 U.S.C. § 7911(8). This term is only defined in Title I “Remedial Action Program” and not Title II “Uranium Mill Tailings Licensing and Regulations.”

<sup>23</sup> 40 CFR 192.01(m).

<sup>24</sup> In guidance, the NRC has interpreted tailings as “wastes produced by the extraction or concentration of source material from ores processed primarily for their source material content.” NUREG-1620, “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, Rev. 1 at iii (June 2003). The NRC website defines “mill tailings,” in part, as “[p]rimarily, the solid residue from a conventional uranium recovery facility in which uranium or thorium ore is crushed and processed mechanically or chemically to recover the uranium, thorium, or other valuable materials.” See <https://www.nrc.gov/reading-rm/basic-ref/glossary/mill-tailings.html>.

<sup>25</sup> *Kerr-McGee Chemical Corp. v. U.S. NRC*, 903 F.2d 1 (D.C. Cir. 1990).

<sup>26</sup> Subsequently, Illinois and the NRC updated their agreement to include 11e.(2) byproduct material. See *supra* n 4.

<sup>27</sup> *Kerr-McGee*, 903 F.2d at 5.



In its opinion, the D.C. Circuit noted that the statutory language was ambiguous and subject to interpretation.<sup>28</sup> But the D.C. Circuit found, after analyzing the legislative intent and history, that the NRC's interpretation of the definition of byproduct material should not be afforded *Chevron* deference because it:

frustrate[d] the twin purposes of the UMTRCA by recreating a gap in NRC licensing authority that the UMTRCA was designed to close and by placing certain radioactive wastes...outside of the regulatory regime established by the UMTRCA to deal with the health hazards posed by uranium and thorium mill tailings.<sup>29</sup>

The D.C. Circuit concluded that “the definition of ‘byproduct material’ proposed by [then NRC Chair Dr. Hendrie] and adopted by Congress was designed to extend the NRC’s regulatory authority over *all* wastes resulting from the extraction or concentration of source materials in the course of the nuclear fuel cycle.”<sup>30</sup>

The NRC has consistently applied the approach described in *Kerr-McGee* for the ensuing 30 plus years. In a subsequent decision, the Commission in *International Uranium (USA) Corporation* also addressed the meaning of “primarily” in Section 11e.(2). Relying on *Kerr-McGee* and also considering the text of UMTRCA and its legislative intent and history, the Commission concluded:

that the requirement that material be “processed primarily for its source material content” most logically refers to the actual act of processing for uranium or thorium within the course of the nuclear fuel cycle and does not bear upon any other underlying or “hidden” issues that might be driving the overall transaction.<sup>31</sup>

The *International Uranium (USA) Corporation* case dealt with the processing of alternate feed and the NRC staff’s associated guidance on the topic. Alternate feed refers to material that is not natural uranium ore. Indeed, at the time of the decision, NRC guidance interpreted the definition of Section 11e.(2) to require an NRC staff inquiry into a licensee’s motives, and it required certain licensees to “certify” that alternate feed material be “processed primarily for the recovery of uranium and for no other primary purpose.”<sup>32</sup> Recognizing that the guidance suggested “that a licensee’s motivations are to be scrutinized, parsed, and weighed,”<sup>33</sup> the Commission required the NRC staff to consider revising the guidance as it found it to be both unsupported by UMTRCA and an unsound policy.<sup>34</sup>

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<sup>28</sup> *Id.* at 7 (noting that “[t]his is not a situation where inconsistent results are mandated by the language Congress has written into law. Here the language is clearly ambiguous, or we would not be concerned with the deference due the agency’s interpretation under the *Chevron* analysis.”).

<sup>29</sup> *Id.* at 2. See also *id.* at 7 (noting that the NRC’s interpretation of the phrase “ore processed primarily for its source material content” was too narrow and achieved an anomalous result that frustrated critical congressional objectives).

<sup>30</sup> *Id.* at 7 (emphasis in original). Thus, the Court effectively rejected the NRC’s arguments that uniform treatment of materials was not legally required by UMTRCA. See, e.g., Brief for Respondents at 32, *Kerr-McGee*, *supra* n. 25. (“*Kerr-McGee* wants similar hazards to be regulated by one administrative body, according to one set of standards. Whether such uniformity is desirable or not, it is not what UMTRCA provides. Instead, UMTRCA, does in fact provide a patchwork division of authority among the states and several federal agencies.”).

<sup>31</sup> *International Uranium (USA) Corp.*, (Request for Materials License Amendment) CLI-00-01, 51 NRC 9, 15 (2000).

<sup>32</sup> “Final Revised Guidance on the Use of Uranium Mill Feed Material Other Than Natural Ores,” 60 Fed. Reg. 49296, 49297 (Sept. 22, 1995).

<sup>33</sup> CLI-00-01, 51 NRC at 15.

<sup>34</sup> *Id.* at 22.



Instead, the Commission stated that the definition of byproduct material in § 11e.(2) “focuses upon the *process* that generated the radioactive wastes—the removal of uranium or thorium as part of the nuclear fuel cycle.”<sup>35</sup>

*International Uranium (USA) Corporation* did not further elaborate on the meaning of “part of the nuclear fuel cycle;” however, legislative history does provide insight. When NRC Chair Hendrie suggested revisions to the draft Section 11e.(2) definition of byproduct he explained, “the intent of the language is to keep NRC’s regulatory authority primarily in the field of the nuclear fuel cycle, [n]ot to extend this out into such things as phosphate mining and perhaps even limestone mining.”<sup>36</sup> Chair Hendrie further stated that the language is meant to distinguish between activities that fall under NRC jurisdiction versus “things that ought to be left to EPA regulation under the Resource Conservation Recovery Act and general authorities.”<sup>37</sup>

In light of Chair Hendrie’s testimony, it is reasonable to interpret the phrase “part of the nuclear fuel cycle” as further clarifying activities within the NRC’s jurisdictional purview under the AEA. The NRC has limited its application of its Section 11e.(2) byproduct authority accordingly and has not applied the 10 CFR Part 40, Appendix A regulations to other mineral processing activities. For example, the staff responded to a request from the State of Nevada in 2018 regarding a proposed facility, which intended to remove and concentrate uranium from ore to produce vanadium.<sup>38</sup> Staff concluded that the project would not produce byproduct material because the processing focused on vanadium production rather than uranium.

Based on the NRC staff’s review of its statutory and regulatory authority, the potential for NRC licensing exists once a material has been removed from its place of deposit in nature and after the mining process has been completed. Additional activities such as remediation may fall within the NRC’s jurisdiction. Remedial activities to cover or stabilize mine waste in place would likely not require an NRC license. In this situation, the definition of unrefined and unprocessed ore would continue to apply to the overburden and subeconomic ore. Removal and offsite disposal of mine waste would likely not require an NRC license, similar to covering the material in place, because the overburden and sub-ore would meet the NRC definition for unrefined and unprocessed ore. However, in either case, if the disposal location is within the licensed area boundary (for a site in decommissioning) or within the long-term care boundary (for a site that has transitioned to Department of Energy (DOE) for long-term care), NRC oversight may be necessary because the unlicensed overburden and sub-ore may have impacts on the NRC-licensed material and site (e.g., impact the tailings impoundment).

Additionally, in accordance with the definitions in the AEA and 10 CFR Part 40, remediation activities that generate tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content require NRC

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<sup>35</sup> *Id.* at 18 (emphasis in original). See also *Sequoyah Fuels Corporation (Gore, Oklahoma Site)*, CLI-03-15, 58 NRC 349, 357 (2003) (“The Commission agrees that ‘the section 11e(2) definition focuses on the *process* that generated the radioactive wastes—the removal of uranium or thorium as part of the nuclear fuel cycle.’ The definition is thus adaptable to situations other than conventional uranium milling. Indeed, the only federal court to address the byproduct material definition directly stated that the definition ‘adopted by Congress was designed to extend the NRC’s regulatory authority over *all* wastes resulting from the extraction or concentration of source materials in the course of the nuclear fuel cycle.”).

<sup>36</sup> Hearings at 344-45.

<sup>37</sup> *Id.*

<sup>38</sup> Letter from NRC to Vanadium Gibellini Co. and Prophecy Development Corp., “Prophecy Development Gibellini Hill Radioactive Materials Licensing Regulatory Analysis” (Nov. 18, 2018) ([ML18283A071](#)).

licensing. The options for licensing presented in the next section of this paper are focused on this type of activity. The regulatory framework for source material is located in 10 CFR Part 40. The options presented below do not include 10 CFR Part 30 or Part 70 licensing pathways because the outputs of remedial technologies considered in this evaluation would not meet the definition of byproduct material under 11e.(1), (3), or (4) of the AEA or the definition of special nuclear material under 11aa. of the AEA, respectively.

### OPTIONS:

Pursuant to the Commission's direction in SRM-M230126, the staff has developed four options for the licensing of emerging technologies used for remediation of mine waste. Within Option 2, the staff discusses two approaches (i.e., Option 2A and 2B). For each option, the staff provides its evaluation of advantages and disadvantages, legal constraints, and viable alternative statutory and regulatory interpretations.

As of the date of this paper, there is no mine waste remediation application before the agency.<sup>39</sup> Therefore, the options are conceptual, permissible licensing options based on the staff's current understanding of known emerging mine waste technology.<sup>40</sup> During any licensing review of a technology to remediate mine waste, the NRC staff would focus its review on the potential doses to workers during operation, doses to the public, and the radiological hazards from thorium-230, thorium-232, radium-226, radium-228, and radon-222. Radium-226 is the radionuclide that presents the greatest radiological hazard. These hazards have the potential to persist in the residual on-site material and migrate to groundwater and surface water after a remedial technology is used. Additionally, these hazards are often latent.

There are also non-radiological hazards (e.g., chemical hazards) associated with remediation of mine waste.<sup>41</sup> The non-radiological hazards can result from the presence of heavy metals such as, but not limited to, selenium, arsenic, cadmium, and vanadium in byproduct material. Similar to the radiological hazards, the non-radiological hazards have the potential to persist in the residual on-site material and migrate to groundwater or surface water. Like the radiological hazards, the non-radiological hazards are often latent. The severity of these hazards would depend on the geology and mineralogy of the input material, remediation technology used, and site-specific circumstances. Under Options 1 and 3, and in accordance with UMTRCA and

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<sup>39</sup> Staff has only received one remediation application and is not aware of any other potential applications. Disa Technologies, Inc., "Resubmission – License Application for a Performance-Based, Multi-Site License, High-Pressure Slurry Ablation (HPSA), Disa Technologies, Inc., Casper, Wyoming" (Aug. 1, 2022) ([ML22213A146](#)). The application that was received is not currently pending before the agency. See NRC, "United States Nuclear Regulatory Commission Staff Regulatory and Acceptance Review of Disa Technologies' License Application for the Use of High-Pressure Slurry Ablation Technology (Docket No. 04038417) (Nov. 29, 2022) ([ML22318A006](#)).

<sup>40</sup> The staff has a limited understanding of the concentrations of constituents in the residual onsite material resulting from mine waste remediation. This limited understanding of the concentrations makes it challenging to understand the severity of the radiological and non-radiological hazards. As more information becomes available, the staff's understanding of these hazards may evolve and further inform the staff's views on the most appropriate licensing framework.

<sup>41</sup> UMTRCA was enacted in large part to address the health and safety implications of these non-radiological hazards. See e.g., § 2 of UMTRCA, 42 U.S.C. § 7901; § 205 of UMTRCA (amending § 84 of the AEA), 42 U.S.C. § 2114.

10 CFR Part 40, Appendix A,<sup>42</sup> the NRC staff would consider potential non-radiological hazards in its review. Under Options 2 and 4, the NRC would not have authority to regulate or consider these hazards.

**Option 1 – license emerging technologies used for remediation of mine waste that extract or concentrate uranium or thorium under the uranium milling (source and byproduct material) framework in 10 CFR Part 40 and Appendix A.**

*Key Points*

Under Option 1, the following key points apply, as described in more detail below:

- Utilizes the existing uranium milling framework (i.e., source and byproduct material would be generated)
- Applies the established flexible requirements in Part 40 and Appendix A that provide a case-by-case, risk-informed approach
- Allows for alternatives or exemptions from Appendix A requirements, including but not limited to liner systems, radon barriers, earthen covers, and long-term care, as appropriate
- Requires no programmatic actions to implement
- Does not generate technologically enhanced naturally occurring radioactive materials (TENORM)
- Does not create a different licensing framework for technology that can also be used for traditional milling
- Does not require any alternative statutory or regulatory interpretations and is consistent with Federal and Commission caselaw
- Has no legal constraints
- Has no programmatic unintended consequences such as altering the NRC's jurisdiction

*Description of Option*

Under this option, the staff would license remediation technologies that process mine waste and extract or concentrate uranium or thorium, thus generating byproduct material, as uranium milling activities. This approach would not require a different statutory or regulatory interpretation as it is consistent with the current, long-standing position on the definition of byproduct material.<sup>43</sup> An applicant would be subject to the regulations of 10 CFR Part 40 as well as Appendix A, with the inherent flexibility provided for in 10 CFR Part 40 and Appendix A, based on the remediation technology.

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<sup>42</sup> A sizeable portion of the Appendix A criteria are focused on non-radiological hazards, primarily through protection of ground water. See, e.g., 10 CFR Part 40, Appendix A, Criterion 5, 7, 7A, and 13, see also "Uranium Mill Tailings Regulations; Conforming NRC Requirements to EPA Standards," 50 Fed. Reg. 41852 (Oct. 16, 1985).

<sup>43</sup> See Letters from the NRC to the Colorado Department of Public Health and Environment, Radiation Control Program (Sept. 23, 2015) ([ML15251A164](#)) and (Oct. 19, 2016) ([ML16272A302](#)) (providing support to the State of Colorado); see also Letter from the NRC to Christopher Pugsley on Behalf of Western Uranium and Vanadium Corporation, "U.S. Nuclear Regulatory Commission Response to White Paper Entitled 'Recommendations on the Proper Legal and Policy Interpretation for Using Kinetic Separation Processes at Uranium Mine Sites'" (July 24, 2020) ([ML20071G215](#)) (responding to a potential applicant).

The regulations in 10 CFR Part 40 address the procedures and criteria for issuance of a license for source material. The Part 40 requirements would apply to the uranium and thorium laden material. The regulations in Appendix A are focused on the requirements for safe disposal of 11e.(2) byproduct material. Appendix A contains 13 criteria on technical, financial, ownership and long-term site surveillance requirements related to the siting, operation, decontamination, decommissioning, and reclamation of uranium mills and tailings or waste retention systems. The technical criteria are focused on maintaining isolation of byproduct material, protection of groundwater, and minimization of radon flux. Because of the safety and environmental issues raised by emerging technologies to remediate mine waste discussed above, including the potential for radioactive material to persist in the residual on-site material and the mobilization of potential contamination and other hazardous materials into air, surface water, or groundwater, the staff views these regulations as appropriately addressing the potential hazards. The Appendix A criteria would apply to the residual on-site material and ensure the safe management of such material, minimizing potential environmental and safety impacts, while providing scrutable and transparent flexibility.

While the NRC originally developed Appendix A criteria for conventional uranium milling, the criteria allow considerable flexibility to license new and novel technologies in a risk-informed manner. Specifically, Appendix A states, in part, “[d]ecisions involved [with implementing Appendix A] will take into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.”

The NRC staff also has experience implementing the inherent flexibilities in Appendix A to license new technologies. Specifically, the NRC used the flexibilities in 10 CFR Part 40 Appendix A to regulate in situ recovery of uranium effectively and efficiently. For example, in situ recovery generally does not generate mill tailings and is regulated accordingly. Appendix A’s inherent flexibilities would similarly be applied to license new and emerging technologies used for remediation purposes.

As outlined below, Appendix A’s inherent flexibilities include: (1) allowing applicants or licensees to propose alternatives to the specific requirements in Appendix A, (2) providing for exemptions from certain requirements within particular criteria, and (3) permitting applicants and licensees to use or seek specific exemptions under 10 CFR 40.14.

First, Appendix A states that “Licensees or applicants may propose alternatives to the specific requirements in [Appendix A].” The Commission may approve of these alternatives provided an equivalent level of protection to EPA’s generally applicable standards found in 40 CFR Part 192 is afforded. These provisions allow for considerable flexibility in maintaining adequate protection of public health and safety and the environment consistent with the flexibility Congress afforded the Commission in regulating byproduct material generally.<sup>44</sup>

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<sup>44</sup> Section 84 of the AEA directs the Commission to “insure that management of any byproduct material, as defined in 11e.(2), is carried out in such manner as—(1) the Commission deems appropriate to protect the public health and safety and the environment from radiological and non-radiological hazards associated with the processing and with the possession and transfer of such material taking into account the risk to the public health, safety, and the environment, with due consideration of the economic costs and such other factors as the Commission determines to be appropriate.”

Both the NRC staff and Agreement States have sought and received Commission approval for alternate standards. In 2013, the Commission approved site-specific alternate standards for soil cleanup levels for the Uravan site in Colorado.<sup>45</sup> In 2004, the Commission approved reliance on institutional controls, instead of groundwater corrective actions, at the Western Nuclear Site in Wyoming.<sup>46</sup> The Commission has also approved generic alternate standards related to groundwater protection that can be used by the State of Utah's uranium recovery program.<sup>47</sup> Therefore, the NRC can and has allowed for different requirements, consistent with the flexibility in the existing regulations.

Second, some Appendix A criteria explicitly include mention of exemptions or alternate requirements based on reduced hazards. For example, Criterion 5A(1) requires construction of a liner system to prevent migration of any wastes into subsurface soil, groundwater, or surface water. However, Criterion 5A(3) permits exemptions to the requirements of 5A(1), provided that the applicant or licensee can demonstrate that the wastes will not migrate. In reviewing an exemption request for Criterion 5A(1), the NRC staff considers the nature and quantity of the residual on-site material, the applicant or licensee's proposed plans, the hydrogeologic setting, and any other factors that could influence potential migration to groundwater or surface water.

Similarly, Criterion 6(1), in disposing of byproduct material requires an earthen cover that will limit radon flux.<sup>48</sup> The cover must provide reasonable assurance of control of radiological hazards for at least 1,000 years, to the extent reasonably achievable, and in any case for at least 200 years. As discussed in Criterion 6(6), the longevity and radon release criteria apply at all portions of a site. However, if it can be demonstrated that the soil cleanup standards, which are based on the concentration of radium in soil, meet certain numeric criteria,<sup>49</sup> then the requirements for longevity and radon flux do not apply.

The staff recognizes that some of the Appendix A criteria may not apply and Agreement States (with 11e.(2) byproduct material licensing authority) may view applicability differently. For example, Criterion 8, which is focused on dryer emissions, is unlikely to be relevant in a remediation setting. The NRC staff could view the need for pre-operational monitoring called for in Criterion 7 differently in a remediation setting. Similarly, the need to set aside funds for site cleanup to address Criterion 9 may not apply if the remedial activity is being performed to clean up a site.

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<sup>45</sup> "Staff Requirements – SECY-12-0042 – Colorado Alternative Standards; Implementation of the Alternative Standards Provision in Section 274o of the Atomic Energy Act of 1954, as Amended" (May 18, 2012) ([ML12139A119](#)).

<sup>46</sup> "Staff Requirements – SECY-05-0200 – Efforts by Western Nuclear, Inc., to Acquire Off-Site Properties in Conjunction with Decommissioning its Uranium Recovery Site and the Need for Institutional Controls" (Nov. 28, 2005) ([ML053320206](#)).

<sup>47</sup> "Staff Requirements – SECY-04-0128 – Amendment to Section 274B Agreement with the State of Utah and Approval of Alternative Groundwater Standards" (Aug. 4, 2004) ([ML042170320](#)).

<sup>48</sup> The radon flux standard is 20 picocuries per square meter per second. 10 CFR Part 40, Appendix A, Criterion 6.

<sup>49</sup> These numeric criteria are exceedance of the background level by more than 5 picocuries per gram (pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 centimeters (cm) below the surface, and (ii) 15 pCi/g of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over 15-cm thick layers more than 15 cm below the surface. 10 CFR Part 40, Appendix A, Criterion 6A. This standard of 5 pCi/g above background is based on potential health effects. See EPA EIS supporting development of the 40 CFR Part 192 regulations, *supra* n. 9.

Finally, the NRC may grant an exemption from the Part 40 regulations either on its own initiative or upon application of any interested person. The NRC may grant an exemption if it meets the requirements in 10 CFR Part 40.14(a).

An example where an exemption may be appropriate for emerging mine waste remediation technologies is the criterion concerning land ownership of disposal sites and the need for long-term monitoring and maintenance. Typically, in accordance with Appendix A Criterion 11, licensees transfer the land used for disposal of byproduct material to the DOE or the host state for long-term care and maintenance. This is done to isolate and protect the byproduct material and its related radiological and non-radiological hazards. However, as discussed in Section 83(b)(1) of the AEA, the Commission can find that transfer of title to the land used for disposal of byproduct material is not necessary or desirable to protect public health, safety, or welfare. Additionally, Section 83(b)(5) of the AEA does not require long-term monitoring and maintenance at the disposal site; rather, it only states that the Commission may require it, as appropriate.<sup>50</sup> Depending upon future license applications for mine waste remediation and the site circumstances following remediation, exemptions from Appendix A Criterion 11 may be appropriate.

In addition to the safety review described above, which would be documented in a safety evaluation report (SER), the staff will perform an environmental review in licensing mine waste remediation technologies. The environmental review would be consistent with the National Environmental Policy Act (NEPA) and 10 CFR Part 51. The NRC's regulations in 10 CFR 51.20(b) provide that a uranium milling license requires preparation of an environmental impact statement (EIS). This requirement contemplates traditional uranium mills.<sup>51</sup> The staff recognizes that some emerging remediation technologies may have different, and potentially fewer, environmental impacts than traditional uranium mills. The NRC's regulations allow for an exemption from the requirement to prepare an EIS, either by application of an interested person or on the NRC's own initiative. Therefore, it is possible that an applicant need not prepare an EIS for a particular mine waste remediation technology, based upon the particular proposal.

Only those seven Agreement States with 11e.(2) authority could implement Option 1; the NRC would be required to license remediation in the remaining 32 Agreement States as well as for Tribal lands.

### *Advantages*

The licensing framework under 10 CFR Part 40 and Appendix A is well established and implemented by the NRC staff, Agreement States, and uranium recovery licensees. This framework can be tailored for mine waste remediation technologies. Licensing remedial technologies for mine waste cleanup under the Appendix A framework is consistent with current NRC practice, existing statutory and regulatory interpretations, the existing licensing framework, the NRCs' Principles of Good Regulation, and applicable, long-standing Federal and Commission case law. This option provides flexibility, assuming an applicant or licensee can demonstrate that alternative standards or exemptions provide an equivalent level of protection

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<sup>50</sup> For example, the NRC has found that in-situ recovery technology, while milling that generates 11e.2 material, does not generate tailings that require long-term surveillance and control. See NUREG-1569, "Standard Review Plan for In Situ Leach Uranium Extraction License Applications," Section 6 and Appendix B (June 2003).

<sup>51</sup> "Environmental Protection Regulations for Domestic Licensing and related Regulatory Functions and Related Conforming Amendments," 49 Fed. Reg. 9351 (Mar. 12, 1984).

commensurate with the associated radiological and non-radiological hazards of a technology. The NRC staff would be able to fully risk inform its approach, based on evolving data that is appropriate for the hazards presented by the remedial technology. While the license issued would be for source and byproduct material, many of the Appendix A criteria may not apply because, for example, the requirements may be inapplicable to a given technology; consequently, the staff would consider alternatives and exemptions. Additionally, this option could be implemented immediately, which would help facilitate mine waste cleanups.

This option allows the NRC and Agreement States to leverage over 40 years of experience with the uranium milling framework. This option also leverages the NRC's in situ recovery licensing experience, which similarly tailored existing milling requirements to address an emerging technology. Further, this option does not have any of the unintended consequences discussed in the other options because there would be no change in the NRC's position on what constitutes milling or byproduct material, no impact to statutory or regulatory interpretations, and no necessary changes to statutory or regulatory provisions or guidance.<sup>52</sup>

Additionally, the NRC staff recognizes that it may be possible to use a remediation technology as part of a traditional milling operation. Using the structure of Part 40 and Appendix A for both potential uses of the same technology would maintain a consistent licensing framework. Moreover, focusing on the "process" of the technology and not the intent for which it is used is consistent with UMTRCA and associated Federal and Commission caselaw (and, therefore, poses the least overall legal risk).

Finally, this option avoids creating any unintended issues for state regulators (not just Agreement States) as it would not result in any regulatory gaps, such as the generation of TENORM, which is material that is defined and regulated by the states, or material that would otherwise be regulated by the EPA. Rather, under this option, the residual on-site material would meet the definition of byproduct material, so it would not be considered TENORM.

Moreover, Option 1 provides NRC staff an opportunity to learn from licensing mine remediation technology before making any programmatic changes. The NRC staff can use the inherent flexibilities in Part 40 to risk inform its review and tailor exemptions and alternatives as appropriate to a specific technology or site, particularly since there may be a limited number of applicants before the NRC.

### *Disadvantages*

Alternate standards and exemptions may be both technology and site dependent and would need to be addressed on a case-by-case basis. This could extend the period of review of an application. However, in time, assuming the NRC receives multiple applications, the NRC staff could identify trends with alternate standards or exemptions. The NRC staff could leverage its experience, in conjunction with the Agreement States with authority for 11e.(2) byproduct material, to develop licensing guidance discussing the applicability of requirements and appropriate exemptions and seek Commission approval of generic alternate standards to better tailor the Appendix A criteria to a remediation setting.

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<sup>52</sup> Some of these unintended consequences are outlined in a February 2023 letter from the Wyoming Mining Association to Senator Lummis. See *infra* n. 666.



### *Legal Constraints*

There are no legal constraints with this option. As discussed at length above, this option is consistent with Federal case law (i.e., the *Kerr-McGee* decision).

### *Viability of Alternative Statutory and Regulatory Interpretations*

This option does not require any alternative statutory or regulatory interpretations.

### **Option 2A – license emerging technologies used for remediation of mine waste that extract or concentrate uranium or thorium under the source material framework in 10 CFR Part 40.**

#### *Key Points*

Under Option 2A, the following key points apply, as described in more detail below:

- Utilizes the source material framework
- Requires changing the definition of “ore” in guidance or defining “ore” in regulation
- May generate what could be characterized as TENORM, which would be state-regulated
- Does not require long-term care, if unrestricted release criteria are met
- Results in different licensing frameworks for similar technologies
- Creates potential for unintended consequences such as altering the NRC’s jurisdiction, creating regulatory gaps that UMTRCA closed, and generating regulatory uncertainty

#### *Description of Option*

Under this option, staff would regulate remediation technologies for mine waste cleanups that extract or concentrate uranium or thorium under the source material framework in 10 CFR Part 40. The source material framework would apply to the uranium and thorium laden material, and the residual on-site material would likely not be regulated by the NRC (assuming it is neither source nor byproduct material). The NRC staff’s oversight would be focused on the possession and use of source material. In order to regulate remediation technologies solely under Part 40’s source material provisions, the NRC staff would need to reinterpret or redefine certain terms in the definition of byproduct material. This could be accomplished via revisions to NRC regulations or a change in agency interpretations, policy, and associated guidance.

Under this option, the agency would regulate the technology under a Part 40 source material license while mine waste remediation activities are in progress. The applicable portions of Part 20 would also apply, including occupational and public doses. At license termination (i.e., after completion of the remediation activities), licensees would need to meet the criteria in 10 CFR Part 20, Subpart E, “Radiological Criteria for License Termination.” The annual dose under Subpart E considers all exposure pathways. These exposure pathways include groundwater and contributions from radium-226 and its decay chain through direct exposure, inhalation, and ingestion of food raised and grown at the site location. The licensee would be required to meet the criteria for unrestricted (or restricted if applicable) release.

The NRC has limited flexibility regarding what terms may be reinterpreted or redefined because of the AEA and Federal case law. The NRC does not have the ability to alter definitions for

terms defined in the AEA. Therefore, it is not possible for the NRC to alter, for example, the definition of “byproduct material,” which is defined in Section 11 of the AEA.

Similarly, as discussed earlier in this paper, the staff is constrained in its ability to reinterpret the meaning of processed “primarily for its source material content” in the definition of byproduct material given the holding in *Kerr-McGee*. As previously discussed, the Court rejected the Commission’s view that “processed primarily” meant a determination of the purpose for which the ore is first processed (i.e., rare earths versus uranium or thorium).<sup>53</sup> Because of the D.C. Circuit decision, the meaning of processed “primarily for its source material content” cannot consider intent (e.g., to preclude processing primarily for site remediation from falling outside the scope of activities generating byproduct material).

In addition, the agency cannot interpret “tailings or waste produced” to exclude material generated from remediation activities because of *Kerr-McGee* and the definition of “tailings” in Title I of UMTRCA. As noted above, “tailings” is defined in Title I as “the remaining portion of a metal-bearing ore after some or all of such metal, such as uranium, has been extracted.” Notwithstanding the other elements in the definition of byproduct material, this definition of tailings would encompass some of the resulting material following application of known emerging mine waste remediation technology. Although the definition of “tailings” applies to Title I of UMTRCA only, it would be legally problematic to adopt an alternative definition or interpretation of this term, especially because EPA has adopted the Title I definition in its implementing regulations, which include implementation of Title II.<sup>54</sup> Finally, to interpret remediation activities as not producing tailings or wastes, for example, because no new material is “produced,” would run counter to *Kerr-McGee*. Specifically, the Court rejected the NRC’s arguments regarding the uniform treatment of this produced material,<sup>55</sup> finding that non-uniform treatment would squarely “frustrate the purposes of the UMTRCA by rendering it inapplicable to waste material that it was clearly intended to reach and recreating a jurisdictional gap it was intended to close.”<sup>56</sup>

Further, during the development of this option, the NRC staff also considered narrowing the definition of “uranium milling” in 10 CFR 40.4, for example, to exclude mine waste remediation activities.<sup>57</sup> The current definition provides that “Uranium Milling means any activity that results in the production of byproduct material as defined in this part.” This definition corresponds to the language in AEA § 11e.2 (and 10 CFR § 40.4), which provides that “byproduct material means the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.” Therefore, revising the definition of “uranium milling” would not change the applicability of AEA § 11e.2 because mine waste remediation technologies would still generate byproduct material given the statutory definition. Thus, revising the definition of “uranium milling” would not alter the framework under which such technologies would be regulated and, therefore, was not further considered.

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<sup>53</sup> *Kerr-McGee*, 903 F.2d at 5. The NRC construes the word “primarily” to mean that the extraction of thorium or uranium must be the first, chief, or principal reason for processing the ore brought to a mill in order for the resulting tailings to be characterized as “byproduct material.” *Id.* at 7.

<sup>54</sup> 40 CFR 192.2(m).

<sup>55</sup> See *supra* n. 30.

<sup>56</sup> *Kerr-McGee*, 903 F.2d at 8.

<sup>57</sup> See CLI-03-15, 58 NRC at 356 (“Neither UMTRCA nor its legislative history explicitly addressed what constitutes milling. Indeed, the statute used the term “processing,” not “milling”; thus, Congress left this subject open for interpretation.”).

While most terms and phrases in the definition of 11e.(2) byproduct material have legal constraints precluding reinterpretation or redefining under this option, one term does have the potential to be reinterpreted or redefined. The statutory and regulatory definition of byproduct material is limited to the extraction or concentration of uranium or thorium from any *ore* processed primarily for its source material content. The term “ore” is not defined in the statute. Currently, “ore” only is defined in Regulatory Issue Summary 2000-03, which is also reprinted in Appendix I of NUREG-1620 “Standard Review Plan for the Review of Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978.”<sup>58</sup> Regulatory Issue Summary-2000-03 defines “ore” 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.

This definition was developed to aid in evaluating alternate feed requests. As currently defined, the material to which the remediation technology would be applied meets the definition of “ore” as it is native matter that has been mined and would now be treated for the extraction of constituents. Because the input material constitutes “ore” and because it is processed primarily for its source material content, the NRC considers the residual on-site material following application of the technology to be byproduct material and the activity to be uranium milling.<sup>59</sup> Under NRC’s existing framework, uranium milling is regulated under Part 40, including Appendix A. However, if the NRC reinterpreted ore not to include the input material, then the NRC would not consider the remediation technology as generating byproduct material, and only a source material license would be required for the uranium and thorium laden material extracted following application of the technology. As such, the Appendix A requirements would not apply.

More specifically, the term “ore” could be reinterpreted or redefined to distinguish between uranium milling and mine cleanup activities.<sup>60</sup> This could be done via revisions to guidance, or the definition could be codified in NRC regulations via a rulemaking. One way of redefining “ore” could include the NRC staff developing a specific date (e.g., material exhumed after a date certain) as a basis for differentiating between the processing of ore and mine waste remediation.<sup>61</sup> If the NRC changed its existing definition of “ore” by codification in NRC regulations, the staff would develop a rulemaking plan for Commission review describing proposed changes to 10 CFR Part 40.

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<sup>58</sup> “Unrefined and unprocessed ore” is however, defined in 10 CFR Part 40.4. See *supra* n. 14.

<sup>59</sup> In *Sequoyah Fuels Corp.*, the Commission stated, “Because the NRC has broadly defined ‘ore’ to include ‘any... matter from which source material is extracted,’ ore actually has a place in both the (traditional) milling and the conversion segments of the fuel cycle.” 58 NRC at 356. The Commission went on to find that front-end waste from yellowcake solvent extraction may be considered 11e.(2) byproduct material. CLI-03-15, 58 NRC at 359.

<sup>60</sup> As the DC Circuit Court noted, the word “ore” is subject to more than one meaning. See *Kerr-McGee*, 903 F.2d at 7 & 8 (1990).

<sup>61</sup> This approach would be conceptually similar to what was done to differentiate between UMTRCA Title I and Title II sites (though, in that case, it was done statutorily). Title I sites are named explicitly in the statute whereas Title II applies to “Any license issued or renewed after the effective date of [UMTRCA] under section 62 or section 81 for any activity which results in the production of any byproduct material, as defined in section 11e.” § 202(a) UMTRCA (amending § 83 of the AEA). Similarly, exhumed material that exists as of a certain date could be deemed as not constituting “ore” but as some other material to distinguish between processing of ore and cleaning up mine waste.

Under this option, until the term “ore” is reinterpreted or redefined, the NRC staff would license remediation technology under the current 10 CFR Part 40 and Appendix A framework using the embedded flexibilities of exemptions and alternative standards on a case-by-case basis. Using the current framework as an intermediate step, as described more fully under Option 1 above, would provide the staff an opportunity to gain experience in licensing and regulating emerging mine waste remediation technology, including how to reinterpret or redefine “ore,” while also providing stakeholders an interim licensing pathway.

When conducting individual licensing reviews under this option, the NRC staff would prepare an SER and conduct an environmental review consistent with NEPA. Under Option 2, preparation of an EIS is not required by 10 CFR 51.20(b). The NRC staff will assess the application and complete the appropriate review (e.g., Environmental Assessment or EIS).

Nearly all Agreement States could implement this option since it is based on the source material framework.

### *Advantages*

Licensing remedial technologies for mine waste remediation under the source material framework may result in a more streamlined licensing process than in Option 1 once the definition of ore is revised, either by regulation or in guidance. When compared to the uranium milling framework, licensing under the source material framework would likely not require exemptions or alternate standards. Instead, reliance on the unrestricted release criteria would be protective of public health and safety and the environment.

Reinterpreting or redefining “ore,” through guidance only, could offer some time and resource efficiencies due to fewer procedural requirements compared with amending 10 CFR Part 40. However, when compared to the approach of revising guidance only, a limited scope rulemaking focused on codifying relevant terminology in NRC regulations would be a more transparent and reliable process. A rulemaking would provide the opportunity for more public, industry, and Agreement State participation, which could elicit comments that could inform and further improve the regulatory distinction drawn between uranium milling activities and cleanup activities. Making changes to the regulations, as opposed to revisiting guidance, would also help ensure consistency across the National Materials Program. Agreement States are obligated to adopt regulations to maintain compatible programs.

### *Disadvantages*

Regulating remediation activities under the source material framework would create different licensing frameworks and requirements for the same technology—a technology would be regulated as source material when used in a remediation capacity and regulated as both source and byproduct material when used in traditional uranium milling situations—despite both uses involving similar, if not the exact same, radiological, and non-radiological hazards. An example is the high-pressure slurry ablation technology. A company in Utah is considering using the technology to extract uranium from ore.<sup>62</sup> Although we do not currently have an application pending before the agency, the same technology has also been proposed for remediation of

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<sup>62</sup> *Company Reveals Plans for New US Uranium Plant*, WORLD NUCLEAR NEWS ([Jan. 24, 2023](https://www.world-nuclear-news.org/Articles/Company-reveals-plans-for-new-US-uranium-plant)), available at <https://www.world-nuclear-news.org/Articles/Company-reveals-plans-for-new-US-uranium-plant>.

mine waste.<sup>63</sup> Because remediation technologies present the same or similar hazards, current NRC and Agreement State licensees would be subject to different, and possibly more burdensome, regulatory requirements.

This approach could also cause the creation of a regulatory gap contrary to congressional intent with passage of UMTRCA. Creating this regulatory gap may cause, for example, state regulators (not just Agreement States) to exert regulatory oversight of residual on-site material as this option may generate TENORM, as defined by the states. As stated earlier, the NRC does not regulate TENORM. There are no national regulations or criteria for TENORM, and states have different definitions and regulatory approaches for TENORM, which could cause additional confusion and inconsistencies.

As discussed above, the concentration of the radioactive material that remains in the residual on-site material is a key factor in determining the health and safety consequences. Under this option, the potential presence of radium-226 may make it challenging for an applicant to demonstrate that the 10 CFR Part 20, Subpart E, criteria can be met.

If the agency revised the definition of “ore” via guidance (as opposed to a rulemaking revising NRC regulations), Agreement States are not required to adopt the same revised definition. This could result in further licensing disparities (in addition to the licensing disparities that would be created if the same technology is used in a remediation capacity and a traditional milling situation). On the other hand, if the agency pursues a rulemaking to revise NRC regulations, the length of time generally needed to complete a rulemaking and develop any associated guidance is a consideration. Agreement States also have a 3-year window to update their programs to be compatible with changes to the NRC’s regulations. Further, even though there are approximately 15,000 abandoned uranium mines across the United States, with more than 500 mines in and around the Navajo Nation, the number of potential remediation technologies or potential applicants using those technologies are unknown. As a result, the cost of developing a rule may not be warranted or may be overburdensome and inefficient if only a limited number of applications are received.

A rulemaking change also could have unintended or unanticipated consequences, including for the NRC’s regulatory authority. Under UMTRCA, Congress gave the NRC authority “to protect the public health and safety and the environment from radiological and non-radiological hazards associated with the processing and with the possession and transfer of [11e.(2) byproduct material].”<sup>64</sup> If the NRC-licensed remediation technologies under the source material framework, the NRC would no longer have authority to regulate any non-radiological hazards (e.g., chemical hazards) associated with such activities. This would be counter to UMTRCA’s purpose and would potentially create regulatory gaps that might need to be filled by the EPA or Agreement States.

Finally, revisiting long-standing NRC positions would create inconsistencies compared to past NRC actions, would depart from over 45 years of licensing and regulatory activities, and could have other unintended consequences within Part 40 and beyond. For example, redefining “ore” despite its long-established meaning could broadly alter the NRC’s or Agreement States’ jurisdiction and potentially create regulatory gaps in the uranium mining and milling stream, a

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<sup>63</sup> See *supra* n. 39.

<sup>64</sup> § 84(a)(1) of the AEA; 42 U.S.C. § 2114.

gap that Congress intended to close with UMTRCA, creating a substantial risk of dual regulation for mine waste remediation technologies with the radiological hazards regulated by the NRC and non-radiological hazards regulated by a different federal or state authority.

Additionally, changes to the definition of ore in regulation or in guidance would create regulatory uncertainty for licensees, Agreement States, and other agencies such as the EPA. Indeed, Agreement States expressed concerns over changing definitions in regulations or guidance and how potential changes in guidance would be interpreted across jurisdictions.<sup>65</sup> The Wyoming Mining Association also provided an industry perspective on the difficulties of altering definitions in this area.<sup>66</sup> For example, the EPA in its regulations defines “uranium byproduct material” very similarly to the NRC’s definition of byproduct material in 10 CFR 40.4.<sup>67</sup> Changes in the way in which the NRC interprets or defines certain terms could result in conflicting definitions, reintroducing the aforementioned regulatory gaps that Congress, through UMTRCA, intended to close. As a result, EPA may, for example, revisit its policy of not listing NRC-licensed UMTRCA sites on the National Priorities List. In addition, if the NRC concluded that wastes and tailings generated by mine waste remediation technologies are not byproduct material, then EPA may similarly reassess its approach to the regulation (or non-regulation) of these materials, including the imposition of similar or more restrictive requirements and dual regulation concerns.

### *Legal Constraints*

Given the D.C. Circuit Court of Appeals decision in *Kerr-McGee*, the meaning of “processed primarily for its source material content” cannot be interpreted to consider intent. For this same reason and because of the definition of “tailings” in Title I of UMTRCA, it would be problematic to interpret “tailings or wastes produced” differently to scope out remediation activities.

Likewise, *Kerr-McGee* could be read to constrain the agency from reinterpreting or redefining “ore” in a way that would have the effect of treating similar materials differently. As discussed, the D.C. Circuit rejected the NRC’s arguments regarding uniformity of treatment and concluded that the AEA definition of 11e.(2) byproduct material covered “all wastes resulting from the extraction or concentration of source materials in the course of the nuclear fuel cycle.”<sup>68</sup> Notably, the D.C. Circuit’s analysis considered “ore” as part of the “key phrase” at issue.<sup>69</sup> Therefore, the D.C. Circuit’s rejection of the NRC’s interpretation of “primarily” in *Kerr-McGee*—because it was inconsistent with Congress’s overarching intent to regulate all wastes in the same manner—could credibly apply to efforts to redefine “ore.”

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<sup>65</sup> See *infra* “Coordination with Agreement States” on page 31, summarizing a discussion that was held with several Agreement States with relevant licensing experience.

<sup>66</sup> Letter from Wyoming Mining Association to Senator Lummis, “Proposed Legislation to Revise the Atomic Energy Act of 1954 as Amended” (Feb. 3, 2023) ([ML23118A392](#)). This letter discusses unintended consequences that would result from revisions to the Atomic Energy Act and the definition of byproduct material. Similar unintended consequences could occur from Option 2.

<sup>67</sup> 40 CFR 192.31 (“Uranium byproduct material means the tailings or wastes produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction operations, and which remain underground do not constitute “byproduct material” for the purpose of this subpart.”) See *also* 40 CFR 61.251(g) (“Uranium byproduct material or tailings means the waste produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction, and which remain underground do not constitute byproduct material for the purposes of this subpart.”).

<sup>68</sup> *Kerr-McGee*, 903 F.2d at 7 (emphasis in original).

<sup>69</sup> See *id.* (“Here, the NRC could easily have placed an alternative construction on the key phrase, ‘ore processed primarily for its source material content,’ that would not have scuttled critical congressional objectives.”).

Even if *Kerr-McGee* is not read as preventing a reinterpretation or redefinition of “ore,” doing so carries other legal risk, particularly if the NRC interpretation or definition does not comport with industry usage and commonly understood meanings across agency and industry practice and use. Additionally, reinterpreting or defining “ore” differently might result in different, and arguably arbitrary, treatment of similar regulated entities based solely on the use they choose to make of that technology for conventional milling or for remediation.

#### *Viability of Alternative Statutory and Regulatory Interpretations*

It is not viable to reinterpret “processed primarily for its source material content” given controlling Federal case law. For this same reason and because of the definition of “tailings” in Title I of UMTRCA, it is not viable to reinterpret “tailings or wastes produced.” It is potentially viable to reinterpret or redefine “ore.” However, such an approach introduces challenges akin to reinterpreting “processed primarily for its source material content,” as the NRC would again be attempting to draw a regulatory distinction based upon a regulated entities’ stated intent, not the process, materials, and radiological and non-radiological hazards implicated in a proposal, which is contrary to *Kerr-McGee*. As discussed earlier, while it is possible to redefine “uranium milling,” doing so would not permit a source material only approach, as the mine waste remediation activity would still generate 11e.(2) byproduct material.

#### **Option 2B – license emerging technologies used for remediation of mine waste that extract or concentrate uranium or thorium under the source material framework in 10 CFR Part 40 via a service provider license.**

##### *Key Points*

Under Option 2B, the following key points apply, as described in more detail below:

- Utilizes the source material framework, with a service provider approach
- Requires changing the definition of “ore” in guidance or by regulation
- May generate what could be characterized as TENORM, which would be state-regulated
- Does not require long-term care, if unrestricted release criteria are met
- Creates different licensing frameworks for similar technologies
- Has higher potential for significant, unintended consequences such as altering the NRC’s jurisdiction, creating regulatory gaps that UMTRCA closed, regulatory uncertainty, and additional remediation measures if needed to reach unrestricted release criteria
- Could be more difficult to implement than Option 2A because of the service provider approach

##### *Description of Option*

Under Option 2B, the NRC would pursue reinterpreting or redefining “ore” as discussed in Option 2A via revisions to regulations or guidance to license remediation technologies under 10 CFR Part 40. In addition, under this approach, the NRC would license such technologies via a service provider license. A service provider licensee is not tied to a specific location but is authorized to perform work at any location (e.g., temporary jobsites) within the jurisdiction of the licensing agency. Since a service provider licensee is authorized to work at temporary jobsites, it is not unusual for a service provider licensee to work in other jurisdictions under reciprocity.



NUREG 1556, Volume 18, “Consolidated Guidance About Materials Licenses, Program-Specific Guidance about Service Provider Licenses,”<sup>70</sup> provides guidance about “service provider” licensing. Specifically, page 1-1 explains that:

*Service providers offer a variety of commercial services to both specific and general licensees, ranging from low- to high-risk activities, and in some instances, recover both licensed and unlicensed material from the public domain. Customers who possess such radioactive material may require commercial services to manage materials at concentrations and activities they are not authorized to handle. In these unique situations, a service provider licensee is authorized to possess these radioactive materials under its license incident to performing specific services required by its customers. Optionally, customers may elect to transfer licensed material, such as radioactive waste and contaminated materials, to service providers (e.g., radioactive waste brokers, decontamination and decommissioning service providers, or nuclear laundry operators).*

The service provider approach is based on a two-licensee arrangement. The NRC issues service provider licenses for the calibration of instruments, source exchange of commercial and medical devices containing radioactive sources, and service or repair of radioactive sources. Less commonly, the NRC issues service provider licenses for decontamination and decommissioning services. In almost all cases, the owner of a site is licensed and authorized for the possession and use of radioactive material. The service provider is licensed for possession or use of these radioactive materials incidental to performing its service. Once the service is complete, the service provider leaves the site, and the site owner retains its responsibility for possession and use of radioactive material at the site.<sup>71</sup>

Under Option 2B, the NRC staff would issue a service provider license to allow for remediation of mine waste. This approach would be a departure from the current two-licensee arrangement because the material at the site itself would not be licensed by the NRC (as the site would be an abandoned mine site). Therefore, the service provider would be licensed but the site itself would not be licensed by the NRC. Rather, in accordance with the terms and conditions of the service provider license and a contract with the site owner, a service provider would remediate the mine waste, reduce the radiological hazards at a site below the release standards of 10 CFR Part 20, Subpart E, and leave the site once the remediation was complete.

Similar to Option 2A, once the NRC issues a license authorizing possession of source material, the decommissioning requirements in 10 CFR Part 20, Subpart E, “Radiological Criteria for License Termination” apply. As discussed earlier in this paper, the concentration of the radioactive material that remains in the residual on-site material is a key factor in determining the health and safety consequences. This is particularly true with respect to the presence of radium-226. Remediation technologies have the potential to alter the form of mine waste, which

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<sup>70</sup> NUREG-1556, Vol. 18, “Consolidated Guidance About Materials Licenses, Program-Specific Guidance About Service Provider Licenses, Rev. 1 (Aug. 2017) ([ML17242A055](#)).

<sup>71</sup> Service provider licensing is distinct from the licensing of nuclear devices or sources such as industrial radiography and well logging. These devices are licensed individually, and while the licensee may move from location to location, the licensee retains possession/control and is responsible for disposal at the end of the device/source life. For more information see NUREG-1556, Vol. 2, “Consolidated Guidance About Materials Licenses, Program-Specific Guidance About Industrial Radiography Licenses”, Rev. 1 (Feb. 2016) ([ML16062A091](#)) and NUREG-1556, Vol. 14, “Consolidated Guidance About Materials Licenses, Program-Specific Guidance About Well Logging, Tracer, and Field Flood Study Licenses”, Rev. 1 (Apr. 2018) ([ML18129A129](#)).

may allow for an easier pathway for contaminants to enter the environment, particularly into groundwater. And similar to Option 2A, because Option 2B also uses the source material framework, the NRC would no longer regulate the non-radiological hazards.

The NRC does not have experience licensing technologies like the known emerging mine waste technologies under the service provider framework, particularly in the absence of a second licensee such as an NRC-licensed site owner. The NRC has only issued a service provider license to operate without a site owner licensee in one instance, and that instance is distinguishable in several ways. Specifically, the NRC issued a service provider license to Water Remediation Technology (WRT) that authorizes the company to offer a water treatment program to remove uranium from drinking water at community water systems and at non-drinking water facilities at sites (without a site owner licensee).<sup>72</sup> However, the NRC staff's current understanding is that there are fundamental differences between the work WRT performs and the work contemplated by an applicant for mine waste remediation. First, WRT extracts uranium from water, not ore, thus not creating byproduct material as defined in § 11e.(2). Second, the potential health and safety risks posed by the two services differ significantly. WRT's system is passive, leaves no material behind, and is a "self-contained water treatment system so releases of uranium residuals are highly unlikely."<sup>73</sup> In contrast, known mine waste remediation technologies would actively disturb land<sup>74</sup> by digging and crushing material to isolate the uranium and thorium laden material. Moreover, the licensee would likely leave large quantities of residual on-site material behind. Thus, unlike in WRT, the system is not passive or self-contained and includes multiple potential pathways for contamination (e.g., dust is created; rock is crushed, increasing its surface area, which can mobilize potential contaminants; and large quantities of residual on-site material remain). Although the staff has issued a service provider license to WRT for remediation services, there are many differences between the two technologies such that staff does not view them as analogous. As explained in greater detail below in the "Disadvantages" section, the staff would need a more fulsome understanding of the hazards associated with a particular mine waste remediation technology before implementing this approach.

Under Option 2B, when conducting individual licensing reviews, the NRC staff would still prepare an SER for the service provider license. The NRC staff would also perform an appropriate environmental review, as discussed more fully below under "Disadvantages."

Nearly all Agreement States could implement this option since it is based on the source material framework.

### *Advantages*

This option has the same advantages as Option 2A discussed above. When compared to the uranium milling framework, licensing under the source material framework with a service provider approach would likely not require exemptions or alternate standards. Additionally, utilization of a service provider approach may streamline the licensing process for remediation

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<sup>72</sup> See Material License SUC-1591 ([ML19210B931](#)); see also NRC Safety Evaluation Report, "Renewal and Amendment for a Performance-Based, Multisite Service Provider License for the Removal of Uranium from Water Resources" (May 3, 2019) ([ML18208A490](#)) (SER).

<sup>73</sup> SER at 43 & 54.

<sup>74</sup> WRT on the other hand installs its system within existing buildings or constructs small sheds to house its equipment, thus disturbing less land. *Id.* at 16, 41, and 48.

of mine waste. Remediation of the on-site residual material to the unrestricted release criteria in 10 CFR 20, Subpart E, would be protective of public health and safety and the environment.

### *Disadvantages*

The disadvantages discussed above in Option 2A would also apply to Option 2B (e.g., creating licensing framework disparities, generating TENORM, limitations of guidance changes instead of revisions to NRC regulations, and the potential for unintended consequences such as altering NRC, Agreement State, and EPA authorities, and creating regulatory gaps and regulatory uncertainty). As discussed below, Option 2B has an additional disadvantage.

Under a service provider licensing framework, the site owner licensee is responsible for maintaining public health and safety at a site before and after the service provider has completed its activities. The presence of a site owner licensee that must address any remaining hazards (including latent or unanticipated hazards) is an essential component of the NRC having reasonable assurance of adequate protection of public health and safety as well as for protection of the environment because the site owner licensee is ultimately responsible for the material and the site. If the NRC were to implement the service provider approach under this option, there would only be one regulated entity (the service provider) to manage potential consequences to public health and safety and the environment following remediation. While the NRC could condition such a service provider license to require that releases meet decommissioning and site release criteria, because of the latent nature of the non-radiological and radiologic hazards, it would be increasingly challenging for the NRC to ensure compliance with those requirements, especially where the service provider is no longer present at the site and where there is no licensee (or licensed material), notwithstanding the condition and hazard at the site as a result of the remediation process.

For example, radium-226 present in mine waste could remain in the residual on-site material after remediation is complete. If the on-site material is later found to be unsuitable for unrestricted release, the staff might require additional measures, such as restricting access or capping the material. But if the service provider is no longer physically present at the site and there is no site owner licensee, it would be very difficult for the NRC or other authority to discern responsibility or enforce mitigation measures. Further, if the service provider is unable to meet the unrestricted release criteria in 10 CFR Part 20, Subpart E, significant regulatory uncertainty for the service provider, NRC, and the site owner (if there is one) would be introduced as to who is responsible for meeting the unrestricted release criteria, and how. Lastly, because service providers are authorized to operate at multiple sites, such issues could arise more quickly (and at multiple sites) than under a typical two-licensee framework or under Option 2A. Option 2B introduces significant practical and regulatory uncertainties for the licensee and the regulator that impair the efficient and effective performance and oversight of mine waste remediation. Ultimately, these regulatory uncertainties could negatively impact the NRC's ability to provide reasonable assurance of adequate protection of public health and safety and to protect the environment.

With respect to NEPA, such reviews would be more challenging because the NRC staff would not be able to rely on previous NRC environmental reviews conducted for the facility license holder (i.e., the facility/site licensee in the typical two-licensee construct). Rather, the NRC would likely need to complete a generic environmental review given the nature of a service provider license to adequately evaluate the impacts of mine waste remediation at multiple sites. The NRC staff's generic environmental analysis could assume bounding parameters (e.g., amount of land disturbed, depth of excavation, quantity and composition of material processed,

proximity to groundwater and surface water, use of existing road infrastructure, remediation to the Part 20 unrestricted release standards, and presence of historic cultural resources and threatened or endangered species). Such a review could result in license conditions restricting operations that have not been subject to an environmental review. In order to conduct activities not subject to an environmental review, the licensee would have to seek a license amendment for NRC approval for activities that fall outside the bounding parameters considered in the generic environmental review. But given the number of possible mine remediation sites and their environmental complexities, this approach could be resource intensive and ultimately, may not provide meaningful efficiency over a site-specific approach.

### *Legal Constraints*

This option presents the same legal constraints outlined in option 2A. This option also presents additional and potentially significant legal constraints because of the one-licensee framework. In particular, if the unrestricted release criteria are not met, there is no site licensee, which could lead to additional challenges ensuring regulatory compliance (including implementation of mitigation measures) necessary for public health and safety following remediation. Further, this option presents challenges for the agency to comply with the NEPA and other statutes such as the Endangered Species Act because this approach would require the application of generic evaluations and license conditions to account for site-specific considerations.

### *Viability of Alternative Statutory and Regulatory Interpretations*

This option presents the same alternative statutory and regulatory interpretation issues as option 2A.

**Option 3 – license emerging technologies used for remediation of mine waste that extract or concentrate uranium or thorium under the source and byproduct material framework in 10 CFR Part 40 and Appendix A, with relief from certain Appendix A criteria if certain standards are met.**

### *Key Points*

Under Option 3, the following key points apply, as described in more detail below:

- Utilizes the uranium milling framework (i.e., source and byproduct material would be generated)
- Applies the established flexible requirements in Part 40 and Appendix A, in a risk-informed manner with relief from certain Appendix A criteria if certain standards are met
- Requires staff development of standardized process (in guidance or regulations) for exceptions from certain Appendix A criteria
- Does not generate TENORM
- Does not create licensing framework disparities for technology that can also be used for traditional milling
- Does not require any alternative statutory interpretations and is consistent with Federal and Commission caselaw
- Has no unintended consequences
- Requires EPA's concurrence if revising regulations

### *Description of Option*

Under this option, the NRC staff would initiate and create a standardized process, through a limited scope rulemaking to revise NRC regulations or through revisions to guidance, in which an applicant can be excepted from certain provisions of Appendix A, potentially including the long-term monitoring provision. Similar to Option 1, the Part 40 requirements would apply to the uranium and thorium laden material and the appropriate Appendix A provisions would apply to the residual on-site material. This new standardized process would establish when certain Appendix A criteria (which were developed for conventional milling) would not apply to mine waste remediation technology. However, if an applicant could not demonstrate compliance with these new standards or with the guidance, then the current licensing framework, as discussed in Option 1, would still apply. While the NRC staff would issue a uranium milling (source and byproduct material) license under this option, as in Option 1, the bulk of the Appendix A requirements may not be applicable to a technology or at a site.

The difference between Option 1 and Option 3 is as follows: under Option 1, the licensee would propose the alternate standards or exemptions, and the staff would consider and evaluate those proposed alternate standards or exemptions on a case-by-case basis, during the licensing review; however, under Option 3, the NRC staff would establish in guidance or a revision to regulations how Appendix A criteria would (or would not) apply. An applicant could then refer to that process when submitting a license application. While Option 1 is immediately available to applicants (and the staff), staff would need to develop Option 3, meaning applications prior to the effective date of a change in regulations or development of guidance would not benefit from this option.

In regulations or guidance, the NRC staff would develop a clear numeric, data-driven approach to determine whether certain Appendix A criteria would not apply. At a high-level, this standardized process would exempt an applicant from many of the requirements of Appendix A where the applicant demonstrates that the site would meet the unrestricted release criteria in 10 CFR Part 20, Subpart E. However, because the NRC implements non-radiological standards, promulgated by EPA under UMTRCA, this standardized process would not except an applicant from criteria tied to 40 CFR Part 192, Subparts D and E. A partial list of the criteria related to 40 CFR Part 192, Subparts D and E, includes Criteria 5, 7, 7A, and 13.

If this option was implemented through a regulation change, exemptions would not be necessary. Whereas if this option was implemented through guidance, exemptions would still be required.

If staff revised NRC regulations, the NRC would publish a proposed rule in the *Federal Register* and the public would have the opportunity to comment. In the proposed rule, the NRC staff would have to consider, at a minimum, modifications to 10 CFR 40.2a(b), 10 CFR 40.31(h), and the introduction to Appendix A of Part 40. The rulemaking could also consider modifying 10 CFR Part 51.20(b), which requires preparation of an EIS for a uranium milling license; under these limited circumstances when relief from certain Appendix A criteria is appropriate when certain standards are met, the regulation could be revised to no longer require an EIS. Following the notice and comment period, a final rule could be adopted.

If NRC staff revised guidance to effectuate this option, it would engage the public and provide an opportunity for public comment before finalizing the revised guidance.<sup>75</sup>

Either in conjunction with a limited scope rulemaking revising NRC regulations or as a stand-alone activity if revising guidance, the NRC staff could develop a Standard Review Plan, similar to NUREG-1620, “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,” or NUREG-1569, “Standard Review Plan for In Situ Leach Uranium Extraction License Applications,” to determine whether the applicant’s proposed activities will be protective of the public health and safety and be environmentally acceptable – principally through compliance with the unrestricted release criteria in 10 CFR Part 20, Subpart E. This guidance would ensure a uniform and efficient staff review in preparation of an SER. Each section in the review plan would provide guidance on what is to be reviewed, the basis for the review, how the staff review is to be accomplished, and what the staff will find acceptable to demonstrate compliance. The review plan would also improve external stakeholder understanding of the staff review process.

Until this effort is complete, the NRC staff would license remediation technology under the current 10 CFR Part 40 and Appendix A framework using the embedded flexibilities of exemptions and alternative standards on a case-by-case basis. Using the current framework, as described more fully under Option 1 above, as an interim step would also inform this option and provide stakeholders an interim licensing pathway.

Only those seven Agreement States with 11e.(2) authority could implement Option 3; the NRC would be required to license remediation in the remaining 32 Agreement States as well as for Tribal lands.

### *Advantages*

This option is similar to Option 1; the advantages discussed in Option 1 would also apply here. This option would maintain consistency with Federal caselaw, past NRC decisions, interpretations, and framework related to uranium milling activities and the definition of byproduct material. Establishment of clear numeric thresholds that determine the applicability of Appendix A would provide for a further risk-informed, technology neutral approach.

This option also avoids any issues with material that would be, under Option 2, classified as TENORM. The residual on-site material would meet the definition of byproduct material, so it would not be considered TENORM.

### *Disadvantages*

This option is similar to Option 1; however, the staff would be developing a standardized approach for determining when an exception to the Appendix A criteria is warranted outside of the licensing process. Once the standardized approach is developed, it would still be implemented on a site-specific basis to determine its applicability. This approach may result in a situation where a remedial technology would meet the exception at one site but would have to meet the Appendix A criteria at another site. Additionally, pursuant to such a standardized

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<sup>75</sup> If an opportunity for public comment is not provided prior to finalization of the guidance, then the procedures in 10 CFR 2.804(e)(2) and (f) for post-promulgation comments would be followed.

approach, regulatory relief would still need to be pursued via exemptions or alternate standards, as appropriate.

This option also carries the rulemaking considerations that were articulated under Option 2A if rulemaking is pursued.

### *Legal Constraints*

This option utilizes the uranium milling framework described in Option 1 but develops numeric thresholds, such as remediation to the unrestricted release criteria in 10 CFR Part 20, Subpart E, to determine the applicability of the Appendix A requirements. A potential legal constraint with this approach is the delineation of authorities between the NRC and EPA under § 275 of the AEA. Depending upon the criteria and applicability of the rulemaking, it could be argued that a numerical, standards-driven approach encroaches on EPA's authority to set standards under UMTRCA and goes beyond the NRC's UMTRCA licensing authority. Additionally, if the NRC revises its regulations, EPA concurrence on the rule must be sought consistent with § 84a.(3) of the AEA.<sup>76</sup>

### *Viability of Alternative Statutory and Regulatory Interpretations*

This option does not require any alternative statutory or regulatory interpretations.

## **Option 4 – propose legislative change to license emerging technologies used for remediation of mine waste outside of the milling framework.**

Under Option 4, the following key points apply, as described in more detail below:

### *Key Points*

- Could utilize the source material framework
- Could be considered as part of a larger effort to address mine waste contamination
- No need for a legislative change as an effective and efficient statutory and regulatory framework already exists
- Uncertain timing for the legislative process
- Could avoid certain legal challenges otherwise encountered under a source material framework like Option 2

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<sup>76</sup> This provision requires that "The Commission shall insure that the management of any byproduct material, as defined in section 11e.(2). conforms to general requirements established by the Commission, with the concurrence of the [EPA] Administrator, which are, to the maximum extent practicable, at least comparable to requirements applicable to the possession, transfer, and disposal of similar hazardous material regulated by the [EPA] Administrator under the Solid Waste Disposal Act, as amended." § 84a.(3) of the AEA, 42 U.S.C. § 2114(a)(3). See also "Proposed Rule: Groundwater Protection at Uranium In Situ Recovery Facilities" SECY-21-0067 at 3-5 (July 23, 2021) ([ML21067A117](#)). The NRC would also need to consider if changes to the EPA/NRC Memorandum of Understanding would be warranted.



### *Description of Option*

Under this option, the NRC would seek to amend the definition of 11e.(2) byproduct material and create new definitions of remediation activities to specify that emerging mine waste remediation technologies (e.g., high-pressure slurry ablation) are not milling such that these technologies could be licensed under the source material framework.

The NRC staff is engaging with Federal partners, including the EPA, DOE, Department of Interior, and the Navajo Nation, to address the human health and environmental risks associated with uranium contamination in the Four Corners area. This effort is focused on identifying disposal options for abandoned uranium mine waste. While the agencies are focused on identifying solutions under their respective authorities, a legislative option may provide a clearer path forward. The NRC staff will stay informed of this effort and would coordinate with these Federal partners before proposing legislative changes for the Commission's consideration.

If Option 4 is pursued, the NRC staff's safety and environmental review responsibilities would be similar to those described in Options 2A and 2B.

### *Advantages*

A legislative change would provide a transparent, reliable, and effective path for applicants and affected stakeholders, including the NRC's Federal partners and Agreement States, as to the appropriate framework for licensing known and emerging mine waste remediation technologies.

This option would avoid challenges that the NRC was arbitrarily reinterpreting existing legislation, regulations, or guidance related to byproduct material and milling. This option could also address the legal constraints imposed by the *Kerr-McGee* decision and the definition of "tailings." Finally, this option would mitigate possible unintended consequences, including creation of a jurisdictional gap with respect to these technologies.

### *Disadvantages*

Federal partners may have concerns with legislative changes to address mine waste at abandoned uranium mines. A legislative change is uncertain and may not result in significant efficiencies. Additionally, any legislative change would likely require associated rulemaking to create new or amend existing regulations. Completing a rulemaking, including any associated guidance, will take time, coupled with the additional 3 years that Agreement States may take to revise their programs to be compatible with the NRC's regulations. This could introduce uncertainty and affect the timeliness of licensing reviews. In addition, a legislative change may not address all aspects of known or future remediation technologies. As a result, the costs of implementing a legislative proposal and the resource implications for the NRC may not be warranted if a limited number of applications are received. Finally, a legislative change may have unanticipated consequences, including unexpected changes to the NRC's authority under the AEA.

### *Legal Constraints*

There are no legal constraints to the NRC staff pursuing a legislative change. But to the extent a legislative change could implicate other agencies' authority in this area, the NRC would need to

be mindful of jurisdictional issues. Any legislative proposal should also consider the D.C. Circuit's ruling in *Kerr-McGee*.

#### *Viability of Alternative Statutory and Regulatory Interpretations*

This option presumes changes to the AEA instead of alternative statutory or regulatory interpretations.

#### COORDINATION WITH AGREEMENT STATES:

The NRC staff discussed remediation of mine waste with Agreement State staff from Colorado, Utah, and Wyoming who have relevant licensing experience. Agreement State staff identified a number of points for the NRC to consider. First, the staff from these states would prefer consistency across Agreement States and the NRC in how any technology used to remediate mine waste is regulated. Second, the Agreement State staff expressed concern with definition changes or re-interpretations as doing so may result in unintended consequences; rather, the Agreement State staff pointed out that the existing regulatory framework under 10 CFR Part 40 and Appendix A is well understood. The Agreement States pointed out that while removal of uranium may provide a benefit, uranium is not the only hazard present. In a remediation setting, any regulatory framework needs to consider the presence of other constituents, such as radium-226, that present a health hazard. Finally, Agreement State staff expressed concern with any option that would not provide for adequate oversight of remediation efforts. The staff would continue to work with the Agreement States to understand and address their concerns as part of implementation of any of the options.

#### OTHER CONSIDERATIONS:

##### *Implementation of Mine Waste Cleanups*

With the licensing of emerging technologies to remediate mine waste, there will be interactions with Tribal, state, and other Federal agency stakeholders. For example, at sites that utilize these emerging technologies, the applicant and the NRC would have to interact with EPA on other statutory authorities that may apply. These authorities include the Clean Air Act; Safe Drinking Water Act; and CERCLA. Additionally, the applicant and the NRC may have to work with the DOE on long-term care and stewardship of these sites, as appropriate. The NRC staff discussed licensing of mine waste remediation with Agreement States and other federal agencies such as DOE and EPA. The NRC staff will continue to communicate with these organizations during the implementation of any option. Additionally, the NRC will continue to participate in the Abandoned Uranium Mine Waste group with Federal and State partners and Tribal representatives. At a June 21, 2023, workshop in Albuquerque, NM, States and Tribes, including the State of New Mexico and the Navajo Nation, reiterated the need for waste disposal options for abandoned uranium mine waste.

#### RECOMMENDATION:

The staff aims to regulate remedial technologies in a manner commensurate with their health and safety risks and recommends Option 1. Licensing remedial technologies for mine waste cleanup under the Appendix A framework would be the most clear, reliable, and efficient pathway for the NRC and its stakeholders. Option 1 is consistent with current NRC practice, the existing licensing framework under the AEA and UMTRCA, the NRC's Principles of Good

Regulation, and relevant case law. The provisions in Part 40, Appendix A, include considerable flexibility to provide an equivalent level of protection commensurate with the associated radiological and non-radiological hazards. The NRC staff would be able to fully risk inform its approach, based on data that is appropriate for the hazards presented by the remediation technology in each particular case. Additionally, Option 1 enables the NRC to learn from licensing mine waste remediation while avoiding the need to make programmatic changes for a limited number of remediation technologies and applicants. If considerable interest in remediation of mine waste is observed, the NRC staff could consider development of generic alternate standards for remediation of mine waste.

While Options 2A, 2B, 3, and 4 are potentially viable, they present different disadvantages and risks. These include additional time and resources, potential for significant unintended consequences, and, in some cases, legal constraints. In particular, Options 2A and 2B have the potential to create a regulatory gap that Congress intended to close with the passage of UMTRCA. Option 2B also introduces practical and regulatory uncertainties, as implementation could be more difficult.

Once the Commission selects an option, the NRC staff will further evaluate fee implications. This is particularly true if Option 1 or 3 is utilized. The current annual fee for a conventional uranium mill may not be warranted in a mine waste remediation setting, given the relative short duration of licensed activities. If Option 2A or 2B is selected, the NRC staff will undertake a similar evaluation. The NRC staff could do so as part of the annual update to the Fee Rule in 10 CFR Parts 170 and 171.

#### STAKEHOLDER OUTREACH:

While the staff did not conduct formal stakeholder outreach during the development of this SECY, the NRC staff maintained its awareness of external interest in mine waste remediation. The NRC staff discussed mine waste remediation during the normal course of business with Agreement States and other federal agencies. The NRC staff will continue to stay informed about developments regarding mine waste remediation.

#### COORDINATION:

The Office of the General Counsel provided extensive input into this paper and has no legal objection to it.

The Office of the Chief Financial Officer reviewed this Commission paper for resource implications and does not have any objections.

Catherine Haney  
Acting Executive Director  
for Operations

SUBJECT: OPTIONS FOR LICENSING EMERGING TECHNOLOGIES USED FOR  
REMEDICATION OF MINE WASTE DATED: June 28, 2023

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