

CHAIRMAN Resource

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Subject: [External_Sender] WESTERN URANIUM & VANADIUM CORPORATION WHITE PAPER ON KINETIC SEPARATION
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Dear Chairman Svinicki and Members of the Commission:

By this electronic transmittal, Western Uranium & Vanadium Corporation (Western) respectfully submits this White Paper entitled *Recommendations on the Proper Legal and Policy Interpretation For Using Kinetic Separation Processes at Uranium Mine Sites* for its consideration. By copy on this electronic transmittal, Western will be providing representatives of the United States Nuclear Regulatory Commission (NRC) Staff in its NMSS and STP offices with copies of this White Paper as the Commission's recommendations on this White Paper will have effects on the administration of each office and its regulatory responsibilities to potential future NRC and Agreement State licensees. The White Paper is being transmitted in PDF word-searchable format for ease of use.

Western's White Paper is being submitted with a request to the Commission to engage in one of the following two tasks: (1) a directive from the Commission to NRC Staff to include proposed revisions to the 10 C.F.R. Part 40 definition of "uranium milling" and to incorporate language into the rulemaking record, using the proposed ISR rulemaking as a vehicle, to conclusively establish that the use of kinetic separation processes at uranium mine sites does not constitute "uranium milling;" or (2) a directive to NRC Staff to conduct a full legal and policy analysis of the use of kinetic separation at uranium mine sites with a final determination as to whether the AEA confers jurisdiction on the Commission to regulate its, if so, should it be regulated and what type of licensing scheme would be appropriate in the form of a SECY paper with multiple potential options for Commission vote. Western believes pursuing either of these two options will provide an open and transparent forum within which NRC, its Agreement States, non-Agreement States, and other interested stakeholders may better understand how the use of kinetic separation processes at uranium mine sites should be regulated. This White Paper is also submitted to the Commission in a manner similar to that offered by the National Mining Association (NMA) in 1998 when it sought NRC Staff and Commission review of several issues, including but not limited to, the extent of the Commission's regulatory authority over "uranium milling" in the context of *in situ* leach uranium recovery (ISR) facilities and its alternate feed guidance. Western believes this avenue of using a White Paper to guide the requested action is consistent with this approach and also is appropriate in light of the fact that NRC Staff is contemplating submission of a paper to the Commission for a potential rulemaking for its "uranium milling" regulations, mostly for ISR facilities. Option 1 offered above seeks to use this vehicle to provide NRC Staff with the ability to clarify its stance on regulating kinetic separation. Option 2 offered above mirrors the approach used by the Commission in the aforementioned NMA example.

Given the long history associated with the legal and policy inquiries requested by Western and its predecessor Black Range Minerals and the multiple interested stakeholders involved in the process, Western is prepared to make its representatives available to the Commission and other appropriate parties to answer any and all questions associated whatever course of action the Commission deems appropriate to take. Should the need for an errata filing arise due to typographical errors or other issues, replacement copies will be promptly provided. Please do not hesitate to contact me if there are any other arrangements for proper filing you require. Thank you very much for your time and consideration in this matter.

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**Recommendations on the Proper Legal and
Policy Interpretation for Using Kinetic
Separation Processes at Uranium Mine Sites**
**Request for Commission Directive or
Rulemaking Action**

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**Recommendations on the Proper Legal and Policy Interpretation
for Using Kinetic Separation Processes at Uranium Mine Sites**

**REQUEST FOR COMMISSION DIRECTIVE AND/OR
RULEMAKING ACTION**

I. INTRODUCTION

Western Uranium & Vanadium Corporation (Western) hereby submits this White Paper respectfully requesting that the United States Nuclear Regulatory Commission (“NRC” or the “Commission”) issue a directive to NRC Staff and its Office of the General Counsel (OGC) to conduct a full legal and policy analysis of the use of kinetic separation or the use of purely physical processes without the need for intentional introduction of or alteration of ores using chemicals from host rock(s) at uranium mine sites for the primary purpose of dissociating uranium fractions from non-mineralized fractions of mined ore and high-grading such ores for subsequent milling at an Atomic Energy Act of 1954 (AEA), as amended by the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), licensed uranium mill or other properly licensed/permitted facilities. Over the past several years, Western (then Black Range Minerals (BRM)), NRC Staff, and the State of Colorado’s Department of Public Health and the Environment (CDPHE),¹ an AEA Agreement State, have engaged in multiple discussions, legal inquiries, and public processes to determine if it is appropriate for NRC and its Agreement States (1) to regulate the use of kinetic separation processes at uranium mine sites under the AEA and, if so, (2) what is the correct regulatory scheme that should be used to regulate these processes. These discussions between Western, NRC Staff, CDPHE, and other interested stakeholders have

¹ The State of Colorado has maintained a compliant AEA Section 274 Agreement State program since 1968 and amended its Agreement to include 11e.(2) byproduct material and “uranium milling” in 1982.

resulted in an incorrect legal interpretation of the AEA's definition of 11e.(2) byproduct material² and the Commission's 10 CFR Part 40 regulations for "uranium milling" defined as any activity that generates 11e.(2) byproduct material, as well as an incorrect application of such regulations to kinetic separation. This incorrect legal determination of what constitutes AEA-defined 11e.(2) byproduct material and "uranium milling," as well as the legally erroneous application of these terms to kinetic separation processes at uranium mine sites invokes significant legal and policy considerations that warrant the Commission's full attention. Given that and based on the fact that the agency has not had an occasion to evaluate its interpretation of these three (3) process categories that would dictate whether AEA jurisdiction attaches and, if so, in what manner it should be exerted since 1980 and the emergence of new kinetic separation technologies and technological approaches, Western respectfully submits this White Paper and requests that the Commission fully and carefully evaluate its arguments and refer the matter to NRC Staff for further detailed analysis. Further, Western respectfully suggests that the Commission strongly consider re-evaluating, and to the extent practicable, revising its 10 CFR Part 40 regulations to reflect a clear and concise position on what activities fall within the following categories: (1) "mining," (2) "source material processing," and (3) "uranium milling" in its potential ISR rulemaking in the year 2020. In the event that the Commission deems it appropriate to direct NRC Staff to re-assess the agency's current regulations on "uranium milling," Western respectfully requests that it direct NRC Staff to fully define what the agency regulates under its AEA-delegated statutory authority so that further technological developments in kinetic separation and other mining techniques may be better understood going forward.

² For purposes of Agreement State compliance, the definition of "11e.(2) byproduct material" is a definition based in statute and is, thus, a Compatibility A requirement that does not allow any alterations to said definition. This definition was changed fundamentally by the State of Texas in 1997, and NRC refused to permit such a change.

II. PURPOSE OF THE WHITE PAPER

Western's White Paper is intended to provide the Commission with sufficient legal and regulatory history and analysis, as well as technical and environmental detail, to determine for purposes of its own regulatory program, as well as those established by its AEA Section 274 Agreement States, whether its exclusive, federal preemptive authority over "source material processing" or "uranium milling" attaches to the use of kinetic separation at a uranium mine site.³ The analysis for the Commission to consider in this White Paper is two-fold: (1) does the AEA confer regulatory jurisdiction upon the Commission over kinetic separation processes at uranium mine sites and, if so, (2) to what extent does it confer jurisdiction and should the Commission exercise such jurisdiction under a specific license (and if so, what type).

Western presents this White Paper to the Commission for its formal, legal determination for several reasons. First, Western originally pursued a legal/regulatory determination from the State of Colorado (CDPHE) that has been an AEA Agreement State for over forty-five (45) years at the time.⁴ The primary purpose of this inquiry was for Western, as well as other mineral recovery companies, to gain a better understanding of the licensing/permitting processes for the use of kinetic separation for uranium mine sites and the associated planning and administrative costs, as well as costs dealing with items including but not limited to waste management. Over the course of several years, CDPHE and NRC Staff engaged in a dialogue regarding what the federal interpretation of the use of kinetic separation processes to create a high-grade uranium-bearing ore for milling at an AEA-licensed uranium mill (e.g., Western's then-licensed uranium

³ Since 2000, it has been well-understood that the Commission, as a matter of law, has exclusive, preemptive federal jurisdiction over 11e.(2) byproduct material and, thus, "uranium milling" operations.

⁴ The State of Colorado's AEA Section 274 Agreement was deemed effective in 1968 and amended in 1982 to include 11e.(2) byproduct material and "uranium milling" due to the 1978 passage of UMTRCA.

mill at Pinon Ridge in the State of Colorado).⁵ At the end of this process which will be described in greater detail below, both the State and NRC Staff in advisory and unsubstantiated legal opinions, agreed that the use of kinetic separation in the proposed manner would constitute “uranium milling” under the AEA and the Commission’s implementing 10 CFR € 40.4 regulations, and corresponding State regulations⁶ and, thus, would generate 11e.(2) byproduct material subject to rigorous additional health and safety and environmental requirements at 10 CFR Part 40 and Appendix A over and above typical State-based mining regulations. At the conclusion of this dialogue and the rendering of these legal/regulatory determinations, Western consulted NRC Staff regarding a potential submission of a White Paper for its consideration to decide whether NRC Staff’s interpretation and CDPHE’s adoption of said interpretation is consistent with past AEA-based NRC agency legal and regulatory practices. NRC Staff responded by stating that it would not consider such a White Paper *de novo* and would, in fact, consider it an internal NRC Staff matter for consideration. Given that NRC Staff already had determined that the State’s decision was acceptable, Western was left with no choice but to prepare and submit this White Paper for the Commission’s consideration.

Second, since the creation of 11e.(2) byproduct material by Congress through amendments to the AEA in 1978 and the Commission’s and EPA’s attempts to finalize a series of regulations and Criteria to implement this Congressional mandate, NRC and its Agreement States have wrestled with the concept of “mining,” which is outside the scope of the AEA, and “uranium milling” which is squarely within the scope of the source and/or 11e.(2) byproduct material management program articulated in the AEA, as amended by UMTRCA. This dilemma

⁵ For reference purposes only, the Pinion Ridge uranium mill was the first conventional uranium milling facility licensed by NRC or one of its Agreement States since the 1970s.

⁶ Part 18 of CDPHE’s regulations compose the vast majority of its AEA Section 274 Agreement State program regulations.

originates in 42 U.S.C. § 2092 of the AEA that states that the Commission does not regulate source material (uranium and/or thorium) until after removal of it from its place in nature.

Should an activity at a mine site constitute “mining” in the view of the Commission, express regulatory authority is delegated to the several States, whether they be AEA Agreement States or not, under their general police powers and other applicable State and/or federal regulatory programs. Should an activity be deemed “source material processing” or “uranium milling,” the State’s police power authority is effectively removed from the activity and the Commission’s/Agreement State’s AEA regulatory program for source and/or 11e.(2) byproduct material controls.

This dichotomy of legal/regulatory analyses is further complicated by NRC interpretations and recent rulemakings differentiating between two different levels of AEA-regulatable activities⁷ known as “source material processing” versus “uranium milling.” Starting with the NRC Staff interpretation embodied in the so-called “Fonner memorandum” and the assessment of different activities at uranium mine sites that are commonplace to facilitate economic uranium recovery, the Commission has further complicated the agency’s interpretation of these activities. This confusion raises the question of what role, if any, does the Commission have within the AEA regulatory program over these three activities to the point where it is unclear what types of activities require an AEA license and/or a State permit and, if an AEA

⁷ The term “regulatable” applies to the fact that while the Commission maintains regulatory jurisdiction over all source material after removal from its place in nature, pursuant to 10 C.F.R. § 40.13(b), the Commission has determined that it would specifically exempt “unrefined and unprocessed ores” from specific license regulation. This regulation is examined in multiple regulatory analyses including, but not limited to, the 1980 Fonner Memorandum, NRC’s alternate feed guidance as embodied and adopted by the Commission in the *International (USA) Uranium Corporation* administrative litigation proceedings, and NRC Staff’s/CDPHE’s legal interpretation of kinetic separation raised in this White Paper. The Commission retains the ultimate authority to determine what is shall and shall not regulate under its exclusive, preemptive federal jurisdiction.

license is required, should a specific license be required and what type of license would be implicated.⁸⁹ This complication is further exacerbated by the fact that the differentiation between AEA and non-AEA regulated activities, as well as AEA activities known as “source material processing” and “uranium milling,” rest solely on legal interpretations of statutory language and not on the primary mission of the AEA which is to provide adequate protection of public health, safety, and the environment. Given that NRC is a fee recovery agency, as are many of its Agreement States, this lack of clarity and the purely legal/regulatory aspects of these interpretations likely will result in an unnecessary expenditure of resources seeking legal/regulatory determinations prior to being able to apply for a required license or permit with no noticeable increase in safeguards to adequately protect public health and safety of the environment. Thus, Western asserts that the Commission would be providing itself, its Agreement States, potential and current licensees, and other interested stakeholders with substantial benefits in the form of regulatory transparency and certainty by evaluating this White Paper.

Third, as discussed above and in greater detail below, NRC Staff’s and its Agreement States’ interpretations of these three (3) activities/categories (i.e., “mining,” “source material processing,” and “uranium milling”) appear to be migrating away from primarily public health

⁸ In the scope of its analysis of the questions raised in this White Paper, Western also strongly urges the Commission consider whether existing mining health and safety and environmental regulations are sufficient to regulate kinetic separation’s use when determining if a specific license is even warranted similar to the exemption for “unrefined and unprocessed ores.” Duplicative and unnecessary regulation should be avoided wherever possible.

⁹ This statement also manifests in what could be a controversial regulatory issue associated with *in situ* leach uranium recovery (ISR) licensing/permitting. Given that the Commission retains exclusive, preemptive federal jurisdiction over 11e.(2) byproduct material and the activities that generate said material, it appears overly redundant and potentially impermissible for States to issue the functional equivalent of a mining permit for such operations, as a non-Agreement State would have no AEA-based jurisdiction to regulate such activity(ies). Where Agreement States have merged their mine permitting scheme into an AEA-based Agreement State program, such regulation is clearly permissible.

and safety and environmental concerns, which was the fundamental intent of Congress in enacting the AEA and amending it with UMTRCA, and towards strict legal/regulatory interpretations with no specific risk analysis and no practical legal understanding of the *intent*-based nature of the 11e.(2) byproduct material definition as it was intended by Congress. A thorough review of past Congressional records, testimony, and even NRC interpretations on the subject matter lead Western to assert that the Commission should visit the issue of kinetic separation for creation of high-grade uranium ores for subsequent “milling” and revise its regulations accordingly or implement appropriate legal determinations under existing regulations. As will be discussed below, Western intends to demonstrate to the Commission that both NRC Staff’s and the State’s legal analysis of this question are fundamentally flawed and inconsistent with the AEA, as amended by UMTRCA, as reflected in its underlying Congressional intent.

Lastly, NRC Staff is currently in the process of determining whether or not to proceed with a rulemaking to revise its 10 CR Part 40 regulations and Appendix A Criteria, for the most part, in an attempt to address their express applicability to ISR facilities and to harmonize such regulations to the extent practicable. However, given that over the past two-plus decades, multiple attempts have been made by NRC, industry, and interested stakeholders to actively participate in a rulemaking to “update” these regulations and Criteria, it should also address what has been a lack of clarity in the Commission’s actual and exertion of AEA jurisdiction over “source material processing” and “uranium milling” and what constitutes “mining” outside its scope. By revising the definition of “uranium milling” with the language offered in this White Paper or by developing a complete legal/regulatory analysis of existing regulations, Western asserts that this lack of clarity can be easily understood and rectified, and current and potential

licensees may better understand what is required of them within the confines of relevant federal and State regulatory programs. With that said, for purposes of this White Paper, Western respectfully requests that the Commission find that the use of kinetic separation to create high-grade uranium ores for subsequent “milling” is not within the scope of the 11e.(2) byproduct material program and represents either “mining” to be regulated under State authority or “source material processing” to be regulated under 10 CFR Part 40 without the need for 11e.(2) byproduct material licensing.

In summary and as stated above, over the course of the past forty (40) years, the Commission and its Agreement States have not had many opportunities to consider the extent of, and the manner in which, its AEA-based jurisdiction can and should be exerted for a variety of reasons. In many instances, either the uranium market has not been sufficient to sustain an industry-sponsored rulemaking, or no administrative vehicle was in place to facilitate and agency-sponsored rulemaking. Now, the circumstances regarding the latter have changed as a vehicle is now available.

Additionally, Western understands that the Commission and NRC Staff may find some inconsistencies in the use of the terms “kinetic separation,” “ablation,” and “AMT” in this White Paper. The reason for this is that “kinetic separation” is intended to embody the broad-based concept of described above of high-grading uranium ores from host rocks using no chemical additions or processes where “ablation” and “AMT” was used by BRM when its first inquiries were conducted with CDPHE and NRC Staff several years ago. The use of these terms is meant to provide the Commission with appropriate record references for its review; but however, the term “kinetic separation” is the primary focus of this White Paper and Western’s request of the Commission.

III. KINETIC SEPEARATION: TECHNICAL OVERVIEW

A. GENERAL CONCEPTUAL OVERVIEW

While not strictly identical to the previously offered example of ablation or AMT, kinetic separation is a broader concept that involves a single objective: to create a high-grade, economically viable mineral-bearing ore from host rock using purely physical processes and not involving the intentional introduction of any chemicals into such processes. Kinetic separation involves the identification of a host rock bearing a specific suite of minerals that can be economically recovered assuming that the cost structure associated with the removal of such ore from host rock, utilization of the kinetic separation process to “high-grade” the ore itself, transportation of the “high-grade” ore to a milling facility, and actual milling is economical in today’s environment. These distinct portions of a mineral recovery process have been used by companies for decades to determine whether a given resource should and can be recovered.

By far, the most costly portion of any mineral recovery operation is the final step or “milling” as the sheer capital investment involved in design, licensing/permitting, location, and construction/operation along with final decommissioning as manifested in financial assurance commitments far outweighs any other component of the cost-benefit analysis. Therefore, it is incumbent on a mineral recovery company to minimize resource expenditures for the other components of the aforementioned process so that mineral recovery may be performed economically and efficiently. As has been the case with any number of industries internationally, technology evolves over time to assist in developing economical approaches to the performance of relevant tasks, especially those that require significant human and financial resource expenditures. Hence, the development of kinetic separation processes for mineral recovery as a

way to make such mineral recovery more economical and to mitigate potential health and safety and/or environmental risk.

As a general matter, kinetic separation is a process by which mineral-bearing fractions of conventional ores are separated from non-mineral bearing fractions for one and only one purpose: to high-grade the mined ore so that costs associated with recovery, transport, and future milling of such ore may be completed with less associated cost and less waste material for final disposal. With specific respect to uranium recovery, high-grading of ore is critical due to the numerous health and safety measures associated with recovery of said mineral, especially those associated with future milling at a conventional milling site. But, with the use of kinetic separation, potential health and safety, as well as environmental risks, can be rendered negligible.

Kinetic separation is intended to use purely physical processes to separate these mineral and non-bearing fractions without the need for introduction of chemicals in order to high-grade ores for more efficient and cost-effective recovery. Kinetic separation is intended to use the natural concept of force to collide fractions of mined ore to separate these mineral-bearing fractions and to allow for disposition of mine waste streams that do not contain hazardous constituents and to reduce potential risks to public health and safety and the environment. Some kinetic separation processes such as the one originally proposed by BRM used high-powered water jets to achieve kinetic separation without the need for chemicals. As kinetic separation evolves, the use of no water such as through air blasting or the use of water simply for dust suppression and control may come to bear fruit. But, regardless of the technical approach, the concept of kinetic separation for regulatory purposes remains the same.

Kinetic separation is most effective when used at a mine site versus a mill site as it is not a milling process and would not result in the same waste disposition benefits at a mill site. For

purposes of uranium recovery, the inherent health and safety, as well as economic, value of kinetic separation's use at a mine site is the return of relatively clean backfill to a mine using kinetic separation rather than transporting more ore (much of which is non-mineral bearing) to a mill site and disposing of the relatively clean backfill in tailings impoundments as 11e.(2) byproduct material. While such wastes would not contain the same physical and chemical characteristics of typical 11e.(2) byproduct material, no mill operator would spend the financial resources to transport the clean fill for alternative disposal when it could simply dispose of it as tailings at its own licensed site. Further, as will be reiterated several times in this White Paper, kinetic separation is not a "uranium milling" technique and cannot, under any circumstances, generate a commercially marketable yellowcake product which is the traditional output from milling. Thus, from a conceptual perspective, terming kinetic separation as "milling" is technically incorrect.

B. ABLATION (AMT) AS ORIGINALLY PROPOSED BY BLACK RANGE MINERALS

For purposes of this White Paper and for correct record reference purposes, AMT is used as a representative example of "kinetic separation." AMT is a method that facilitates the disassociation of constituent fractions of a composite material from each other. In doing so it becomes possible to use *physical* characteristics that are unique to fractions, to separate particular fractions from other fractions of post-AMT material.

The inherent nature of the deposition of mineralization in sandstone-hosted uranium deposits allows practical application of the AMT as a mining process to this type of mineral deposit. One of the key reasons why AMT can be applied successfully to sandstone-hosted uranium deposits arises from the location of uranium and/or other mineralization, on a granular scale, within most sandstone host rocks. In these deposits, uranium and/or other minerals are located within a mineralized crust which coats, and is located between, individual sand grains that

make up the majority of the host rock (as opposed to the mineralization being present *within* the individual sand grains themselves).

The processes that formed sandstone-hosted uranium and/or other mineral deposits determine the location of the identified mineralization within the host rock. A model for the formation of these deposits involves the migration of mineral bearing solutions through permeable surface and subsurface channels in the host rock, until conditions change due to natural lateral and/or vertical variations in the chemistry of the host rock. Although the host rock as a whole is relatively porous and permeable, the individual sand grains (commonly quartz and feldspar grains) themselves are not permeable. As such mineral-bearing solutions flow predominantly around and between the impermeable sand grains. When the fluids encounter a reducing agent such as carbon, or a reduction in overall permeability, dissolved minerals precipitate out of solution to form a fine coating of stable minerals over individual sand grains within the host sandstone. When substantial quantities of minerals precipitate and are concentrated within a small volume of the host formation, a mineral deposit is formed.

AMT can be used effectively to separate the precipitated minerals from the sand grains. It involves the application of a two-stage *mechanical* process that (i) disassociates the minerals that form the crust on the sand grains from the sand grains themselves, and then (ii) separates the finer-grained minerals from the coarser sand grains. In this section we describe these two stages in more detail.

(i) **Disassociation**

Within the context of applying AMT as a mining process to a typical sandstone-hosted uranium deposit, the first step is to disassociate the mineralized crust from the underlying

individual grains of the sandstone host rock. To do this, a sandstone host rock is typically crushed to minus 3.35 millimeters and then mixed with water to form a slurry comprising approximately twenty (20) percent solids by. The slurry is pumped through opposing nozzles, creating two high-velocity slurry streams that directly collide with each other (Figure 1). The collision of these high-velocity slurry streams creates a high energy impact zone where individual particle-to-particle (i.e. mineral-crust sand grain to mineral-crust sand grain) collisions impart energy that disassociates the mineral crust (ore) from the underlying sand grains (waste rock). The energy in the impact zone is carefully controlled to prevent destruction of the underlying sand grains themselves. Once the bond between the ore and the waste rock is broken, AMT is complete.



Figure 1. Nozzle array within the semi-commercial scale AMT unit that is under construction (the front set of nozzles is deliberately uncovered and slightly offset for illustrative purposes).

The residence time in the AMT system is important, as is the energy imparted in the collision zone, both of which can be controlled during mining operations. Disassociation takes place more efficiently when greater energy is available in the collision zone. However once AMT has removed the mineral crust from the underlying sand grain, continuation of AMT may result in

the gradual size reduction of individual sand grains as they collide with each other in the impact zone resulting in minimal physical changes to the ore yielding a higher grade mineral-bearing fraction and no resulting chemical changes or alterations like those in processes such as ISR where uranium is dissolved into solution using a lixiviant. Because ore is recovered by grain-size separation (see below), it is highly preferable that AMT continues no longer than is necessary to disassociate the mineral crust from the sand grains. As such the optimal residence time in the AMT system will differ for ores from different deposits. It will be dependent on the energy imparted in the collision zone (higher energy = more effective AMT = lower required residence time) as well as the nature and degree of cementation of the sand particles in the host rock (better cemented = more difficult for AMT = longer required residence time).

(ii) Separation

After disassociation, the post-impact slurry stream comprises a mixture of coarse-grained waste rock (sand grains), finer-grained disassociated ore crusts, and water. This slurry can be subjected to separation by physical screening,¹⁰ based on grain size, where the finer ore minerals are separated from the coarser waste rock.

Screening could be undertaken to separate any size fraction(s). Experimentally, it has been determined that in many cases defining and separating “ore,” as all material finer than approximately 400 mesh (0.037 mm) yields high mineral concentrations, with the added advantage that the over-sized material comprises a clean (very low mineral content) coarse-grained waste product. This preferred size classification is however based on limited testwork. In some cases,

¹⁰ It is important to note that NRC’s new general license rule states that screening is not considered to be a “processing” operation, let alone a milling operation designed to create a marketable yellowcake product or, even in the case of *Sequoyah Fuels* as discussed in this White Paper, a yellowcake product that merely requires concentration or purification processes to remove contaminants.

utilization of other screen sizes may optimize ore to waste dissociations and the resultant properties of the segregated fractions.

Upon separation, the waste rock stream typically comprises approximately ninety (90) percent of the mass but contains only about five (5) percent of the uranium (and any other minerals) that were present in the pre-AMT material. Logically, the ore stream comprises the balance of the mass (~10%) and contains the balance of the uranium and other minerals that coated individual sand grains prior to AMT (~95%).

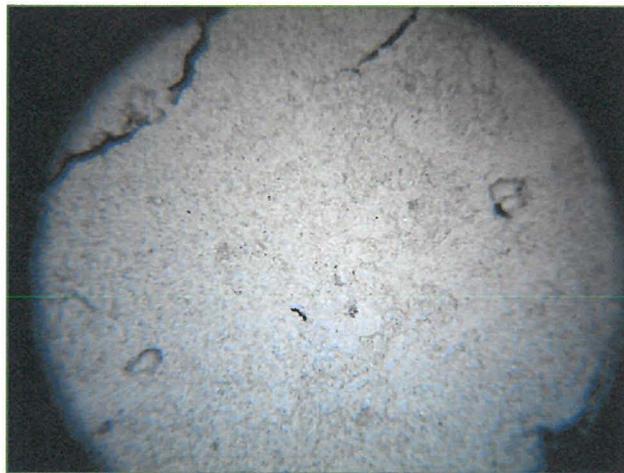
After separation, each fraction is dewatered to the extent practical, leaving three post-AMT products: a dewatered fine-grained ore fraction, a dewatered coarser-grained waste rock fraction, and a water stream which typically will be recycled through the AMT system.

The ore fraction is a collection of very fine-grained mineral grains and other material that predominantly comprised the cement between and the coating on the pre-AMT sandstone grains. Small fragments of individual sand grains, which have been broken down during AMT, may also report to this fraction. Micrograph 2 shows the fine-grained ore product, following AMT, under magnification.

The waste rock fraction is comprised of the grains around which the mineralized crust (ore) forms during deposition in the host rock; typically quartz and feldspar grains. Physically and chemically, the waste rock reports as clean (low concentrations of minerals) sand grains. Micrograph 3 shows representative clean sand grains post AMT. In comparison, mineralized pre-AMT sandstone is shown in Micrograph 1, showing the mineralized crust coating individual sand grains, before it has been disassociated.



Micrograph 1 – Mineralized sandstone prior to AMT, with an outer coating of mineralization evident on most of the individual sand grains.



Micrograph 2 – Very fine-grained mineral grains in the ore fraction following AMT and screening.



Micrograph 3 – “Clean sand” or “coarse-grained waste rock” grains post-AMT and screening.

In addition to lower concentrations of uranium, the waste rock fraction typically contains lower concentrations of any other associated minerals that were present in pre-AMT mineralized sandstone crust on the sandstone grains and the mineralized cement between them. For example, in various tests, the waste rock fraction exhibited reductions in arsenic by more than 88 percent, mercury by 93 percent, molybdenum by 90 percent, and tin by 80 percent. Importantly, limited studies to date on materials subject to AMT show that all other radiometric elements respond similarly to uranium (i.e. they too predominantly report to the fine-grained ore fraction).

From a mineral composition perspective, the individual mineral grains recovered in the fine-grained ore fraction are identical to the minerals present in the mineralized crust that surrounded the sand grains in the pre-AMT sandstone (i.e. there is no change in mineralogy as a result of AMT). If uranium minerals such as uraninite (UO_2), coffinite ($\text{U}(\text{SiO}_4)_{1-x}(\text{OH})_{4x}$) and brannerite ($\text{U}_{0.5}\text{Ca}_{0.3}\text{Ce}_{0.2}\text{Ti}_{1.5}\text{Fe}^{2+}_{0.5}\text{O}_6$) were present in the pre-AMT sandstone, these same minerals will be present in the fine-grained ore (while essentially absent from the coarser-grained waste product). AMT does not alter the composition of uranium or other identified minerals at all; most certainly not to U_3O_8 (“yellowcake”), as occurs during “milling”. AMT simply disassociates

these minerals from the underlying sand grains. In addition, there is no change to the amount of individual minerals in the dissociated materials, as if they were recombined, the relative amounts of these minerals would be identical.

A key characteristic of AMT is that it is a purely *mechanical* process. The sandstone material in AMT is simply mixed with water. No chemicals or reagents are added to the system. As a result, there is no chemical change to the materials in AMT, and no new chemical compounds are created. Within the context of AMT of sandstone-hosted uranium deposits, this means that the sandstone host rock is not chemically altered during AMT. Without chemical change, the elemental, mineral and physical properties of the host rock remain constant throughout AMT. AMT results in the disassociation of minerals from the host rock, producing coarse-grained waste whose composition is virtually identical to the sand grains that were present in the host rock prior to the deposition of minerals. Barring the potential for slight grain size decrease due to impacts in the collision zone, the quartz and feldspar grains of the host rock remain intact and are in the same physical form before and after AMT.

(iii) Worker Health and Safety, AMT, and Environmental Protection

AMT itself comprises a closed system of primarily rigid steel tanks and pipes. As such there is a very low risk that ore can escape the system during operations. Despite this, a precautionary secondary spill-containment system has been incorporated into the modules constructed to date, in the form of steel sumps at the base of all modules. Figure 2 shows the Pilot-scale AMT unit. The Semi-commercial scale AMT unit is shown in Figure 3. On a commercial scale it is anticipated that the AMT modules will be located within a tertiary spill-containment system, which could comprise concrete pads surrounded by impermeable barricades.

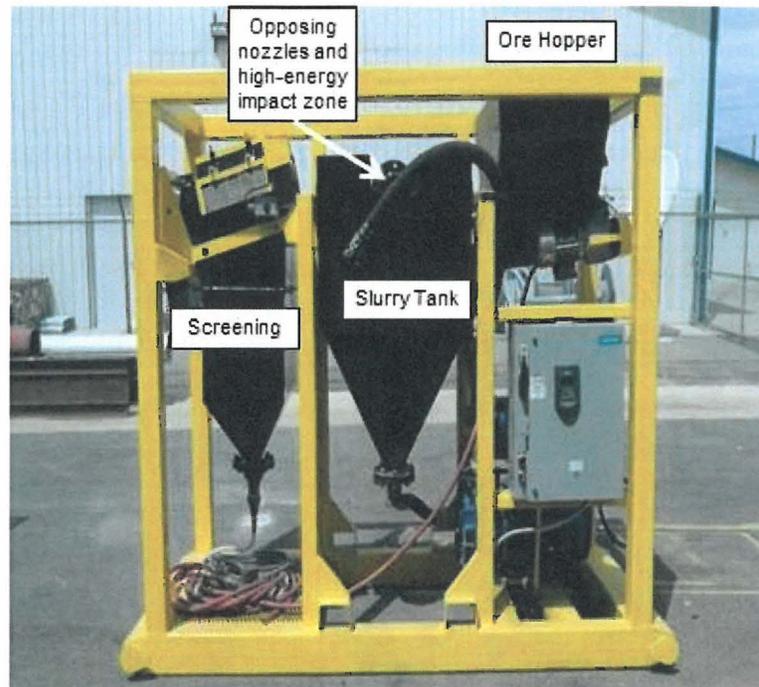


Figure 2. Pilot-scale AMT unit.



Figure 3. The semi-commercial scale AMT unit under construction. A slurry mix tank, being fed by a conveyor, is in the foreground. Three interconnected AMT modules are positioned immediately behind the mix tank. Three water storage tanks are evident in the background.

AMT typically takes place in a “wet” environment; hence ore dust is minimal to essentially non-existent. A wet mineral-slurry enters the AMT system and, on completion of AMT, a wet slurry product is transferred either to tanks or directly to wet-screens for grain-size separation.

The steel tanks, pipes and water act as shields that offer workers protection from the very low level of radiation present in the host rock as it passes through the AMT system. Thus, there is little to no concern for occupational health and safety outside the ambit of typical mining regulations on the federal and State levels that would require increased regulatory oversight such as an AEA-based license.

Limited evaluation to date indicates that, during screening, not only uranium but also other alpha-, beta- and gamma emitters report to the finest size fractions. As such these are removed from the remnant coarse-grained waste, leaving a “clean” waste product that can be emplaced and stored for the long term either on the surface or returned underground as mine backfill.

It is anticipated that water that is used during screening will be re-circulated through the AMT system. If however, at a particular mine site, it becomes necessary to dispose of excess water, it is considered it will be both economically beneficial as well as environmentally preferable to treat the water to recover any uranium and remove any other potential constituents of concern (COC) that may be present in solution prior to disposal through an NPDES permit, evaporation or deep well disposal. Suitable commercial-scale water treatment systems are readily available.

The fine-grained ore product will comprise a moist paste. It is anticipated that this will be enclosed in appropriate containers prior to transportation to an AEA-licensed conventional

uranium recovery facility.¹¹ The moisture, coupled with the containing barrier(s) will attenuate radioactive emissions, thereby minimizing any potential radiological hazard.

Day-to-day operations will be run in compliance with Mine Safety and Health Administration (MSHA) standards. MSHA requires that all workers are properly trained and follow written procedures to work safely at mine sites. Safety procedures are required to eliminate potential hazards, and mining equipment is required to be certified to meet certain standards. At uranium mines, MSHA requires that radon and gamma surveys to be conducted to identify possible exposures to workers. Mitigation activities such as dust suppression, ventilation, use of respirator protection, and reduction in work assignment time will be utilized as necessary reduce workers' exposure to potential hazards. Engineered controls for the crushing, screening, and ore handling systems will afford workers protection as required by MSHA. Workers conducting operations in areas of possible exposure are required to wear dosimeters to monitor individual exposure levels. Strict record keeping and reporting of worker exposure is required by MSHA.

(iv) Benefits of AMT

AMT units will operate at mining sites, as the process is a mining technology designed to remove valuable ore from host rock consistent with previously identified and approved mining procedures. Following AMT, it will be necessary to process the fine-grained ore product at a conventional uranium recovery facility ("mill"). Because AMT significantly reduces the ore mass (by ~90% or more) and creates a moist slurry material to go into a container, not only the traffic between mine and mill, but the potential impacts of a process upset or spill, will be greatly reduced.

¹¹ These facilities are referred to as AEA-licensed due to the potential for such material to be transported to uranium recovery facilities licensed under the AEA by NRC or an Agreement State.

As such the potential impact on both the environment and local communities will be reduced dramatically.

The low-mass, fine-grained AMT ore will be considerably more valuable than non-AMT material. As such it will be economically viable to transport the fine-grained ore greater distances than non-AMT material. Hence AMT will improve the economic viability of building new or maintaining existing uranium processing facilities; thereby, potentially helping to achieve and maintain an optimum number of active uranium processing facilities. .

Furthermore, if a uranium processing facility were designed to take delivery of only fine-grained AMT ore, it will have a smaller surface footprint, hence a lower environmental impact than those under current operating assumptions. This is because (i) crushing and grinding circuits will not be required at the mill site; and (ii) it will be necessary to deliver considerably less (approximately 90% less) material to the facility to recover a comparable quantity of yellowcake, hence the number and size of leach tanks at a mill will be reduced considerably.

Importantly, energy consumption at the mill will be reduced significantly because (i) there will be no need to operate energy-intensive crushing and grinding circuits; and (ii) by delivering a higher-grade material to the mill, less energy will be required to handle materials throughout the processing circuit to produce a comparable quality and amount of yellowcake.

It is anticipated that some processes within processing facilities will utilize significantly less reagents than currently are consumed. For example, consumption of sulfuric acid, which is typically used during acid leaching, is expected to be substantially reduced because acid should more efficiently dissolve the uranium minerals because they will be in higher concentrations, and present within a finer grained medium, than a non-AMT ore.

Notably, AMT is applied prior to milling, the amount of 11e.(2) material that will need to be managed and stabilized at a licensed mill facility will be reduced dramatically (by ~90% or more to produce a comparable quantity of yellowcake without AMT). As such substantially smaller impoundment facilities will be required, considerably reducing both short- and long-term environmental impacts. Indeed, given the dramatically reduced quantity of 11e.(2) material, it may be viable to dry-stack the material rather than impound a slurry, thereby reducing the long-term impact as well as the time and cost of final reclamation.

IV. HISTORICAL BACKGROUND OF URANIUM RECOVERY

A. URANIUM RECOVERY IN GENERAL

In order to properly understand the context of “uranium milling,” “source material processing,” and “mining” within and without the scope of the AEA over the past forty (40) years, this White Paper will open with an overview of the historical context in which the various versions of the AEA evolved from its initial inception in 1946 through its amendments including UMTRCA in 1978.

After it was discovered that uranium source material could provide a valuable source of the mineral for both domestic defense and electricity generation purposes, the United States government devised programs to incentivize domestic uranium recovery. However, the federal government realized that uranium mining was not sufficient to sustain a domestic nuclear program and that a domestic uranium “milling” industry also would be required. As such, the then-AEC issued contracts to subsidize the construction and operation of uranium mills so that sufficient sources of yellowcake (U₃O₈) could be generated. These contracts were tailored to provide companies with sufficient capital to establish and operate these facilities along with a reasonable return on their investments.

The AEA, as enacted in 1946 and 1954 and amended by UMTRCA in 1978, provides the bases for the development of NRC's and all Agreement State regulatory programs for "source material" and "source material recovery." With respect to *source material*, Congress used the AEA to establish a system by which the identification, extraction, possession and transfer of uranium or thorium would be regulated using licenses containing specific license requirements or conditions. In Chapter 7 of the AEA, Congress created a program under which entities seeking to engage in the production of *source material* could be required to obtain licenses from the Atomic Energy Commission (AEC now NRC) so that such *source material* could be used for a variety of purposes such as research and development and the creation of special nuclear material.¹² It is extremely important to note that, under the AEA's statutory framework, NRC now (as opposed to the AEC previously) is an *independent* regulatory agency and, as such, "has no authority to encourage and promote the development of atomic energy for peaceful purposes. Nor does it bear any responsibility for the development or regulation of other energy sources."¹³ Thus, a private entity (e.g., source material recovery company) or governmental entity (e.g., United States Department of the Army) is required to voluntarily submit license or license amendment applications to the Commission in order to possess, use, and transfer AEA materials to which NRC reacts.¹⁴ "[T]he Commission has no power to compel an applicant to come forward or to require an applicant, once having come forward, to prepare and submit a totally different proposal."¹⁵ When reviewing a license or license amendment application, "the available alternatives [to NRC] are to grant the application, grant the application subject to

¹² 42 U.S.C. § 2093(a)(1-4).

¹³ 49 Fed. Reg. 9352, 9353 (March 12, 1984).

¹⁴ In the event of a potential imminent hazard such as national security concerns, NRC can issue orders without waiting for a licensee to propose an action (i.e., compensatory measures or immediately effective orders).

¹⁵ *Id.*

certain conditions, or deny the application, either with or without prejudice.”¹⁶ Thus, under this scheme, ultimately the licensee, and not the Commission, is *primarily* responsible for the safe management of AEA materials.

Prior to implementing a licensing program for *source material*, Congress needed to define the point at which the AEC’s AEA jurisdictional authority over *source material* would be triggered. Given that there are delineations between *source material* (i.e., uranium or thorium) as it resides in nature, the extraction of *source material ores* by mining, and the *processing* of such *ores* to recover their *source material* content, Congress determined that the AEC’s jurisdiction should be invoked only after removal of *source material from its place in nature*. As stated in Section 62 of the AEA:

“[u]nless authorized by a general or specific license issued by the Commission...no person may transfer or receive in interstate commerce, transfer, deliver, receive possession of or title to, or import into or export from the United States any *source material after removal from its place in nature*....”¹⁷

Yet, AEC’s/NRC’s 10 CFR Part 40 regulations define a class of *source material ores* that have been removed from their place in nature, nevertheless, is not subject to Commission regulation termed *unrefined and unprocessed ores*. Such ore is defined as “*ore in its natural form prior to any processing, such as grinding, roasting or beneficiating, or refining*.”¹⁸ Thus, *source material ore* that has not undergone *processing* activities such as those that take place at a uranium *mill* (e.g., crushing, grinding, beneficiating) is not subject to NRC’s jurisdiction.

¹⁶ *Id.*

¹⁷ 42 U.S.C. § 2092 (emphasis added).

¹⁸ 10 CFR § 40.4.

The meaning of the phrase “after removal from its place in nature” was further clarified in NRC’s 1980 Generic Environmental Impact Statement on uranium milling. (GEIS), which explains that this phrase refers to *source material* “associated with processing” (i.e., at a licensed uranium mill):

“Section 205(a) of the UMTRCA [Uranium Mill Tailings Radiation Control Act of 1978] amends the Atomic Energy Act of 1954 by adding a new Section 84 which states in part that ‘the Commission shall insure that the management of any *byproduct material*, as defined in section 11e.(2) , is carried out in such a manner as...the Commission deems appropriate to protect public health and safety and the environment from radiological and nonradiological hazards *associated with the processing* [of source material ore] and with the possession and transfer of such material...”¹⁹

Similarly, the Atomic Safety and Licensing Appeal Board in *In the Matter of Rochester Gas and Electric* states:

“The Atomic Energy Commission’s jurisdiction in this area was transferred to the NRC on January 19, 1975, by the Energy Reorganization Act of 1974, 42 U.S.C. § 5841(f). As the quoted observation indicates, the Commission’s authority over uranium *ore* and other ‘*source material*’ attaches only ‘*after removal from its place of deposit in nature,*’ and *not when the ore is mined.*”²⁰

Therefore, *source material* in uranium *ore* at a uranium *mill* is subject to AEC/NRC jurisdiction, while *source material* in uranium *ore* at a uranium *mine* or during transport to a uranium *mill* prior to *processing* is not subject to AEC/NRC jurisdiction, regardless of its *source material* concentration.

Section 62 of the AEA requires that entities seeking to transfer or receive in interstate commerce or to transfer, deliver, receive possession of or title to or to import into or export from the United States *source material* obtain a license from the Commission.²¹ Section 62 also

¹⁹ GEIS at A-89 (emphasis added).

²⁰ 8 NRC 551, *6 (November 17, 1978), *citing* 42 U.S.C. § 2092 (2005) (emphasis added)

²¹ 42 U.S.C. § 2092.

addresses *unimportant quantities* of *source material* (which Congress empowered the AEC to define) by stating that “licenses *shall not be required* for quantities of *source material* which, in the opinion of the Commission, are unimportant.”²² By regulation, the AEC/NRC defined “unimportant quantities” of *source material* to mean, “[a]ny person is exempt from the regulations in this part and from the requirements for a license set forth in section 62 of the Act to the extent that such person receives, possesses, uses, transfers or delivers *source material* in any chemical mixture, compound, solution, or alloy in which the *source material* is by weight less than one-twentieth of 1 percent (0.05 percent) of the mixture, compound, solution or alloy.”²³ Quantities of *source material* exceeding the 0.05% or 500 parts per million (ppm), by weight, threshold are, therefore, referred to as *licensable source material*. The AEC General Counsel’s evaluation of Section 62 determined that its provisions are *mandatory*.²⁴

The AEC’s choice of the 0.05%/500 ppm, by weight, threshold for *licensable source material* had little to do with potential radiological risks to public health and safety or the environment. At the time the “unimportant quantities” determination was issued, the Commission was attempting to gauge the types of uranium-bearing *ores* that likely would be necessary to create special nuclear material.²⁵

²² 42 U.S.C. § 2092.

²³ 10 CFR § 40.13(a).

²⁴ See Letter to H. L. Price, Director, Division of Licensing and Regulation from Neil D. Maiden, Acting General Counsel, Atomic Energy Commission, *Re: Mill Tailings* (December 7, 1960).

²⁵ The basis for the selection of the “unimportant quantities” threshold was recently highlighted in 2003 when an Interagency Working Group recommended to the Commission that a legislative amendment to the AEA be obtained to limit Commission authority over quantities of source material under the “unimportant quantities” threshold. This recommendation was rejected by the Commission stating: “Although the Commission agrees that the proposed approach is the most efficient way to address the issue, because the probability of success is very limited, the Commission does not wish to expend the resources.” See Staff Requirements Memorandum - SECY-03-0068 – Interagency Jurisdictional Working Group Evaluating the Regulation of Low-Level Source Material or Materials Containing Less Than 0.05 Percent by Weight Concentration Uranium and/or Thorium, (October 9, 2003).

In addition, current NRC regulations provide for a second type of “unimportant quantities” exemption from regulation under AEA Section 62. As stated in 10 CFR § 40.13(c)(1)(vi), “rare earth metals and compounds, mixtures, and products containing not more than 0.25/2,500 ppm percent by weight thorium, uranium, or any combination of these” are exempt from licensing.²⁶ This exemption often plays a crucial role at rare earths (e.g., lanthanides) recovery facilities that recover source material as part of a “side-stream” recovery process or that produce waste streams containing source material.

As the domestic uranium industry grew and increasing amounts of yellowcake were generated, questions began to arise regarding the potential public health and safety and the environmental impacts of the tailings from such production. During the early days of the uranium recovery industry, these tailings were not regarded as a source of health and safety or environmental threats and, as a result, regulatory entities did not develop any regulatory programs to address such tailings. However, in the late 1960s, the attitude towards such potential impacts changed.

Starting with concerns raised with the disposition and dispersal of mill tailings in Grand Junction, Colorado, potential health risks over the use of mill tailings for material in building foundations were raised due to radon emanation from such material into enclosed building structures. Congress reacted to this information quickly by providing for a program to fund and manage the clean-up of contaminated sites in that area and opened further inquiries into the AEC’s legal authority to regulate such tailings. Initially, the AEC determined that the then-recently enacted National Environmental Policy Act of 1969 (NEPA) provided the agency with

²⁶ 10 CFR § 40.13(c)(1)(vi).

supplemental *substantive* regulatory authority to regulate mill tailings following license termination. Later, federal courts determined that NEPA does not convey supplemental substantive authority to regulate a given area and that, in fact, an agency must derive its regulatory jurisdiction through an organic statute.

In response to these legal determinations, NRC (the AEC's successor) developed a series of policy documents known as Branch Technical Positions (BTP) that did not have the force and effect of regulations; but rather, embodied NRC Staff's interpretation for implementation of existing regulations. For example, NRC issued a 1977 BTP on uranium mill tailings management in which the agency set out eight (8) general principles intended to govern the siting and design of uranium mill tailings piles as well as the management of those tailings both during and after active milling operations. But, these policies were eventually deemed to be insufficient to address the problem of mill tailings management.

In the mid-1970s, Congress introduced legislation to grant the Commission explicit authority to directly regulate uranium mill tailings and related wastes. In 1978, Congress enacted UMTRCA to provide express statutory authority to regulate the production, containment, and monitoring of uranium and thorium mill tailings during and after active recovery operations. Prior to UMTRCA's passage, the Commission's interpretation was that it had no authority to regulate tailings after active milling operations ceased as such tailings were no longer licensable source material. UMTRCA was based upon a finding that uranium and thorium mill tailings located at *active* (i.e., licensed) and *inactive* (i.e., abandoned) mill sites may pose a significant, potential radiation health hazard to members of the public.²⁷ In explaining the need for

²⁷ Pub L. No. 95-604, at 2(a), 92 Stat. 3021-22.

UMTRCA, the House Report accompanying the legislation relied upon the description of the potential public health hazard of mill tailings in the testimony of then-NRC Chairman, Dr.

Joseph Hendrie:

“The NRC believes that long-term release from tailings piles may pose a radiation health hazard if the piles are not effectively stabilized to minimize radon releases and prevent unauthorized use of the tailings.”

The centerpiece of this new grant of direct authority to regulate uranium mill tailings was the creation of a new category of AEA-regulated materials. Specifically, the definition of “byproduct” material was modified when Congress created “11e.(2) *byproduct material*,” which is defined to mean:

“the tailings or wastes produced by the extraction or concentration of uranium and thorium from any *ore* processed *primarily* for its source material content.”²⁸

This class of material was (and is) unique among the materials regulated under the AEA, because it is not defined solely in terms of its radiological characteristics, but instead is defined broadly enough to encompass “all wastes”—both radioactive and *non*-radioactive—resulting from uranium *ore* processing at AEA-licensed uranium recovery facilities.²⁹ Since this new definition of “*byproduct material*” was intended to be expansive and to cover the broad range of wastes associated with uranium milling, the tailings and *all* other wastes associated with uranium recovery produced at AEA-licensed uranium milling facilities are referred to as “11e.(2) *byproduct material*.” *The relationship between source material and 11e.(2) byproduct material*

²⁸ AEA Section 11e.(2) (42 U.S.C. § 2014(e)(2) (emphasis added). Previously, “*byproduct material*” had been defined to mean “any radioactive material (except special nuclear material) yielded or made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear material.” See 42 U.S.C. § 2014(e)(1). This definition is currently located at Section 11e.(1) of the AEA.

²⁹ See 57 Fed. Reg. 20,525, 20,526 (1992).

is the fundamental driving force behind uranium recovery regulations, relevant guidance and policies, and licenses/permits from 1978 to the present.

With the enactment of UMTRCA and the creation of a new class of AEA material known as 11e.(2) byproduct material came the need for NRC to determine where its jurisdictional line should be drawn with respect to activities and materials that it could regulate under the amended AEA. As time passed and due to the intent-based provisions of the AEA definition of 11e.(2) byproduct material, NRC's regulatory jurisdiction with respect to source material activities can be defined as two distinct license categories (1) source material processing and (1) combined source and 11e.(2) byproduct material or "uranium milling."

The latter category known as "uranium milling" is easily defined using the intent-based provisions of the 11e.(2) byproduct material definition. Typically, it is assumed that ores are processed *primarily* for their source material content at an NRC or Agreement State AEA-licensed milling facility such as a conventional mill, heap leach site, or now, an ISR facility.

Further, given that the statute was enacted to respond to potential health risks associated with the potential long-lived threat posed by 11e.(2) *byproduct material* (mill tailings), the second focus of UMTRCA's regulatory program (other than the creation of a licensing program) is the requirement that all 11e.(2) *byproduct material* and the land on which such material is deposited be transferred to the federal government or the State in which the material and land on which it is located for long-term surveillance and monitoring.³⁰ Section 83 of the AEA, as amended by UMTRCA, states that:

"ownership of any *byproduct material*, as defined in section 11e.(2), which resulted from such licensed activity shall be transferred to (A) the United States or (B) in the State in which such activity occurred if

³⁰ See generally 42 U.S.C. § 2113 *et seq.*

such State exercises the option under subsection b. (1) to acquire land used for disposal of *byproduct material*.³¹

Section 83(b) also provides for the transfer of land used for disposal of 11e.(2) *byproduct material* to either the United States or the State “unless the Commission determines prior to such termination [of a license] that transfer of title to such land and such *byproduct material* is not necessary or desirable to protect the public health, safety or welfare or to minimize or eliminate danger to life or property.”³² Further, UMTRCA mandates that the long-term custodian (State or DOE) be an NRC general licensee in perpetuity and that the 11e.(2) *byproduct material* and its associated land be transferred *at no cost to the government*.³³

Later, in 1983 and in response to discontent manifested by Agreement State regulators and uranium recovery licensees seeking to propose site-specific alternatives, Congress amended Section 84 of the AEA to allow NRC to approve licensee or Agreement State-proposed “alternatives” to the Commission’s requirements if the proposed alternatives provide a level of protection that is “equivalent to, to the extent practicable, or more stringent than” the level of protection afforded by NRC applicants.³⁴ Congress’ 1983 amendments also clarified NRC’s responsibilities under Section 84(a) of the AEA by specifically requiring that EPA/NRC consider environmental and economic costs and balance those costs against potential risks when

³¹ 42 U.S.C. § 2113(a)(2).

³² 42 U.S.C. § 2113(b)(1)(A).

³³ 42 U.S.C. § 2113(b)(5 & 7). It is also worth noting that UMTRCA provides for unique “land status” requirements for 11e.(2) *byproduct material* produced at facilities under a license in effect on UMTRCA’s effective date (i.e., November 8, 1981). As stated in Section 83(b)(4) of the AEA, “the Commission shall take into consideration the status of the ownership of such land and interests therein and the ability of the licensee to transfer title and custody thereof to the United States or a State.”

³⁴ 52 Fed. Reg. 43, 553 (1987).

developing standards and requirements for the management of 11e.(2) *byproduct material*.³⁵ In its report on these amendments, the conference committee explained that:

“The conferees are of the view that the economic and environmental costs associated with standards and requirements established by the agencies should bear a reasonable relationship to the benefits expected to be derived. This recognition is consistent with the accepted approach to establishing radiation protection standards, and reflects the view of the conferees that, in promulgating such general environmental standards and regulations, EPA and NRC should exercise their best independent technical judgment in making such a determination.”³⁶

The regulatory scheme created by the UMTRCA amendments to the AEA was and is unique because of the manner in which jurisdiction over the radiological and *non*-radiological aspects of 11e.(2) *byproduct material* previously is divided among three major federal agencies: EPA, NRC, and Department of Energy (DOE) and, potentially, a State. Each federal agency is assigned different active responsibilities associated with creation and implementation of a uniform and comprehensive regulatory regime for the active oversight and long-term control of 11e.(2) *byproduct material*.

In Title I of UMTRCA, Congress established a program to identify and remediate so-called “inactive” sites; that is, sites at which uranium milling operations had occurred in the past or that contained tailings and other wastes produced during such operations and that were not covered by an existing license.

Under the program set out in Title I of UMTRCA, DOE is authorized to enter into “cooperative agreements” with States containing *inactive* sites for the purpose of remediating those sites. Remedial actions undertaken by DOE under Title I are required to have the Commission’s concurrence and to conform with *generally applicable standards* developed by

³⁵ Pub. L. No. 97-415 § 22 (1983).

³⁶ S. Rep. No. 97-113 (1982), reprinted in 1982 U.S.C.C.A.N. 3592, 3617.

EPA for the protection of public health and safety and the environment from potential radiological and *non*-radiological hazards associated with tailings and other uranium milling wastes.³⁷ Following remediation of these *inactive* sites, title to the tailings and wastes from the sites and to the land used for their disposal resides with DOE, and the sites are to be maintained by DOE in perpetuity pursuant to license issued by the Commission.³⁸ In addition, the Commission is authorized to require that DOE, as the custodian of remediated inactive sites, undertake such monitoring, maintenance, and emergency measures as the Commission may deem necessary to protect public health and safety.³⁹ The Commission also can require DOE to take other actions that the Commission deems necessary to comply with EPA's generally applicable standards for protection against potential radiological and *non*-radiological hazards associated with uranium mill tailings and related wastes.⁴⁰

Like Title I, Title II establishes a tripartite jurisdictional scheme involving EPA, NRC, and DOE or a State,⁴¹ each of which have a defined role, which for NRC and DOE are similar yet different. Under Title II, NRC has the lead on addressing regulation and closure of sites, and DOE (or potentially a State) has only the long-term surveillance and monitoring responsibility

³⁷ 42 U.S.C. § 7918 (1994).

³⁸ 42 U.S.C. § 7914 (1994); *see also* 10 CFR § 40.28.

³⁹ 42 U.S.C. § 2113(b)(5).

⁴⁰ In many respects, the role assigned to DOE under Title I of UMTRCA is akin to that of a super "potentially responsible party" or (PRP) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601 *et seq.*, since DOE is responsible for remediating Title I sites and maintaining them in perpetuity, and the agency is responsible for most of the costs associated with those efforts. Indeed, because of the unique role performed by DOE at Title I sites, Congress deemed it appropriate to specifically exclude those sites from the reach of CERCLA. *See* 42 U.S.C. § 9601(22).

⁴¹ In 1974, the AEC was terminated and divided into a promotional and a regulatory agency. The Energy Research and Development Administration, the precursor to the current DOE, was the promotional agency. The new regulatory agency was NRC.

that it also has under Title I. EPA's responsibilities are essentially the same under both Titles I and II.

Pursuant to Section 275 of the AEA, Congress assigned EPA the authority to promulgate *generally applicable standards* for the protection of public health and safety and the environment from the potential radiological and *non-radiological* hazards associated with the possession, transfer, and disposal of 11e.(2) *byproduct material*.⁴² For the *non-radiological* hazards associated with 11e.(2) *byproduct material*, these *generally applicable standards* are to provide equivalent protection to that provided by EPA's Resource Conservation and Recovery Act (RCRA) standards.⁴³ As a result, 11e.(2) *byproduct material* is specifically exempted from EPA regulation under RCRA⁴⁴ and permitting authority over such material is deliberately withheld from EPA.

While the regulations developed for the Title I "inactive" uranium mill tailings sites are not directly relevant to this paper's discussion of regulatory regimes associated with active or future uranium recovery operations, a discussion has been included here to provide a complete overview of the evolution of the UMTRCA regulatory program applicable to source material recovery operations. Implementing UMTRCA's mandate, EPA issued its first set of *generally applicable standards* in 1983 which applied only to "inactive" mill tailings sites (i.e., sites regulated under Title I of UMTRCA that were no longer operated under an active license).⁴⁵ This occurred a full three years after NRC issued its GEIS and its initial regulations for uranium milling. Although these types of sites were not addressed in NRC's initial regulations, EPA's

⁴² 42 U.S.C. § 2022(b).

⁴³ 42 U.S.C. § 2114(a)(3).

⁴⁴ See 40 CFR § 261.4.

⁴⁵ 48 Fed. Reg. 590 (January 5, 1983).

inactive site regulations opened a window on some important differences between EPA and NRC requirements, particularly with respect to the establishment of standards for control of radon emissions from mill tailings. For example, EPA adopted a radon emission standard of 20 picocuries per meter squared per second (pCi/m²/s), while NRC had adopted a much more stringent standard of 2 pCi/m²/s within a minimum of ten (10) feet of cover. In addition, EPA's regulations did not include any specific requirements for construction of radon barriers (since, arguably, EPA does not have any authority to impose such a control requirement on tailings facilities) although, in its rulemaking materials, EPA indicated that its 20 pCi/g/m²/s radon standard was premised on the use of thick radon barriers.

EPA's inactive site regulations also established what has come to be known as the "5/15" clean-up standard for radium-226 in soil, primarily due to "windblown" tailings or other operational spills (process leaks, yellowcake slurry process upsets, etc). Under this standard, radium concentrations in soil are to be reduced to levels of no more than 5pCi/g in the first 15 cm of soil and no more than 15 pCi/g in each descending 15 cm soil horizon averaged over 100 square meter segments. In addition, EPA required that disposal systems be designed to provide "reasonable assurance" of achieving the tailings radon emission standard for 1,000 years, but no less than 200 years and to do so without the need for "active" maintenance. Finally, EPA did not, in its inactive sites regulations, establish any *generally applicable standards* for groundwater contamination because, in EPA's view at the time, the risks from groundwater contamination were not sufficiently significant to require the development of such standards. Thus, in the preamble to its inactive sites regulations, EPA explained:

“We do not believe that the existing evidence indicates that groundwater contamination from inactive mill tailings is or will be a matter of regulatory concern. We have decided, therefore, not to establish general substantive standards on this subject.”⁴⁶

Consequently, instead of establishing *generally applicable groundwater standards* in its inactive sites regulations, EPA concluded that groundwater issues would have to be addressed by DOE on a site-by-site basis.⁴⁷

Later that same year, EPA issued its *generally applicable standards* for active sites (i.e., licensed sites regulated under Title II of UMTRCA).⁴⁸ As with the inactive site standards, EPA’s active site regulations require that radon emanation from mill tailings disposal sites be limited to 20 pCi/m²/s,⁴⁹ that the controls provide “reasonable assurance” of achieving this standard for 1,000 years, but not less than 200 years,⁵⁰ and EPA’s active site regulations also incorporate the “5/15” standard for radium-226 in soil.⁵¹ Even though EPA’s *generally applicable standards* for “inactive” and “active” mill sites are essentially the same with respect to these requirements, the “active” sites regulations deviate significantly with respect to the *generally applicable groundwater standards*.⁵² The groundwater standards in EPA’s *active sites* regulations, which were directed at both potential radiological and *non-radiological* (i.e., hazardous) constituents, are intended to provide a level of protection for *non-radiological* (i.e., hazardous) constituents equivalent to that provided by EPA’s regulations under RCRA.⁵³ The latter were lifted directly from EPA’s RCRA hazardous waste groundwater corrective action requirements at 40 CFR Part 264 *et seq.* The groundwater standards were divided into a *primary*

⁴⁶ *Id.* at 599.

⁴⁷ *Id.* at 599-600.

⁴⁸ 48 Fed. Reg. 45,926 (1983).

⁴⁹ *Id.* at 45,947.

⁵⁰ *Id.*

⁵¹ *Id.*

⁵² See 60 Fed. Reg. 2854 (1995).

⁵³ 42 U.S.C. § 2114(a)(3).

standard and a *secondary* standard. The *primary* standard is a *design* standard, requiring the installation of a bottom liner under all new tailings impoundments and under new extensions of existing impoundments. The *secondary* standard is a *performance* standard, requiring that groundwater at the point of compliance (POC) (i.e., the downgradient edge of the tailings impoundment) meets background levels or drinking water standards (i.e., maximum contaminant limits “MCLs”), whichever is higher. Additionally, in the event that neither background nor an MCL is achievable, licensees can seek an alternate concentration limit (ACL) which is a site-specific, risk and constituent-based limit. ACLs assure that concentrations at the POC will result in groundwater constituent concentrations that are protective of public health, safety, and the environment at the point of exposure (“POE”). Interestingly enough, although neither EPA’s initial “inactive” sites regulations nor NRC’s initial regulations for “active sites” provided such standards for groundwater corrective action, site closure experience indicates that, in most cases, the ACL-based POE will determine the geographical boundaries of Title II sites to be turned over to DOE for long-term custodianship, as the early uranium milling sites were designed to leak to maintain sufficient water balance in the tailings impoundment.

Pursuant to the *American Mining Congress v. Thomas*⁵⁴ case in the United States Court of Appeals for the Tenth Circuit (Tenth Circuit), EPA was required to review its “inactive” site program and to conform its “inactive” site regulations for groundwater to those for “active” sites, which EPA eventually did.

⁵⁴ *American Mining Congress v. Thomas*, 772 F.2d 617, 640 (10th Cir. 1985) (“On remand, the EPA will have to treat these toxic chemicals that pose a ground water risk as it did in the active mill site regulation.”).

Under UMTRCA, Congress specifically designated NRC as the lead agency for implementing and enforcing EPA's *generally applicable standards* through licensing.⁵⁵ Section 275(d) of the AEA provides that "[i]mplementation and enforcement of the standards promulgated [by EPA] pursuant to subsection (b) of this section shall be the responsibility of the Commission in the conduct of its licensing activities under this Act."⁵⁶ In addition, Congress expanded NRC's regulatory authority under Section 84 of the AEA to develop its own requirements for the management of 11e.(2) *byproduct material*. Specifically, Section 84(a) of the AEA directs NRC to ensure that any 11e.(2) *byproduct material* is managed in a manner:

- (i) that the Commission deems appropriate to protect health, safety, and the environment from the potential radiological and non-radiological hazards associated with such materials;
- (ii) that *conforms* with the generally applicable standards developed by EPA; and
- (iii) that conforms with the general requirements established by NRC, comparable to standards applicable to similar hazardous materials regulated under the Solid Waste Disposal Act [42 U.S.C. § 6901 et seq.].⁵⁷

Pursuant to its new UMTRCA authority, in April of 1979, NRC issued a Draft Generic Environmental Impact Statement (DGEIS) examining the potential environmental ramifications of uranium milling activities and possible regulatory standards pertaining to those activities. A few months later, NRC issued proposed regulations governing active uranium milling and long-term control and maintenance of mill tailings facilities.⁵⁸ These proposed regulations were controversial for two reasons. First, they incorporated very conservative standards (e.g., a maximum radon emanation rate of 2 pCi/m²/s with a required minimum cover of at least ten (10) feet to address radiation risks that were admitted to be quite small for potentially exposed

⁵⁵ 42 U.S.C. § 2022(d).

⁵⁶ *Id.*

⁵⁷ 42 U.S.C. § 2114(a)(1-3) (emphasis added).

⁵⁸ 44 Fed. Reg. 50,015 (1979).

individuals. Second, the proposed regulations were controversial, because they were issued before EPA had developed its *generally applicable standards* for such sites. Since, under the regulatory scheme set out in UMTRCA, regulations developed by NRC governing uranium mill tailings (11e.(2) *byproduct material* generally) are to *conform* to the *generally applicable standards* promulgated by EPA, it was argued at the time that NRC's proposed regulations were premature.

However, despite these objections, NRC proceeded to finalize these proposed regulations. In the fall of 1980, NRC published its final regulations for uranium milling activities⁵⁹ contained in 10 CFR Part 40, Appendix A and also announced the availability of the final GEIS.⁶⁰ In keeping with its proposed regulations, NRC's final regulations adopted extremely conservative standards for the management and disposal of uranium mill tailings. In addition, the final regulations were directed, for the most part, at abating radon which, at the time, was seen to be the primary potential threat to health posed by uranium mill tailings and related wastes. Notably, groundwater protection issues were left to be addressed on a site-by-site basis.

Then, since EPA's *generally applicable standards* for "active" sites were issued after the Commission issued its regulations under UMTRCA and, because its regulations must *conform* to EPA's standards, NRC was forced to revise its regulations. In 1985, NRC focused its conformance efforts on EPA's standards for surface stabilization and radon protection.⁶¹ The Commission published a final rule in 1985 that replaced its 2 pCi/m²/s radon standard with EPA's 20 pCi/m²/s standard. Similarly, the Commission eliminated the requirement in its

⁵⁹ 45 Fed. Reg. 65,521 (1980).

⁶⁰ See GEIS, NUREG-0706 (1980).

⁶¹ 50 Fed. Reg. 41, 852 (1985).

original regulations for a minimum cover of ten (10) feet and adopted in its place EPA's longevity standard under which the system employed to contain mill tailings must provide "reasonable assurance" of remaining effective for 1,000 years and, in any event, at least 200 years utilizing "passive" controls.⁶² Also, NRC modified its regulations to specify that radon and longevity standards apply only to portions of a site or disposal area that exceed the "5/15" radium in soil standard.⁶³ In 1990, NRC issued final surface stabilization guidance⁶⁴ which required most licensees to revise their approved surface closure plans. Although NRC conformed its regulations to EPA's radon and surface stabilization standards reasonably quickly, it took significantly longer to conform its regulations to EPA's groundwater standards. Indeed, although NRC published an advance notice of proposed rulemaking in November of 1984, it was not until three (3) years later, at the end of 1987, that NRC's final groundwater requirements in Appendix A were promulgated.⁶⁵ Those regulations, like EPA's groundwater regulations, include a design standard and a performance standard. Also, like the EPA regulations, NRC's performance standard requires the licensee to achieve background concentrations, drinking water standards or an ACL. Further, the Commission initiated a program by which licensees are required to implement groundwater corrective action programs (GWCAPs) within eighteen (18) months if contamination is found to pass the POC to ensure compliance with relevant groundwater standards.

NRC's failure to promulgate final groundwater regulations prior to 1987 created difficulties for some mill operators. Since world uranium market conditions were beginning to

⁶² *Id.* at 41,856.

⁶³ *Id.* at 41,860.

⁶⁴ See United States Nuclear Regulatory Commission, Final Staff Technical Position, *Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites* (August 1990).

⁶⁵ 52 Fed. Reg. 43,553 (1987).

depress the domestic uranium recovery industry, many uranium mills were placed on “standby” status and began to address final site closure seriously. However, achieving final site closure was, as a practical matter, impossible until NRC’s groundwater regulations were completed, and such closure efforts were further delayed due to NRC’s failure to timely issue guidance on obtaining ACLs. Indeed, NRC did not issue “final” guidance on ACLs until December of 1992. Thus, as a practical matter, it was not until 1993 that NRC’s regulatory requirements and associated guidance were in place so that licensees could proceed to final site closure and license termination with reasonable assurance about the “rules of the game.”

Over time and as the domestic uranium recovery regulatory program evolved, additional questions regarding statutory and regulatory jurisdiction over 11e.(2) byproduct material arose pointing more towards which entities could regulate the material itself or portions thereof rather than whether any entity could regulate the material at all. After the enactment of UMTRCA and the creation of 11e.(2) byproduct material as an AEA material, NRC was faced with the dilemma of determining what type of regulatory authority NRC possessed over 11e.(2) byproduct material. In April of 1980, NRC’s Office of the Executive Legal Director (OELD) issued an advisory opinion addressing the question of whether, and to what extent, federal law preempts *non*-Agreement State authority over the *non*-radiological aspects of 11e.(2) *byproduct material*.

In reaching this conclusion, OELD conceded:

“[W]e conclude that the question is so close that the Commission could reasonably choose either interpretation, but that the better legal view is that non-Agreement States and the NRC have concurrent jurisdiction to regulate the non-radiological hazards of mill tailings, both before and after the November 8, 1981 date upon which the Mill Tailings Act becomes fully effective.”⁶⁶

⁶⁶ Memorandum from Howard K. Shapar, Executive Legal Director, NRC, to Chairman Ahearne. NRC, *OELD Legal Opinion on Two Questions Relating to the Operation of the Uranium Mill Tailings Radiation Control Act of 1978*, Attachment B, 2-3 (April 28, 1980) (emphasis added).

Thus, despite the fact that the arguments favoring federal preemption were deemed persuasive, OELD concluded that *non*-Agreement States could exercise *concurrent jurisdiction* over the *non*-radiological aspects of 11e.(2) *byproduct material*.⁶⁷

OELD's advisory opinion presented significant potential regulatory problems for uranium recovery licensees (e.g., the NRC/DOE Working Protocol requirement to resolve all issues with State regulatory authorities). As a result, NMA's 1997 White Paper⁶⁸ presented a detailed analysis arguing that the advisory opinion's conclusion was incorrect and that it was not a "close" question in light of the then-*current* regulatory environment. NMA asserted that, when viewing the *then-current* UMTRCA-based regulatory environment, the federal scheme set out by the statute satisfied two separate tests established by the Supreme Court, either one of which would be sufficient to demonstrate federal preemption with respect to the *non*-radiological aspects of 11e.(2) *byproduct material*.

Briefly stated, according to the federal preemption doctrine, the Supremacy Clause of the United States Constitution elevates federal law above the laws of the individual states by declaring federal law to be the "supreme law of the land."⁶⁹ The United States Supreme Court has identified three different circumstances under which State law will be preempted. First, State authority will be preempted in cases where Congress *expressly* indicates, in the language of a

⁶⁷ NRC's legal staff subsequently reaffirmed this position in a letter dated October 28, 1993 to the Attorney General of the State of Wyoming. See Letter from William L. Brown, Regional Counsel, NRC, to Mike Barrish, Senior Assistant Attorney General, State of Wyoming (October 28, 1993). Interestingly, the Attorney General of Wyoming concluded in 1971 that UMTRCA preempted State regulation of *both* radiological and *non*-radiological hazards associated with mill tailings. See Memorandum from John D. Troughton, Attorney General, State of Wyoming, to Ed Herschler, Governor, State of Wyoming (December 1, 1979) (emphasis added).

⁶⁸ See generally *Recommendations for A Coordinated Approach to Regulating the Uranium Recovery Industry* (2018).

⁶⁹ U.S. Constitution, Article VI, clause 2.

statute, its intent to displace State regulation in a given area.⁷⁰ Second, even if Congress fails to expressly signal its intent to preempt State law, such intent may be implied from a scheme of federal regulation that is “*so pervasive* as to make reasonable the inference that Congress [intended to leave] no room for the States to [augment] it.”⁷¹ Congress’ intent to displace State law also will be implied in instances where federal law touches upon an area in which “the federal interest is so dominant that the federal system will be assumed to preclude enforcement of state laws....”⁷² Finally, the courts have held that State law will be preempted to the extent that it *actually conflicts* with federal law: if it is “[physically] impossible” to comply with both laws or where a state law “stands as an obstacle to accomplishment and execution of the full purposes and objectives of Congress,”⁷³ State law will be preempted.

Addressing these doctrines, NMA first argued that the AEA, as amended by UMTRCA, establishes a *pervasive federal scheme* for the regulation of uranium mill tailings and their related wastes (i.e., 11e.(2) *byproduct material*). As discussed above, no less than three federal agencies play an active role in regulating mill tailings. Pursuant to Section 275 of the AEA, as amended, EPA has issued detailed, *generally applicable standards* to address both radiological and *non-radiological hazards* associated with 11e.(2) *byproduct material*. The standards for

⁷⁰ See e.g., *English v. General Electric Co.*, 496 U.S. 72, 78-79 (1990); *Pacific Gas & Electric Co. v. State Energy Resources Conservation and Development Comm’n*, 461 U.S. 190, 203 (1983).

⁷¹ *English v. General Electric Co.*, 496 U.S. at 79 (emphasis added).

⁷² *Id.*

⁷³ *Id.* (emphasis added). State courts also have recognized preemption where there is a serious incompatibility between State and federal laws. In *Hermes Consolidated, Inc. v. Illinois*, 849 P.2d 1302. (Wyo. 1993), the Supreme Court of Wyoming held that a federal consent decree entered under RCRA preempted the hazardous waste remediation plan issued by the State Department of Environmental Quality and noted:

“If Congress has not entirely displaced state regulation over the matter in question, state law is still preempted to the extent it actually conflicts with federal law, that is...*where the state law stands as an obstacle to the accomplishment of the full purposes and objectives of Congress.*”

Hermes at 1306 (emphasis added).

potential *non*-radiological hazards are “lifted from” EPA’s RCRA regulations. In turn, NRC has incorporated these regulations into its criteria for the management, closure, and long-term monitoring of mill tailings sites, as set out in 10 CFR Part 40, Appendix A. Under UMTRCA, NRC or an Agreement State has the responsibility for implementation and enforcement of all AEA requirements applicable to active uranium mill tailings sites and final disposal of the tailings themselves. Indeed, with respect to final disposal and license termination of an active uranium recovery site, any Agreement State decision to terminate a license must be approved by the Commission pursuant to Section 274(c) of the AEA. Finally, thus far, DOE completes the federal oversight “circle” of 11e.(2) *byproduct material* by becoming the permanent long-term custodian and perpetual licensee of sites used for the disposal of such wastes under Title II of UMTRCA, as well as exercising primary responsibility for selecting and overseeing the remediation of inactive uranium mill tailings sites and permanent custodianship thereof under Title I of UMTRCA subject to NRC concurrence.

The OELD opinion was issued at a time when the federal regulatory program governing uranium mill tailings and their related wastes was in its infancy. At that particular time, the roles of the federal agencies (i.e., EPA, NRC, and DOE) assigned under UMTRCA in implementing the statutory regime had not yet been firmly defined in regulations. In addition, it appeared at the time that the radiological hazards (e.g., radon emissions) associated with those tailings and wastes would be the primary focus of regulatory concern (e.g., note that initially both EPA’s “inactive” site and NRC’s “active” site regulations addressed groundwater only on a site-by-site basis). Indeed, the OELD cited this apparent primary focus on radiological hazards as supporting the conclusion that federal regulation of mill tailings preempted *non*-Agreement State regulation *only* with respect to the radiological aspects of 11e.(2) *byproduct material*. However,

over the nearly twenty years since the OELD opinion was written, NMA argued the regulatory scheme set out in UMTRCA had developed into a robust and comprehensive federal program that actively regulates both radiological and *non-radiological* components of 11e.(2) *byproduct material*, from the point of generation through to ultimate disposition. The pervasiveness of this federal regime indicates that Congress did not intend to allow *non-Agreement* States to exercise concurrent jurisdiction over either the radiological or the *non-radiological* aspects of 11e.(2) *byproduct material*.

Second, NMA argued that the exercise of concurrent jurisdiction over 11e.(2) *byproduct material* conflicts with federal law, because it is inconsistent with the overall statutory scheme created by the AEA, as amended by UMTRCA, and it frustrates Congress' purpose in enacting UMTRCA to grant NRC the authority to regulate 11e.(2) *byproduct material*. This inconsistency is most evident in the impact of concurrent jurisdiction on the Agreement State program. While Agreement States must carefully conform their regulation of radiological and *non-radiological* hazards associated with 11e.(2) *byproduct material* to federal standards, as required by Section 274(o) of the AEA, as amended, *non-Agreement* States would be free to regulate the *non-radiological* components of 11e.(2) *byproduct material* without any regard to consistency with federal standards. In other words, Agreement States that have to comply with NRC requirements to achieve and retain their Agreement State status have less authority (at least with respect to *non-radiological* components of 11e.(2) *byproduct material*) than they would otherwise have as *non-Agreement* States. Such a result, NMA argued, denigrates and devalues the Agreement State program.

Similarly, the exercise of concurrent jurisdiction by *non*-Agreement States would conflict with the role established for NRC under Section 84 of the AEA, which directs the Commission to ensure that the management of any 11e.(2) *byproduct material* is carried out in a manner that:

“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 economic costs and such other factors as the Commission deems appropriate.”⁷⁴

If *non*-Agreement States are allowed to exercise concurrent jurisdiction over *non*-radiological aspects of 11e.(2) *byproduct material*, then *non*-Agreement States could force licensees to perform remedial actions above and beyond those required by NRC, regardless of the net risk, cost or environmental impact and, conceivably, even after termination of the license granted by NRC.⁷⁵ Under this policy, the Commission would be unable to weigh the impacts of State-imposed actions with the other factors mandated for consideration by the statute, thereby leading to inappropriate management of 11e.(2) *byproduct material*, in contravention of Section 84 of the AEA.

Finally, NMA argued that the exercise of concurrent jurisdiction would interfere with license termination and final site closure at Title II active uranium mill tailings sites. After

⁷⁴ 42 U.S.C. § 2114(a)(1).

⁷⁵ Indeed, potential *non*-Agreement State assertions of regulatory authority over *non*-radiological constituents after license termination were a matter of special concern to DOE as the likely long-term custodian. In particular, it was feared that DOE might attempt to refrain from taking title to such sites because of the possibility that the additional regulatory burdens imposed by the *non*-Agreement State after license termination, and the economic costs associated with those regulatory burdens, would conflict with the directive contained in Section 83 of the AEA, which requires that the transfer of title to DOE occur *without cost to the government* other than administrative and legal costs associated with the transfer itself. This concern was, in part, based on the waiver of sovereign immunity under the Federal Facilities Compliance Act with respect to management of *hazardous* substances under State law or delegated authority.

operating for many years under federal standards governing *non*-radiological hazards and having implemented groundwater corrective action programs based on those standards, some facilities were faced with the prospect of having to comply with additional requirements imposed by the State, which the Working Protocol with DOE noted above had made a condition of site closure.⁷⁶ If concurrent jurisdiction were exercised, NMA argued that, not only would closure costs increase substantially, but license termination, particularly in instances where the State-imposed requirements were technologically or economically infeasible, could be delayed or even denied. Nowhere in UMTRCA is this potential result contemplated and, allegedly, this result also would be unacceptable to NRC.⁷⁷ By impeding final site closure and license termination, the exercise of concurrent jurisdiction by *non*-Agreement States would frustrate one of the primary goals underlying UMTRCA (i.e., the orderly, timely closure and remediation of mill tailings sites). NMA noted that this effect would be greatly amplified by the large number of Title II sites that were preparing for final site closure.

After reviewing NMA's analysis regarding concurrent jurisdiction over 11e.(2) *byproduct material*, on August 11, 2000, the Commission held that any regulation of the *non*-radiological hazards of AEA materials by *non*-Agreement States is federally preempted.⁷⁸ As stated by former NRC Chairman Richard Meserve in his comments on the issue, "there is pervasive evidence that Congress intended to establish a comprehensive regulatory regime over the *non*-radiological hazards of mill tailings that is exactly parallel to the NRC's jurisdiction over

⁷⁶ See United State Nuclear Regulatory Commission, *License Termination/Site Transfer Protocol Between the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission* (1998).

⁷⁷ NRC legal counsel have publicly stated at several NMA meetings that perpetual licenses for Title II licensees were not contemplated by UMTRCA and would not be acceptable to NRC.

⁷⁸ Commission Voting Record, SECY-99-0277, *Concurrent Jurisdiction of Non-Radiological of Uranium Mill Tailings* (August 11, 2000).

radiological hazards.”⁷⁹ Chairman Meserve, noting that there is no explicit language in UMTRCA calling for preemption of State regulatory authority, cited the Supreme Court’s decision in *Pacific Gas & Electric Co. v. State Energy Resources Conservation and Development Comm’n*⁸⁰ to demonstrate NRC’s preemptive authority over the radiological safety aspects of the construction and operation of nuclear power plants. Congress, when enacting UMTRCA, placed radiological and *non*-radiological hazards on “the same footing” and, Chairman Meserve suggested that Congress intended the same “sweeping federal preemption to cover both types of hazards.”⁸¹

Additionally, Chairman Meserve cited the United States Court of Appeals for the District of Columbia Circuit’s (D.C. Circuit’s) decision in the *Brown v. Kerr-McGee Chemical Corp.* case as support for federal preemption. The D.C. Circuit stated that UMTRCA was enacted “to provide a comprehensive remedial program for the safe stabilization and disposal of uranium and thorium mill tailings.”⁸² Further citing the *Kerr-McGee* case, Chairman Meserve stated that “it was logical for Congress to link radiological and *non*-radiological hazards together because both hazards arise from the same material and are ‘inextricably intermixed.’”⁸³

⁷⁹ *Id.* (emphasis added).

⁸⁰ Quoting their decisions in *Fidelity Federal Savings & Loan Ass’n v. De la Cuesta* and *Rice v. Santa Fe Elevator Corp.*, the Court stated that:

“Absent explicit preemptive language, Congress’ intent to supersede State law altogether may be found from a ‘scheme of federal regulation...so pervasive as to make reasonable the inference that Congress left no room for the States to supplement it,’ because ‘the Act of Congress may touch a field in which the federal interest is so dominant that the federal system will be assumed to preclude enforcement of State laws on the same subject,’ or because ‘the object sought to be obtained by the federal law and the character of obligations imposed by it may reveal the same purpose.’”

461 U.S. 190, 203-204 (1982).

⁸¹ Commission decision on SECY-99-0277 at 4.

⁸² 903 F.2d 1, 8 (D.C. Cir. 1990).

⁸³ 767 F.2d 1234, 1241 (7th Cir. 1985), *cert. denied*, 175 U.S. 1066 (1986) (emphasis added).

Agreement States also are subjected to various conditions and constraints on their AEA/UMTRCA regulatory power over 11e.(2) *byproduct material*. They are required to follow certain procedures in licensing cases, including detailed reporting requirements for public hearings and judicial scrutiny.⁸⁴ Chairman Meserve concluded that “it would be anomalous in the extreme for Congress to require Agreement States to comply with these various requirements and constraints and yet to allow *non*-Agreement States to regulate non-radiological impacts without any such limitations.”⁸⁵ Chairman Meserve, with two other Commissioners concurring, concluded that *non*-Agreement States cannot exercise concurrent jurisdiction over the *non*-radiological hazards associated with 11e.(2) *byproduct material*.

After the Commission issued its opinion, several States asserted their displeasure but did not take affirmative action to challenge the Commission’s decision. The States of Wyoming, Utah, and New Mexico all voiced their objections and concerns to uranium recovery licensees and NRC Staff. While these States were mulling potential legal challenges to the Commission’s decision, in June of 2001, NRC Staff notified such States that, in no uncertain terms, NRC preempts State authority over the *non*-radiological components of 11e.(2) *byproduct material* and that the States were expected to accept the decision.

In summary, NRC’s revised position on concurrent jurisdiction plays a crucial role for all types of source material recovery sites (i.e., conventional mills, heap leach facilities, and ISR sites). By exercising exclusive regulatory control over *all* components of 11e.(2) *byproduct material*, NRC has made clear that there is one set of regulatory standards that must be followed and that there is no threat of dual or overlapping jurisdiction over such material. Further, NRC

⁸⁴ See 42 U.S.C. § 2021(o).

⁸⁵ United States Nuclear Regulatory Commission, *SRM-SECY-99-0277*, at 5-6 (emphasis added).

has also demonstrated that its authority cannot be superseded by EPA or *non*-Agreement States under statutes such as RCRA, even though there are *non*-radiological (hazardous) constituents in 11e.(2) *byproduct material*. Most importantly, it also prevents *non*-Agreement States from interfering by right in final site closure and license termination decisions at active source material recovery sites and, similarly, removes the threat of their intervention in DOE long-term surveillance and monitoring actions after license termination at Title II mill tailings sites.⁸⁶

Based on the Commission's 2000 determination that it possesses exclusive, federal preemptive authority over all components of AEA materials such as 11e.(2) *byproduct material* and, by implication, source material, this White Paper is properly directed to the Commission for a formal legal/policy determination as to whether the use of kinetic separation to create a high-grade uranium ore for future "milling" is within its AEA jurisdiction and, if so, under what regulatory program a license would be required to engage in this activity. Thus, Western respectfully requests that the Commission render a formal legal determination on the questions contained herein.

⁸⁶ See *Waste Action Project v. Dawn Mining Corp.*, 1998 U.S. App. LEXIS 4115 (9th Cir., 1998) (emphasis added). In this opinion, the Ninth Circuit held that EPA lacks the authority to regulate the discharge of *byproduct material* into the nation's waterways under the Clean Water Act ("CWA"), noting that 11e.(2) *byproduct material* was excluded from the definition of "pollutants" within the meaning of the Act. More importantly, the Ninth Circuit flatly rejected plaintiff's assertion that Section 275(e) of the AEA implicitly "preserved" EPA's regulatory authority over 11e.(2) *byproduct material* under the CWA. The Ninth Circuit held:

"The AEA 'created a *pervasive* regulatory scheme vesting exclusive authority to regulate' with the AEC [now NRC] and "*pre-empting*" regulation by other agencies... Thus, Congress intended to exclude materials regulated under the AEA from the definition of "pollutant" under the CWA..."

Dawn Mining, 1998 U.S. App. LEXIS at 1430, citing *Train v. Colorado Public Int. Research Group*, 426 U.S. 1, 16 (1975).

Prior to the enactment of the Mill Tailings Act [UMTRCA], the EPA was not regulating tailings. The NRC had been regulating uranium mill tailings at active sites under its licensing power, but it had no authority to regulate tailings at *inactive* sites or after active site closure since such tailings were no longer licensable source material. Thus, the Mill Tailings Act [UMTRCA] was enacted in part to close the regulatory gap and give NRC the express power to regulate mill tailings at [licensed and] *inactive* sites."

B. BACKGROUND ON ISSUES RAISED

As is to be expected in any area of the commercial world involving the use of technology, advances in approaches to making the identified activity more cost-effective and efficient consistently come to the forefront and require detailed technical evaluation. In the case of innovative and unique approaches to uranium recovery (e.g., ISR techniques), detailed technical and health and safety/environmental evaluations in light of adequate protection and compliance with applicable requirements is required. In the instant case, the use of kinetic separation to create a high-grade uranium ore intended for subsequent “milling” is no different.

Since the use of kinetic separation in the manner discussed above relates indirectly, if not directly, to the high-grading of source material uranium ores, potential regulatory implications for mining or AEA-related activities are relevant. After developing a pilot and commercial scale business approach to using kinetic separation as proposed in an effort to recover source material uranium and other minerals from conventional ores, BRM, (now Western), initiated consultations with relevant regulatory authorities in the State of Colorado and NRC to determine what type of licensing/permitting would be required for active operations. At the time of the opening of these discussions, BRM already possessed a license to construct and operate a conventional uranium mill known as Pinon Ridge in Western Colorado that could process uranium-bearing ores and dispose of subsequent mill tailings as 11e.(2) byproduct material in mill tailings impoundments on-site. The company’s initial approach to the use of kinetic separation would be to conduct pilot test studies of the technology to determine if the two ultimate goals of the process could be achieved: (1) to create an economical, high-grade uranium ore for subsequent milling into a commercial-grade yellowcake product in a time when uranium market prices were depressed and (2) to effectively minimize potential tailings for disposal at the

Pinon Ridge site by creating otherwise “clean” backfill to return to a conventional mine without impacting public health and safety or the environment. It was envisioned that the Pinon Ridge conventional uranium mill could minimize the tailings created and land needed for transfer of 11e.(2) byproduct material to a mandatory long-term custodian while maintaining more than adequate yellowcake production to sustain the operation of the mill facility.

Prior to actively engaging NRC and the State in these discussions, several entities inquired into the regulatory requirements for the use of kinetic separation in this manner. The primary question raised by these entities was whether or not the AEA’s and, by definition, the Commission’s jurisdiction attaches to the use of kinetic separation to create a high-grade uranium ore intended for subsequent “milling” at a licensed AEA uranium recovery facility. Initially, these inquiries stemmed from questions from the State of Colorado that were raised by interested stakeholders regarding this issue. After its preliminary review of this question, NRC Staff transmitted an advisory opinion to the State concluding that it was likely that at least a source material license would be required for this activity. However, a detailed review of this issue had not yet been completed and a final legal determination was not made available.

Then, BRM prepared and submitted a White Paper to NRC Staff for its consideration regarding this legal question. This White Paper set forth a number of items beginning with its proposed action which is articulated above. This proposed action was developed to provide regulatory agencies and interested stakeholders with a number of tangible benefits, including but not limited to: (1) a technical overview of kinetic separation (in this case “ablation” as originally proposed) as a process operation demonstrating that it can create a high-grade uranium ore for subsequent milling and that can return the otherwise clean backfill to a mine without public health and safety or environmental risks; (2) a mass-balance analysis showing that subsequent

milling would result in a minimization of 11e.(2) byproduct material in the form of mill tailings well below the typical percentage of the previously mined ore; (3) a legal analysis showing that the use of kinetic separation processes in this manner constituted “mining” and should be regulated by the State under its broad police powers; (4) a legal analysis showing that, should NRC Staff deem that AEA jurisdiction did attach to kinetic separation as proposed that it required only a source material license under 10 CFR Part 40 and not a combined source and 11e.(2) byproduct material license which would incorporate 10 CFR Part 40 regulations *and* Appendix A Criteria; and (5) a series of policy arguments showing that allowing the use of kinetic separation as proposed would not result in any significant threats to public health and safety or the environment while making uranium recovery more cost-effective.

Prior to the submission of the White Paper, BRM requested and was granted a public meeting with NRC Staff in which a number of interested stakeholders, including the State of Colorado, participated. The substance of the White Paper was discussed in great detail, and the historical administrative record of past NRC Staff actions with respect to regulation of activities that were substantially similar to kinetic separation’s intended use were offered as support for the requested determination from NRC Staff. After final internal review, Black Range Minerals submitted its White Paper for NRC Staff’s consideration with copies going to the State of Colorado for review.

As anticipated, NRC Staff reviewed the arguments offered in the White Paper and its own internal administrative records to determine what regulatory position it would take. As NRC Staff was reviewing the White Paper and it became clear that BRM sought to implement kinetic separation as proposed in Colorado, the State initiated and completed a public process in which comments from all interested stakeholders, including public meetings, were received. A

review of these comments resulted in another letter of inquiry from the State to NRC asking two (2) specific questions: (1) whether the wastes generated by the use of kinetic separation to create a high-grade uranium ore for subsequent milling are 11e.(2) byproduct material and (2) what type of currently available regulatory program can adequately address regulation of kinetic separation used in the proposed manner. On October 19, 2016, NRC Staff issued a two (2) page non-binding and unsubstantiated legal advisory opinion stating that the use of kinetic separation as proposed constitutes “uranium milling” under 10 CFR € 40.4 with the resulting waste streams being classified as 11e.(2) byproduct material. NRC Staff also noted that, upon a showing of adequate data and information, WUC could obtain approval of an alternative waste disposal option that would not waive the classification of the waste streams as 11e.(2) byproduct material but would allow for the return of said waste stream to the mine from which it was originally removed. However, the requirements of both 10 CFR Part 40 source material regulations and Appendix A Criteria for 11e.(2) byproduct material management and disposal would continue to apply.

After receipt of this advisory opinion letter, the State engaged in a public process and solicited comments from interested stakeholders as to the viability of NRC Staff’s legal opinion and how such opinion should be implemented. A number of interested stakeholders provided comments including BRM. When this public process was completed, the State issued a legal opinion package with responses to said public comments concurring with NRC Staff’s opinion and, thereby, declaring that it would regulate kinetic separation as proposed as “uranium milling.” Thus, the regulatory landscape was set for kinetic separation in the State of Colorado and, presumably, at NRC.

After issuance of this position by the State, BRM sought NRC Staff's legal opinion on whether a research and development (R&D) license or exemption from 10 CFR Part 40 regulations could be reasonably obtained in order to demonstrate the commercial-scale viability of kinetic separation as proposed. Drawing on NRC Staff's and Colorado's legal opinions regarding the potential for an alternative waste disposal scheme for 11e.(2) byproduct material, BRM requested that NRC Staff render a legal opinion as to whether this was possible given that the main focal point of such a proposal would be demonstrating the lack of significant risk to public health and safety and the environment of returning the waste stream to the mine of origin. Then, NRC issued an opinion letter stating that, absent a specific exemption, BRM would be required to obtain a full source material license if the source material uranium generated from the pilot-scale testing exceeded the "unimportant quantities" threshold of 500 ppm uranium *and* the general license limits which are now much smaller than the previous "15/150" limits and are now "3.8/15/4" pounds. In essence, both NRC and Colorado have opined that the use of kinetic separation as proposed must be regulated as a uranium milling function despite the fact that it does not generate yellowcake product and requires a full milling process at an off-mine-site AEA-licensed uranium mill facility. Through this White Paper, Western seeks a Commission directive to NRC Staff to do a full legal analysis of its previously offered unsubstantiated advisory opinion and Colorado's final conclusions on this matter and to provide the Commission with options through a SECY paper for a final Commission vote, including the options that kinetic separation as proposed is either "mining" and outside AEA jurisdiction or "source material processing" requiring a source material license under 10 CFR Part 40, as NRC Staff initially opined.

C. ISSUES PRESENTED

Prior to offering the Commission a detailed technical and legal analysis of kinetic separation used to create a high-grade uranium ore for subsequent milling, it is important to properly understand the issues that are relevant to a legal inquiry into the regulatory landscape for this activity. The centerpiece of any regulatory review of whether an activity within the realm of uranium recovery falls within AEA jurisdiction is whether the wastes from the activity are classified as 11e.(2) byproduct material. The definition of 11e.(2) byproduct material is an *intent-based* definition and requires that the activity engaged in involve concentration or extraction of uranium source material from an ore *primarily* for its source material content. Thus, the following questions will be addressed in this White Paper and should serve as the foundation for NRC Staff's and the Commission's analysis:

1. Is the *primary* intent of kinetic separation to generate a high-grade uranium ore for subsequent milling primarily to recover source material as typically regulated by the Commission?
2. What other NRC and non-NRC regulated activities does the use of kinetic separation as proposed resemble and what was their regulatory classification?
3. If AEA jurisdiction does indeed attach to kinetic separation as proposed, what type of license would be required?
4. As a policy matter, why and how should kinetic separation be regulated?

As will be discussed below, Western asserts that the Commission should direct NRC Staff to issue a legal opinion that the use of kinetic separation is either "mining" and outside AEA jurisdiction or "source material processing" requiring only a 10 CFR Part 40 source material

license. Further, Western also requests that the Commission direct NRC Staff to include in this legal opinion that side-stream creation of a high-grade uranium ore using kinetic separation when recovering other minerals be classified as “mining” or “source material processing.”

D. ARGUMENT IN SUPPORT OF KINETIC SEPARATION BEING SOURCE MATERIAL PROCESSING AND NOT URANIUM MILLING

1. THE STATE OF COLORADO’S LEGAL REASONING AND RESPONSE TO COMMENTS CLASSIFYING KINETIC SEPARATION AS PROPOSED AS “URANIUM MILLING” ARE FUNDAMENTALLY FLAWED

After consideration of the legal standards associated with a Commission determination regarding kinetic separation used to generate a high-grade uranium ore for subsequent milling, Western offers a legal/regulatory analysis of the document issued by the State of Colorado in support of its determination that the use of kinetic separation as proposed is “uranium milling.” This document entitled *Decision Analysis for Regulating Ablation Mining Technology at the Sunday Mine under the Colorado Rules and Regulations Pertaining to Radiation Control* is rife with legal/regulatory flaws, misinterpretation of NRC AEA regulations and associated State regulations as deemed adequate and compatible with NRC requirements under the State’s Section 274 Agreement, and a gross misunderstanding of Congressional intent in UMTRCA and NRC’s historical handling of mining and other related activities. This White Paper offers the Commission a comment-by-comment analysis of this document and asserts that the State’s and NRC Staff’s interpretations are legally incorrect.

COMMENT #1: **Scope of the State of Colorado’s Agreement State Program: Page 14 of 37**

In this Section of the State’s paper, CDPHE lists the process steps resulting in the State’s Section 274 Agreement and the AEA materials over which the Commission discontinued jurisdiction and allowed the State to regulate under an adequate and compatible regulatory

program. In this comment, CDPHE specifically states that it has the authority to regulate source and 11e.(2) byproduct material through this Agreement which Western does not dispute. This comment appears to have been meant simply to set forth CDPHE's authority under its Section 274 Agreement and not to offer any legal conclusions.

COMMENT #2: Source Material Exemption under NRC's 10 CFR Part 40.4 as Unrefined and Unprocessed Ore

While Western does not dispute CDPHE's authority to determine what is an what is not "unrefined and unprocessed ore" and that the aforementioned Fonner memorandum allows NRC the authority to regulate ores that undergo some form of processing such as grinding or roasting, CDPHE also fails to note that the portion of the Fonner memorandum quoted by CDPHE states that such activities "*may* be viewed as a licensable situation." This statement that is used as express support for its position by CDPHE affords considerable discretion in determining whether or not to exercise jurisdiction over a given activity by NRC or its Agreement States. In a manner of speaking, this statement affords a regulatory entity the discretion to determine (1) whether it *should* regulate the given activity; (2) what manner of regulation is appropriate to regulate said activity and, most importantly, (3) is there another regulatory authority that can adequately regulate said activity without the need for overly burdensome and unnecessarily duplicative safeguards.

It is obvious from the process operation offered by Western that there are processes required to grade the naturally mined ore and prepare it for use in kinetic separation processes. However, as will be shown to be a prevailing theme in this White Paper, kinetic separation as proposed and in general is not and has never been intended to be used as a "milling" process as typically understood in the regulated community. As is the case with conventional uranium mining with subsequent milling or mining with the use of heap leaching, the process itself is

disjointed, most often at different physical locations, the activity that results in creation of the uranium-bearing ore to be milled at a licensed facility is not regulated as a “uranium milling” activity. Each example cited by CDPHE and by other interested stakeholders that resulted in some form of AEA-based regulation required only a source material license and not a full combined source and 11e.(2) byproduct material or “uranium milling” license. This past precedent is in direct contradiction to CDPHE’s findings.

COMMENT #3: Kinetic Separation Results in a Physical Change to the Naturally Mined Ore But Not a Chemical Change

On Page 17 of 37 of its supporting document, CDPHE concludes that kinetic separation as proposed does not result in a chemical change to the naturally mined ore, a comment that Western supports. Kinetic separation uses only water to dissociate uranium crusts from the naturally mined ore and does not intend to use any chemicals or chemical-based processes to create the high-grade uranium ore for subsequent milling at a licensed facility. Thus, unlike ISR or conventional/heap leach milling processes which involves the intentional introduction of chemicals in the form of lixiviant or leaching agents into the process operation, kinetic separation does not intentionally or unintentionally introduce chemicals into its process operation. As a result, a direct nexus to “uranium milling” as it is typically understood in the regulated community does not exist.

But, in an effort to demonstrate that kinetic separation is not subject to NRC’s specific legal exemption for “unrefined and unprocessed ore” in 10 CFR Part 40.4, CDPHE argues that kinetic separation results in a physical change to the ore and, therefore, cannot fall under the exemption. While it is clear that there is a physical alteration to the naturally mined ore through some pre-kinetic separation crushing and/or grinding (which is not part of “kinetic separation” processed) as performed by kinetic separation technology, the type of physical alteration does

nothing more than sort and high grade ore without the need for human intervention other than operating a piece of technology. CDPHE's focus is on the difference between sorting and blending that would fall under the exemption which constitute the typical conventional sorting and blending approaches that do not incorporate new or innovative technologies and kinetic separation which is new and innovative. Indeed, CDPHE's viewpoint on this difference is nothing less than shortsighted in that the end result of kinetic separation more closely resembles a final product produced by these conventional and widely accepted processes and not the product resulting from other examples cited as non-exempt processes and products. For example, CDPHE uses ion-exchange (IX) technology as a representative example of AEA-based licensing that would not fall under the "unrefined and unprocessed ore" exemption. Western agrees that the use of IX processes to concentrate uranium source material should not fall under this exemption, but vehemently disagrees with the assertion that kinetic separation is somehow similar to IX in terms of licensing approach. IX processes are specifically intended to concentrate uranium as part of the process operation but also intended to concentrate said uranium for a very different purpose such as treating drinking water to meet discharge limits at mines or to meet public drinking water requirements. Kinetic separation as a process itself is not intended to perform either function. Kinetic separation is not intended to concentrate uranium into a single product source; but rather, it is intended to economically create a high-grade uranium ore using physical processes that result in a product that resembles that of typical ore sorting or blending. The intent behind the latter is the same as the former: produce a high-grade uranium ore for subsequent milling. This factor represents the shortsighted nature of CDPHE's reasoning in that its analysis has limited itself to what was previously seen as exempt sorting and blending processes previously and does not sufficiently analyze kinetic separation for what its

process operation represents which is a more sophisticated ore sorting or blending process. Since the primary focus of whether an activity is AEA-licensable is on the process itself and not the intent, it is clear that kinetic separation potentially could be licensable under the AEA but that such regulation has been waived by the Commission as it produces “unrefined and unprocessed ore.”

CDPHE’s use of the examples involving ore buying and sorting as representative of kinetic separation as outside the “unrefined and unprocessed ore” exemption is equally unavailing. First, ore buying as a licensable matter makes little if any sense whatsoever regardless of past NRC practices. First and foremost, under NRC regulations at 10 CFR Part 40.21, any person may purchase and have ownership of source material without the need for any form or license. This is the case, because AEA and Commission regulations emanate from the possession of source material and not from ownership. Since the AEA’s primary mission is the adequate protection of public health and safety, ownership of source material is irrelevant to that mission. If you are an entity that owns the source material *and* possesses it as well, then AEA public health and safety requirements are triggered. Hence, this is the reason that all Commission and Agreement State regulations are tailored towards the possession and use of source material, including transport, transfer, and actual use of the material such as in the milling and conversion processes. Indeed, even the use of IX technology by licensees concentrating uranium for purposes other than *primarily for its source material content* require licenses because their process involves possession and use. The “unrefined and unprocessed ore” exemption is simply an express waiver of the licensing requirement for those processes meeting its criteria because of low risk levels, availability of other regulatory programs to address any potential hazards, and other relevant requirements. But, the fact that this exemption exists means

that the Commission determined that it may regulate such ores but chooses not to regulate based on these factors. As a result, CDPHE failed to conduct this analysis in its supporting document and did not opine as to whether kinetic separation would be an activity that could simply be regulated as a mining activity.

The lack of a chemical change to the naturally mined ore further supports the assertion that kinetic separation as proposed does not require more regulation than that offered by a State-based mining permit. Kinetic separation does not intentionally or unintentionally introduce chemicals into its process as it is designed to be environmentally friendly and, as such, does not result in the potential mobility of uranium or other constituents typical in chemical-based processes. Even the absurd statement that oxygen inadvertently introduced into kinetic separation processes may affect some form of chemical change is nonsensical as it does not result in increased risk associated with the high graded ore or the resulting clean backfill. Indeed, this type of inadvertent introduction of oxygen into any previously used mining or process operation is unavoidable and would render any mineral recovery process a “milling” operation. Indeed, oxygen introduced in large volumes to underground uranium mines that encounters uranium in and out of water solutions has never been considered to be “milling.” Thus, there are no are chemical changes in kinetic separation that could lead one to believe that this is a “processing” activity in the traditional sense.

COMMENT #4: Kinetic Separation as Proposed is Not a “Mining” Process

CDPHE’s initial analysis leads into its assessment beginning on Page 18 of 37 as to whether kinetic separation used to generate a high-grade uranium ore is a “mining process.” CDPHE’s assessment begins with a citation to a United States Court of Appeals for the Tenth Circuit (Tenth Circuit) case entitled *In the Matter of Hydro Resources, Inc.*, which is the seminal

NRC administrative law case on the AEA's regulatory jurisdiction over "uranium milling" and, in the former, ISR processes. The supporting document quotes the Tenth Circuit as stating that the AEA licensing requirement applies to ISR and cites to the Commission's ruling in that case supporting such a conclusion. However, CDPHE's supporting document errs in the fact that it states that this case stood for the conclusion that "federal and NRC administrative courts have repeatedly held that NRC does not have regulatory jurisdiction over uranium mines, *with the exception of in situ recovery*. Page 18 of 37 (emphasis added). While the citations to the Tenth Circuit and the Commission decisions are legally correct, CDPHE's conclusion is clearly erroneous. ISR facilities, as a matter of law, are *not* uranium mines; but rather, per the Commission's prior determinations in the 1980s that ISR operation processes are not "mining" and are "milling underground" and 2000 finding that restoration fluids and thus the entirety of the ISR project lifecycle is "uranium milling," ISR projects require AEA specific licenses. The Commission is empowered by the AEA to determine what activities fall within its regulatory jurisdiction and has determined that ISR processes are "uranium milling" and, thus, require a combined source and 11e.(2) byproduct material or "uranium milling" license. Even though Colorado is an Agreement State and has successfully established an adequate and compatible program under its Section 274 Agreement, it is not empowered to make final determinations as to what is and what is not within the AEA's regulatory scope. The best example of this is when the State of Texas through its Section 274 Agreement attempted to broaden the scope of the statutory definition of 11e.(2) byproduct material to include certain low-level radioactive wastes. NRC's OGC specifically instructed that this attempt to redefine the scope of what is within the scope of UMTRCA definition and the Commission's express, preemptive federal jurisdiction would constitute grounds for revocation or alteration of its Agreement State program. As a

result, the State of Texas reversed its position and returned to the statutory definition of 11e.(2) byproduct material. Thus, CDPHE's legal analysis should be highly scrutinized because of an incorrect assessment of existing case law and the Commission has the inherent authority to reverse its findings on kinetic separation if it sees fit.

COMMENT #5: Kinetic Separation is Not Similar to Blasting and, Thus, is Not a Mining Activity

CDPHE's assessment of kinetic separation as a "mining" process" continues with answers to comments received during the public process regarding the similarities between "blasting" and kinetic separation. CDPHE states that "blasting" fits squarely within the definition of "mining" and is outside the scope of the AEA, but kinetic separation "always takes place after the ore is mined, even if AMT [ablation] takes place at a mine or underground."⁸⁷ Citing to Section 42 USC € 2092, CDPHE then concludes that "[t]he ore has thus already been removed from its place of deposit in nature." This is one of the primary foundations for CDPHE's conclusion that kinetic separation is not a "mining" activity.

CDPHE's attempt to distinguish "blasting" from kinetic separation using the difference in timing of "blasting" and kinetic separation in a mining project cycle cannot withstand scrutiny. CDPHE's own legal analysis specifically references ore sorting of certain types that are outside the scope of the AEA and that do not require some form of AEA license. Ore sorting, by definition, can occur inside of an underground mine or outside of said mine on an ore pad *but always occurs* after removal of an ore from its place in nature. It is clear from this analysis that activities, including those that are classified as generating "unrefined and unprocessed ore" that occur after removal of ore from its place in nature can be classified as either outside the scope of

⁸⁷ Indeed, there potentially may be technological advances on the horizon where kinetic separation may be used to remove uranium from a host rock directly.

the AEA or within its scope but not selected for regulation by an AEA-empowered entity. Additionally, CDPHE's reference to ISR activities as further justification of the narrow limitations of "mining" is equally without merit. This is the case, because ISR involves the intentional introduction of chemicals (lixiviant) into a process whereby uranium dissolved from a host ore body (sandstone) into solution and is then pumped to the surface and uses IX technology to remove the uranium from said solution. The entirety of the ISR process involves the use of chemical alteration of the uranium source material from a host ore body into solution or removal from its place in nature *and* by chemical change through the use of a lixiviant such as oxygen. In the context of comparing a "mining" activity such as kinetic separation to a "uranium milling" activity such as the operational phase of an ISR facility, CDPHE's legal analysis shows no logical connection between the two examples. Their use in the same analysis is so different as to render it nonsensical.

CDPHE also ignores the inherent inconsistency in the Commission's decision regarding the operational phase or ISR processes where a licensee is intentionally seeking to recover uranium source material and the restoration (decommissioning) phase where a licensee is attempting to comply with 10 CFR Part 40, Appendix A, Criterion 5B(5) groundwater quality requirements. In the 1980s, the Commission determined that the underground activities associated with the operational phase of ISR processes constitute "uranium milling" for AEA licensing purposes and that 11e.(2) byproduct material in the form of spent IX resin and process fluids were generated. In addition, because the ISR physical facilities such as the wellfield pipes and CPP components are used within the scope of this operational phase, if unable to be decontaminated for unrestricted use, could be disposed of as 11e.(2) byproduct material at a properly licensed site. This is consistent with the traditional AEA regulatory interpretation that

conventional mill building components may be properly disposed of in mill tailings impoundments as 11e.(2) byproduct material if not released for unrestricted use. This activity was properly determined to be uranium milling, even though viable arguments can be made that the *underground* component of ISR operational processes does not involve “uranium milling” but possibly “source material processing” requiring an inquiry into whether the uranium in solution at such facilities exceeds the 10 CFR Part 40.13 500 ppm “unimportant quantities” exemption for licensable source material (Section 62 of the AEA).

But, the inconsistency that CDPHE fails to account for in its analysis is the stark difference between the *intent* associated with the operational and restoration phases of the ISR project lifecycle. Whereas with the operation ISR phase, a licensee is specifically intending to remove uranium from its place in nature and process the resulting uranium-bearing solution *primarily for its source material content* into yellowcake, the restoration phase of the ISR process removes source material from restoration fluid *primarily to comply with groundwater restoration criteria*. This is consistent with NRC’s current interpretation of 10 CFR Part 40.42 on timeliness in decommissioning where a wellfield must be restored within twenty-four (24) months or a licensee must seek as alternate schedule for decommissioning.⁸⁸ Restoration to meet Criterion 5B(5) groundwater quality requirements per NRC’s interpretation that such requirements apply *as a matter of law* to ISR wellfields is no different from NRC’s interpretation that water treatment at mine sites to meet discharge limits or at community water system sites to meet SDWA public drinking water standards is not “uranium milling” because uranium source material recovered in such activities is recovered *primarily* to meet these standards and not

⁸⁸ NRC Staff currently views the “decommissioning” phase of ISR operations for purposes of the Part 40.42 timeliness in decommissioning rule of twenty-four (24) months for final decommissioning to include wellfield restoration despite its separation of programmatic environmental impacts in NUREG-1910 into two (2) phases: (a) restoration and (b) decommissioning.

recover uranium as a commodity. Despite this obvious and inherent inconsistency in the Commission's opinions, this is the current legal interpretation of the AEA. Thus, the use of ISR as a supporting example of why kinetic separation is not mining has no logical nexus to the instant legal inquiry and should be disregarded.

COMMENT #6: As an AEA-regulated activity, kinetic separation should be regulated as "uranium milling" (pages 19-27 of 37)

After determining that kinetic separation as proposed did not constitute a "mining" activity, CDPHE concluded that the AEA should apply in some manner. This result led to the question of what type of AEA would be required for kinetic separation to generate a high-grade uranium ore for subsequent milling: (1) a "source material license" based on 10 CFR Part 40 regulations and corresponding CDPHE regulations or (2) a "uranium milling license (combined source and 11e.(2) byproduct material license)" based on the same regulations and Appendix A Criteria. At the end of this analysis, CDPHE concluded that the latter should apply. This resulted in an unduly burdensome and unnecessarily duplicative set of regulatory practices that are without legal or health and safety bases.

Prior to addressing the specific reasoning behind CDPHE's conclusion that kinetics separation as proposed is a "uranium milling:" activity worthy of the most stringent level of regulation, it is important to note that regulatory agencies should take great care in assuring that regulatory practices are not too burdensome and are commensurate with the level of risk associated with the given activity. In the instant case, regardless of the Commission's final determination, kinetic separation will be regulated at a given mine site under an applicable State-based mining permit. These permits, especially in Colorado where the mining regulatory program is highly robust, sophisticated, and well-tested, incorporate a wide range of public and occupational health and safety requirements emanating from federal and State programs such as

the Clean Air Act (CAA), Clean Water Act (CWA), and Mine Safety and Health Administration (MSHA) radiological dose requirements. These requirements closely resemble those associated with the AEA in 10 CFR Part 20 and 40 and are more than sufficient to regulate mine site activities, including kinetic separation which is specifically designed to return clean backfill to a mine. As shown above, CDPHE engages in a splitting of hairs when determining that ablation is not a mining activity where NRC has on occasion chosen not to exercise its AEA authority over such activities. To impose a burdensome, long-term regulatory program on kinetic separation such as the “uranium milling” program is unduly burdensome and not commensurate with the associated potential health and safety risks. As a policy matter, the Commission should consider this when evaluating the AEA’s legal applicability to kinetic separation as proposed, because the Congressional intent behind UMTRCA was health and safety based and was aimed at isolation and minimization of mill tailings at minimal locations.

This policy matter is further perpetuated by CDPHE’s discussion on Page 29 of 37 of its supporting document regarding a potential new category of AEA-regulated material and/or activity. CDPHE specifically states that there were specific concerns raised by interested stakeholders about the “significant differences between the kinetic separation process and the conventional uranium ore milling process about the creation of byproduct material.” *See* Page 29 of 37. Indeed, BRM at the time stated that such an approach was unnecessary due to the availability of existing regulatory programs under the State’s mining and, if necessary, Agreement State programs. The wastes generated by the kinetic separation process would either result in water that is reused, treated for release/discharge or evaporated that does not result in a “waste” classification, water that is treated to meet mine discharge permits, and/or kinetically separated material that results in clean backfill to be returned to a mine. CDPHE incorrectly

asserts that it cannot assume that this is the case without further evidence. This is a clear dismissal of the requested interpretation from Western which is if these facts are true, would the process require an AEA license and, if so, in what form. Thus, even in this instant, CDPHE's analysis failed to render a proper opinion on the regulation of kinetic separation as requested and, if the facts as posited by Western, and also ignores the fact that kinetic separation wastes are environmentally benign and can be adequately regulated by mining regulations, such as the wastes from the former Climax molybdenum mine and mill side-stream uranium recovery performed under a "source material processing" license.

With that said, CDPHE's legal analysis resulting in a classification of kinetic separation as proposed as "uranium milling" is in direct contradiction of UMTRCA, the Congressional intent behind the passage of UMTRCA, and past Commission determinations. First, this White Paper will begin with a general discussion of past determinations resulting in classification of uranium recovery activities as "uranium milling." As discussed above, CDPHE's illogical use of ISR processes as "uranium milling" to distinguish kinetic separation as proposed from a "mining" activity serves as an example of why AEA-regulation of kinetic separation should be strictly limited to "source material processing." Like conventional milling processing such as heap leach and conventional acid leach technologies, ISR processes involve the intentional introduction of chemicals (lixiviant) into a given ore or saturated ore body to dissolve and remove uranium into a solution for milling into a final yellowcake product. This is the source of the intentional chemical change that creates a uranium milling process. But, kinetic separation as proposed and, indeed, in any other form, does not involve a chemical change either intentionally or unintentionally and does not generate a yellowcake product.⁸⁹ Is the line drawn by NRC Staff

⁸⁹ In addition, the example of Sequoyah Fuels conversion facility in the State of Oklahoma provides further support here. In that case, the Commission determined that the facility received yellowcake

in its recent 10 CR Part 40 rulemaking providing for a “source material processing” license for activities generating licensable source material but not intentionally processing ores *primarily for their source material content*. If CDPHE’s interpretation were to hold true, then several Commission determinations and rules would be directly contradicted including those associated with drinking and mine water treatment processes.

With respect to its legal analysis, CDPHE begins by linking the UMTRCA definition of 11e.(2) byproduct material to that incorporated by Colorado into its Agreement State regulations, which Western does not dispute. As demonstrated through past attempts by at least one Agreement State (Texas) to alter the definition of 11e.(2) byproduct material which was halted by the Commission in the late 1990s, this definition is not subject to change as it is a statutory definition and a Compatibility A requirement. CDPHE further states that the creation of 11e.(2) byproduct material is not related to location of an activity or the physical characteristics of a given waste material. As stated above, it is commonly understood that the definition of 11e.(2) byproduct material is intent-based due to the language of processing ores *primarily for their source material content* and, therefore, can include a broad range of characteristics and come from multiple locations. Thus, CDPHE’s conclusions here are correct.

product from mill facilities that contained enough impurities preventing conversion into UF6 for introduction into the commercial nuclear fuel cycle. Thus, the facility incorporated a yellowcake refining circuit that removed said impurities and produced clean yellowcake. This activity was post-milling and the wastes therefrom were determined to be 11e.(2) byproduct material. While kinetic separation is a pre-milling, high-grading process, the SFC process was a *post-milling* and purifying process. It is unclear from CDPHE’s Footnote #11 citing this example is intended to apply to a “chemical process prior to milling,” but if it is, then the example is used incorrectly as SFC activities classified as generating 11e.(2) were actually post initial milling and only a method of purification primarily for the source material content. NRC verbally agreed during discussions about this finding that if a conventional mill run was re-run at the mill site to purify/concentrate the uranium product, the resulting tailings would constitute 11e.(2) byproduct material.

This discussion of the 11e.(2) byproduct material continues with CDPHE asking several questions of the kinetic separation process and the waste materials that are generated. First, as discussed above, CDPHE claims that it cannot assume that facts as stated by BRM previously and by Western to date that wastes such as process water would be recycled are true for purposes of its analysis. This point is irrelevant as the very point of a request for a legal determination is to assume that facts as presented are true and, if so, what would the requested legal determination be based on such facts. Thus, CDPHE's comment here should be disregarded.

With respect to its statements regarding the eventual treatment and/or disposal of process water after the use of kinetic separation technology/processes, there are two very significant points here that CDPHE ignores in its analysis. First, CDPHE ignores the fact that water treated to meet discharge limits after being used in the kinetic separation process, depending on the extent of treatment, may meet State and/or federal water quality standards for a specific "class of use." These classes can range anywhere from drinking water quality to agricultural or stock water use to commercial industrial use. If a product, any product, is used for a particular purpose, it cannot by definition be a "waste." This is consistent with the RCRA definition of waste material used in the context of alternate feed material when the Commission classified otherwise discarded waste materials are *ores* for purposes of uranium recovery as an alternate feed material.⁹⁰ The same should be applied by the Commission to ISR wellfields where it has determined that the depleted underground ore body after ISR operations is *not* 11e.(2) byproduct material but the water within the aquifer is 11e.(2) byproduct material. This factor is what the Commission deemed enough for it to exercise jurisdiction over groundwater restoration *as a matter of law* over ISR wellfields. While the Commission has not had the occasion to consider

⁹⁰ See 40 C.F.R. € 261 *et seq.*

this issue, it is in direct parallel to the kinetic separation inquiry as many, if not all, ISR wellfields are eventually restored to a particular State-based class of use standard as NRC does not currently have such a standard. By restoring such groundwater in a manner similar to treating water associated kinetic separation to a certain class of use would transform the regulatory classification of such water to a non-discarded material and, thus, it would no longer be a waste. CDPHE ignores this factor and does not even attempt to refute it.

Second, CDPHE also does not account for the fact that, even in the face of treating water that meets class of use as a “waste” or the process water not meeting such standards, process water is frequently treated to discharge limits and released in mining operations. State-based mining programs, including those in Colorado, adequately address this type of discharge and have been well-tested over the course of time. Indeed, even water treatment technologies qualifying for an AEA-based “source material processing” license at mine sites that discharge water to meet certain water quality standards are regulated under a site’s mine permit (for Colorado see Schwartzwalder). Thus, it is wholly unnecessary to use the discharge of process water or the potential future use of such process water when determining whether or not kinetic separation as proposed is AEA-regulated. Therefore, CDPHE’s first question regarding what the wastes are produced at the Sunday mine using kinetic separation is improperly addressed and is irrelevant to this inquiry.

The second question CDPHE’s legal analysis addresses is whether the waste produced by kinetic separation as proposed is produced by the extraction or concentration of uranium. The legal analysis offered by CDPHE in its supporting document focuses directly on whether there is so definition, State or federal, that would provide criteria for extraction or concentration of source material and whether it would lend guidance to the kinetic separation inquiry. No such

definition was found by CDPHE. However, CDPHE attempted to define concentration of uranium source material using common definitions of “concentration” to determine whether kinetic separation concentrates uranium source material. These sample definitions included those from a typical dictionary and concluded that if an end-product from a process operation results in a higher mass-balance of a given mineral (e.g., uranium) than in the original ore, then the process operation can be labelled as concentrating that mineral.

This conclusion, while typically used when a regulatory definition is not available, should not be considered dispositive here for a number of reasons. First and foremost, the act of “concentrating” uranium is not the entirety of the inquiry when considering whether or not a process operation is indeed “uranium milling.” There is an intent-based inquiry that must be conducted, which CDPHE attempts to do later in its supporting document, in order to make a proper determination. Second, in the context of mining versus AEA-regulated activity and whether the Commission would actually exert its AEA jurisdiction over a given process operation, the threshold for determining jurisdiction is primarily based on removal of source material from its place in nature. Thus, as is well-understood through the Fonner memorandum, the Commission could exert AEA jurisdiction over any source material ore after it is removed from its host rock through any technique. But, in most instances, the Commission has refrained from exerting such jurisdiction. “Concentration” of source material through activities that continue to fall under the Commission exemption of “unrefined and unprocessed ore” represent just one of many areas where the Commission can refrain from regulating such activities as high-grading “source material processing” or “uranium milling.” CDPHE even concedes that there are many activities that can occur at a uranium mine that do not fall within the AEA or that the Commission does not exert regulatory jurisdiction over while being conducted—activities more

closely associated with “mining” rather than “milling” or physical versus chemical separation for blending and transport. Lastly, if the term “concentration” in the context of mining were to be defined the way in which CDPHE articulates, *any* activity that results in removal of a mineral-bearing ore from a host rock as simple as blasting would be subject to increased regulation. Using blasting as an example, the host rock, or identified portion thereof, contains a specific concentration of uranium and the resulting ore to undergo future milling has an increased concentration of that uranium simply because that is the purpose of mining: to identify uranium-bearing deposits and remove them from host rock to maximize recovery and to minimize transportation costs and tailings. While it is clear that CDPHE realizes that the inquiry into AEA stretches beyond whether an activity in “concentrating” source material, the inquiry into kinetic separation as proposed should have stopped here and resulted in either an activity that the Commission cannot or should not regulate.

With respect to the term “extraction,” CDPHE concedes that it makes no legal decision regarding application of that term to kinetic separation as proposed. CDPHE does, however, cite to the removal of a “fraction” of an ore via physical process as constituting “extraction” per common dictionary definitions. Western concedes that it does remove a uranium-bearing fraction from an ore taken from its host rock but, for purposes of AEA regulation, “extraction” through a process operation is designed to identify activities that are actually taking the uranium *out of an ore* rather than manipulating an ore into a higher grade of the same ore. Kinetic separation is designed to perform the latter function and not designed to actually “extract” the uranium from an ore. “Extraction” of the source material or other mineral from the high-grade ore takes place at an AEA-licensed uranium mill where it is processed *primarily for its source material content*. However, another factor here is whether the redefined ore using kinetic

separation is sent to a non-AEA licensed uranium mill facility such as a rare earths facility for recovery of another mineral or to an AEA-licensed mill for recovery of vanadium with a “side-stream” recovery circuit, AEA-licensed circuit or, if not licensable source material is created in that circuit, a non-AEA-licensed side-stream circuit. There, the uranium is indeed being “extracted” from the ore itself but the ore is not processed *primarily for its source material content* and, thus, does not generate 11e.(2) byproduct material. These are the type of hard detail inquiries that must be conducted when making a legal determination on regulatory jurisdiction of a mining process operation. But, since CDPHE does not render any legal determination on whether kinetic separation as proposed “extracts” uranium from an ore, Western respectfully asserts that it does not extract uranium from an ore, but rather high-grades and redefines ores, including source material uranium, for further processing.

The third question asked by CDPHE during its legal analysis is whether kinetic separation as proposed is “processing” of an ore. CDPHE begins its assessment by stating that Western asserts that kinetic separation as proposed does not result in a chemical change to an ore and, thus, does not constitute “uranium milling.” They substantiate this further by citing to comments from Western stating that oxygen introduced into the process is not intended to solubilize uranium resulting in a chemical change. CDPHE then concludes that the Fonner memorandum’s reference to physical procedures to alter the ore’s previous condition results in “processing.”

While Western does not dispute that there is a “physical change” to an ore when kinetic separation is conducted, including possible crushing or grinding prior to introduction to the process operation, it does dispute CDPHE’s use of example referring to generation of byproduct material interchangeably with the use of the term “processing.” This ignores the critical aspect

of the legal inquiry which is the primarily purpose of the processing activity. Indeed, CDPHE even concedes a long list of “mining” activities that would be substantially similar to kinetic separation, especially if conducted underground at a mine site such as blasting, underground crushing or grating and, by implication, ore sorting and high-grading which can be done in tandem with these activities. CDPHE’s legal analysis is far too simplistic and does not delve into the details of kinetic separation in a manner sufficient to determine whether this is “processing” in the context of AEA jurisdiction. This is further evidence by CDPHE’s paraphrasing of Western’s comment that some activities that have been typically considered to be mining activities could be classified as milling through application of the Fonner memorandum. Western’s comment on this matter serves as an example of the fact that any common sense use of terms such as “physical or chemical change,” “extraction or concentration,” and “removal from its place in nature” is so activity-specific and detail oriented that an overly simplistic assessment can result in the ability of any regulatory entity to find a reason to regulate any given activity under any of the three previously discussed regulatory classifications aside from activities at an AEA-licensed uranium mill facility where it is presumed that you are processing ores *primarily for their source material content* or why would you go through the trouble of obtaining an AEA license in the first place?

CDPHE’s analysis on the use of the term “processing” should be taken in conjunction with its inquiry into whether kinetic separation as proposed is “uranium milling.” Both inquiries conducted by CDPHE are rife with errors based on incorrect legal interpretations and direct contradiction of Commission precedent. First, its analysis fails to account for the AEA category of licenses known as “source material processing” licenses that result in extraction or concentration of uranium through a processing activity but not for the *primary* purpose of

recovering the source material uranium through so-called “side-stream” recovery. There are multiple examples of such process operations that occur at mine sites or at facilities that are not mine sites where “extraction or concentration” of source material from ores that are “processed” may occur but do not constitute uranium milling. The discussion below provides the Commission with some of these examples but is not intended to be exhaustive.

1. Typical Mining Activities

This category of alleged processing goes without saying. It has been conceded in the supporting document that mining activities such as blasting and others typically have not fallen within the scope of AEA-regulated materials as it has been deemed as an activity that occurs prior to the removal of an ore’s place in nature per the statute. However, CDPHE’s document then goes on to attempt to refute Western’s comments regarding mining versus milling activities by stating that NRC considers physical and chemical procedures altering ore from the condition it was in just after its removal from its place in nature. But, it also is the case that activities after removal from its place in nature primarily associated with “mining” such as ore sorting and blending, as well as underground crushing or grating (with grizzly), are not considered typically to be AEA activities. While CDPHE disagrees with this statement, past NRC precedent does not. This renders CDPHE’s conclusion on this subject inconsistent with the AEA and incorrect based on Commission precedent.

CDPHE also states that “no mining activities (except ore sorting) extract or concentrate uranium.” Page 22 of 37. This is patently incorrect, because mining activities such as blasting from a host ore body, underground crushing with grizzly, and even ore sorting and blending from site ore pads (high-grading ore blending) would be considered “milling” under CDPHE’s analysis as extraction or concentration of source material uranium. Blasting ore from a host

rock, while it is the activity that removes ore from its place in nature, physically alters the ore itself by reducing the fraction of the host rock containing source material and extracting the uranium from the host rock. Further, it can be reasonably argued that a mining activity such as blasting or ore sorting and blending concentrates uranium because, by the cited dictionary definition, a mass-balance analysis of the removed ore is higher in uranium concentration than the host rock. The concept of extraction would equally apply, because the blasting “extracts” the source material from the host rock and the sorting and blending “extracts” the source material from the removed ore. The considerable confusion associated with these discussions shows that the passage of the AEA’s definition of mining being removal of source material from its place in nature was based on mining practices available at the time of passage and a presumed focus for regulatory agencies that have been re-evaluated in light of new and emerging technologies and approaches. It also shows that action must be taken to clearly define the differences between “mining,” “source material processing,” and “uranium milling.”

2. Processing Activities Previously Classified as “Source Material Processing”

The discussion in this subsection is intended to show that an inquiry into whether an activity, AEA-regulated or not, “extracts” or “concentrates” source material and whether it is done *primary for its source material content* are inextricably linked and must be addressed in a single inquiry. There are a variety of examples of instances where facilities have engaged in activities where they have indeed recovered source material through a process operation that involved extraction and/or concentration of source material and an activity currently understood to be processing but was not classified as “uranium milling” due to the intended purpose of the process operation.

The first process operation falling within the scope of “source material processing” is known as “byproduct” or “side-stream” recovery of source material. Generally speaking, this process operation involves a facility that contains at least one or more recovery circuits for different types of minerals, as well as a separate circuit designed specifically to recover source material. This type of mineral recovery became commonplace when companies found that uranium came along with sister minerals such as rare earths and/or vanadium and that the economic value of processing the same ores for all mineral components obviously was much more economically viable and also minimized the potentially hazardous constituents in the resulting waste streams. Indeed, currently, Energy Fuels Resources’ White Mesa Mill in Blanding, Utah (as did Union Carbide’s mill in the Gas Hills region of Wyoming) has a side-stream vanadium recovery circuit where ores processed primarily for their source material content also have vanadium removed for sale on the commercial market. For purposes of this White Paper, however, the side-stream recovery operations that are most relevant are those where processing facilities such as rare earths facilities find that recovery and sale of source material provides additional revenue. Indeed, another example is located in Colorado at the Climax Molybdenum mine and mill site wherein multiple recovery circuits recover different minerals other than molybdenum such as lead, zinc, copper, and source material uranium. At this site, due to the side-stream recovery of source material uranium recovery, the associated waste streams are not considered to be 11e.(2) byproduct material despite the evident extraction and/or concentration of said source material uranium.

There are numerous examples of rare earths facilities that generated licensable source material through side-stream recovery but did not generate 11e.(2) byproduct material. First, the Heritage Minerals, Inc. (HMI) facility in Lakehurst, New Jersey was a former ASARCO titanium

recovery facility when it was discovered that thorium in the form of monazite was strongly present in the stream of titanium-bearing sands mined at the site. At the time, the company determined that the market for the monazite sand was favorable and that recover of a monazite-concentrate was warranted. As part of its wet and dry mill processing facilities, HMI utilized physical processes such as gravity spirals and shakers to separate the relevant mineral-bearing fractions and used no chemicals whatsoever in these processes. As was to be expected, the monazite concentrate exceeded the Commission's licensable source material levels in 10 CFR Part 40.13 and, as such were subject to AEA licensing. But, when it addressed the need for a license, NRC Staff informed HMI that only a limited portion of its entire permit area (covered under a State mining permit) would require an AEA license and that the license would only require "source material processing" equivalent regulation and not "uranium milling." As part of the licensing process and because the monazite processing facilities were intertwined with the titanium circuits, NRC Staff issued an AEA source material license for the "wet" and "dry" mill buildings and the monazite sand pile outside and adjacent to these buildings only. No 11e.(2) byproduct material was ever generated at this site and, indeed, the monazite sand was later processed as an alternate feed material at the White Mesa Mill as an "ore."

While CDPHE attempts to differentiate the *intent* associated with the HMI process to remove monazite from kinetic separation as "inadvertent," this does not detract from the fact that the primary purpose of the HMI process was not to recover the source material content, but rather to recover titanium-bearing minerals. As stated above, kinetic separation is no different as the primary purpose of using the process is to high-grade uranium-bearing ores and not to recover the source material content. CDPHE's statement that the "economical" purpose of kinetic separation is to recover the source material is no different than if HMI decided to sell the

monazite sands. The “economical” purpose of *any* mining operation is to recover a targeted mineral, whether it be source material or not, and this argument alone would fundamentally change the way in which source material *mining* would be regulated. By this logic, any activity including the actual mining of source material bearing ores would potentially fall under a “milling” category regardless of the UMTRCA statutory exception on mining itself. It is nonsensical to believe that a processing company would recover a mineral without an economic purpose behind its business approach. Further, as stated previously, kinetic separation in any form cannot under any circumstances and without additional process technology generate yellowcake product. Why would you classify an activity as “uranium milling” if it cannot generate the end product that was the target of Congressional intent prior to the passage of UMTRCA?

Further, a persuasive NRC Staff interpretation of the waste streams associated with the HMI process lies in the final cleanup requirements for the NRC-licensed portion of the site prior to license termination. Prior to license termination, a surface scan of the NRC-licensed portion of the HMI site found that there were surface and subsurface pockets of materials that exceeded NRC-licensable source material levels. These materials were considered to be waste materials from the site associated with NRC-licensed side-stream source material thorium recovery activities (had they not later been sent as alternate feed materials for further “milling”) that required final disposition. In a document dated May 18, 2006, NRC Staff classified these pockets of material as *fugitive* source material from the licensed process operation and *not 11e.(2) byproduct material*.⁹¹ Thus, this conclusion further supported the proposition that “side-

⁹¹ United States Nuclear Regulatory Commission, SECY-06-0117, *Termination of Nuclear Regulatory Commission License for the Heritage Minerals Inc. Site in Manchester Township, New Jersey* (May 18, 2006).

stream” recovery of source material does not result in the generation of 11e.(2) byproduct material wastes. Like kinetic separation, the HMI process generates waste streams from what can be characterized as “side-stream” uranium recovery if other minerals are recovered and, as such and based on this precedent, cannot generate 11e.(2) byproduct material.

The second type of processing that falls into this category is the use of processing technologies such as IX to remove uranium from water sources. CDPHE references mine and mill facilities that utilize these processes which do not trigger an AEA “uranium milling” license such as the Kennecott Sweetwater mill. This example is representative of a concentration of source material with a specific, non-milling purpose. Further, and what CDPHE ignores, is the fact that eventually that concentrated uranium-bearing was eventually intended for subsequent milling at the Sweetwater mill. Like kinetic separation, the primary purpose was not source material recovery; but rather, compliance with water discharge limits. But the “economic” purpose of generating the uranium-bearing resin was to process it to generate yellowcake at a license uranium mill for sale on the commercial market. So, economics here are an ineffective way to properly characterize the intent of a process operation.

The Kennecott example is also similar to the example of Water Remediation Technology, LLC (WRT), currently licensed by the Commission and several of its Agreement States under a source material processing license. WRT is the holder of the only performance-based, multi-site license for removal of source material uranium from public drinking water sources to comply with EPA’s SDWA uranium in drinking water standards. The scope of these licensed activities was later expanded through its license renewal application where NRC authorized the use of the IX-based process to mine water and other water treatment operations. But, despite this expansion, one thing remained constant: WRT was removing source material uranium from the

water sources primarily to comply with drinking water standards and not to actually recover the uranium itself. While this comparison is not directly parallel to kinetic separation as proposed, the following additional determination made by NRC Staff is relevant. NRC Staff determined in both WRT's initial license and subsequent license renewal application that WRT's approved primary disposition option for its uranium-loaded IX resin, which exceeded licensable source material limits, would be to recycle the resin at a licensed AEA uranium mill (ISR or conventional) with IX stripping capability. Since the primary purpose of WRT's process was not recovery of the source material itself to generate yellowcake and even though it would eventually be milled for its source material content, WRT's wastes would not be 11e.(2) byproduct material *but* the wastes from the recycling process at a licensed AEA milling facility would be 11.e(2) byproduct material. In short, the end-product (yellowcake) is the economical goal of this process and not the uranium-loaded resin generated by WRT. Thus, WRT would not be a generator of 11e.(2) byproduct material wastes.

This example is not different from kinetic separation where the primary purpose is not to generate yellowcake product (economical) but rather to high-grade an ore so that *eventually at a licensed AEA milling facility*, this economic product can be generated. CDPHE's characterization of kinetic separation processes as having an economic goal of generating source material is not synonymous with the *primary purpose* of kinetic separation which is to high-grade ore to maximize production and minimize future tailings. There is a stark difference between an economic goal of a process operation and the primary purpose of the same operation. Kinetic separation as proposed, while geared towards the eventual generation of a yellowcake product is not the primary process for generating said product; but rather, kinetic separation as proposed is designed to high-grade source material uranium or other mineral-bearing ores and

not to generate yellowcake. As stated previously, kinetic separation cannot as a process operation generate yellowcake or anything even technically close to said product. Thus, kinetics separation as proposed cannot be classified as “uranium milling.”

E. ADDITIONAL RECOMMENDATIONS

As stated above, in the light of the need for an updated interpretation of the terms “mining,” “source material processing,” and “uranium milling” as well as identification of the differences between the three classes of licensable and non-licensable activities, Western respectfully suggests that the Commission also consider a second approach that could be helpful in addressing these concerns. Currently, NRC Staff issued a request for and has received multiple sets of comments from interested stakeholders regarding a possible rulemaking to revise and update its 10 CFR Part 40 regulations and Appendix A Criteria to harmonize and update their applicability to ISR facilities. Through the comments submitted by these interested stakeholders, it has become apparent that the Commission has not had an opportunity to consider major updates these regulations and Criteria for ISR *or for any other* source material related regulations since the early 1980s with limited exceptions. This White Paper presents the Commission with an additional opportunity to revise and update its regulations in a way that will provide regulatory transparency and certainty for the regulated community and its interested stakeholders on an activity (i.e., mining) that has not been addressed since its inception under the AEA and UMTRCA in 1978-1983. Thus, Western proposes that the Commission can adequately address the issues raised in this White Paper with a simple, clarifying revisions to its 10 CFR Part 40 regulations, so that all regulated entities properly understand what constitutes “mining,” “source material processing,” and “uranium milling.”

Initially, the Commission currently establishes what uranium source material recovery activities fall under the AEA through a simple definition of “ore” and “uranium milling” in 10 CFR Part 40.4 and approved by the Commission in subsequent administrative litigation and NRC Staff’s alternate feed guidance. More specifically, there is no definition of “ore” in the Commission’s regulations, even though the term is expressly used in the UMTRCA statutory definition of “11e.(2) byproduct material.” However, the Commission indirectly addresses this issue by having a “catch-all” definition of “uranium milling:”

“Uranium Milling means any activity that results in the production of byproduct material as defined in this part.”

10 CFR € 40.4 (2019).

This definition is further supplemented through NRC Staff’s alternate feed guidance, which has the force and effect of law through the Commission’s past alternate feed decision in the *International Uranium (USA) Corp.* series of cases where the definition of “ore” was formalized:

“Ore means any natural or native matter or any other matter from which source material can be extracted at a licensed AEA uranium milling facility.”

Using these definitions, the remainder of the inquiry into whether a source material-bearing ore is removed from its place in nature via the AEA is left to NRC Staff’s otherwise broad discretion, hence the advent of the Fonner Memorandum and other subsequent interpretations, including the opinions rendered by NRC Staff and Colorado on kinetic separation. Based on the fact that this broad discretion has resulted in several confusing interpretations of these terms, that the definitions as applied to the current state of mining technology have not been fully updated for at least three (3) decades, and that NRC Staff’s discretion should be further clarified to embody the Commission’s views on these activities, Western asserts that the Commission should consider adopting the following revisions and/or additions to 10 CFR Part 40 through the

aforementioned rulemaking while considering this White Paper. Following the suggested changes, a brief legal justification for each will be provided.

First, the Commission should consider adopting its approved definition of the term “ore” to provide further clarification on what materials may fall under the definition of 11.e(2) byproduct material and what materials qualify as “ore” and not necessarily as waste materials or source material uranium recovery products. The following is a recommended definition the Commission should consider:

Ore means any natural or native matter or any other matter from which source material (uranium and/or thorium) can be extracted at a licensed AEA uranium milling facility.

The recommended definition of “ore” is substantially similar, if not identical, to the definition offered in NRC Staff’s alternate feed guidance and as approved by the Commission in administrative litigation. Since the definition of “ore” is legally codified through the Commission’s decisions, adoption of this definition into 10 CFR Part 40.4 serves as a simple clarification of the Commission’s interpretation of the term “ore” as it appears in the AEA.

Then, to supplement the addition of the definition of “ore” and to further clarify the definition of “11.e(2) byproduct material,” Western suggests that the Commission consider an amendment to the definition of “uranium milling” to provide more detail as to the extent of NRC Staff’s discretion when interpreting what activities constitute “mining” or an AEA-regulatable activity such as “source material processing” or “uranium milling:”

Uranium Milling means any activity that results in the production of byproduct material as defined in this part. The term “uranium milling” is not intended to apply to activities in or at a uranium or other mineral mine including, but not limited to: (1) blasting including split-shooting; (2) high-grading; (3) ore sorting, high-grading, blending or separation; and (4) off-mill-site crushing, grinding, beneficiation or activities identified in (1-3).

These proposed revisions to “uranium milling” are meant to codify where NRC’s AEA jurisdiction over source material processes attaches and where activities associated with said

processing crosses into the scope of “uranium milling.” There has been considerable confusion associated with where an almost forty (40) year old memorandum known as the Fonner memorandum explains where this line can be drawn and has resulted in some questionable regulatory interpretations by NRC Staff on company inquiries (i.e., the regulatory differences between “source material processing” and “uranium milling”). These revisions are intended to further clarify this jurisdictional line recognizing that NRC has resisted getting involved in activities closely associated with mining such as ore sorting, blending and other activities listed in the proposed revision, as well as ore pads at mine sites for future shipping of ores to a uranium milling facility. Given that NRC already has gone through a rulemaking for “source material processing” and a re-definition of “unimportant quantities” for source material possession, it would be to NRC’s benefit to clearly draw the aforementioned jurisdictional line in this manner. NRC’s historical actions show that it typically does not attempt to extend its regulatory authority to mining sites, even if ores had been removed from its place in nature. But, even if NRC were to extend this authority to certain mine-site-related activities, the concept of “uranium milling” should not be extended to such activities.

Another reason that this definition should be added to limit and more clearly define NRC Staff’s regulatory discretion is that the statutory definition of 11e.(2) byproduct material is “intent-based” and is not derived from any true public health and safety, risk-informed assessment other than the Congressional intent described above. Congress’ intent when enacting UMTRCA was to address a long-standing health and safety risk from uranium mill tailings generated from the production of yellowcake product by providing the Commission with exclusive, preemptive jurisdiction over the radiological and non-radiological components of uranium mill tailings and to isolate them in safely contained impoundments (rather than piles) so

that their future use would be severely restricted to long-term stabilization and management by a mandatory feral custodian (DOE). But, once an inquiry goes past the Congressional intent embodied in the legislative history of UMTRCA, the discussion over the potential public health and safety risks associated with said material ceases. The inquiry merely shifts to whether the identified ore is processed *primarily for its source material content*. It is clear from the evolution of UMTRCA that the idea behind 11e.(2) byproduct material was to identify uranium mill tailings as representing a significant threat to public health and safety and previously generated and to encompass such materials that were generated specifically from the production of yellowcake under past AEC contracts and subsequent source material recovery for use in the commercial nuclear fuel cycle. In essence, the end product of this process was yellowcake and the resulting waste streams were considered to be uranium mill tailings to be isolated from public use and distribution unless under the custody of an AEA licensee.

The theory here that all 11e.(2) byproduct material was to be isolated at specific AEA-licensed uranium milling facilities manifests itself in a number of ways. First, the legislative history of UMTRCA and subsequent NRC documents including NUREG-0706 on conventional milling envisions single uranium milling sites where uranium mill tailings and yellowcake were and would continue to be generated and that these tailings needed to be safely contained and managed. The health and safety risk associated with such tailings was readily understood and did not require any additional technical and risk assessment. Thus, the definition of 11e.(2) byproduct material was created to focus on the *intent* behind the processing activity and not the actual risk associated with such resulting tailings. This intent is embodied in the Commission's ongoing interpretation of 10 CFR Part 40, Appendix A, Criterion 2 which attempts to minimize the locations where 11e.(2) byproduct material is finally disposed and managed under long-term

surveillance requirements. The characterization of kinetic separation, which is designed to occur at multiple mine sites across the country, as “uranium milling” would fly in the face of these factors and disrupt the Congressional intent in UMTRCA with no identifiable risk. This is even more apparent considering that NRC Staff and Colorado left open the possibility of Western pursuing a disposal alternative for the resulting 11e.(2) byproduct material where Appendix A Criteria would not necessarily be expressly followed. In this instance, NRC Staff and Colorado would be permitting a violation of Congressional and Commission-intent with material that requires the most stringent regulation despite lower public health and safety risk simply based on a misinterpretation of the intent behind the use of kinetic separation at mine sites. As previously stated, under no technical circumstances, absent the presence of leaching facilities such as SX or IX circuits where uranium can be isolated and yellowcake generated, can kinetic separation as proposed generate a yellowcake product. Thus, kinetic separation does not fit the mold of any identifiable “uranium milling” activity and its intent is not to generate yellowcake, but rather to generate a high-grade uranium-bearing ore for future milling. This type of misinterpretation should not be permitted.

Further, kinetic separation is a “mining” technology and not intended to be installed as the single mechanical process associated with yellowcake generation. Certainly, kinetic separation technology could be installed at an existing or future proposed uranium mill where it would merely be a component of the total milling process. However, while this is true, other technologies such as IX are used by entities to extract source material as a mechanical process that does not generate 11e.(2) byproduct material such as the examples noted above. Also, NRC’s “source material processing” rulemaking identified activities that generate licensable source material but do not require Appendix A regulation due to the fact that they do not

generate 11e.(2) byproduct material. This rulemaking was the subject of an additional health and safety evaluation as it was conducted in tandem with an adjustment of the Commission's 10 CFR Part 40.22 general and specific license quantity limits. By adjusting the possession limits of source material require for a specific license downward, the Commission determined that there was a health and safety risk associated with such activities that warranted specific license requirements such as radiation protection for lower quantities. But, the lack of intent to recover that source material from ores primarily for their source material content removed any possibility that such activities could be classified as "uranium milling." Thus, as previously stated, the entire inquiry into whether an activity is indeed "uranium milling" focuses solely on the process's intent. With kinetic separation, the intent is not to process an ore primarily for its source material content and it is its intent to generate high-grade ores, including potentially uranium ores, for future milling. Therefore, Western recommends that the Commission consider amending its 10 CFR € 40.4 regulations to re-define and clarify the existing definition of "uranium milling" so that future new and innovative mining technologies may be properly regulated.

F. CONCLUSION

As stated above, Western is respectfully requesting Commission action on this White Paper that may take one of the following two (2) approaches: (a) a directive from the Commission to NRC Staff to include proposed revisions to the 10 C.F.R. Part 40 definition of “uranium milling” and to incorporate language into the rulemaking record, using the proposed ISR rulemaking as a vehicle, to conclusively establish that the use of kinetic separation processes at uranium mine sites does not constitute “uranium milling;” or (b) a directive to NRC Staff to conduct a full legal and policy analysis of the use of kinetic separation at uranium mine sites with a final determination as to whether the AEA confers jurisdiction on the Commission to regulate its, if so, should it be regulated and what type of licensing scheme would be appropriate in the form of a SECY paper with multiple potential options for Commission vote. Western believes pursuing either of these two options will provide an open and transparent forum within which NRC, its Agreement States, non-Agreement States, and other interested stakeholders may better understand how the use of kinetic separation processes at uranium mine sites should be regulated. Western and its representatives are prepared answer any and all questions posed by the Commission on this issue at its convenience.

Respectfully submitted:

**/Executed (electronically) by
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