State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

L. Scott Baird
Executive Director

DIVISION OF WASTE MANAGEMENT
AND RADIATION CONTROL
Ty L. Howard
Director

August 21, 2020

David Frydenlund
Senior Vice President and General Counsel
Energy Fuels Resources (USA) Inc.
225 Union Blvd., Suite 600
Lakewood, CO 80228

RE: Amendment #10 of 11e.(2) By Product License No. UT 1900479
Groundwater Quality Discharge Permit No. UGW370004 Modification
Energy Fuels Resources (USA) Inc.
White Mesa Uranium Mill San Juan County, Utah

Dear Mr. Frydenlund:

In the matter referenced in the subject line, the Division of Waste Management and Radiation Control ("Division") has received comments from a variety of persons during the public comment period. These comments are available on the Division's website. Some of these comments are especially detailed and several commenting parties have submitted supplemental information with their comments. This notice relates specifically to the comments submitted by the parties listed, submitted by the Ute Mountain Ute Tribe, the Grand Canyon Trust, Uranium Watch, Friends of Cedar Mesa, and Mark Kerr ("Comments").

While the public comment period for this matter is now closed, the procedural provisions governing the permit review process set forth in the Utah Code anticipate that the Utah Department of Environmental Quality division directors may solicit supplemental information in response to public comments. *See* Utah Code Section 19-1-301.5(9)(b)(vii). The statute does not afford the right to any person to unilaterally supplement the record, only to do so in response to a request made by a division director. If the director then designates such requested information as the basis for the decision on any given permit order, it will become part of the official administrative record. *Id.*

(Over)

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To assist the Division in its review of the Comments, and to help create a more balanced administrative record, the Director has decided to solicit the submission of reply comments from Energy Fuels Resources. More specifically, pursuant to this letter, the Director requests reply comments addressing the following Comments:

Ute- Mountain Ute Tribe:

Comment #s: 4, 5, 6, 7, 9.h, 9.j., 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 23, 24 a. – c., 25, 27, 28 a. – e., 29, 30, 31, 32, & 33

Uranium Watch:

Comment #s: 1.2, 1.5, Section 2, Section 3.4

Grand Canyon Trust, et. al.:

Comment #s: 2, IIA, III, VI,

Bike Packing Roots:

Comments: All

Navajo Utah Commission:

Comments: All

The Director may designate all or any portion of reply comments as part of the administrative record in this matter. Reply comments should be submitted no later than **September 25, 2020**. This schedule is necessary in order to meet the Division's commitment to render a final decision in this matter by the end of the year. The Division also believes that reply comments will help others who may be asked to review the administrative record and the Division's permitting orders. Thus, this extended review process should serve the interests of transparency and efficiency on all levels.

If you have any questions, please contact Bret Randall at (801) 536-0284.

Sincerely,

Ty L. Howard, Director
Division of Waste Management and Radiation Control

TLH/RMJ/as

Enclosures: Ute Mountain Ute Tribe's Comments for Amendment #10
Grand Canyon Trust's Comments for Amendment #10
Uranium Watch's Comments for Amendment #10
Bike Packing Roots' Comments for Amendment #10
Navajo Utah Commission's Resolution

UTE MOUNTAIN UTE TRIBE

P.O. Box 248
Towaoc, Colorado 81334-0248
(970) 565-3751

July 10, 2020

Via email: dwmrcpublic@utah.gov

Division of Waste Management and Radiation Control
195 North 1950 West
Salt Lake City, UT 84116

The Ute Mountain Ute Tribe hereby submits the following comments regarding Radioactive Materials License UT1900479, Amendment 10, and proposed modifications to Groundwater Quality Discharge Permit No. UGW37004:

TRIBAL BACKGROUND

The Ute Mountain Tribe is a federally-recognized Indian tribe with lands located in southwestern Colorado, northwestern New Mexico, and southeast Utah. There are two Tribal communities on the Ute Mountain Ute Reservation: Towaoc, in southwestern Colorado, and White Mesa, in southeastern Utah. Ute Mountain Ute Tribal Members ("UMU Tribal Members") have lived on and around White Mesa since time immemorial and intend to remain there forever. The community of White Mesa depends on groundwater resources buried deep in the Navajo aquifer for its municipal (domestic) needs. UMU Tribal Members continue traditional practices, which include hunting and gathering and using the land, plants, wildlife and water in ways that are integral to their culture.

The White Mesa tribal community is located approximately three miles south of the White Mesa Mill (WMM) facility. The WMM is located on Ute ancestral lands, a much broader landscape containing resources and sacred sites throughout. The WMM's upgradient location from the Tribal community means that contamination from WMM facility operations generally flows through ground and surface water towards the Tribal community. As a result the White Mesa tribal community is bearing the disproportionate burden of environmental contamination brought on by the WMM and the decisions of the Division of Waste Management and Radiation Control. The Tribe is concerned that ongoing contamination of air, surface resources, surface water resources, and groundwater could make Tribal lands and the ancestral cultural landscape uninhabitable for future generations of Tribal members.

UTE MOUNTAIN UTE TRIBE'S POSITION REGARDING PROPOSED ACTIONS

The Division should not approve Amendment #10 and the modification of the Groundwater Permit for the reasons set forth below and set forth and agreed on in the public comments submitted by the Grand Canyon Trust. The Tribe also makes specific requests in the following comments for Division action regarding its authority over the mill operations and related consequences that should be considered.

1. The Director of the Division has the authority and responsibility to "ensure the maximum protection of the public health and safety to all persons at, or in the vicinity of, the place of use, storage, or disposal" of radioactive materials. R313-12-2.

2. Before approving an amendment to a radioactive materials license for a uranium mill, the Director must determine, among other things, that the applicant has satisfied all applicable requirements, including, among others, the environmental analysis required under R313-24-3 and determined that "the issuance of the license will not be inimical to the health and safety of the public." R313-22-33, -39.

3. The Director's authority is not limited to including in a license only those elements expressly enumerated in the Division's rules. The Director has broad authority to incorporate into licenses "additional requirements and conditions with respect to the licensee's receipt, possession, use and transfer of radioactive material subject to R313-22 as the Director deems appropriate or necessary in order to ... minimize danger to public health and safety or the environment." R313-22-34(2) (a).

> [We can preface more specific "action" demands (like our demand for emergency notification) with the foregoing, e.g., "The Director has the authority and responsibility and should require EFRI to ...."]

4. The Mill was originally designed, evaluated for environmental impacts, and licensed in 1979 – over 40 years ago - on the limited basis that it would process conventional uranium ores mined locally from the Colorado Plateau over an operational life of only 15-20 years and then be reclaimed.

5. The original Environmental Report for the Mill, written in 1978, made scant mention of the public health, safety and environmental quality concerns of either the Ute Mountain Ute Tribe's White Mesa Community or their neighbors to the south, the Navajo Nation. Both federally recognized Tribes are downwind and downgradient from the White Mesa Mill and depend upon the Navajo Aquifer as the sole source for their drinking water and domestic use, and also utilize the shallow Burro Canyon aquifer that is being contaminated by the Mill.

6. Despite the limited purpose and design life of the Mill and its legacy tailings cells and the limited scope of the environmental analysis, EFRI now takes the position that the "mill has no predetermined operation life," and "Since there's no set schedule for filling any one of the ponds, there's no set schedule for actual final closure of the mill." See response of Harold Roberts of EFRI to question from Scott Clow of the UMUT regarding the expected remaining operational and pre-reclamation life of the Mill as recorded in the Transcript of June 8, 2017 Public Hearing, Corrected Version, during the 2018 License Renewal. More recently, in a May 1, 2020, interview with Crux Investor posted on Youtube, Energy Fuels Resources (USA) (EFRI) CEO Mark Chalmers described the Mill as "state of the art, designed for a thousand years."

7. The state of Utah must recognize and acknowledge the reality that the Mill is far past its design life and no longer a conventional uranium mill, but, instead, a radioactive waste dump seeking to operate for decades, if not a millennium. By incrementally approving new and expanded radioactive waste streams from around the world, Utah is implicitly fostering that reality without fully explaining the reality of the facility and the state's regulatory actions to the public and without undertaking robust and comprehensive review of the Mill's impacts and potential impacts on surrounding communities, public health and the environment. Utah does not take this type of lax regulatory approach in evaluating radioactive waste streams sought by licensed low-level radioactive disposal facilities utilizing dry disposal in RCRA-compliant disposal cells located far from residential communities. Utah must face the reality, inform the public, and allow a full and fair opportunity for public input on whether a 40-year-old conventional uranium mill with a design life of only 15-20 years that utilizes wet disposal in tailings cells and has already extensively contaminated the shallow groundwater should be transformed into a radioactive waste disposal facility with an indefinite operational life receiving radioactive waste shipped to Utah from around the World.

8. <u>R313-24-3 governs "Environmental Analysis" of major amendments for uranium mills:</u>

> (1) Each new license application, renewal, or major amendment shall contain an environmental report describing the proposed action, a statement of its purposes, and the environment affected. The environmental report shall present a discussion of the following:
>
> (a) An assessment of the radiological and nonradiological impacts to the public health from the activities to be conducted pursuant to the license or amendment;

(b) An assessment of any impact on waterways and groundwater resulting from the activities conducted pursuant to the license or amendment;

(c) Consideration of alternates, including alternate sites and engineering methods, to the activities to be conducted pursuant to the license or amendment; and

(d) Consideration of the long-term impacts including decommissioning, decontamination, and reclamation impacts, associated with activities to be conducted pursuant to the license or amendment.

(2) Commencement of construction prior to issuance of the license or amendment shall be grounds for denial of the license or amendment.

(3) The Director shall provide a written analysis of the environmental report which shall be available for public notice and comment pursuant to R313-17-2

9. Proposed Amendment #10 is a major amendment and should not be approved because EFR and the Division and have not undertaken the requisite environmental report and environmental analysis required by R313-24-3, evaluating impacts of the Mill from inception over its projected operational life through reclamation and in light of the existing and increasing degradation of the shallow groundwater.

9 a. There is no environmental analysis of the impacts of the Mill as a facility with an indefinite operational life, either as a purely conventional uranium mill receiving locally mined ores or as a perpetual radioactive waste dump receiving radioactive materials and waste shipped from all over the Nation and the world.

9 b. There is no environmental analysis of the impacts of indefinitely operating legacy tailings cells constructed 40 years ago with single, thin PVC liners and without adequate leak detection systems.

9 c. There is no environmental analysis of the impacts of transporting wastes from foreign locations to White Mesa. The report supporting EFRI's application to receive the radioactive Silmet waste from Estonia lacks any description of the means and pathways by which the waste will be shipped from Estonia to the United States and then across the United States to White Mesa. The report briefly mentions transportation of the waste within Utah, but provides no assessment of environmental impacts of transporting the radioactive waste from Estonia.

9 d. There is no environmental analysis of the impacts of extending the Mill's license to include an additional 3,000 acres. Specifically the Division proposes to add Sections 4, 5, 6, 8, 9 in Township 38 South, Range 22 East to the License, without any accompanying environmental analysis. Most of those lands are rich in cultural resources and subject to a BLM Cultural Resources Easement.

9 e. There is no "assessment of the radiological and nonradiological impacts to the public health from the activities to be conducted pursuant to the license or amendment" over an indefinite operational life of the Mill as required by R313-24-3(a).

9 f. There is no "assessment impact on waterways and groundwater resulting from the activities conducted pursuant to the license or amendment" over an indefinite operational life of the Mill as required by R313-24-3(b).

9 g. There is no "Consideration of the long-term impacts including decommissioning, decontamination, and reclamation impacts, associated with activities to be conducted pursuant to the license or amendment" over an indefinite operational life of the Mill.

9 h. As set forth in greater detail in the Tribe's comments regarding water quality concerns, the lack of an assessment of long-term impacts on groundwater is of particular concern in light of the Division's questionable regulatory approach of allowing EFRI to resolve noncompliance with its groundwater compliance limits by continually adjusting background concentrations and statistically relaxing the compliance limits without any regard or consideration of how the quality of the shallow Burro Canyon aquifer can be preserved and protected over the long-term. The regulatory approach gives a green light to continued degradation of classified groundwater without an endpoint - contrary to the goals of the Utah Groundwater Protection Program of preserving Utah's groundwater within their quality and use classifications and without any assessment of the long-term impacts on the quality, uses and potential uses of the Burro Canyon aquifer from the existing and increasing contamination, the indefinite operation of the Mill, and the continued relaxation of compliance limits.

9 i. There is no "Consideration of alternates, including alternate sites and engineering methods, to the activities to be conducted pursuant to the license or amendment" as required by R313-24-3(c).

9j. There is no environmental analysis taking into account the fact that the Moffat Tunnel waste, which is derived from treatment of contaminated groundwater, will be generated in perpetuity. By proposing to approve that waste stream, the Division is again acknowledging that the Mill will be a perpetual repository for radioactive waste material from outside sources forever. There needs to be a comprehensive Environmental Analysis of perpetual radioactive waste disposal from perpetual sources.

10. The BLM has specific roles and requirements regarding the surveying and protection of cultural resources on these additional lands in T. 38 S., R.22 E, SLBM, Sections 4, 5, 6, 8 and 9, .as well as T. 37 S., R.22 E., SLBM, Sections 29 and 33 that have previously been included the radioactive material license. It is not addressed adequately in License Condition 9.7, and is not addressed in this RML amendment. (White Mesa Mill Cultural Resources Monitoring Plan 2016, Simonis 2016; Energy Fuels – BLM Land Exchange, Cultural Resource Easement Agreement, 1985 Amendment to Memorandum of Agreement, ACHP, 1983)

11. Cell 3 is inadequate to safely continue to receive in-situ leachate wastes in perpetuity. It has no leak detection system until groundwater becomes polluted, and the DWMRC continues to use unsubstantiated and outdated hypotheses and lines of evidence provided by Energy Fuels Resources (USA) (hereafter EFRI) that the groundwater is not being polluted. While proposing an increase in the disposal of ISL waste and no limitation on how long into the future this can occur, DWMRC is simultaneously relaxing groundwater standards around the perimeter of Cell 3. In an inspection in 2017, U.S. EPA officials expressed their preference that alternate feeds and by-products thereof from EPA clean-up activities be disposed of in Cells 4A and 4B, "since these are double-lined cells with leak detection systems." (EPA report on CERCLA Offsite Rule Inspection May, 2017. Linda Jacobson, EPA Inspector, to David Frydenlund, EFRI, February 15, 2018)

12. Allowing twice as much ISL waste from external entity facilities and as much as they want from their own ISL facilities further demonstrates that the profitable use of the White Mesa facility is not as a mill but as a disposal facility or "dump."

13. Allowing twice as much ISL waste from external entity facilities and as much as they want from their own ISL facilities increases the risk of transportation accidents. EFRI continues to disregard the Tribe's request for neighborly notification of unusual events like

roadside spills or facility malfunctions. The Tribe has provided the information EFRI requested in this regard, but EFRI has not followed through to make it happen. The State of Utah should impose this upon EFRI to notify the Tribe when undesirable events occur to alleviate fear and reduce risk to public health and environment.

14. In 1993, the State of Utah requested that a limit of 5,000 cubic yards of material from a single facility (the first such facility authorized to bring ISL waste to the mill). While staff have changed and documentation of the request's purpose seem to have been lost or misunderstood currently by DWMRC (as it is documented in the Statement of Basis for this action that no technical basis was available in 2020 for that prior request), it is clear to the public and the Ute Mountain Ute Tribe that the State of Utah was concerned then about the broadening of the use of the mill for such purposes as disposal of ISL wastes and alternate feed materials, and its potential impact to the long term health of the public and environment. The proposal to allow the unlimited quantity of ISL waste from EFRI facilities and up to 10,000 cubic yards from other individual facilities into Cell 3, is irresponsible and disregards prior concerns by Utah DEQ.

15. No description of transportation routes to White Mesa from Estonia have been provided by the State. An Environmental Impact Analysis for the transportation must be conducted by someone. If not the State of Utah, then the Nuclear Regulatory Commission. While the DWMRC has repeatedly indicated that it is not their responsibility to conduct transportation related analyses, DWMRC is proposing to permit the activity, and as an Agreement State, they have inherited the obligation to consider the impact beyond the borders of the State of Utah if authorizing it to happen.

16. In the Technical Evaluation and Environmental Analysis (TEEA) for the Silmet (Estonia) Alternate Feed White Mesa Uranium Mill renewal application (Silmet Application) on page 21, and repeated in the TEEA for the Moffat Tunnel Alternate Feed on page 41-41, the Division wrote:

"In previous licensing actions, there have been several comments and concerns from the public about radon emanating from the White Mesa Uranium Mill. In a recent NRC guidance document, DIVISION OF DECOMMISSIONING, URANIUM RECOVERY, AND WASTE PROGRAMS INTERIM STAFF GUIDANCE DUWP-ISG-01 EVALUATIONS OF URANIUM RECOVERY FACILITY SURVEYS OF RADON AND RADON PROGENY IN AIR AND DEMONSTRATIONS OF COMPLIANCE WITH 10 CFR 20.130,1 published in June of 2019 the NRC references a study that indicates that radon emissions from a uranium recovery facility would be statistically no different, or indistinguishable, from natural

background radon levels at a distance of one mile from the source of the radon. This is due to air dispersion. The closest residences to the White Mesa Uranium Mill in any direction are more than one mile away. This means radon emission from the White Mesa Uranium Mill is not a significant contributor to Public dose outside the mill fence line."

The Silmet and Moffat Tunnel TEEA completely neglected the very important discussion also stated in that section referenced above, (from the NRC guidance document) which discusses radon concentrations from mill tailings from a variety of mill locations:

"In many cases, the low speed, drainage winds that occur at night under relatively stable atmospheric conditions are the winds that may result in the highest radon concentrations and may contribute the most to annual doses. Thus, effects of topography should be considered when determining likely locations of highest radon concentrations."

As indicated in the 2017 response to the WMM License renewal, the wind rose below (Figure 1), a compilation of meteorological data from the White Mesa Community, indicated the majority of the calm winds come from several of the northern sectors *toward* the White Mesa Community and are less than 3.6 m/s or 8 miles per hour. This same observation has been documented in the WM Mill's own data files Figures 2-6 (taken from Appendix C to the EFR's 2018 Cells 5A and 5B License and GWDP Amendment Request which are presented below). The windroses present the exact conditions of ***low speed drainage winds***, which are cautioned by the NRC as those that pose the most risk or highest radon concentrations. These low speed winds impact the White Mesa Community and members and visitors sense these impacts through the smell of surrogate organic fumes that, unlike radon, can be experienced by the human population.

The natural features surrounding the mill and the White Mesa Community are varied, indicating a 'complex' terrain which is not accounted for in models such as MILDOS, and should be seriously evaluated as a concern to the community downwind who may be at risk.

Figure 1 UMUT Wind Data from 2016

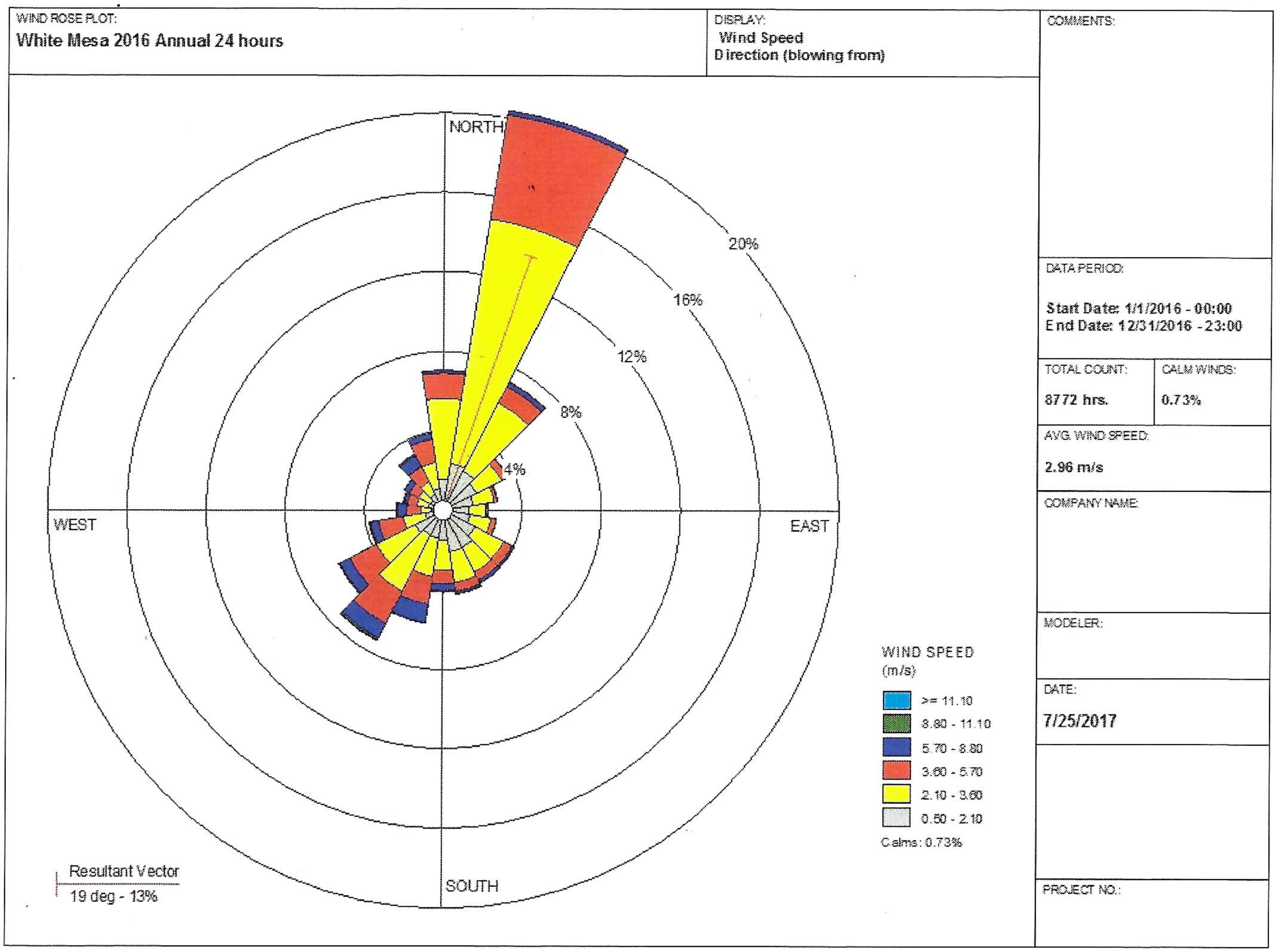


Figure 2

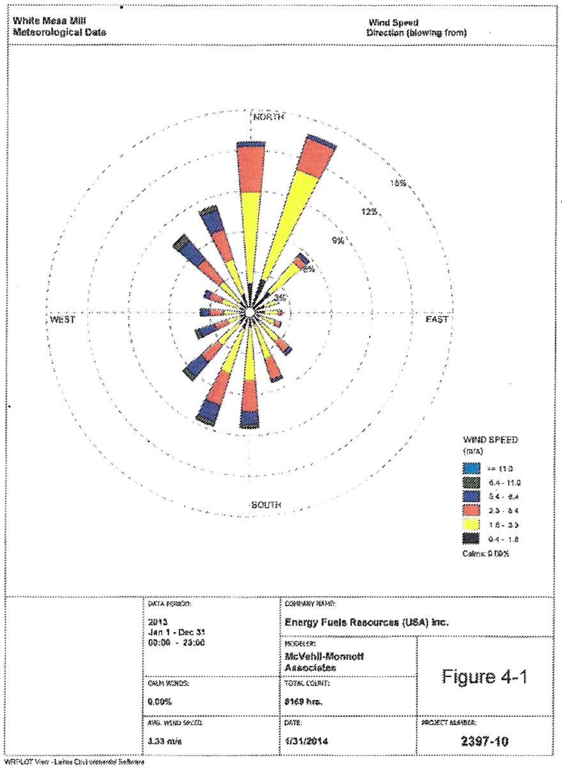
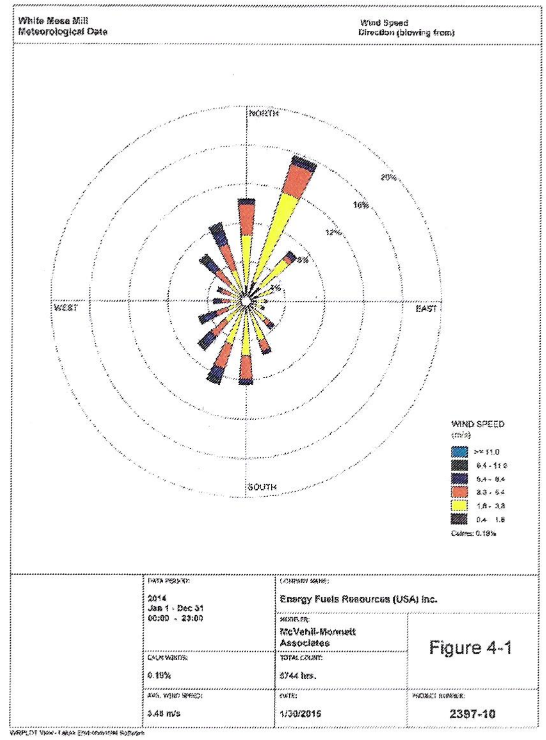


Figure 4-1 January – December 2013 Wind Rose

Figure 3



'igure 4-1 January – December 2014 Wind Rose

Figure 4

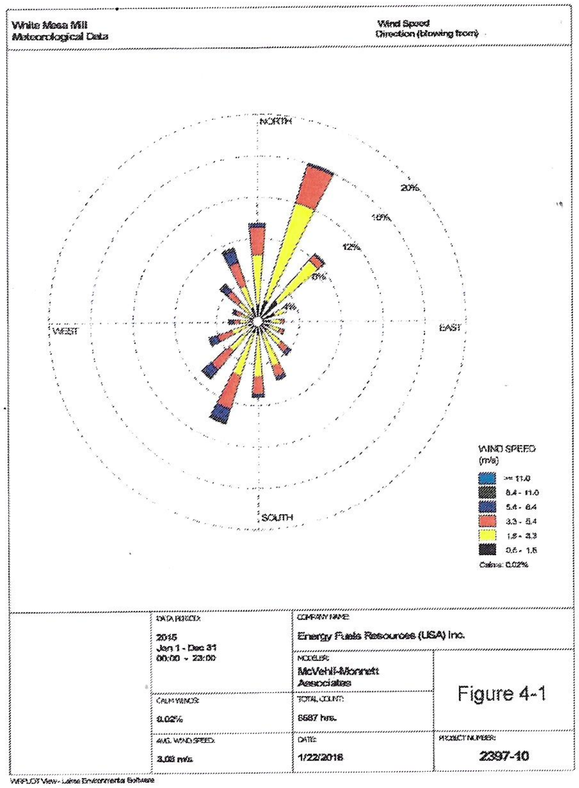


Figure 4-1 January – December 2015 Wind Rose

Figure 5

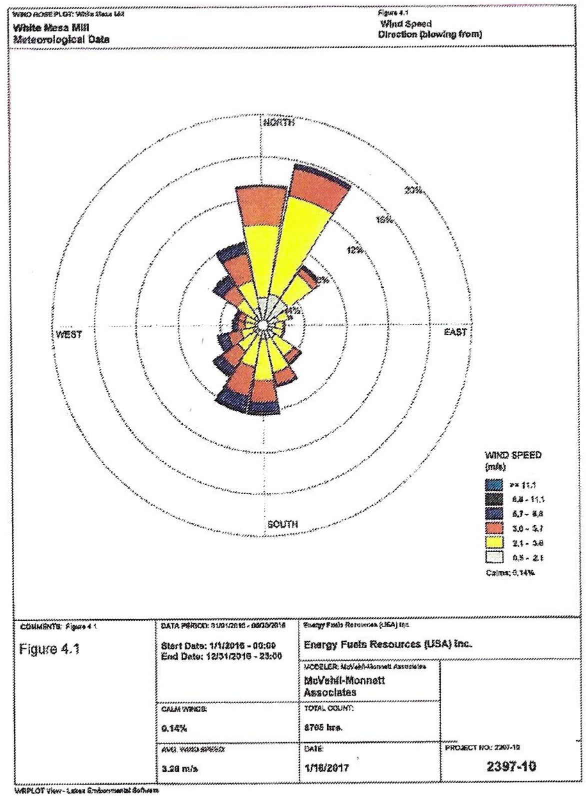


Figure 4-1 January – December 2016 Wind Rose

Figure 6

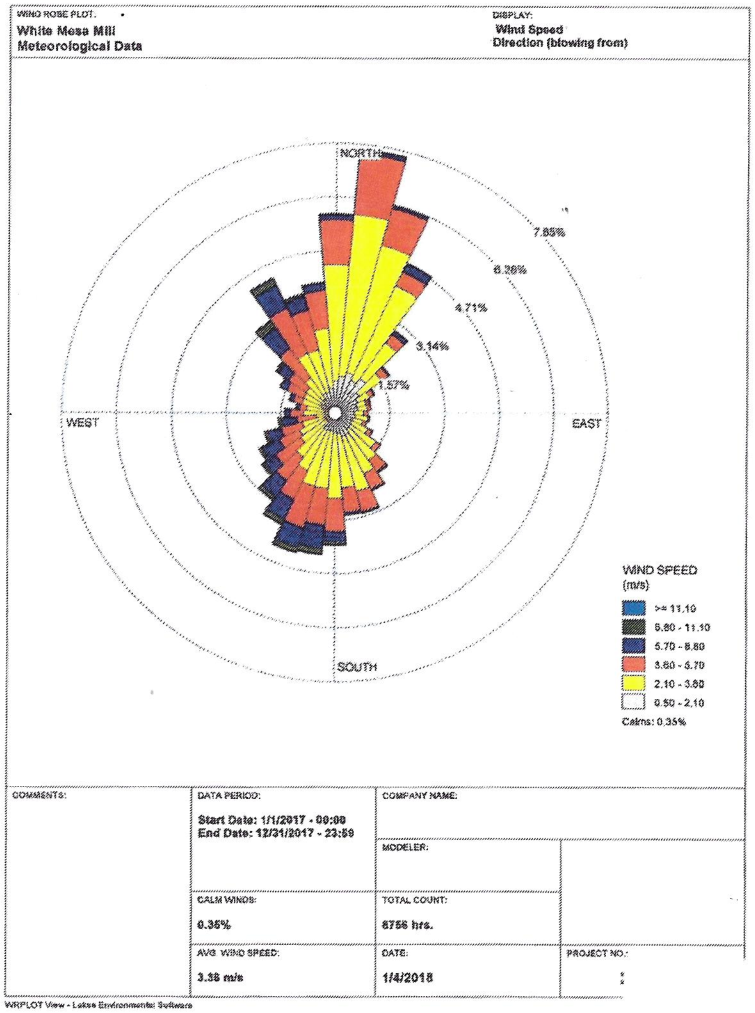


Figure 4-1 January – December 2017 Wind Rose

(wind direction was divided up into 32 sectors here)

17. Also on page 31 of the TEEA for the Silmet, (also reiterated in the Moffat Tunnel TEAA on page 41-42) the Division wrote,

"Radon measurements collected from the Mill's environmental monitoring stations and reported to the Division in the semi-annual environmental reports confirm this study's conclusions. Therefore, processing the Silmet uranium bearing material will not increase the public dose from radon."

Regarding monitoring efforts by the WM Mill, in the 1998 Study at White Mesa Mill by Nielson and Walter of Rogers Engineering and Associates, the background location for radon had been questioned with the statement below.

"However, analysis of the total concentrations at the background location (BHV-3) during active and inactive mill operations shows that the " background" levels are about twice as high during active operations as during inactive periods.

The cause of the background bias may be that the back ground sit is too close to the Mill (about 2.6 miles, instead of the 9.4 mile minimum originally stated by NRC in its Environmental Statement for the White Mesa Mil)l."

In effect, this statement proves that the background location is not measuring true background, but a value higher than background. Because the net effluent concentrations are a result of the effluent measurements data where the 'higher than background value' is subtracted out, this causes the reported effluent concentrations to be *lower* than actual.

(From Nielson, K. K., Walter, P., Rogers and Associates Engineering Corporation Preliminary Risk Assessment for the White Mesa Community. P17, 1997)

18. The Silmet Materials are from what could be considered as a 'legacy' site from a country ruled under the old USSR. The plant began processing uranium in 1940, and operated through until 1990, manufacturing reactor-fuel-grade uranium during that time period from other Soviet block countries. Though the application maintains that the waste stream had operations "in a separate portion" of the facility, as stated In the Silmet Allternative Feed Application (April 2019), cross-contamination could have occurred as it had in some facilities in the US, where fission product contamination had been discovered in a uranium metal facility.

In the application, there was testing data for expected radionuclides (Ra-226 and Ra-228) and not any others. More thorough testing to include ***gamma spectroscopy for possible fission product identification*** from possible contaminants from this 'legacy' site is essential prior to acceptance and processing.

19. What is the technical basis for the Silmet Materials or the materials consisting of the residuals from niobium and tantalum recovery from columbite and tantalite ore concentrates not being disposed or further processed in Estonia? Estonia processed the materials and the materials should be kept there, reducing risk from transportation and ultimately to the White Mesa Community Members in Utah.

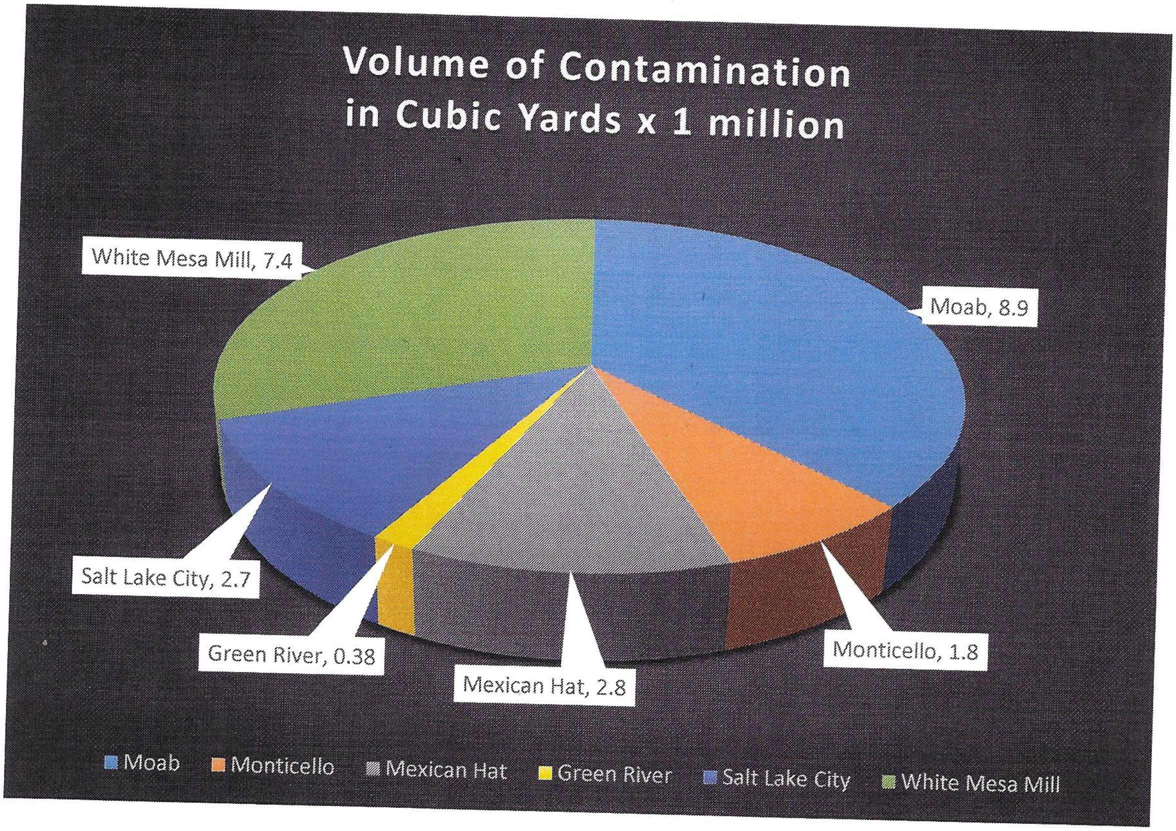
20. According to the original EA of 1978 and historical practices, the White Mesa Mill should have already entered closure and ceased accepting any more material. The Tribe has commented over the past years on the Alternate feed materials being processed at a Mill (originally stated in the Environmental report of 1978 that the uranium materials would be from the Colorado Plateau mines and Arizona Strip Mines). The Tribe upholds that opinion and opposes the importation of feed material from overseas. For the conventional tailing impoundments, based on maximum capacity of Cell 2 and 3, and Cell 4a processed volume (as of 2016), the amount of radioactive tailings in the White Mesa cells are about 7,360,000 cubic yards, which is about half the total

volume of ***all*** the past Uranium Mill Tailing Remediation Act or Superfund Project Sites (mill tailing sites) in Utah. In fact, the tailings impoundments at the White Mesa Mill in Utah are currently almost as large as the Moab Mill cleanup. See Table 1, The Utah Uranium Mill Site Contamination Volumes and associated Areas and Costs, and Figure 7: The Utah Uranium Mill Site Contamination Volumes.

Table 1: The Utah Uranium Mill Site Contamination Volumes and associated Areas and Costs

Utah Uranium Mill Sites	**Volume of contamination (Cubic Yards x 1,000,000)**	**Per cent of Past Total U Mill Sites**	**Area of Tailings**	**Costs of Cleanup normalized to 2010 (In Millions of Dollars)**
Moab	8.9	0.54	160	720
Monticello	1.8	0.11	318	520
Mexican Hat	2.81	0.17	250	105
Green River	0.38	0.02	48	NA
Salt Lake City	2.71	0.16	128	177
Total Utah	**16.59**		904	
White Mesa Mill	*7.36*	*0.44*	*284*	

Figure 7: The Utah Uranium Mill Site Contamination Volumes



21. Statement on the Reclamation Plan Surety Costs:
    In Table 1, the costs associated with the closed and reclaimed uranium mills in Utah are listed with inflation to indicate the expenses in 2010. The Energy Fuels surety required by the license should be raised to comparable levels to ensure environmental (including land, surface water and groundwater) risks will be reduced to 'safe' levels during and post-closure at the mill site for one thousand years. Current surety bonds for the White Mesa Mill are in the ***tens*** of millions (approximately $20 million on average) while clean-up costs for similar mills historically have been in the ***hundreds*** of millions.

22. The Division has provided no assessment or explanation of reclamation and the amount of reclamation surety required to ensure adequate reclamation of the Mill as radioactive waste disposal facility with an indefinite operational life. The reclamation plan and surety should be addressed prior to, not after, approval of new waste streams.

23. Preservation and protection of the groundwater and seeps in and around White Mesa is a matter of extreme concern to the Tribe and its members.

The Mill overlies the deep Navajo aquifer which is the source of drinking water for Tribe's White Mesa Community. The shallow Burro Canyon aquifer underlies White Mesa and is connected to surface water springs relied on for cultural use which may include drinking water and for the support of native ecology and wildlife.

Under Utah's Groundwater Protection Program, the deep Navajo aquifer beneath the White Mesa is classified as a Class Ia_ and 1b groundwater as both a pristine and irreplaceable active source of community drinking water, while the shallow Burro Canyon aquifer is classified varyingly as Class 1c, II and Class III groundwater.

Class 1a pristine groundwater is to be protected for use as drinking water or other similar beneficial use. UAC R317-6-3.2

Class 1b irreplaceable groundwater is a source of water for a community public drinking water system and is to be protected for use as drinking water or other similar beneficial use. UAC R317 6-3.3.

Class 1c groundwater is ecologically important groundwater to be protected for the continued existence of wildlife habitat. UAC R317 6-3.4.

Class II ground water is to be protected for use as drinking water or other similar beneficial use with conventional treatment prior to use. UAC R317-6-4.5.A.

Class III ground water is to be protected as a potential source of drinking water, after substantial treatment, and as a source of water for industry and agriculture. UAC R317-6-4.6.A.

24. Quarterly groundwater monitoring reports submitted by EFRI, including the most recent in 2020, show progressive and alarming degradation of the quality of the shallow groundwater, with exceedances of groundwater contaminant levels (GWCLs), lowering pH to more acidic conditions, and increasing trends in many monitored metals and other parameters.

24.a . Ongoing corrective actions to address the chloroform contaminant plume and the nitrate/chloride contaminant plume have not achieved any significant reductions in the areal extent, concentrations or contaminant masses of these plumes after several years of corrective action. Corrective Action Plan Comprehensive Monitoring Reports submitted by EFRI conclude that the current corrective actions will not remove the plumes or reduce them to acceptable levels for decades or hundreds of years, if ever.

24.b. The Tribe urges the Division to require EFRI take additional effective investigative and corrective actions to identify and address the root causes of the contamination, rather than artificially relaxing GWCLs to excuse noncompliant data and allow further degradation of groundwater quality.

24.c. The Division should not approve additional waste streams and feed materials at the Mill until the root causes of the contamination have been identified and controlled.

25. EFR is being allowed to circumvent the Utah Groundwater Protection Regulations by constantly adjusting background levels to justify successive resetting of GWCLs to more lenient compliance levels to bring the facility into compliance, rather than being required to take effective corrective action to identify and control the sources of contamination and to achieve compliance with the Groundwater Contamination Limits specified in its permit.

26. The Division's regulatory approach of resetting background to allow increased GWCLs and avoid noncompliance and corrective action, is clearly inconsistent with the letter and intent of the Utah Groundwater Protection Program, because it fails to ensure, or even take into consideration whether, groundwater protection levels are being protected and residual contaminant levels are protective of human health and the environment.

27. Under the Corrective Action regulations in UAC R317-6.15, the Division may approve Alternate Corrective Action Concentration Limits ("ACACLs"), provided that numerous requirements are satisfied, including, among others, that the facility take steps to correct the source of the contamination and that any proposed Alternate Corrective Action Concentration Limit **"shall be protective of human health, and the environment…."** UCA R317-6.15 G.1. Protection of human health and the environment is the over-arching standard for corrective action, and therefore, it must necessarily be the standard for assessing ongoing compliance.

27.a. The Division has not adequately evaluated or explained:

(i) how its regulatory approach of repeatedly resetting background and loosening GWCLs will preserve the shallow groundwater within the established classifications for use as drinking water;
(ii) how that approach is or will be protective of human health and the environment over the projected operational life of the Mill – which according to EFRI is now indefinite or for 1,000 years; or
(iii) how the Division and the Mill have complied with the environmental analysis requirements of UAC R313-24-3, including "consideration of the long-term impacts" that will result to groundwater (both shallow and deep) and to human health and the environment over the indefinite life of the Mill if the shallow groundwater compliance limits are continually relaxed.
26.b. The Division has a challenging and complicated regulatory responsibility to protect and preserve groundwater quality. It cannot choose expediency over its responsibility in its regulation of the Mill. The Division must require the Mill operator to identify and control the sources of the extensive and increasing contamination in the shallow groundwater and restore water quality through effective corrective action.

28. The groundwater monitoring data show that rare toxic metals, including cadmium, beryllium, thallium, cobalt, nickel, selenium, and uranium, are accumulating in increasing concentrations in the Burro Canyon aquifer. These very same metals are found in abundance in the tailings cells, mill facility, and process solutions. There is no validated empirical evidence confirming that these toxic metals come from any other source. The state and EFRI claim these metals occur naturally in the Burro Canyon formation and aquifer, yet the state has never required EFRI to do any specific testing of the geochemistry of the Burro Canyon formation to support their assumption that the metals derive from the formation in the levels being detected in the contaminated groundwater. This is a critical data gap that must be addressed if shallow groundwater is to be preserved in accordance with the Utah Groundwater Protection Program. In the absence of such test data on the geochemistry of the Burro Canyon formation, there is no scientific basis to conclude that the alarming accumulation of toxic metals comes from any source other than the Mill's tailings cells, facility, and process solutions.

The state must require EFRI to test the geochemistry of the Burro Canyon formation and provide empirical evidence to confirm whether or not the rare metals accumulating the shallow groundwater are present naturally at the levels at which they are being detected in the shallow groundwater.

The state must also require an updated comprehensive isotopic study of the shallow groundwater to provide empirical evidence of whether or not the Mill's process solutions in the tailings cells are present in the shallow groundwater.

28.a. Cadmium is an indicator parameter of facility impact to the groundwater. Raising the GWCL for cadmium in MW-25 will conceal continuing facility releases and impact to the Burro Canyon aquifer. MW-25 is now the fifth well which shows rising trends of Cadmium at concentrations greater than 1.5 ug/L (Map 1) and is on the way to joining MW-22, MW-24/MW-24A, MW-28 exceeding health based water quality standards (UT R-317-6).

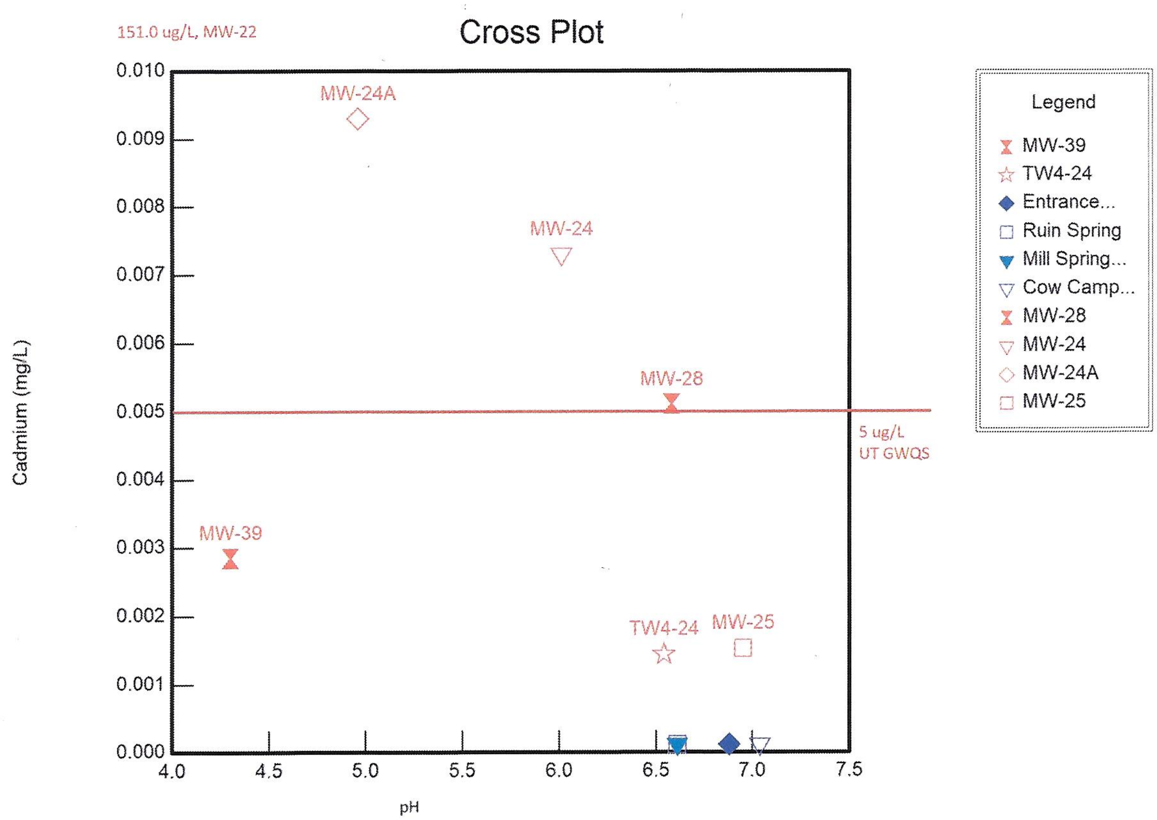
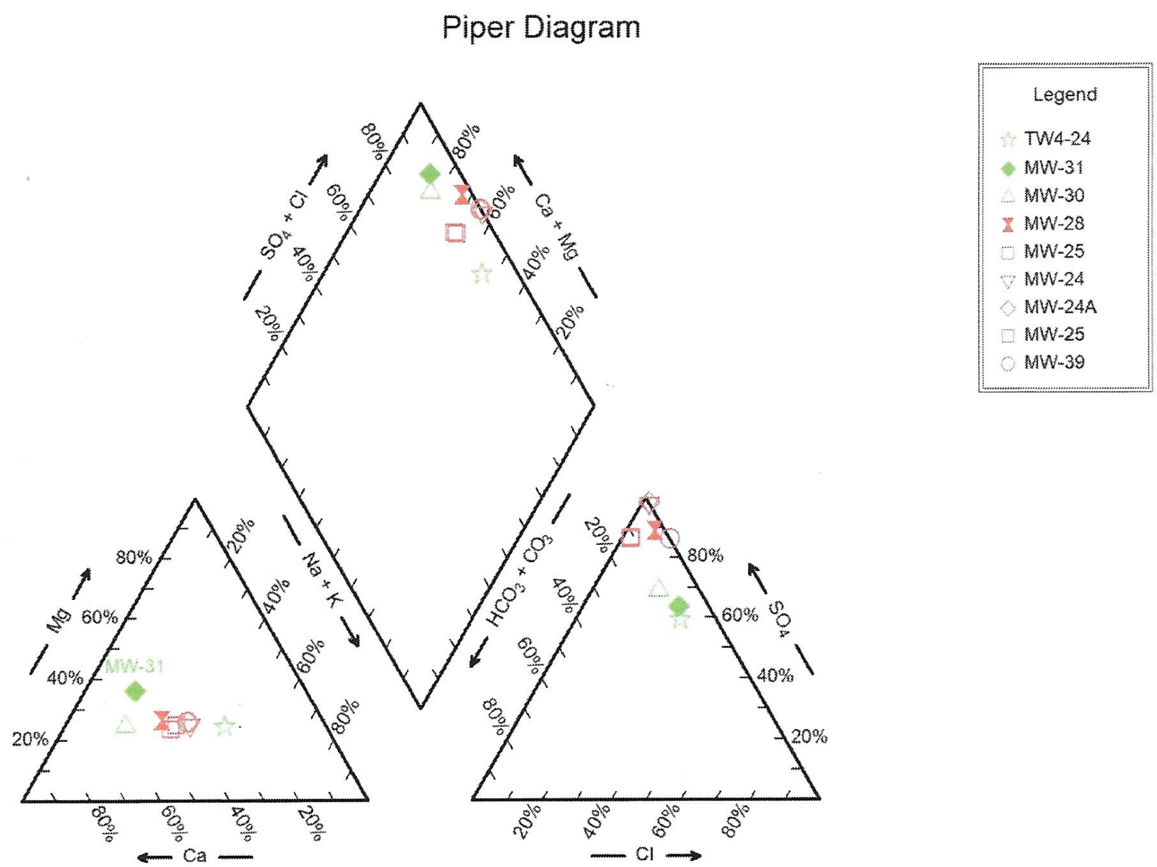


Figure 8: Cadmium/pH cross plot data for wells is from the 1st Quarter 2020 Quarterly monitoring report

28.b. The water chemistry at MW-25 places it in a group with five wells which are exhibiting rising trends in cadmium with a corresponding decline in pH. This group is distinguished by an ion signature elevated in sulfate and depleted in sodium and alkalinity compared to monitoring wells completed in the nitrate and chloride plume like MW-30 and MW-31. TW4-24 has been revealed to have extremely elevated and dangerous concentrations of uranium (663 ppb, 05/17/2018) after we requested the well be screened for the full analyte table in the GWDP during a previous re-licensing action also has a distinct ion signature and should be required to be investigated with isotopic testing to calculate the activity ratio for uranium isotopes to determine conclusively if it is associated directly with the mill facility.

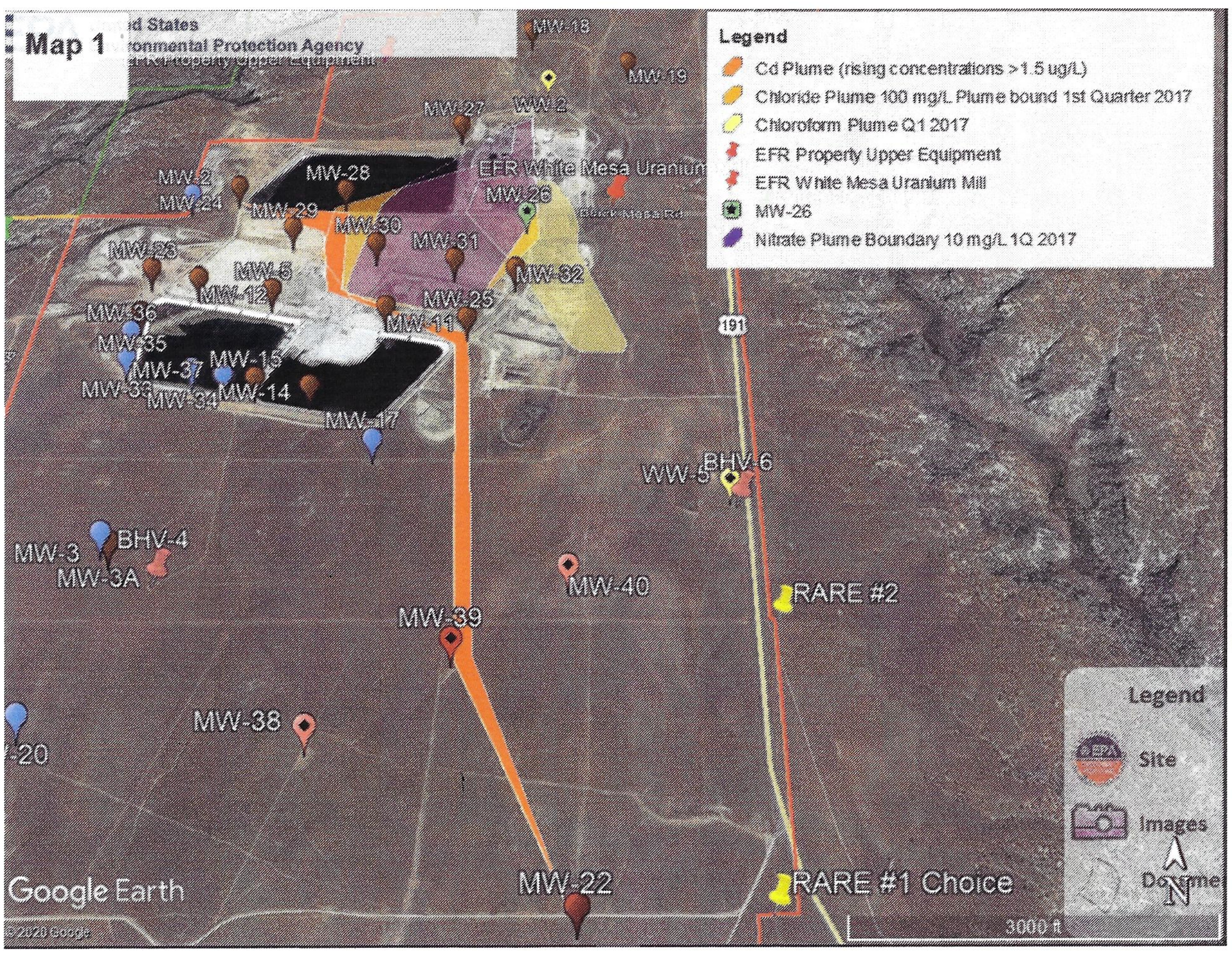
Figure 9: Piper Diagram: 1st Quarter 2020 Groundwater Data



28.c. In addition to the ion and cadmium signature, the presence of rising concentrations of Cobalt and nickel in MW-24/MW-24A, MW-28, MW-39 and MW-22 distinguish this group of wells as impacted by the mill facility and are two constituents that can be expected to show up at MW-25 in the near future as impacts from the facility continue to increase to dangerous levels in the aquifer if this GWCL proposal is authorized and the facility is allowed to continue to discharge to the groundwater.

28.d. Thallium is now exceeding the Utah criteria of 2 ug/L in both MW-24 and MW-39 and beryllium is exceeding the state criteria of 4 ug/L at MW-39 and MW-22. A rising trend in Beryllium with levels rapidly approaching the criteria for this metal is apparent at MW-24/MW-24A as well.

28.e. Presence of manganese and ammonia for this group of wells also distinguishes them as impacted and indicates reducing conditions which are present in the aquifer at the margins of the oxidized conditions present in the nitrate plume. It is important that the Director and regulatory staff recognize that geochemical conditions at the site are strongly influencing contaminant fate and migration



29 . Since the state has not compelled EFR to do any specific leach testing of Burro Canyon aquifer materials to prove they may be the real source of the rare list of toxic metals accumulating in the groundwater beneath the site or an updated comprehensive isotopic study of groundwater for over a decade which has seen a radical deteriorating change in groundwater condition, the most likely source of the contaminants are the tailing cells and the mill facility. The process solutions and cells are absolutely loaded with extreme concentrations of cadmium, beryllium, thallium, cobalt, nickel, selenium, uranium and remain the most likely explanation and source of pollution. In the past the Director has stated that contamination in the Burro Canyon aquifer is of little concern because it is a long way from potential receptors and unrelated to the mill and the Director also implies the aquifer is not used for domestic supplies and that it doesn't deserve protection for that future use. In fact, the Burro Canyon aquifer does serve nearby residents as a home domestic supply and also supplies irrigation and stock water to hundreds of users (Kirby, 2008) and the Burro Canyon aquifer extends continuously beneath White Mesa from north of the Mill through the Mill area to the White Mesa community south of the Mill. See Stefan Kirby, Utah Geological Survey Special Study 123, "Geologic and Hydrologic Characterization of the Dakota-Burro Canyon Aquifer near Blanding, San Juan County, Utah" (2008), Plate 3 — Structure Contour Map of the Base of the Burro Canyon Formation, and Plate 4 — Potentiometric Surface for the Dakota-Burro Canyon Aquifer. (Available online at: https://ugspub.nr.utah.gov/publications/special_studies/ss-123/ss-123.pdf);see also Charles Avery, State of Utah Department of Natural Resources Technical Publication No. 68, "Bedrock Aquifers of Eastern San Juan County, Utah (1986), Figure 19. - "Areal extent, water levels, and water quality in the D aquifer, 1982-83." (Available online at:https://waterrights.utah.gov/docSys/v920/w920/w92000ab.pdf.

The State's role in protecting drinking water quality should be much more active. For example, with the State's agreement that the pollution in the Burro Canyon aquifer on the mill site is due to naturally occurring conditions from pumping wells, what is the implication for nearby residents with a well pumping water from the same formation every day into their drinking, cooking and bathing water? Are they at risk of exposure from cadmium, beryllium, thallium, cobalt, nickel , selenium or uranium that may naturally be rising in the formation to toxic conditions? The state has a responsibility to future generations to protect our shared water resources at the highest possible level.

30. The proposed GWCL increase for selenium and uranium at well MW30 would not be protective of human health and the environment. Rising trends in both of those parameters along with a strongly increasing trend in chloride are a signature of facility impact to the groundwater and the source of the continuing contamination must be conclusively determined with an updated comprehensive isotopic test of groundwater condition at each POC well along with a selection of wells from the general monitoring wells and the TW4 and TWN series.

31. New Well MW-24a is chemically identical to existing Well MW-24 and there is no need to spend two more years collecting data to develop new GWCL for new well MW-24a. The existing GWCL for MW-24 should be used to recognize the exceedances at this location as a POC well for old outdated cells 1 and 2. MW-24 is associated chemically with a signature of facility impact as discussed in our Comment #1. The Director is proposing to allow EFR more than two years to collect data from a new well, MW24a, as they explore if a well construction issue is to blame for the rise in specific ions and metals in MW-24 (See Comment #1, MW-24 fits in a group with MW-25, MW-28, MW-39 and MW-22). Data from the first quarter 2020 first sampling event show water chemistry in MW-24a is obviously similar to that in MW24 (Stiff diagrams, piper diagram and comparison table below from the 1st Quarter 2020 Groundwater Monitoring Report). There is no need to wait for additional quarterly samples, and it makes no sense to delay for two years. Water chemistry trends in MW24 are confirmed. The trends at this location fit into a distinct pattern with other site wells including MW-25, which indicates an anthropogenic continuing source from the Mill site. A source ID requirement for cadmium site-wide needs to be conducted and must include updated comprehensive geochemistry and isotopic tests for all POC wells and general monitoring wells along with TW4 and TWN series wells to conclusively determine the sources of the recognized nitrate chloride plume which is associated with uranium concentrations far above health based standards (TW4-24, 663 ppb 05/17/2018), the chloroform plume which continues to increase in size and concentration (1st quarter 2020 chloroform report) and the cadmium plume associated with cobalt, nickel, molybdenum, thallium, beryllium and manganese.

Figure 10

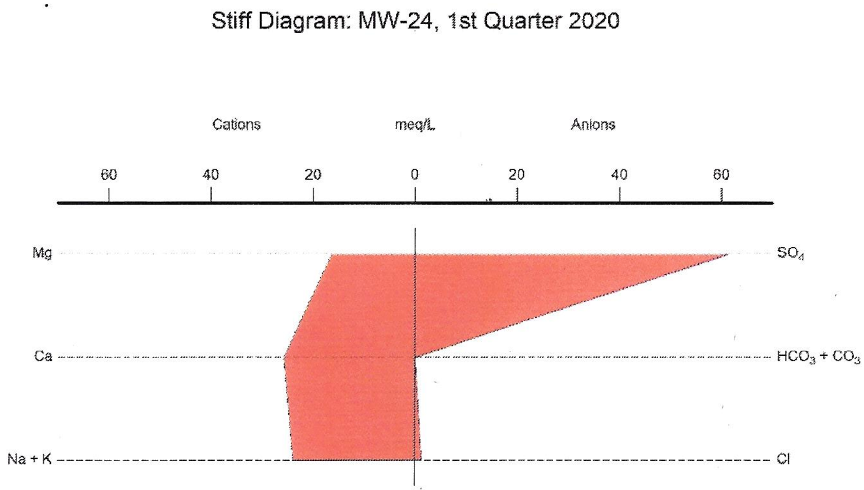


Figure 11:

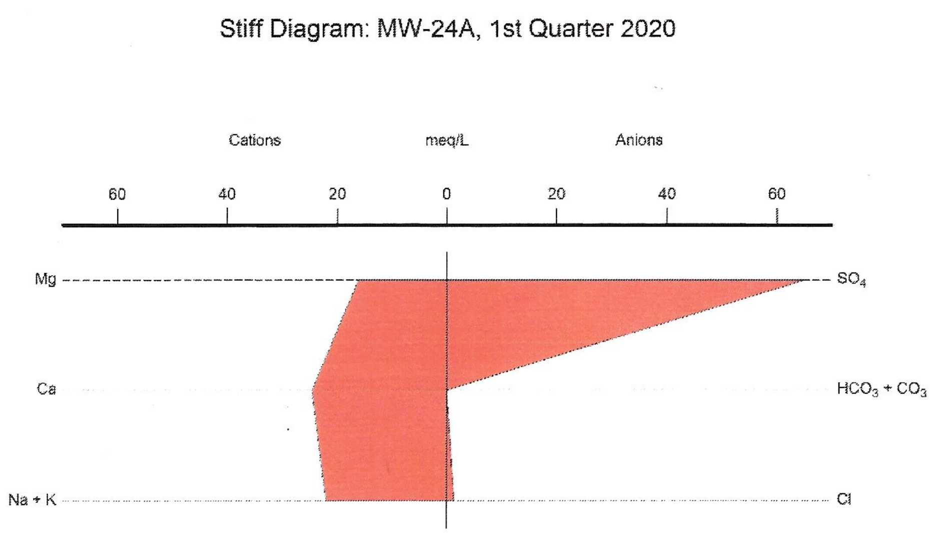
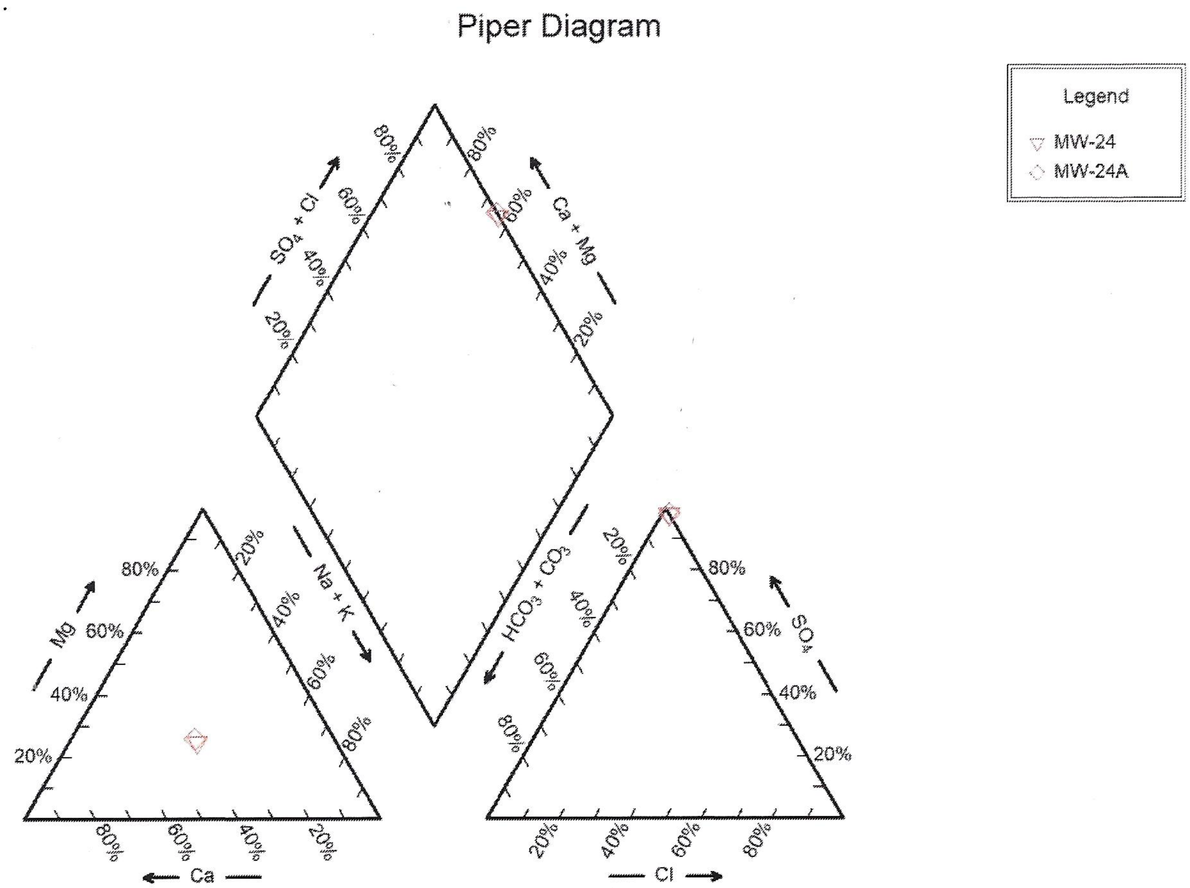


Figure 12:



Piper Diagram
Legend
MW-24
MW-24A
SO4 + Cl
Ca + Mg
Na + K
HCO3 + CO3
Mg
Ca
SO4
Cl
20%
40%
60%
80%

Table 2: MW-24 and MW24A Data Comparison

Name	Unit	MW-24	MW-24A
Sample ID		MW-24	MW-24A
Date		1/22/2020	1/22/2020
Calcium	mg/L	515	492
Magnesium	mg/L	199	196
Sodium	mg/L	542	498
Potassium	mg/L	13.1	12.7
Bicarbonate	mg/L	10	5.2
Sulfate	mg/L	2960	3130
Chloride	mg/L	47.8	47.5
Dissolved Solids	mg/L	4160	4420
pH		6.01	4.96
Fluoride	mg/L	0.808	1.41
Ammonia	mg/L	0.118	0.174
Nitrate	mg/L	0.332	0.189
Beryllium	mg/L	0.00207	0.00396
Cadmium	mg/L	0.0073	0.0093
Chromium	mg/L	0.01	0.01
Cobalt	mg/L	0.115	0.138
Copper	mg/L	0.01	0.0122
Iron	mg/L	0.0698	0.001
Lead	mg/L	0.0016	0.001
Manganese	mg/L	7.01	7.43
Molybdenum	mg/L	0.01	0.01
Nickel	mg/L	0.0681	0.065
Selenium	mg/L	0.00816	500E-6
Thallium	mg/L	0.00192	0.00125
Uranium	mg/L	0.00489	0.00543
Vanadium	mg/L	0.015	0.015
Zinc	mg/L	0.143	0.125
Conductivity	µmho/cm	4400	4298
Eh	mV	693	619

32. The elevated iron concentrations in groundwater downgradient of the tailings cells indicate impact to groundwater from tailings solutions. The Division should evaluate this line of inquiry. As recognized in the technical evaluation of the Moffat tunnel waste suggests that iron concentrations in groundwater can serve as a surrogate for monitoring potential impact to groundwater from this waste stream stating, "Analogous geochemical behavior of iron in the tailings wastewater with iron as a more conservative tracer of potential tailings wastewater in the groundwater than aluminum (UDWMRC, 2020.)" We presented a report in 2015 and again in 2017 with updated data (Geologic, 2017) which also used an analysis of iron

concentrations in groundwater along with concentrations of other metals present in the tailings wastewater to identify tailings impact to the groundwater downgradient of the facility. These findings were presented in the report in both a written narrative and illustrated with figures like the one below and show iron and other metals spiking in concentration in the groundwater downgradient of the tailings cells:

Figure 13: from Geo-Logic Report, Geo-logic, 2017.

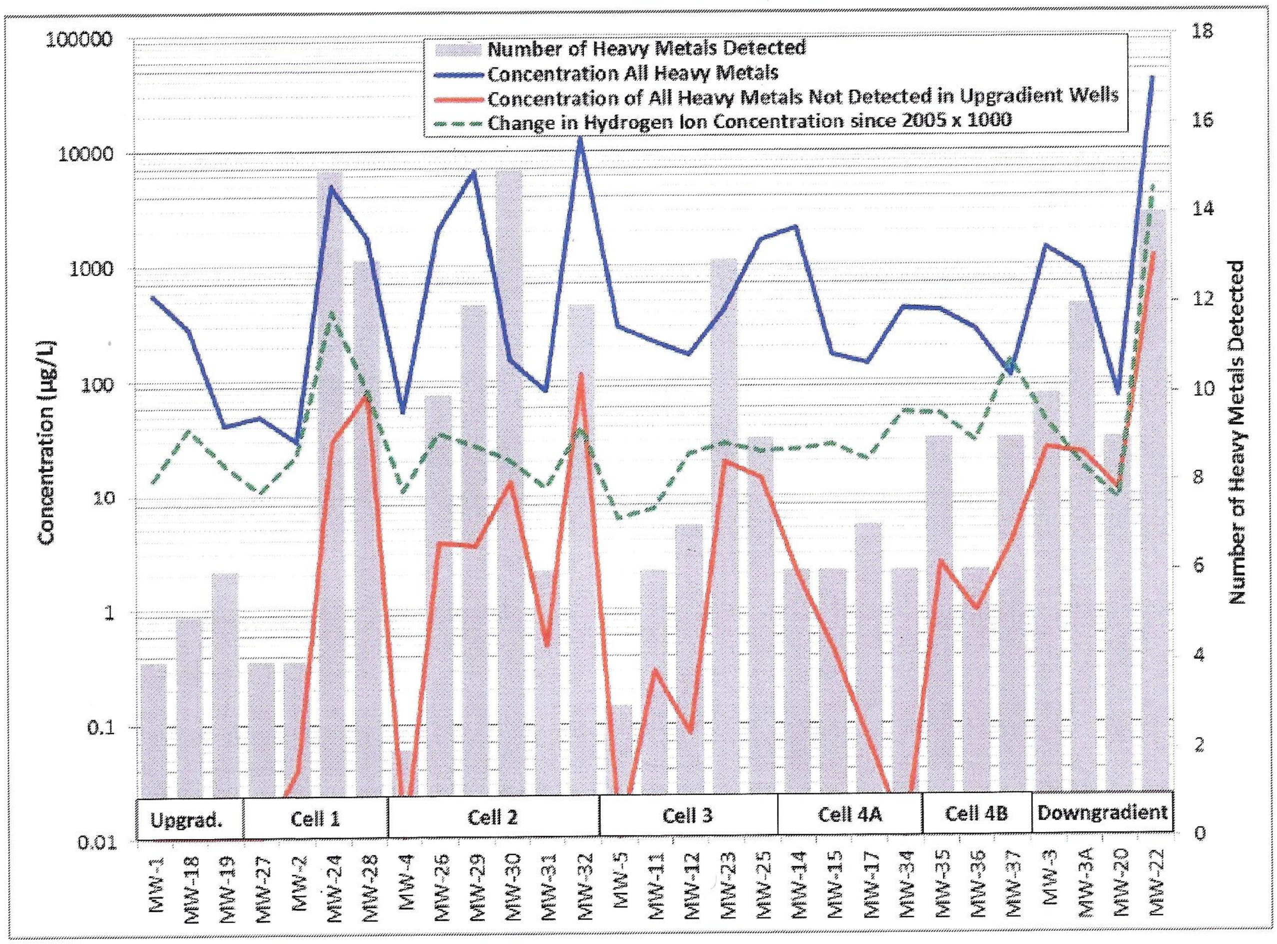


FIGURE 27 - HEAVY METALS IN MONITORING WELLS

State of Utah Department of Environmental Quality. Division of Waste Management and Radiation Control. Technical Evaluation and Environmental Analysis Moffat Tunnel Alternate

Feed Request Energy Fuels Resources (USA) Inc. White Mesa Uranium Mill Utah Division of Waste Management and Radiation Control April 2020.

33. As suggested in the Division's June 27, 2000 review memorandum and as recommended in the 2017 Geo-Logic Report as a standard industry practice, EFRI should be required to calculate an annual water balance for water received, consumed and lost at the Mill, and report the balance with annual DMT reports to assist with evaluation and performance of the discharge minimization technology required under the Groundwater Permit. Currently, there is no accounting of water use and loss at the Mill.

34. The Tribe and the DWMRC had set up a data sharing system wherein DWMRC provided formatted data for use in specific computer modeling software used by each party. This was a constructive and helpful way to share and analyze data in similar fashions. The Tribe has not been provided with any such data in more than two years, while the State has undertaken multiple groundwater permit modifications.

35. The Public Notice published by the Division misleadingly refers to "Public Comment on the White Mesa RML Renewal." There is no explanation of what renewal is contemplated. There is no basis for a renewal of the RML.

Summary:

The Tribe requests that the Director deny Amendment 10 to Radioactive Material License UT1900479 and the proposed modification of Groundwater Quality Discharge Permit No. UGW370004. The Tribe opposes the importation of alternate feed materials from Estonia and from the perpetual source in the Moffat Tunnel. The Tribe further requests that the Director consider a holistic view of the environmental contamination occurring at the White Mesa Uranium Mill and the long-term implications to the environment and local public, including the Tribe.

Thank you for your consideration.

Sincerely,

Scott T. Clow

Environmental Programs Director

Cc: Tribal Council, Ute Mountain Ute Tribe

Manuel Heart, Chairman, Ute Mountain Ute Tribe

REFERENCES

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Grand Canyon Trust
HEAL Utah — Powering Action to Protect Utah
SUWA — Southern Utah Wilderness Alliance
Friends of Cedar Mesa
Utah Diné Bikéyah
The Wilderness Society
Center for Biological Diversity — Because life is good.
Sierra Club
Multicultural Alliance for a Safe Environment — SWUraniumImpacts.org
Great Old Broads For Wilderness — Get Into The Wild
New Mexico Environmental Law Center
WildEarth Guardians — A Force for Nature
Western Watersheds Project

Aaron M. Paul
Staff Attorney
Grand Canyon Trust
4404 Alcott Street
Denver, Colorado 80211
D: 303-477-1486

July 10, 2020

By Electronic Mail

Ty L. Howard
Director, Division of Waste Management and Radiation Control
Utah Department of Environmental Quality
P.O. Box 144880
Salt Lake City, Utah 84114-4850
dwmrcpublic@utah.gov

Re: Comments on Proposed Amendment No. 10 to the Radioactive Materials License for the White Mesa Uranium Mill

Dear Mr. Howard:

Energy Fuels Resources (USA), Inc. has asked the Division of Waste Management and Radiation Control for permission to process and dispose of two new, so-called "alternate feed" materials at the White Mesa uranium mill.[1] One of those materials is a waste generated in the Republic of Estonia whose disposal in Estonia that country's government has disallowed for health and safety reasons.

And yet, over the objection of another sovereign nation—the Ute Mountain Ute Tribe—the Division is proposing to amend Energy Fuels' radioactive materials license for the mill to approve the company's requests, yet again imposing a deeply unjust burden on the small tribal community of White Mesa that sits next to the pits at the mill in which this waste is to be forever buried.[2]

We recognize that balancing the competing demands facing the

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[1] *See* Application for an amendment to Radioactive Materials License No. 1900479 to authorize processing of NPM Silmet OU alternate feed material, DRC-2019-003761 (Apr. 18, 2019) ("Silmet Application"); Application for an amendment to Radioactive Materials License No. 1900479 to authorize processing of Moffat Tunnel alternate feed material, DRC-2019-017284 (Dec. 23, 2019) ("Moffat Tunnel Application").

[2] *See* Division of Waste Management and Radiation Control, "Statement of Basis: Radioactive Material License (RML) No. UT 1900479," DRC-2020-007011 (Mar. 2020) ("Am. 10 Statement of Basis").

Division as it regulates the White Mesa mill is a tall order and that the Division has improved upon the work of the Nuclear Regulatory Commission in that task. Yet the Division can do better still, especially on the subject of regulating alternate feeds. That is what we urge the Division to do in these comments on the proposed license amendments submitted on behalf of the Grand Canyon Trust, Center for Biological Diversity, Downwinders Inc., Friends of Cedar Mesa, Great Old Broads for Wilderness, Healthy Environment Alliance of Utah, Multicultural Alliance for a Safe Environment, New Mexico Environmental Law Center, Sierra Club Utah Chapter, Southern Utah Wilderness Alliance, The Wilderness Society, Utah Audubon Council, Utah Diné Bikéyah, Western Watersheds Project, and WildEarth Guardians.

For ease of review, the principal requests we make in these comments are listed below. This list isn't exhaustive and isn't meant to diminish the importance of other requests or critiques made elsewhere in these comments. We ask the Division to:

1. Deny Energy Fuels' requests to allow the company to possess, process, and dispose of the two new alternate feeds, from Estonia and from Colorado.

2. If the Division nonetheless approves Energy Fuels' application concerning the material from Estonia, the Division should make its approval subject to two conditions: (a) that Energy Fuels acquires a specific import license from the Nuclear Regulatory Commission; and (b) that Energy Fuels returns to Silmet in Estonia all waste resulting from processing the Silmet material at the mill.

3. The Division should revise its assertions in the licensing documents that "11(e)(2) byproduct" material is not "waste."

4. The Division should not approve Energy Fuels' request to increase the volume of in-situ leaching waste discarded at the mill, for that license change is not adequately justified in the proposed licensing documents.

I. The Commenters

A. The Grand Canyon Trust

The Grand Canyon Trust is a membership-based, non-profit advocacy organization founded in 1985. It's headquartered in Flagstaff, Arizona, and has offices in Salt Lake City and Castle Valley, Utah, and Durango and Denver, Colorado. The mission of the Trust is to safeguard the wonders of the Grand Canyon and the Colorado Plateau, while supporting the rights of its Native peoples. In service of that mission, the Trust has worked for years to oppose irresponsible uranium mining and milling on the Plateau, and to see that the contamination around the Plateau that the uranium industry has repeatedly left in its wake is cleaned up.

B. Center for Biological Diversity

The Center for Biological Diversity ("Center") is a 501(c)(3) non-profit environmental organization with over 1.5 million members and online activists. The Center is headquartered in Tucson, Arizona and has offices in Arizona, New Mexico, California, Colorado, Nevada, Oregon, Alaska, Illinois, Minnesota, Vermont, Florida, Washington, D.C., and Baja California Sur, Mexico. The Center works through science, law, and policy to secure a future for all species, great or small, hovering on the brink of extinction. The Center and its members have for more than a decade engaged federal and state agency decision-making to ensure that uranium mining and milling in the Four Corners region does not further harm people and the environment.

C. Downwinders, Inc.

Downwinders, Inc. is a nonprofit educational foundation created in the late 1970′s to bring a halt to all nuclear weapons testing, development and deployment, and to seek justice for victims and survivors of radiation exposure from fallout from atmospheric atomic testing and weapons manufacturing, and from participation in the uranium industry. Downwinders has been a critic of the operation of the White Mesa mill and waste disposal operation since the mid-1990′s, and more broadly, of a flawed and failing radioactive waste disposal regime nationally and regionally.

D. Friends of Cedar Mesa

Friends of Cedar Mesa is a non-partisan, non-profit conservation organization founded in 2010. The Friends work to protect and build respect for the cultural and natural landscapes of the greater Bears Ears region (e.g. the lands that surround the White Mesa Mill). Because the lands we work to protect are ancestral lands of many indigenous peoples, we work closely to support Tribes like the Ute Mountain Ute nation, which is the community most impacted by the Mill. With our headquarters in the town of Bluff just 17 miles from the Mill, our staff and board members drink water that flows from the aquifer underlying the Mill's tailing ponds.

E. Great Old Broads for Wilderness

Great Old Broads for Wilderness ("Broads") is a national grassroots organization, led by women, that engages and inspires activism to preserve and protect wilderness and wild lands. Founded in 1989 with the national office based in southwestern Colorado, Broads currently has 40 chapters around the country that focus on education, advocacy, and stewardship for public lands protection. With three chapters in Utah and four in western Colorado, the organization has a strong interest in protecting the lands, water and people of this region. We have witnessed the short- and long-term impacts of inappropriate industrial development of lands in the Four Corners region, and find particularly abhorrent the disproportionate impact on indigenous communities. A former council member of the Ute Mountain Ute Tribe serves on our Council of Advisors.

F. Healthy Environment Alliance of Utah

The Healthy Environment Alliance of Utah (HEAL) is a non-profit advocacy organization, headquartered in Salt Lake City with 15,000 members. For over twenty years, HEAL has worked to prevent the exposure of Utahns to hazardous waste including the above ground storage of high-level nuclear waste on the Goshute Reservation, the construction of a nuclear power plant on the Green River, and Energy Solutions attempts to dispose Class B and C waste, depleted uranium, and Italian waste at their Clive facility. We continue to inform and support both citizens and state agencies about the risks of such proposals in order to assure that Utah will be a safe and healthy place to live for us and future generations.

G. Multicultural Alliance for a Safe Environment

The Multicultural Alliance for a Safe Environment is a network of five groups based in New Mexico. We work collaboratively to stop new uranium mines and to address the environmental and health legacy from past uranium mining. We are rooted in the experiences of uranium-impacted communities, working to restore and protect the natural and cultural environment through respectfully promoting intercultural engagement among communities and institutions for the benefits of all life and future generations.

H. New Mexico Environmental Law Center

Founded in 1987, the Law Center's mission is to engage in environmental protection litigation and advocacy with a primary focus on pursuing issues that advance the interests of environmental justice. The Law Center works with communities to protect New Mexico's land, air, and water from challenges posed by local, state, national and worldwide threats to the environment.

The Law Center works with communities to address disparities in environmental protection and exposure to pollution that are a result of racist and classist legal and social frameworks. The Law Center has two goals of equal priority. The first is to provide legal representation to low-income communities and communities of color to address the environmental pollution issues those communities have identified as important. The second is to work with environmental justice communities to impact environmental laws, regulations and policy.

I. Sierra Club Utah Chapter

Today, the Utah Chapter is a grassroots environmental organization that harnesses the power of people working together to make change happen. We amplify the power of its members and supporters to protect and enjoy Utah's outdoors and natural landscapes; educate and advocate for the responsible preservation of clean air, water and habitats; support development of clean energy to benefit present and future generations; and advance principles of equity, inclusion, and justice throughout our organization and the broader community.

J. Southern Utah Wilderness Alliance

The Southern Utah Wilderness Alliance is a non-profit, membership-based environmental organization with members in all fifty states and offices in Washington, D.C. and Utah. It is dedicated to the sensible management of all federal public lands within the State of Utah, the preservation and protection of plant and animal species, the protection of clean air and water found on federal public lands, the preservation and protection of cultural and archaeological resources, and the permanent preservation of Utah's remaining wild lands.

K. The Wilderness Society

The Wilderness Society is a non-profit national organization founded in 1935, with members who reside throughout the nation. TWS works to protect America's wilderness lands through public education, scientific analysis, and advocacy. TWS's mission is to protect wilderness and inspire Americans to care about our wild places, so that future generations will enjoy the clean air, water, wildlife, beauty, and opportunities for recreation and renewal that pristine deserts, mountains, forests, and rivers provide. Protecting wilderness quality and other sensitive lands managed by BLM is vital to achieving The Wilderness Society's mission.

L. Utah Audubon Council

Utah Audubon Council is the public policy arm of the four Audubon societies in Utah, and consists of the leadership of Great Salt Lake, Wasatch, Bridgerland, and Red Cliffs Audubon, representing over 1,200 members statewide. Utah Audubon Council works to protect and preserve birds and wildlife and their habitats, and the human and natural environment.

M. Utah Diné Bikéyah

Utah Diné Bikéyah (UDB) has an all-Native American Board of Directors (comprised of Navajo and Ute community leaders) and is based in San Juan County, Utah. The Board works on public lands conservation by integrating traditional knowledge and Native leadership into land planning. UDB's primary goal is assisting Tribes and federal agencies in engaging Indigenous communities and Indigenous knowledge keepers in developing truly well-informed policies and plans that protect communities and indigenous cultures over the long term. These lands are the homes of Ancestors, Native American sacred spaces, villages areas, traditional cultural properties, and burial places that exist in and around the White Mesa mill and throughout Bears Ears National Monument and are the most at-risk when poor decisions and bad management planning occurs. All of the Native American communities in San Juan County have been harmed by the toxic impacts and legacy of uranium mining, processing, testing, and transportation. UDB's mission is, "to preserve and protect the cultural and natural resources of ancestral Native American lands to benefit and bring healing to people and the Earth."

N. Western Watersheds Project

Western Watersheds Project is a non-profit organization with more than 12,000 members and supporters. Our mission is to protect and restore western watersheds and wildlife through education, public policy initiatives and legal advocacy. Our watersheds work includes advocating for the protection of the health and well-being of Indigenous people and environmental justice communities. We work throughout the western United States, including Utah.

O. WildEarth Guardians

WildEarth Guardians (Guardians) is a membership-based non-profit organization dedicated to protecting and restoring the wildlife, wild places, wild rivers, and health of the American West. Guardians envisions a world where wildlife and wild places are respected and nature has an inherent right to exist and thrive. Guardians has more than 220,000 members and supporters, including many who use and value federal public lands on the Colorado Plateau for hiking, observing archeological sites, bird watching, observing wildlife, spiritual rejuvenation, photography, and other recreational and professional pursuits.

II. Background

A. The White Mesa Mill

No description of the mill's operations appears in any of the documents on which the Division is seeking comment. So that the record is complete, and for the sake of readers who aren't already familiar with the White Mesa mill and the regulatory framework at issue, we've set out below a brief factual background about the mill. The last time the Grand Canyon Trust submitted comments with a background section along these lines, the Division responded that "[m]uch but not all of this information is accurate."[3] If the Division continues to believe that any part of the following account is inaccurate, we would be grateful for an explanation of what specific points the Division disputes so that we may reevaluate our understanding of the facts.[4]

The White Mesa mill is an acid-leaching, uranium-processing mill that turns uranium ore and other uranium-bearing substances into a product called yellowcake, which is then enriched for use in nuclear reactors. Black flake, a substance used in other industrial processes, has also been made at the mill by extracting vanadium from some feeds. Mostly what comes out of the mill, though, is radioactive waste. This waste, commonly called tailings, is discarded in big pits spanning about 275 acres next

[3] Ex. 1 at 214.

[4] We recognize that the Division prefers to use a "regulatory lexicon," Am. 10 Statement of Basis at 3, that varies from the ordinary language we often use, and we take as a given that the Division disputes our word choice. Our request is simply to understand if the Division believes we've misunderstood the facts.

to the mill. There are five of these pits, or "impoundments," at the mill, named Cell 1, Cell 2, Cell 3, Cell 4A, and Cell 4B. They and the mill are about five miles north of the centuries-old Ute Mountain Ute community of White Mesa and about six miles south of downtown Blanding.

A company called Energy Fuels Nuclear, Inc., began building the mill in the late 1970s to process low-grade uranium ore from the surrounding region.[5] Back then, the company planned to run the mill for 15 years, then close and reclaim it.[6] The radioactive tailings were to be cleaned up in phases while the mill was operating.[7]

But that didn't happen. Instead, Energy Fuels Nuclear, fired up the mill in 1980, made yellowcake for about three years, and pumped the resulting radioactive tailings into Cells 1, 2, and 3.[8] Then, when the price of yellowcake plummeted, the company laid off most of the mill's workers and let the mill go mostly, if not completely, dormant.[9] This pattern has continued ever since. An ore-processing "campaign" is run when enough source material has piled up at the mill and yellowcake is fetching a good enough price, and then the mill lapses into "standby" when the price of yellowcake falls.[10] Though about 40 years have now passed, not one of the mill's big waste pits has been completely reclaimed.

Ownership of the mill has been similarly tumultuous. Over the years, it has changed hands at least four times.[11] In the mid-1990s, after Energy Fuels Nuclear sold and rebought the mill, the company ran out of money. When it couldn't pay its

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[5] Ex. 2 at 1-3 (arguing that the mill has independent utility for the purpose of processing low-grade, regional ores); *id.* at 10-21 (observing that small mines with low-grade ore would not be economically viable without the mill); Ex. 3 at 2-1.

[6] Ex. 2 at iii (explaining that production will last for 15 years); *id.* at 1-1, 3-15 (same); *id.* at 3-18 (showing projected operating life of 15 years and phased reclamation schedule extending no more than 5 more years); *id.* at 4-3 ("Based on the capacity of the tailings cells, the mill has a potential to operate 15 years."); Ex. 4 at 1-2 ("The mill is planned to have a 2,000 tons-per-day capacity and a projected life of 15 years."); *id.* at 5-38 ("The area occupied by the proposed mill and tailing retention system (about 310 acres) would be committed until the life of the mill ends, about 15 years.").

[7] Ex. 2 at 3-17 ("The tailings ce1ls will be reclaimed sequentia1ly as each cell is filled, beginning after about the fourth year of operation and every four years thereafter until termination of project operations.").

[8] Ex. 5 at 11 (Table 3 showing "tailings placement period" beginning in 1980 for Cell 2, 1981 for Cell 1, and 1982 for Cell 3).

[9] Ex. 6 at 2–3; Ex. 7; Ex. 8.

[10] Ex. 5 at 5 (showing "standby" periods with no production of U_3O_8 in 1984, 1991–1994, 2000–2004, with minimal production in 1998 and 2005).

[11] Ex. 3 at 2-1.

employees, it laid them off.[12] Within a month, the asset-holding parts of Energy Fuels Nuclear declared bankruptcy,[13] and the mill was sold for "almost nothing."[14]

Today, a company called Energy Fuels, Inc., owns and operates the mill through subsidiaries. Energy Fuels is careful to claim that it and Energy Fuels Nuclear are "unrelated entities,"[15] perhaps to distance itself from any environmental liabilities that Energy Fuels Nuclear could not discharge through bankruptcy. But Energy Fuels, Inc., was formed in 2005 by a prior owner of Energy Fuels Nuclear[16] and touts on its website that "much of our senior management team began their careers and learned about the U.S. uranium industry from the earlier successes of Energy Fuels Nuclear."[17]

The mill's business model has also changed over time, no doubt due to volatility in the uranium market. Around the early 1990s, Energy Fuels Nuclear began pursuing a new source of revenue by processing "alternate feeds" and discarding the resulting waste at the mill. These feeds include uranium-bearing wastes from other contaminated places around the country. In 1998, for example, Energy Fuels[18] was paid over $4 million to process and dispose of radioactive soil that was contaminated not only by the Manhattan Project, but also by other industrial and chemical ventures.[19] From these sorts of feeds, the waste pits at the mill now contain radioactive and contaminated wastes from rare-metals mining,[20] uranium-conversion plants,[21] and contaminated defense facilities,[22] among other sources. The two new "alternate feeds" that the company is seeking permission to accept—which the Division calls the Silmet "material" and the Moffat Tunnel "material"—would bring the list of materials that Energy Fuels has been licensed to process and discard to around twenty.

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[12] *See* Ex. 9.

[13] Ex. 10 at Addendum to Permit Transfer Request (PDF p. 38).

[14] Stephane A. Malin, The Price of Nuclear Power: Uranium Communities and Environmental Justice, 96 (2015) ("Malin").

[15] Ex. 11 at PDF p. 4.

[16] Malin at 95–96.

[17] Ex. 11 at PDF p. 4.

[18] At the time, the mill was owned by a company called International Uranium (USA) Corporation. For simplicity's sake, these comments generally refer to the mill's prior owners as Energy Fuels.

[19] *See* Ex. 12 at 1 (observing that Energy Fuels would be paid a fee of $4 million to process and dispose of the material, an amount that far exceeded the value of the yellowcake to be produced).

[20] *See* Ex. 13 at 2–3.

[21] *See* Ex. 14 at 1.

[22] *See, e.g.*, Ex. 15 at 1–4.

Processing alternate-feeds is not the mill's only waste-disposal business. Wastes generated at operations that recover uranium by in-situ leaching are also buried in the mill's pits. Unlike alternate feed, these wastes aren't processed at the mill before being discarded. These wastes include, for example, barium-sulfate sludge from treating waste solutions at an in-situ uranium leaching operation Wyoming.[23] Leaking shipments of that sludge have arrived at the mill twice since 2015.[24] In the past, similar wastes have been shipped, at a minimum, from Texas, Nebraska, and Wyoming to be buried at the mill.[25]

By running its business, Energy Fuels has also fouled the groundwater beneath the mill. Exactly how some of that contamination got into the groundwater aquifers beneath the mill is a subject of debate. But it's undebatable that the groundwater is contaminated by pollutants like nitrate, nitrite, chlorides, and chloroform.

B. Source-Material and Byproduct Material Licensing

To mill uranium, Energy Fuels is required to get a license from the Utah Division of Waste Management and Radiation Control that authorizes the company to possess and process "source material"—generally meaning uranium ore—and to dispose of the waste "byproduct material" that the mill generates.[26] The Division is authorized to issue this license under state law, exercising authority delegated to the state by the U.S. Nuclear Regulatory Commission.

That delegation was made under the Atomic Energy Act of 1954, the fundamental federal law regulating source, byproduct, and other nuclear materials. That Act authorizes the Nuclear Regulatory Commission to issue regulations governing the possession and use of source and byproduct material "to promote the common defense and security or to protect health or to minimize danger to life or property…."[27]

The Commission has issued three main rules regulating uranium milling: (1) the agency's general standards setting radiation dose limits for the general public and mill workers (10 C.F.R. Part 20); (2) the Commission's rules for domestic licensing of source material (10 C.F.R. Part 40), which establish health, safety, financial, and other requirements that uranium-mill operators must meet to get a license; and (3) Appendix A to those licensing regulations, which establishes standards for managing and reclaiming mill tailings. The State of Utah has set its own radiation-dose standards and has adopted wholesale many, but not all, of the latter two

[23] *See* Ex. 16.

[24] *Id.*

[25] Ex. 17.

[26] Utah Code § 19-3-104.

[27] 42 U.S.C. § 2201.

Commission rules.[28]

The main requirements for managing and disposing of tailings originate from a federal law passed in 1978 called the Uranium Mill Tailings Radiation Control Act. Congress found in UMTRCA that "uranium mill tailings located at active and inactive mill operations may pose a potential and significant radiation health hazard to the public" and sought to regulate tailings in "a safe and environmentally sound manner … to prevent or minimize radon diffusion into the environment and to prevent or minimize other environmental hazards from such tailings."[29] It was to comply with UMTRCA that the Commission issued Appendix A.[30]

III. The Division should reject Energy Fuels' requests to process the Silmet and Moffat Tunnel Materials.

A. The Silmet Material

The "Silmet material" is a waste generated by a rare-metals plant in Sillamäe, Estonia run by NPM Silmet OÜ.[31] The plant sits on land that has been an industrial site for about a century.[32] The area first housed a production plant for oil shale,[33] but in the 1940s, it was converted by the Soviet Union into a "top secret," "large industrial complex" for producing uranium.[34] Modifications in the 1970s allowed the plant to begin producing niobium, tantalum, and rare earth metals, which the plant continues to do today.[35]

Until Estonia joined the European Union in 2004, wastes from the industrial operations at the Silmet plant site were dumped in a pit about twenty to fifty meters from the Baltic Sea.[36] Owing to the threat this posed to the environment and public health, the pit was taken out of use in 2004 and cleaned up over the next four years.[37]

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[28] Utah Admin. Code R313-24-4 (incorporating much of 10 C.F.R. Part 40 and Appendix A by reference); Utah Admin. Code R313-15 (establishing standards that apply to the Division's licensees for protection against ionizing radiation).

[29] 42 U.S.C. § 7901.

[30] "Uranium Mill Licensing Requirements," 45 Fed. Reg. 65,521 (Oct. 3, 1980).

[31] Silmet Application at 1.

[32] *Id.* at 3.

[33] *Id.*

[34] Ex. 18 at 171.

[35] *Id.*

[36] *Id.* Energy Fuels uses a different set of dates in the Silmet Application. *See* Silmet Application at 4. It is unclear which dates are accurate, so we've elected to use those given in the article attached as Exhibit 18, which was co-authored by a staff member of the Estonian Radiation Safety Department.

[37] Ex. 18 at 171–72.

But that created a new problem for Silmet, for it continued to produce a radioactive waste stream in its rare-metals operations.[38] And by 2004, under Estonia's Radiation Act, these wastes could not be discarded in Estonia, for "there is no radioactive waste management operator for [naturally occurring radioactive materials] waste in Estonia."[39] As a result, the plant's operator has been packaging the wastes in 55-gallon drums and storing them at the plant for about the last 15 years while searching for a foreign, waste-disposal option.[40] When operating, the plant generates about 80 tons per year of this waste.[41]

Silmet now has about 600 metric tons of this waste stored at its Sillamäe plant in about 2,000 drums.[42] The company's radiation practice license allows it to accumulate no more of this waste, and as a consequence, the plant's niobium and tantalum operations have ceased, and the Estonian Ministry of Environment has refused to allow operations to resume until the waste is discarded off site.[43] It is this waste, and any additional waste generated if operations at the plant resume, that Energy Fuels is seeking permission to process and discard at the White Mesa mill.

B. The Moffat Tunnel Material

The Moffat Tunnel "material" is a waste containing radionuclides that is generated by a water-treatment plant in Winter Park, Colorado that was built to clean up discharges from the Moffat Tunnel.[44] The Moffat Tunnel was built a century ago to allow trains to travel under the Continental Divide near Colorado's Front Range.[45]

Groundwater and other precipitation seeps into the tunnel and flows out each end, carrying with it contaminants picked up on the way.[46] About five years ago, the Colorado Department of Public Health and Environment required the Tunnel's operator, the Union Pacific Railroad, to build a water treatment plant at the Tunnel's west end to treat the discharge before it flows into the Fraser River.[47]

Because the outflows from the west end of the tunnel contain radionuclides, the "centrifuge cake" generated by the water treatment plant has "elevated" levels of

[38] *Id.* at 172.

[39] *Id.* at 173.

[40] Silmet Application at 4.

[41] *Id.*

[42] *Id.* at 1.

[43] *Id.* at 1–2.

[44] Ex. 19 at 3; Ex. 20 at 1-1, 2-2.

[45] Ex. 19 at 2; Ex. 20 at 1-1.

[46] Ex. 19 at 3; Ex. 20 at 1-1.

[47] Ex. 19 at 3; Ex. 20 at 2-2.

radionuclides.[48] As a consequence state regulators in Colorado have required the Union Pacific Railroad to get a radioactive materials license to dispose of this waste centrifuge cake.[49] This is the Moffat Tunnel "material" that Energy Fuels is seeking permission to process and discard at the White Mesa mill. Energy Fuels anticipates that it may receive this waste material "indefinitely" in quantities of up to 200 tons per year on a wet basis.[50]

C. The Division may deny the alternate-feed applications to protect the environment and public health, and it should exercise that authority.

Licensing alternate feeds for processing and disposal at the mill is a practice that ought to end outright, absent the consent of the Ute Mountain Ute Tribe, absent an act of Congress specifically allowing uranium mills to process alternate feeds, and absent an open public debate about whether that practice should occur at the White Mesa mill.

The Division has the discretion under existing law to reject alternate-feed license applications upon finding that their issuance would be "inimical to the health and safety of the public."[51] We urge the Division to exercise that discretion to deny the applications to process the Silmet and Moffat Tunnel materials.

To lawfully make yellowcake and bury the resulting wastes at its mill, Energy Fuels must process "ore" primarily for its "source material" content.[52] Source material means uranium or thorium, or any ore containing one of those elements at concentrations established by the Nuclear Regulatory Commission.[53] In the 1990s, Commission staff released guidance that defined "ore" to mean anything from which uranium or thorium are extracted in a licensed mill.[54] This tautological definition had the effect of allowing Energy Fuels to run anything from which it could extract uranium through the White Mesa mill and discard the resulting wastes on site, provided the feed wasn't a so-called "listed" hazardous waste.[55] And Energy Fuels took the view that it could even charge fees to process and discard wastes that the

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[48] Moffat Tunnel Application at 1.

[49] *Id.*

[50] *Id.* at 3.

[51] Utah Admin. Code R313-22-33(1)(d).

[52] *See* 42 U.S.C. § 2014(e)(2).

[53] 42 U.S.C. § 2014(z).

[54] "Uranium Mill Facilities, Notice of Two Guidance Documents: Final Revised Guidance on Disposal of Non-Atomic Energy Act of 1954, Section 11e.(2) Byproduct Material in Tailings Impoundments; Final Position and Guidance on the Use of Uranium Mill Feed Materials Other Than Natural Ores," 60 Fed. Reg. 49,296, 49,296 (Sep. 22, 1995).

[55] 60 Fed. Reg. at 49,296–297.

waste generator was willing to pay to get rid of.[56]

The State of Utah balked at this idea and took the issue to the Nuclear Regulatory Commission.[57] The Commission ultimately decided against the State.[58] As a result, through a guidance document issued by Commission staff and an administrative appeal before the Commission, Energy Fuels was given permission to make money disposing of radioactive waste at the White Mesa mill. That outcome bypassed any true public debate about how to get rid of a host of uranium-bearing wastes that have been discarded at the mill since the early 1990s. Indeed, Energy Fuels' "alternate-feed" business has never been blessed by an act of Congress, nor a state law, nor any other publicly debated kind of lawmaking.

The result of this quiet revolution in the law is that the White Mesa mill, as a practical matter, has been given a license to operate indefinitely, not milling much or any uranium ore, but instead accepting wastes for "processing" and disposal. The core problem with that outcome, though there are others, is that the prospect of an indefinitely operating *waste-disposal business* was not at all the subject of discussion and analysis when the federal government and Energy Fuels chose in the late 1970s to build the mill on White Mesa. What was debated back then was whether to license a uranium mill to process low-grade uranium ore from the region for 15 years, before closing and reclaiming the mill.[59] Forty years later, the community of White Mesa is burdened by something else entirely: a landfill for low-level radioactive waste that may forever be running, fed by massive waste-hauling trucks, polluting the air, killing wildlife, and making the already-polluted groundwater ever more toxic.

Indeed, for most or all alternate feeds, the additional pollution from running the mill to process those feeds—the toxins the mill puts into the air, the chemicals it uses to extract yellowcake, and the like—burdens the environment and the people around the mill *only* so that the resulting waste may be deemed "byproduct material" that can be discarded on site. This pollution would not happen if it was the market for selling yellowcake, rather than the market for disposing of radioactive waste, that controlled

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[56] Ex. 12 at 1.

[57] *Id.*

[58] *Id.*

[59] Ex. 2 at 1-3 (arguing that the mill has independent utility for the purpose of processing low-grade, regional ores); *id.* at 10-21 (observing that small mines with low-grade ore would not be economically viable without the mill); *id.* at iii (explaining that production will last for 15 years); *id.* at 1-1, 3-15 (same); *id.* at 3-18 (showing projected operating life of 15 years and phased reclamation schedule extending no more than 5 more years) *id.* at 4-3 ("Based on the capacity of the tailings cells, the mill has a potential to operate 15 years."); Ex. 4 at 1-2 ("The mill is planned to have a 2,000 tons-per-day capacity and a projected life of 15 years."); *id.* at 5-38 ("The area occupied by the proposed mill and tailing retention system (about 310 acres) would be committed until the life of the mill ends, about 15 years.").

whether these alternate-feed deals occurred. Put another way, the expense of transporting and processing the feeds so far outweighs the value of the resulting yellowcake that it is only for waste-disposal that most or all alternate-feeds are ever brought to the mill.

All of this is happening over the persistent objections of the Ute Mountain Ute Tribe. And rather than listen to those objections and confront the failure of governance motivating them, the Division appears to believe that it is bound by federal law to approve any alternate-feed application if the feed has uranium in it (i.e., is ostensibly "ore"), does not contain listed waste, and will be processed at the mill.[60] But this is not so, for the Division has discretion to reject alternate-feed license applications on the grounds that they are "inimical to the health and safety of the public" regardless of the Commission's guidance,[61] and the Utah Waste Management and Radiation Control Board has the power—which it could exercise at the Division's behest—to amend or abandon the Commission's guidance altogether.[62]

The Division contends that, when Utah first obtained agreement-state status, it agreed to use "best efforts … to assure that the State's program will continue to be compatible with the program of the Commission for the regulation of like materials."[63] Yet that commitment does not require the Division to approve any license amendment that would be "inimical to the health and safety of the public," including an amendment to process alternate feeds, for protecting the health and safety of the public is surely compatible with the Commission's regulations.[64]

The Division also observes, without citation, that the State committed in its 2003 agreement-state application to apply the Commission's guidance for evaluating whether to license alternate feeds for processing.[65] But that description of the application omits a crucial caveat: The agreement said nothing about the alternate feed guidance, but made only a general commitment to follow guidance issued by the Commission writ large "unless doing so will compromise protection of human health

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[60] Utah Division of Waste Management and Radiation Control, "Technical Evaluation and Environmental Analysis: Silmet Alternate Feed Request," DRC-2020-007005, p. 13 (Apr. 2020) ("Silmet Technical Evaluation") ("The Division concludes that using its "best efforts" includes following established judicial and administrative precedents, as well as NRC guidance and regulations.").

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

[62] *See* 42 U.S.C. § 2021(o)(2); Utah Code §§ 19-3-104(7) and 19-3-104(8)(a).

[63] *See* Ex. 21, Article VI.

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

[65] Silmet Technical Evaluation at 15; Utah Division of Waste Management and Radiation Control, "Technical Evaluation and Environmental Analysis: Moffat Tunnel Alternate Feed Request," DRC-2020-007007, p. 16 (Apr. 2020) ("Moffat Tunnel Technical Evaluation").

and the environment."[66] And the amendment that the Commission and the State of Utah ultimately signed to expand the State's agreement-state power, which reflects the binding commitments each party made, says nothing about following the Commission's guidance, concerning alternate feeds or any other subject.[67]

Added to that, the State of Utah has the authority to depart from the Commission's alternate-feed guidance, for the Atomic Energy Act explicitly allows agreement states to adopt requirements that are more stringent than federal law:

> In the licensing and regulation of byproduct material … a State shall require … compliance with standards which shall be adopted by the State for the protection of the public health, safety, and the environment from hazards associated with such material which are equivalent, to the extent practicable, *or more stringent than*, standards adopted and enforced by the Commission for the same purpose….[68]

It is consequently not true that the Division's hands are tied by federal law.

We accordingly urge the Division to exercise its authority to find that it is inimical to the health and safety of the public to allow Energy Fuels to process the Silmet and Moffat Tunnel wastes at the mill. At the very least, the Division has the power to find that it is inimical to the health and safety of the public to allow alternate feeds to be shipped to the White Mesa mill when the feed's generator is incurring more expense in the deal than Energy Fuels stands to gain from processing the feed, for in that circumstance the feed would never be sent to the mill *but for* the ability to discard the resulting waste in Utah's environment, next to Utah's communities. This financial arrangement, as explained below, doubtless applies to the Silmet material, and we suspect it is true of the Moffat Tunnel waste too. And at least on this basis, we urge the Division to deny the applications to process these alternate feeds.

IV. If the Division approves the request to process the Silmet material, that approval should be contingent on Energy Fuels' acquisition of a specific import license.

While we urge the Division to deny outright Energy Fuels' application to process the Silmet waste, if the Division nonetheless approves that request, that approval should be conditioned on Energy Fuels' acquisition of a specific-import license from the Commission, for the Commission's general-import license does not authorize Energy Fuels to import the Silmet material.

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[66] *See* Ex. 22 at PDF p. 3.

[67] Ex. 23.

[68] 42 U.S.C. § 2021(o)(2) (emphasis added); *see also* Utah Code §§ 19-3-104(7) and 19-3-104(8).

A. Energy Fuels cannot import the Silmet material using a general-import license.

Energy Fuels has asserted that it may bring the Silmet material into the United States from Estonia using a general-import license established by 10 C.F.R. § 110.27(a).[69] The Division has concurred with that view.[70] Yet the general license in § 110.27(a) does not allow for the importation of "radioactive waste," as that term is defined by the Commission's import regulations.[71] And because the Silmet material is a "radioactive waste," it cannot be imported under a general license.

1. The Silmet material is a "radioactive waste" if Energy Fuels will not import it "solely" for the purpose of recycling.

The Commission's regulations provide that "a general license is issued to any person to import … source … material if the U.S. consignee is authorized to receive and possess the material under the relevant NRC or Agreement State regulations."[72] But that general license is subject to conditions,[73] one of which provides that "radioactive waste" may not be imported under a general license.[74]

"Radioactive waste" has a unique and complex definition in the Commission's export and import rules, which provides in pertinent part:

> Radioactive waste … means any material that contains or is contaminated with source … material that by its possession would require a specific radioactive material license in accordance with this Chapter and is imported or exported for the purposes of disposal in … a disposal area as defined in Appendix A to 10 CFR part 40…; or recycling, waste treatment or other waste management process that generates radioactive material for disposal in … a disposal area as defined in Appendix A to 10 CFR part 40….[75]

Further complicating the matter, some radioactive materials that would otherwise be radioactive wastes under this definition are excluded by rule. These include materials "[i]mported solely for the purposes of recycling and not for waste management or disposal where there is a market for the recycled material and evidence of a contract or business agreement can be produced upon request by the NRC."[76] It is

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[69] *See* Silmet Application at 12–13.

[70] *See* Silmet Technical Evaluation at 20.

[71] 10 C.F.R. § 110.27(c); 10 C.F.R. § 110.2 (defining "radioactive waste").

[72] 10 C.F.R. § 110.27(a).

[73] *Id.* (granting license "[e]xcept as provided in paragraphs (b) and (c) of this section…").

[74] 10 C.F.R. § 110.27(c).

[75] 10 C.F.R. § 110.2.

[76] *Id.*

under this exclusion that Energy Fuels asserts that it can import the Silmet material.[77] But that assertion is flawed.

For the Silmet material to qualify under this exclusion, it must be imported *solely* for the purpose of recycling.[78] When adopting this exemption in 2010, the Commission warned against its misuse:

> The Commission is aware that there could be instances in which a person intends to import what is in fact radioactive waste, but which is argued to be for recycling purposes (i.e., sham recycling). Any person who imports materials under a general license for recycling, but with the purpose of disposing of them in the United States, would be subject to NRC enforcement action.[79]

The Commission further recognized that "there may be instances in which some small value may be obtained from the materials that are imported, but the primary intention is for disposal."[80] In such cases, to avoid possible enforcement action, the staff recommends that the Commission be consulted before any such imports are made."[81]

For the reasons explained below, the possible value that Energy Fuels might obtain from processing the Silmet material is a small fraction of the expense of transporting it to White Mesa and processing it, not accounting for permitting costs, overhead, marketing, and the like. At best, this is the precise circumstance that the Commission envisioned would amount to "sham recycling" and warned licensees not to attempt.

And it is important to stress that, on the subject of "sham recycling," the analysis under the Commission's import rules is different than the domestic-licensing rules for alternate feeds. The core question of law for "alternate feeds" originating in the United States is whether processing them will result in "wastes produced by the extraction or concentration of uranium … from any ore processed *primarily* for its

[77] *See* Silmet Application at 12–13.

[78] 10 C.F.R. § 110.2. There is no question that the remaining elements of the definition of "radioactive waste" are satisfied. Processing the feeds will generate radioactive material to be disposed of in a "disposal area"—the tailings cells at the mill—as that term is defined in Appendix A. *See* 10 C.F.R. Part 40, App. A ("Disposal area means the area containing byproduct materials to which the requirements of Criterion 6 apply.").

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

[80] *Id.*

[81] *Id.*

source material content."[82] The Commission has interpreted this language to allow a licensee to process a "source material"—like an alternate feed—even if the licensee's primary motive is to receive a disposal fee, so long as the act of processing is completed primarily to extract the feed's source-material content and not something else.[83] In so holding, the Commission observed that there is "no reason under UMTRCA why licensees cannot have several motives for a transaction."[84]

But this analysis does not apply when evaluating how a foreign-sourced "alternate feed" should be treated under the Commission's import regulations, for those regulation require that the material be imported "solely" for the purpose of recycling. It is not enough that "recycling" is *one* ostensible reason, however trivial, among other reasons for importing a material: It must be the sole reason.

For similar reasons, the Division's legal review of the import-license question should be revisited. In that analysis, the Division reasons that the Commission would not require an import license today because it did not require one when Energy Fuels began importing materials from Cameco Corporation's operations in Ontario, Canada in 1998.[85] But the Commission changed its import rules in 2010 to adopt the definition of "radioactive waste" discussed above, including the recycling exclusion.[86] Thus, the Commission's conclusions about the 1998 import license have no bearing on how its modified import rules apply today.

All told, conceding for the sake of argument that Energy Fuels may process domestically sourced "alternate feeds" at the mill even if the company's primary motivation is to generate waste-disposal fees, that is not true of whether Energy Fuels may *import* foreign-sourced "alternate feeds." On that score, it must import the material "solely" for the purpose of recycling, a requirement that—as explained below—is not met here.

2. Energy Fuels is not importing the Silmet material *solely* for the purposes of recycling.

Even assuming, for the sake of argument, that one of the purposes for importing the Silmet material is to "recycle" the tiny fraction of uranium it contains, there is no denying that another purpose—and indeed, in our view, the only purpose[87]—is disposal of the remaining 99.5-plus percent of the Silmet material. This

[82] 42 U.S.C. § 2014(e)(2) (emphasis added).

[83] *In re Int'l Uranium (USA) Corp.*, 51 NRC 9, 23 (2000).

[84] *Id.* at 18.

[85] Silmet Technical Evaluation at 20.

[86] 75 Fed. Reg. at 44,076.

[87] For this reason, we believe that it is proper to conclude that Energy Fuels is importing the Silmet waste "for the purposes of disposal in … a disposal area as defined in Appendix A to 10 CFR part 40…" and that the recycling exclusion does not apply at all,

is evident for several reasons.

First, Energy Fuels estimates that the Silmet material averages about 0.27 percent U_3O_8.[88] So, if Energy Fuels receives 2,000 drums of the Silmet material, Energy Fuels would effectively bury just over 1,994 of those drums in the mill's waste pits and produce a bit less than 6 drums' worth of yellowcake (assuming *all* the uranium could be extracted from the Silmet material, which it cannot).[89] As a simple mathematical matter, the outcome of importing the Silmet material will be to discard nearly all of it permanently at the mill.

Second, it is plain that Silmet treats the "Silmet material" as waste that Silmet is anxious to dispose of. Energy Fuels' application to process the material explains that the Republic of Estonia has refused to renew Silmet's radiation activity license and has shut down Silmet's plant until it gets rid of the "Silmet material."[90] For Silmet, and for the Republic of Estonia, the only goal is to export the material from the country because it cannot be lawfully discarded in Estonia due to its radioactive content.[91] Silmet's purpose is decidedly not "recycling," but rather, waste disposal.

Third, the finances of the transaction reveal that the value in the deal for Silmet and Energy Fuels is from waste disposal, not "recycling." Though Energy Fuels has not disclosed any information about the financial aspects of the Silmet deal, we have no doubt that the cost of transporting the material to White Mesa and processing it far exceed the revenues Energy Fuels could generate from selling uranium "recycled" from that material.

Indeed, the cost of transporting the Silmet material *alone* surely exceeds the value of any yellowcake it can yield. The rough estimates we've unearthed suggest that shipping 20′ intermodal or similar containers from the Port of Tallinn in Estonia to the Port of Houston is likely to cost at least $1,700 per container, with a range up to $2,800, perhaps more.[92] At the midpoint of those rates, shipping 50 containers, as

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though we direct our comments here to disputing Energy Fuels' claim that it is importing the material "solely" for the purposes of recycling.

[88] Silmet Application at 6.

[89] 2,000 * 0.0027 = 5.4 drums of yellowcake.

[90] Silmet Application at 1–2.

[91] *See* Ex. 18 at 170–74 (explaining that the Radiation Control Act, as amended after Estonia joined the European Union, imposes disposal requirements that cannot currently be met, for "[t]here is no radioactive waste management operator for [naturally occurring radioactive material] waste in Estonia.")

[92] *See* Ex. 24 at 1, Ex. 25 at 1. Energy Fuels' application does not describe the container size that would be used to ship the materials from Estonia to Houston, but based on the math, it appears the company intends to use 20′ shipping containers, given the volume of materials (2,000 drums) and the number of containers Energy Fuels expects to ship (50).

Silmet plans to do to export the material it currently has on hand, would cost $112,500.[93] And judging by Energy Fuels' past estimates for transporting similar shipments by truck to the mill, the cost to deliver the material to White Mesa from Houston is likely to be on the order of another $160,000.[94] These calculations, though rough, suggest that transporting the materials from Estonia to White Mesa will cost somewhere around $275,000.

That probable shipping cost will far exceed the value of any uranium produced from the Silmet material at today's uranium prices. Assuming that the Silmet material contains on average 0.27% U_3O_8 and that the mill has a 100% recovery rate (which it does not), processing 600 metric tons of Silmet material would yield about 3,500 pounds of yellowcake.[95] At a spot-market price of $33/lb, 3,500 pounds of yellowcake would fetch about $115,500.[96] Thus, considering only the transportation costs, the deal to "recycle" the material at the mill will generate a net financial loss of somewhere around $150,000.

And the milling cost will only significantly increase the net financial losses entailed by the Silmet transaction. In 2008, the Nuclear Regulatory Commission estimated that the per-ton milling cost for another alternate feed was about $125, a figure we suspect does not include overhead, marketing, and other expenses necessary to sell the resulting yellowcake.[97] Using that cost estimate adjusted to today's dollars, processing 600 tons of material would set Energy Fuels back by about $91,000.[98] Taken together with the transportation cost, the expense to process the Silmet material will far exceed the value of the yellowcake that can be made from that material. Indeed, we suspect that Silmet is willing to pay not only the cost to transport the material to White Mesa but also a tipping fee to compensate Energy Fuels for processing the material and discarding the waste.

Added to all this, there is no evidence, in the record or otherwise that Silmet has an alternative option for disposing of the "Silmet material" and is electing instead to incur additional cost to "recycle" it out of environmental goodwill or for some other reason. That is, it is not the case that Silmet prefers to spend more to "recycle" the

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[93] $2,250 * 50 = $112,500.

[94] *See* Ex. 26 at F-11 (estimating, in 2008, average per-ton cost to truck raffinate sludge 975 miles from Gore, Oklahoma to White Mesa of $189.40). We calculated a figure of $160,000, by adjusting this per-ton trucking cost to account for inflation and the distance from Houston to White Mesa (1,200 miles), as so: $189/975 mi. = $0.1938 cost per mile * 1,200 = $232.61/per ton * 600 tons = $139,569 (2008). Adjusted for inflation, this figure comes to $165,186.

[95] 600 metric tons = 1,322,772 lbs. 1,322,772*0.0027 = 3,500 lbs.

[96] *See* Ex. 27 at 1 (showing average spot price as of late June 2020 of about $33/lb).

[97] *See* Ex. 26 at F-11, F-24 (showing estimated processing cost of $125/ton from "NRC, 1/23/08"). Sillamäe, Ida-Viru County, Estonia

[98] $125 (2008) in today's dollars = $152 * 600 tons = $91,200.

material even though it could discard it in Estonia or elsewhere. What matters to Silmet is securing some way to dispose of the waste that it cannot lawfully discard in Estonia.

All told, it is overwhelmingly clear that the purpose for sending the Silmet material to the White Mesa mill is to reclassify it as a "waste[] produced by the extraction or concentration of uranium … from any ore processed primarily for its source material content" so that the Division will allow Energy Fuels to discard that waste at the mill. Put differently, there can be no doubt that if the waste could not be discarded at the mill, Energy Fuels and Silmet would not contract to transport the material 5,000 miles to White Mesa for "recycling."

We recognize that the figures we've used to reach this conclusion are estimates, though those estimates are based on the best information we've been able to gather. And consequently, we fear that the Division may be inclined to contend that our analysis is imperfect and therefore should be disregarded. If that's the case, we urge the Division to check our work by performing and disclosing to the public an independent analysis of the economics of the Silmet deal and also by requiring Energy Fuels to submit information about its projections of the costs and revenues for importing, processing, and marketing the Silmet material. We're confident the Division's analysis will confirm our estimates, and without the Division having performed that analysis, there is no basis for concluding that Energy Fuels may import the Silmet material using a general license.

And regardless of whatever forecasts the Division makes about the Silmet deal and the parties' intent in undertaking it, we ask the Division to impose a simple test in the license that will unequivocally reveal whether "recycling" is the sole purpose for importing the Silmet material: Require Energy Fuels to ship *back* to Estonia for disposal all the waste that results from "recycling" the Silmet material at the mill. If Silmet and Energy Fuels decline to go forward with their deal with that condition, it will be plain that the purpose of importing the Silmet material is to discard it at the mill, not to recycle it.

* * *

It is plainly evident to us, as we believe it should be to the Division, that the Silmet material will not be imported "solely for the purposes of recycling" if Energy Fuels' license application is granted. That material is consequently a "radioactive waste" for the purposes of the Commission's import rules. And it therefore may not be imported under a general license. As a result, if the Division approves Energy Fuels' application to allow for possession and processing of the Silmet material, the Division should make its approval subject to two conditions: (1) that Energy Fuels acquires a specific import license from the Commission; and (2) that Energy Fuels returns to Silmet in Estonia all waste resulting from processing the Silmet material at the mill.

V. The Division should revise its assertions that "11(e)(2) byproduct" material is not "waste."

The Division claims in several of the documents published for public comment that 11(e)(2) byproduct material is not waste.[99] These claims are at odds with the statutory definition of byproduct material, and they imply incorrectly that radioactive wastes are not discarded at the mill. The Division should revise these assertions to accurately portray the waste-disposal business that occurs at the mill.

The Division has proposed to revise the text of Energy Fuels' radioactive materials license in several places to replace the word "waste" with the regulatory term "11(e)(2) byproduct material."[100] While the Division's proposal to use "byproduct material" as a term of art in the license for the sake of clarity is unobjectionable, the Division's explanation for that change is problematic. In particular, the Division's statement of basis for the proposed changes to the license makes the following assertion: "Byproduct material as defined under 11e.(2) is not the same thing as *waste*, a term that has a specific and narrow meaning in the radiological regulatory lexicon, and proper usage will provide clarity."[101]

Yet it is exactly the opposite effect—to sow confusion—that will result from claiming that byproduct material is not waste. Section 11(e)(2) of the Atomic Energy Act specifically defines "byproduct material" to be waste: "byproduct material" means the "tailings or *wastes* produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content."[102] Thus, there is no disputing that byproduct material is waste. And indeed there is no question that Energy Fuels and the Division intend for the mill's radioactive leavings to buried next to the mill and remain there forever. To suggest that this amounts to anything other than waste disposal is misleading.

The Division should accordingly revise the licensing documents to recognize that "11(e)(2) byproduct material" is by definition waste.

VI. The Division hasn't adequately explained its proposed approval of Energy Fuels' request to increase the volume of in-situ leaching waste discarded at the mill.

The Division has not sufficiently justified and should revisit its proposal to modify the limits in License Condition 10.5 governing the amount of in-situ-leaching

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[99] *See* Am. 10 Statement of Basis at PDF p. 3; Silmet Technical Evaluation at 2; Moffat Tunnel Technical Evaluation at 3.

[100] *See, e.g.*, Am. 10 Statement of Basis at PDF pp. 2–3 (describing changes to License Conditions 9.5 and 9.8).

[101] *Id.* at 3.

[102] *See* 42 U.S.C. § 2014(e)(2) (emphasis added); 10 C.F.R. § 40.4; Utah Code Ann. § 19-3-102(3); Utah Admin. Code R313-12-3.

wastes that Energy Fuels may accept for disposal.

License Condition 10.5 authorizes Energy Fuels to discard byproduct material from in-situ leaching operations at the mill. That Condition, however, limits the amount of waste from any one source to 5,000 cubic yards. The Division is proposing to replace that limit with a three-part standard, which would (1) establish an annual cap of 10,000 cubic yards on the amount of wastes accepted in the aggregate from out-of-state sources; (2) eliminate the cap altogether for sources owned by Energy Fuels or its affiliates; and (3) allow for unlimited disposal at the mill of byproduct material from sources located in Utah.

Energy Fuels has been authorized to accept in-situ-leaching wastes for disposal to foster a federal policy that disfavors the "proliferation of small waste disposal sites…."[103] Owing to that policy, the Commission's uranium-mill licensing regulations require wastes from in-situ leaching operations to be "disposed of at existing large mill tailings disposal sites; unless, considering the nature of the wastes, such as their volume and specific activity, and the costs and environmental impacts of transporting the wastes to a large disposal site, such offsite disposal is demonstrated to be impracticable or the advantages of onsite burial clearly outweigh the benefits of reducing the perpetual surveillance obligations."[104]

Replacing the source-specific cap with an annual cap, as proposed, would allow in-situ-leaching operations to ship wastes to the mill in unlimited amounts, so long as the shipments from out-of-state operations that Energy Fuels doesn't own are less than 10,000 cubic yards total each year. This change in the license could allow for the disposal of in-situ-leaching wastes at the mill in large volumes even if the "advantages of onsite burial" near the waste generator "clearly outweigh the benefits of reducing the perpetual surveillance obligations" by shipping the wastes to the mill. And yet, the Division has not supplied any analysis of whether that standard may be satisfied.

Rather, the Division's analysis of this proposed license change reasons only that Energy Fuels is already licensed to receive 11(e)(2) byproduct material and that "changes in the quantities would not increase the impact to human health and the environment."[105] But that line of reasoning does not address the relevant standard under Appendix A, for it does not weigh the advantages of onsite burial against the benefits that the Division foresees of discarding those wastes at the mill.

Furthermore, it is indefensible for the Division to assert that changing "the quantities would not increase the impact to human health and the environment" and that "[a]s long as the material meets the definition of 11e.(2) byproduct material, changing the requirement to an annual limit does not affect the health and safety at the

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[103] 10 C.F.R. Part 40, App. A, Criterion 2.

[104] *Id.*

[105] Am. 10 Statement of Basis at 4.

Mill."[106] It is indisputable that *some* increment of additional harm to the environment and public health results from discarding additional wastes at the mill, for it concentrates yet more radioactive material at the mill, intensifies and perhaps prolongs the mills operations, increases the likelihood of transportation accidents, and contributes to Energy Fuels' plans for building yet more waste pits. Indeed, trucks hauling in-situ-leaching wastes to the mill have spilled their contents in the past on roadsides stretching from Wyoming to Utah. The risk of yet more accidents will only increase if the limits on how much in-situ-leaching waste Energy Fuels may accept at the mill are all but eliminated.

Rather than giving Energy Fuels nearly carte blanche to discard at the mill as much in-situ-leaching waste as the company likes, the Division should evaluate the additional incremental risks to the environment and public health from allowing greater volumes of these wastes to be shipped to and discarded at the mill and should craft waste-volume limits that strike the balance that Appendix A calls for between consolidation of these wastes at existing large sites and on-site burial when warranted.

VII. Conclusion

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

Very truly yours,

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106 *Id.* at 4.

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Energy and Mining Campaign Director
Western Watersheds Project

Chris Krupp
Public Lands Guardian
WildEarth Guardians

Enclosures

EXHIBIT LIST

Exhibit 1	Utah Division of Waste Management and Radiation Control, "Public Participation Summary: Radioactive Material License UT1900479 Renewal, Groundwater Quality Discharge Permit UGW370004 Renewal and Sequoyah Fuels Alternate Feed Request," DRC-2018-000762 (2018).
Exhibit 2	U.S. Nuclear Regulatory Commission, "Final Environmental Statement Related to operation of White Mesa Uranium Project, Energy Fuels Nuclear, Inc." (May 1979).
Exhibit 3	Energy Fuels Resources (USA) Inc., "Reclamation Plan: White Mesa Mill, Blanding, Utah – Radioactive Materials License No. UT1900479, Revision 5.1" (Aug. 2016).
Exhibit 4	Dames & Moore, "Environmental Report: White Mesa Uranium Project, San Juan County, Utah for Energy Fuels Nuclear, Inc." (Jan. 30, 1978).
Exhibit 5	Letter from D. Frydenlund, V.P. Regulatory Affairs & Counsel, to C. Garlow, Attorney-Advisor, U.S. Environmental Protection Agency (June 1, 2009).
Exhibit 6	Letter from C.E. Baker, Manager, Regulatory Compliance, Energy Fuels Nuclear, Inc. to Utah Dep't of Natural Resources, Division of Oil, Gas and Mining (Jan. 27, 1983).
Exhibit 7	Letter from H. Roberts, Senior Project Engineer, Energy Fuels Nuclear, Inc., to T. Tetting, Utah Dep't of Natural Resources, Division of Oil, Gas and Mining (Mar. 12, 1984).
Exhibit 8	Energy Fuels goes on standby at Blanding, PAY DIRT, Jan. 1983.
Exhibit 9	Associated Press, "65 Lose Jobs as Ore Mill in Blanding Closes," Deseret News (Feb. 27, 1995) *available at* http://www.deseretnews.com/article/406882/65-lose-jobs-as-ore-mill-in-blanding-closes.html?pg=all.
Exhibit 10	Letter from H. Roberts, Executive Vice President, International Uranium (USA) Corporation, to M. Leavitt, Governor, State of Utah (June 18, 1997).
Exhibit 11	Energy Fuels, "Our History," 3 (July 11, 2017) available at http://www.energyfuels.com/corporate/history/ (last visited July 10, 2020).
Exhibit 12	Memorandum and Order, In re International Uranium (USA) Corp., CLI-00-01, Docket No. 40-8681-MLA-4 (Feb. 10, 2000).
Exhibit 13	Letter from M. Rehmann, Environmental Manager, International Uranium (USA) Corporation, to M. Leach, Director, Fuel Cycle Licensing Branch, U.S. Nuclear Regulatory Commission (Oct. 17, 2001).

Exhibit 14	Energy Fuels Nuclear, Inc., "Request to Amend Source Material License SUA-1358 White Mesa Mill, Docket No. 40-8681" (Sep. 20, 1996).
Exhibit 15	International Uranium (USA) Corporation, "Request to Amend Source Material License SUA-1358, White mesa Mill, Docket No 40-8681" (Mar. 16, 2000).
Exhibit 16	Letter from S. Anderson, Director, Division of Waste Management and Radiation Control, to B. Tharakan, U.S. Nuclear Regulatory Commission (Apr. 26, 2016).
Exhibit 17	Letter from D. Turk, Manager, Environmental Health and Safety, Energy Fuels Resources (USA) Inc., to R. Lundberg, Director, Division of Radiation Control (Nov. 8, 2013).
Exhibit 18	M. Lust and E. Realo, "NORM Related Production of Rare Earth metals in Estonia" in EU-NORM 1st International Symposium: 5–8 June 2012, Tallinn, Estonia (June 2012) (excerpts).
Exhibit 19	Colorado Department of Public Health & Environment, "Colorado Discharge Permit System (CDPS) Fact Sheet to Permit Number CO0047554: Union Pacific Railroad, Moffat Tunnel West Portal, Grand County" (Aug. 31, 2018).
Exhibit 20	Union Pacific Railroad, Letter Enclosing 2016 Compliance Report for Moffat Tunnel Permit CO-09947554 (Apr. 22, 2016).
Exhibit 21	Agreement Between the U.S. Nuclear Regulatory Commission and the State of Utah for Discontinuance of Certain Commission Regulatory Authority and Responsibility within the State Pursuant to Section 274 of the Atomic Energy Act of 1954 (Mar. 29, 1984).
Exhibit 22	Utah Department of Environmental Quality, Divisions of Radiation Control and Water Quality, "Elements of a Utah Agreement State Program for Uranium Mills Regulation" (Aug. 26, 2000).
Exhibit 23	Amendment to Agreement Between the United States Nuclear Regulatory Commission and the State of Utah for Discontinuance of Certain Commission Regulatory Authority and Responsibility within the State Pursuant to Section 274 of the Atomic Energy Act of 1954, as Amended (Aug. 16, 2004).
Exhibit 24	Freightos, Freight Calculator: Air and Sea Shipping Costs (July 5, 2020) *available at* https://www.freightos.com/freight-tools/freight-rate-calculator-free-tool/.
Exhibit 25	World Freight Rates, Freight Calculator (July 5, 2020) *available at* https://www.worldfreightrates.com/en/freight.
Exhibit 26	U.S. Nuclear Regulatory Commission, "Final Environmental Impact Statement for the Reclamation of the Sequoyah Fuels Corporation Site in Gore, Oklahoma: Final Report" (May 2008) (excerpts).

Exhibit 27 Cameco, "Uranium Price" (July 5, 2020) *available at* https://www.cameco.com/invest/markets/uranium-price.

Exhibit 1

Public Participation Summary

Radioactive Material License UT1900479 Renewal
Ground Water Quality Discharge Permit UGW370004 Renewal
And
Sequoyah Fuels Alternate Feed Request
Energy Fuels Resources (USA) Inc. (Energy Fuels)
White Mesa Uranium Mill
San Juan County, Utah

Ownership of the mill has been similarly tumultuous. Over the years, it has changed hands at least four times.[15] *In the mid-1990s, after Energy Fuels Nuclear sold and rebought the mill, the company ran out of money. When it couldn't pay its employees, it fired them.*[16] *Within a month, the asset-holding parts of Energy Fuels Nuclear declared bankruptcy,*[17] *and the business was eventually liquidated.*[18]

Division Response: In this section of the Grand Canyon Trust's comments, a general discussion of the White Mesa Mill is provided. Detailed response to this comment is not required because it is in the nature of the commenter's version of background information regarding the Mill. Much but not all of this information is accurate. The Division incorporates, generally, by reference the Division General Response #1. In addition, the Division provides the following information in response to this background information:

The NRC has jurisdiction to determine the status of radioactive materials. A s discussed in detail in the Division's Response to Comment No. 1, mill discharges to the tailings management system are byproduct material, not waste. Further, in his recent order in a related matter involving the commenting party (referenced in Response to Comment No. 8), Judge Waddoups determined that this byproduct material has two components and that only the solids are called tailings, with the liquid portion of the slurry and any liquid discharge going by other names. To call the liquid "tailings" is not warranted by this record. As a result, Cells 1 and 4B do not receive tailings at this time. The fluids managed in Cells 1 and 4A are not tailings, and tailings have never been being placed in Cells 1 or 4B. *See* Memorandum Decision and Order at 35-38.

As with the reference to process fluid as tailings, the statement that the Mill did not operate as represented is misleading. The Mill has fulfilled its design function, and continues to do so to this day. Placing the Mill in standby status during periods of low demand is not a violation of the represented function of the Mill. The Licensee has been performing concurrent reclamation activities. *Grand Canyon Trust v. Energy Fuels Resources (U.S.A.) Inc.* (finding that the license had been engaged in decommissioning of Cell 2, contrary to the presentation here that the Licensee had done nothing toward cell closure).

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[9] *Ex. 2 at 1-3 (arguing that the mill has independent utility for the purpose of processing low-grade, regional ores); id. at 10-21 (observing that small mines with low-grade ore would not be economically viable without the mill); Ex. 1 at 2-1.*

[10] *Ex. 2 at iii (explaining that production will last for 15 years); id. at 1-1, 3-15 (same); id. at 3-18 (showing projected operating life of 15 years and phased reclamation schedule extending no more than 5 more years) id. at 4-3 ("Based on the capacity of the tailings cells, the mill has a potential to operate 15 years."); Ex. 3 at 1-2 ("The mill is planned to have a 2,000 tons-per-day capacity and a projected life of 15 years."); id. at 5-38 ("The area occupied by the proposed mill and tailing retention system (about 310 acres) would be committed until the life of the mill ends, about 15 years.").*

[11] *Ex. 2 at 3-17 ("The tailings ce1ls will be reclaimed sequential1y as each cell is filled, beginning after about the fourth year of operation and every four years thereafter until termination of project operations.").*

[12] *Ex. 4 at 11 (Table 3 showing "tailings placement period" beginning in 1980 for Cell 2, 1982 for Cell 1, and 1983 for Cell 3).*
[13] *Ex. 5 at 2–3; Ex. 6; Ex. 7.*
[14] *Ex. 4 at 5 (showing "standby" periods in 1984, 1991–1994, 2000–2004, with minimal production in 1998 and 2005).*
[15] *Ex. 1 at 2-1.*
[16] *See Ex. 8.*
[17] *Ex. 9 at Addendum to Permit Transfer Request (p. 37).*
[18] *Stephane A. Malin, The Price of Nuclear Power: Uranium Communities and Environmental Justice, 96 (2015) ("Malin").*

Exhibit 2

DCF copy

final

NUREG-0556

environmental statement

related to operation of

WHITE MESA URANIUM PROJECT

ENERGY FUELS NUCLEAR, INC.

MAY 1979

Docket No. 40-8681

U. S. Nuclear Regulatory Commission • Office of Nuclear Material Safety and Safeguards

NUREG-0556

FINAL ENVIRONMENTAL STATEMENT

related to the
Energy Fuels Nuclear, Inc.,

WHITE MESA URANIUM PROJECT

(San Juan County, Utah)

Docket No. 40-8681

May 1979

prepared by the
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUMMARY AND CONCLUSIONS

This Final Environmental Statement was prepared by the staff of the U.S. Nuclear Regulatory Commission and issued by the Commission's Office of Nuclear Material Safety and Safeguards.

1. This action is administrative.

2. The proposed action is the issuance of a Source Material License to Energy Fuels Nuclear, Inc., for the construction and operation of the proposed White Mesa Uranium Project with a product (U_3O_8) production limited to 7.3 x 10^5 kg (1.6 x 10^6 lb) per year.

3. The following is a summary of environmental impacts and adverse effects.

   a. Impacts to the area from the operation of the White Mesa Uranium Project will include the following:

      - Alterations of up to 195 ha (484 acres) that will be occupied by the mill, mill facilities, tailings area, and roads. Approximately 135 ha (333 acres) will be permanently committed to tailings disposal.
      - An increase in the existing background radiation levels of the mill area as a result of continuous but small releases of uranium, radium, radon, and other radioactive materials during operation.
      - Socioeconomic effects on the towns of Blanding and Monticello, Utah, where the majority of mill workers will be housed during mill construction and operation.
      - Production of waste material (tailings) from the mill, which will be produced at a rate of about 1.8 x 10^6 kg (2000 tons) per day for 15 years and will be deposited onsite in subsurface pits.

   b. Surface water will not be affected by normal milling operations. Mill process water will be taken from the Navajo aquifer, and process water will be discharged to the tailings impoundment at about 1.18 m^3 (310 gal) per minute. Approximately 5.9 x 10^5 m^3 (480 acre-ft) of water per year will be utilized by the mill, and this is not expected to have an effect on the Navajo aquifer.

   c. There will be no discharge of liquid or solid effluents from the mill and tailings site. The discharge of pollutants to the air will be small and the effects negligible. The estimated total annual whole-body and organ dose commitments to the population within 80 km (50 miles) of the proposed mill site are presented below. Natural background doses are also presented for comparison. These dose estimates were based on the projected population in the year 2000. The dose commitments from normal operations of the proposed White Mesa mill will represent only very small increases from those due to current background radiation sources. Radiation dose commitments to individuals living in nearby residences will not be permitted to exceed the 25-millirems-per-year EPA limit (40 CFR Part 190).

Annual population dose commitments to the population within an 80-km (50-mile) radius of the plant site in the year 2000

	Dose (man-rems/yr)	
Receptor organ	Plant effluents	Natural background
Total body	3.4	7,500
Lung	7.1	7,500
Bone	6.4	7,500
Bronchial epithelium	13.2	23,000

d. Construction and operation of the White Mesa mill will require the commitment of small amounts of chemicals and fossil fuels, relative to their abundance.

e. Construction and operation of the White Mesa mill will provide employment and induced economic benefits for the region, but may also result in some socioeconomic stress.

f. The area devoted to the milling operations will be reclaimed after operations cease, but the approximately 135 ha (333 acres) tailings area may be unavailable for further productive use. However, when reclamation is completed and testing shows that radiation levels have been reduced to acceptable levels, it may be possible to return the tailings area to its former use as grazing land.

g. Historical and archeological surveys have identified archeological and historic sites within the proposed project area. Pursuant to 36 CFR Part 63.3, the NRC requested a determination from the Secretary of the Interior that the area on which the archeological sites are located is eligible for inclusion in the National Register of Historic Places (National Register) as an Archeological District. The resulting determination was that the White Mesa Archeological District is eligible for inclusion in the National Register. Although a similar request was made for determinations of eligibility for the historic sites, these determinations await supplementary documentation. It is anticipated that the NRC will enter into a Memorandum of Agreement under 36 CFR Part 800, "Procedures for the Protection of Historic and Cultural Properties," to ensure adequate mitigation of impacts to cultural resources.

4. Principal alternatives considered are as follows:

   a. alternative sites for the mill,
   b. alternative mill processes,
   c. alternative of using an existing mill,
   d. alternative methods for tailings management,
   e. alternative energy sources, and
   f. alternative of no licensing action on the mill.

5. The following Federal, State, and local agencies were asked to comment on the Draft Environmental Statement:

   Department of Commerce
   Department of the Interior
   Department of Health, Education, and Welfare
   Federal Energy Regulatory Commission
   Department of Energy
   Department of Transportation
   Environmental Protection Agency
   Department of Agriculture
   Advisory Council on Historic Preservation
   Department of Housing and Urban Development
   Utah Board of Health
   Utah State Planning Coordinator
   Utah Division of Oil, Gas, and Mining

6. This Final Environmental Statement was made available to the public and to the specified agencies in May 1979.

7. On the basis of the analysis and evaluation set forth in this Environmental Statement, it is proposed that any license issued for the White Mesa mill should be subject to the following conditions for the protection of the environment.

   a. The applicant shall construct the tailings disposal facility to incorporate the features described in Alternative 1 of Sect. 10.3 and in Sect. 3.2.4.7 and to meet the safety criteria specified in NRC Regulatory Guide 3.11.

   b. The applicant shall implement an interim stabilization program that minimizes to the maximum extent reasonably achievable dispersal of blowing tailings. This program shall include the use of written operating procedures that specify the use of specific control methods for all conditions. The effectiveness of the control methods used shall be evaluated weekly by means of a documented tailings area inspection.

c. The applicant shall implement the environmental monitoring program summarized in Table 6.2 of this document. The applicant shall establish a control program that shall include written procedures and instructions to control all environmental monitoring prescribed herein and shall provide for periodic management audits to determine the adequacy of implementation of these environmental controls. The applicant shall maintain sufficient records to furnish evidence of compliance with these environmental controls. In addition, the applicant shall conduct and document an annual survey of land use (grazing, residences, etc.) in the area surrounding the proposed project.

d. Before engaging in any activity not assessed by the NRC, the applicant shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not assessed, or that is greater than that assessed in this Environmental Statement, the applicant shall provide a written evaluation of such activities and obtain prior approval of the NRC for the activity.

e. If unexpected harmful effects or evidence of irreversible damage not otherwise identified in this Environmental Statement are detected during construction and operation, the applicant shall provide to the NRC an acceptable analysis of the problem and a plan of action to eliminate or reduce the harmful effects or damage.

f. The applicant shall conduct a meteorological monitoring program as specified in Section 6.1 of this document. The data obtained from this program shall be tabulated and made available for NRC inspection.

g. The applicant shall provide for stabilization and reclamation of the mill site and tailings disposal areas and mill decommissioning as described in Alternative 1 of Section 10.3 and in Section 3.3 of this document.

h. The applicant shall provide surety arrangements to ensure completion of the mill site and tailings area stabilization, reclamation, and decommissioning plans.

i. The applicant shall consult and coordinate with the Utah Division of Wildlife Resources regarding the extent of fencing and other ways to mitigate any adverse impacts that may occur to deer.

j. The applicant shall routinely monitor the tailings discharge system at 4-hr intervals and document the results. The applicant shall monitor the use of the impoundment by wildlife in conjunction with the program to monitor the tailings discharge system.

8. On the basis of the analysis and evaluation set forth in this Environmental Statement, it is proposed that any license issued for the White Mesa mill should be subject to conditions for the protection of historic, archeological, architectural, and cultural resources. The conditions should be similar to those outlined in the proposed Memorandum of Agreement in Appendix E.

9. The position of the NRC is that, after weighing the environmental, economic, technical, and other benefits of the operation of the White Mesa Uranium Project against environmental and other costs and after considering available alternatives, the action called for under the National Environmental Policy Act of 1969 and 10 CFR Part 51 is the issuance of a Source Material License subject to conditions 7a through 7j and in 8, above.

   As announced in a *Federal Register* notice dated 3 June 1976 (41 FR 22430), the NRC is preparing a generic environmental statement on uranium milling. Although it is the NRC's position that the tailings impoundment method discussed in this Statement represents the most environmentally sound and reasonable alternative now available at this site, any NRC licensing action will be subject to express conditions that approved waste-generating processes and uranium mill tailings management practices may be subject to revision in accordance with the conclusions of the final generic environmental impact statement and any related rule making.

1. INTRODUCTION

1.1 THE APPLICANT'S PROPOSAL

Pursuant to Title 10, *Code of Federal Regulations* (CFR), Part 40.31 and to 10 CFR Part 51, Energy Fuels Nuclear, Inc. (the applicant), on February 6, 1978, applied to the Nuclear Regulatory Commission (NRC) for an NRC Source Material License to construct and operate a uranium processing mill. This mill, hereafter referred to as the White Mesa Uranium Project, will process ores from independent and company-owned mines. There will be no uranium mining at the project site.

The project will consist of construction and operation of a mill with a nominal processing capacity of 1800 metric tons (MT; 2000 tons) per day with provision for recovery of vanadium as well as uranium.

The applicant presently controls by ownership, lease, or contract, ore reserves of approximately 8600 MT (9500 tons) of U_3O_8 with an average ore grade of 0.125%. The proposed operating schedule is 24 hr/day, 340 days per year. At this schedule, there are about 11 years of ore supply. The applicant has designed for a 15-year project lifetime with the expectation that other ore sources will be discovered later. Based on these figures and a 94% recovery, the mill will produce approximately 730 MT (800 tons) of U_3O_8 per year.

Waste materials (tailings) from the mill will be produced at about 1800 MT (2000 tons) of solids per day and stored onsite. Sequential preparation, filling, and reclamation of tailings impoundment cells are planned (Sect. 3.2.4.7). This will decrease the amount of tailings exposed (and radon exhaled) during operation of the mill.

In accordance with NRC Guides 3.5 and 3.8, the applicant has submitted a Source Material License Application (Form AEC-2),[1] an Environmental Report (ER),[2] and supplements to the ER in response to questions by the NRC staff.

1.2 BACKGROUND INFORMATION

The proposed Energy Fuels Nuclear, Inc., mill will be located in San Juan County, Utah, about 8 km (5 miles) south of Blanding, Utah (Fig. 1.1). Ore for the mill feed will be provided through two existing ore buying stations, one near Hanksville in Wayne County, Utah, and the other adjacent to the planned mill on the same site (Fig. 2.1). These buying stations, owned by Energy Fuels, purchase ore from independent mines and will also receive ore from company-owned mines.

The surface area of the project site is owned by Energy Fuels Nuclear, Inc., or controlled by mill site claims. The mill will occupy about 20 ha (50 acres) of the site, including 6 ha (16 acres) presently occupied by the existing ore buying station. At the end of the proposed 15-year project lifetime, the tailings disposal cells will occupy approximately another 135 ha (333 acres).

The purpose of this Environmental Statement is to discuss in detail the environmental effects of project construction as well as monitoring and mitigating measures proposed to minimize the effects of the project on the immediate area and surrounding environs.

1.3 FEDERAL AND STATE AUTHORITIES AND RESPONSIBILITIES

Under 10 CFR, Part 40, an NRC license is required in order to "receive title to, receive, possess, use, transfer, deliver ... import ... or export ... source material ..." (i.e., uranium and/or thorium in any form or ores containing 0.05% or more of uranium, thorium, or combinations thereof). 10 CFR Part 51 provides for the preparation of a detailed Environmental Statement pursuant to the National Environmental Policy Act of 1969 (NEPA) prior to the issuance of an NRC license to authorize uranium milling.

The NEPA became effective on January 1, 1970. Pursuant to Section 102(2)(C), in every major Federal action significantly affecting the quality of the human environment, Federal agencies must include a detailed statement by the responsible official on

1. the environmental impact of the proposed action,
2. any adverse environmental effects that cannot be avoided should the proposal be implemented,
3. alternatives to the proposed action,
4. the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and
5. any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented.

This detailed Environmental Statement has been prepared in response to the above requirements.

The State of Utah implements other rules and regulations affecting the project through necessary permits and approvals provided by State agencies. The Utah Division of Oil, Gas, and Mining is the responsible agency for all mine and mill sites within the State under the "Utah Mined Land Reclamation Act of 1975." Title II of the "Uranium Mill Tailings Radiation Control Act of 1978" gives the NRC direct licensing authority over uranium mill tailings. Bonding arrangements will be required to assure funding for reclamation of the tailings impoundment and mill site grounds and for decommissioning of the facility.

1.4 STATUS OF REVIEWS AND ACTIONS BY FEDERAL AND STATE AGENCIES

The only regulatory action required from the NRC is the issuance of a Source Material License. In addition, before construction and operation of the White Mesa Uranium Project can be completely implemented, the State of Utah requires that permits or licenses be obtained prior to the initiation of various stages of construction and operation of the mill. The current status of these regulatory approvals and permits is given in Table 1.1.

1.5 NRC MILL LICENSING ACTIONS

In June 1976 [*Fed. Regist.* 41(108): 22430-22431 (June 3, 1976)], the NRC specified that applicants requesting a Source Material License prior to the NRC's issuance of its generic environmental impact statement on uranium milling (scheduled for release in 1979) should address five criteria that will be weighed by the Commission in licensing and relicensing actions. These criteria are considered below as they apply to the White Mesa Uranium Project.

1. *It is likely that each individual licensing action of this type would have a utility that is independent of the utility of other licensing actions of this type.*

   This statement is manifestly true for uranium mills in general and for the White Mesa mill in particular. This mill is located near multiple mining operations producing low-grade ore (≈0.13%). The costs of hauling this ore over longer distances make this project virtually independent of other milling operations. This milling project can be considered on its own merits, licensing actions with respect to other mills are independent of this mill, and a separate cost-benefit analysis can be performed.

Radon-222 gas is expected to be released in significant quantities from dry tailings areas. Releases from saturated tailings, or tailings that are under water, are severely limited due to the low diffusivity of radon gas in water. The staff assumes that two 40-ha (100-acre) cells may be drying prior to reclamation while a third cell is being filled. Radon releases from the driest cell (8% moisture content), the other cell drying out prior to reclamation (15% moisture content), and the beach area of the filling cell (50% beach, 37% moisture content) are estimated to be 5550 Ci/yr, 2480 Ci/yr, and 30 Ci/yr, respectively (see Appendix F for details). The total annual radon-222 release is estimated to be 8060 Ci/yr. Radon releases from underwater tailings materials or reclaimed tailings cells are insignificant in comparison and have been ignored.

3.2.4.8 Uranium concentrate transportation

The uranium concentrate will be transported in 55-gal drums by truck because no rail transportation is available at the site. Uranium shipment, about 2000 drums each year, will result in an external radiation dose[5] to an individual of 2 mR/hr at any edge of the truckbed. Under normal operating conditions, no significant release of radioactive particulates would occur. However, release could occur during transportation accidents as discussed in Sect. 5.3.1.

3.2.4.9 Source terms

Sections 3.2.4.1 through 3.2.4.8 describe the nature and quantity of radioactive effluents conservatively estimated to be generated by milling operations at the White Mesa Uranium Project. Estimates employed in the above discussions were derived from project design parameters and data from similar mills.[6-37] The estimates reflect operation of the fully developed mill and tailings area. Initial releases from the tailings area will be lower than the estimated values for several years after startup. Therefore, the use of full-scale operation as the basis for estimates adds some additional conservatism to the analysis. Table 3.2 gives the design parameters used in estimates of radioactive release rates. The source terms for the milling operations and areas are presented in Table 3.3.

3.3 INTERIM STABILIZATION, RECLAMATION AND DECOMMISSIONING

3.3.1 Interim stabilization of the tailings area

Interim *stabilization* is defined as measures to prevent the dispersion of tailings particles by wind and water outside the immediate tailings retention area. Such measures will be required at the White Mesa mill during the 15 years of operation (for in-use and drying cells) and the years required to dry the final tailings cell and evaporation cells after operation (see Sects. 3.2.4.7 and 10.3.2, Alternative 1) prior to reclamation.

As a license condition, the staff will require that the applicant implement an interim stabilization program which minimizes dispersal (via airborne particulates) of blowing tailings to the maximum extent reasonably achievable. The program shall include the use of written operating procedures that specify the use of specific control methods for all conditions. The effectiveness of this control measure shall be checked at least weekly by means of a documented site inspection.

3.3.2 Reclamation of the mill tailings area

In accordance with the Utah Mined Land Reclamation Act of 1975 and the requirements of the NRC, the applicant has prepared a stabilization plan for the tailings area. The goal of the applicant's plan is to meet the performance objectives for tailings management (Sect. 10.3.1).

The proposed reclamation program calls for a 0.6-m (2.0-ft) layer of compacted clay, a 1.2-m (4-ft) layer of silt-sand overburden material, and a 1.8-m (6-ft) layer of rock overburden material over the tailings area. The proposed cover is considered sufficient to reduce

The cover would also be graded and sloped at a grade of 2% or less to prevent impoundment of surface runoff. Slopes on the perimeter of the cover would be no steeper than 6:1 (horizontal to vertical) and would be constructed of riprap. A layer of topsoil 0.15 m (0.5 ft) thick will be placed over the cover. The area would be fertilized and revegetated with a suitable mixture of grasses, forbs, and shrubs. Grasses and shrubs whose root structures would penetrate the cover will not be planted. The approximate volumes of material required would be 7.38×10^5 m^3 (9.65×10^5 yd^3) of clay, 1.76×10^6 m^3 (2.30×10^6 yd^3) of overburden, 2.2×10^6 m^3

Table 3.2. Principal parameter values used in the radiological assessment of the White Mesa Uranium Project

Parameter	Value[a]
General data	
Average ore grade, % U_3O_8	0.15
Ore concentration, pCi of U-238 and daughters per gram	423
Ore processing rate, MT/day	1800
Days of operation per year	340
Blanding ore crusher	
Ore processing rate, MT/day	1800
Fraction released as particulates	4×10^{-7}
Fraction of radon released	0.1
Dust:ore concentration ratio	2.5
Ore storage piles[b]	
Actual area, ha (acres)	2.4 (6)
Effective dusting area, ha (acres)	3.0 (7.3)
Annual average dust loss rate, $g/m^2 \cdot sec$	1.8×10^{-7}
Dust:ore concentration ratio	2.5
Semiautogenous grinder	
Ore processing rate, MT/day	1800
Fraction released as particulates	1×10^{-6}
Fraction of radon released	0.2
Dust:ore concentration ratio	2.5
Yellow cake drying and packaging	
Fraction U to yellow cake	0.94
Fraction Th to yellow cake	0.05
Fraction Ra and Pb to yellow cake	0.002
Annual U_3O_8 production, MT	863
Annual yellow cake production, MT	959
Fraction of yellow cake to scrubber	0.012
Scrubber release fraction	0.01
Tailings impoundment system[b,c]	
Fraction U to tailings	0.06
Fraction Th to tailings	0.95
Fraction Ra and Pb to tailings	0.998
Area, ha (acres) per cell	40 (100)
Area subject to dusting, ha (acres)	100 (250)
Annual average dust loss rate, $g/m^2 \cdot sec$	1.8×10^{-5}
Dust:tails concentration ratio	2.5

[a]Parameter values presented here are those selected by the staff for use in its radiological impact assessment of the White Mesa Uranium Project. These values, which include emissions from the Blanding ore buying station, represent conservative selections from ranges of potential values in instances where insufficient data has been available to be more specific.

[b]Appendix F provides additional information regarding the calculation of radon releases.

[c]Effective dusting area is 36 ha (90 acres); 20% of two 40-ha (100-acre) cells drying prior to reclamation and 50% of a 40-ha (100-acre) operational cell.

(2.89×10^6 yd^3) of rock, and 2.2×10^5 m^3 (2.88 yd^3) of topsoil. Staged constructed, operation, and reclamation will minimize stockpiling and handling requirements.

The reclamation plans have been developed from recommendations from the U.S. Department of Agriculture (USDA) Soil Conservation Service and Forest Service (ER, Sect. 9.4). These plans are also in accordance with the regulations of the State of Utah Division of Oil, Gas, and Mining.[38,39]

Table 3.3. Estimated annual releases of radioactive materials resulting from the White Mesa Uranium Project

Source	Annual releases (Ci)[a]			
	U-238	Th-230	Ra-226	Rn-222
Blanding ore crusher	2.6×10^{-4}	2.6×10^{-4}	2.6×10^{-4}	2.6×10
Ore storage piles	1.7×10^{-4}	1.7×10^{-4}	1.7×10^{-4}	2.4×10^{2}
Secondary crusher	6.5×10^{-4}	6.5×10^{-4}	6.5×10^{-4}	5.2×10
Yellow cake scrubber	2.9×10^{-2}	1.6×10^{-3}	6.2×10^{-5}	0.0
Tailings system	1.3×10^{-2}	2.0×10^{-1}	2.1×10^{-1}	8.1×10^{3}

[a] Releases of other isotopes in the U-238 decay chain are included in the radiological impact analysis. These releases are assumed to be identical to those presented here for parent isotopes. For instance, the release rate of U-234 is taken to be equal to that for U-238.

The project site will be revegetated to return it to the original uses of grazing and wildlife habitation. The soils are relatively uniform and adequate for these reclamation procedures (ER, Sect. 9.1.1). The reclamation schedule for the tailings impoundment site is depicted in Fig. 3.9. The tailings cells will be reclaimed sequentially as each cell is filled, beginning after about the fourth year of operation and every four years thereafter until termination of project operations. A clay cap [0.6 m (2 ft)], and onsite clayey-silt soil [1.2 m (4 ft)], and rock overburden [1.8 m (6 ft)], will be placed over the dried tailings. Except for the rock-lined drainage ditches, rock-filled slopes along the edges of the soil-covered tailings cells, and the rock-filled southernmost dike of cell 5, about 0.15 m (0.5 ft) of topsoil will be placed on the surface of all disturbed areas and seeded with a mixture of grasses, forbs, and shrubs (Table 3.4). Any excess rock will be disposed of at the 14.6-ha (36-acre) borrow area prior to its reclamation.

The applicant's selection of seeds is representative of the vegetation on the site prior to construction and will suffice in reclaiming the site to the preconstruction land condition. The staged reclamation plan will permit optimizing the seed mixture for a maintenance-free vegetative cover which will maximize soil stability. In the long term native vegetation is expected to return to the area. The seed should be obtained from those areas that have soil characteristics and climate similar to the project site.[40]

The mixture of seed will be planted in November with a rangeland drill. Because soil nitrogen is low (ER, Sect. 2.10.1), it may be necessary to apply an appropriate fertilizer prior to seeding. The applicant claims that the topsoil will contain sufficient debris so that mulching will not be required. However, by the time reclamation begins, much of the debris will be decomposed. Mulches increase infiltration and reduce erosion and evaporation, thereby encouraging seed germination and plant growth. Therefore, it may be necessary to crimp mulch into the soil of all disturbed areas prior to seeding. Revegetated areas will be monitored (Sect. 6.2.2).

The staff notes that the information developed in the Generic Environmental Impact Statement on Uranium Milling being prepared by NRC could be used to modify or change the procedures proposed herein. The generic statement will contain the results of ongoing research to assess the environmental impacts of uranium mill tailings ponds and piles, and will suggest means for mitigating any adverse impacts. The current NRC licensing action regarding the White Mesa mill will be subject to revisions based on the conclusions of the Final Generic Environmental Impact Statement on Uranium Milling Operations and any related rule making.

The applicant will be required to make financial surety arrangements to cover the costs of reclaiming the tailings disposal area and of decommissioning the mill.

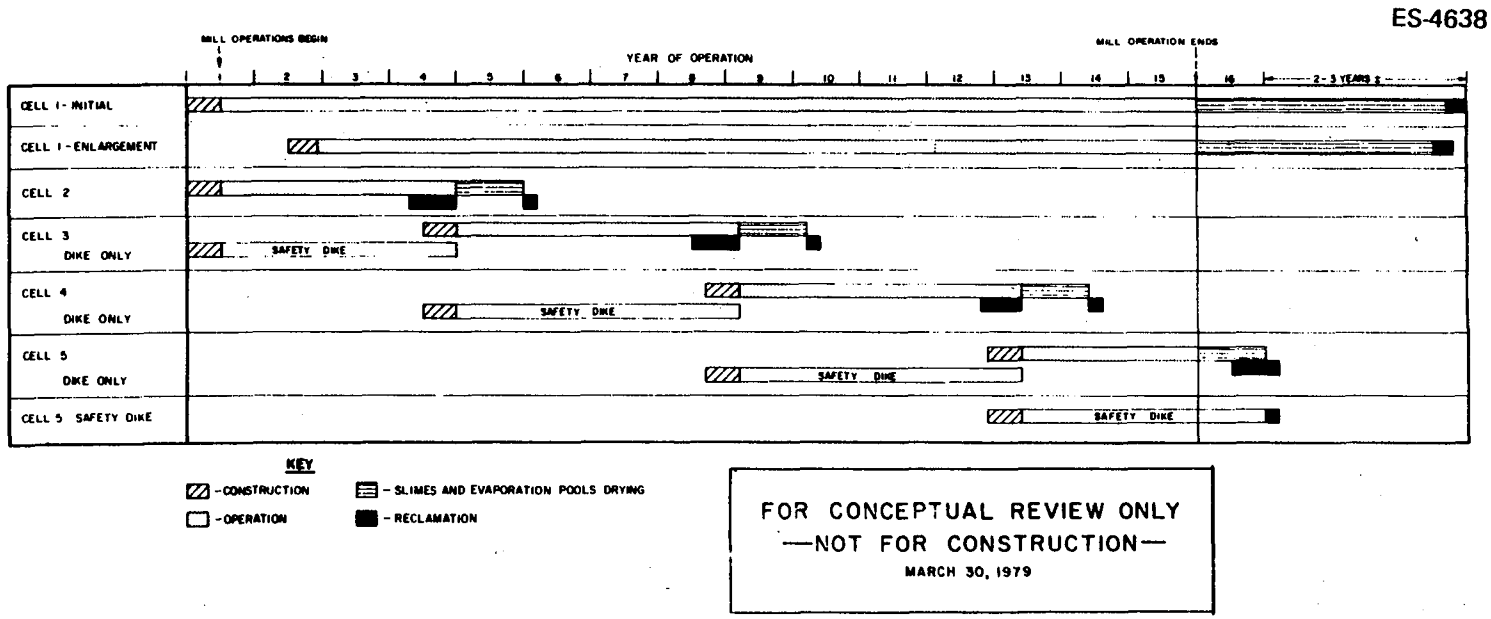

Fig. 3.9. System schedule. Source: Energy Fuels Nuclear, Inc., "Transmittal of Conceptual Review Construction Drawing Set and Synopsis, Tailings Management System, White Mesa Uranium Project, Blanding, Utah," Apr. 2, 1979.

Table 3.4. Species, seeding rates, and planting depths of tentative seed mixture to be used in reclamation of the project site

Species	Seeding rate		Depth	
	kg/ha	lb/acre	cm	in.
Grasses				
"Luna" pubescent wheatgrass	6.16	5.5	0–0.64	0–0.25
Fairway (crested) wheatgrass	1.68	1.5	0–0.64	0–0.25
Forbs				
Yellow sweetclover	1.12	1.0	1.27–2.54	0.5–1.0
Palmer penstemon	0.112	0.1	0–0.64	0–0.25
Alfalfa	1.12	1.0	1.27–2.54	0.5–1.0
Shrubs				
Fourwing saltbush	0.56	0.5	0.64–1.27	0.5–1.0
Common winterfat	0.56	0.5	0.64–1.27	0.5–1.0
Big sagebrush	0.112	0.1	0.64–1.27	0.5–1.0
Total	11.424	10.2		

Source: Energy Fuels Nuclear, Inc., *Source Materials License Application, White Mesa Uranium Mill, Blanding, Utah,* Denver, Sept. 26, 1978.

Prior to the termination of the license the NRC will require that the reclaimed tailings impoundment area be deeded to the Federal government.

In addition, although revegetation is an effective erosion control method under normal climatic and edaphic conditions, it is not known whether continued growth of vegetation can be assured at this site without irrigation or other supportive measures. Therefore, to assure that a stable cover will be established, the staff recommends that riprap (or gravel cover) over the entire basin be planned as an optional erosion control method. The final choice between gravel and vegetation can be made based on some years of testing and research currently in progress, and on the performance of various reclamation schemes which are completed in the interim.

3.3.3 Decommissioning

Near the end of the useful life of this project and prior to the termination of the license the NRC will require a detailed decommissioning plan for the White Mesa mill, which will contain plans for decontamination, dismantling, and removing or burying all buildings, machinery, process vessels, and other structures and cleanup, regrading and revegetation of the site. This detailed plan will include data from radiation surveys taken at the site and plans for any mitigating measures that may be required as a result of these surveys and NRC inspections. Before release of the premises or removal of the buildings and foundations, the licensee must demonstrate that levels of radioactive contamination are within limits prescribed by NRC and the then-current regulations. Depending on the circumstances, the NRC may require that the applicant submit an Environmental Report on decommissioning operations prior to termination of the license.

4. ENVIRONMENTAL IMPACTS

4.1 AIR QUALITY

4.1.1 Construction

The major nonradiological air pollutants associated with construction of the mill facility will be gaseous emissions from internal combustion engines and fugitive dust generated from moving vehicles and wind erosion. In general, these emissions will not produce significant impacts to air quality.

The maximum expected emission rate for any of the major pollutants (NO_2, SO_2, CO, and hydrocarbons) from each piece of construction equipment is less than 0.2 g/sec.[1] Using conservative χ/Q (sec/m^3) values (Appendix H, Table H.1), the staff calculated the annual atmospheric concentration of each pollutant per vehicle to be less than 1 $\mu g/m^3$ at the property boundary in the direction of the prevailing wind.

Fugitive dust associated with construction of the facility will average about 0.4 to 0.7 MT/ha (1 to 2 tons/acre) per month.[2] Based on a total of about 142 ha (344 acres) disturbed at any one time (Sect. 4.2.1), about 121 to 241 g/sec of particulates will be emitted. Annual average atmospheric concentrations of particulates were calculated by the staff using the χ/Q values (Appendix H, Table H.1) for the 16 compass directions at a distance of 2.4 km (1.5 miles). The average of these 16 concentrations indicates that particulate loading due to construction will range from 26 to 53 $\mu g/m^3$ (Table 4.1). These are conservative calculations because the χ/Q values assume a point source; the construction activities actually will be widespread, creating many scattered, diffuse sources. Furthermore, the larger dust particles would deposit rapidly, another condition not accounted for in the calculation. Although dust could cause occasional localized degradation of air quality at the site, the duration will be only during the construction phase. To minimize fugitive dust, the applicant will frequently water exposed areas and heavily traveled areas, and all vehicles will be operated at a reduced speed.[3]

4.1.2 Operation

Air quality during operation of the facility could be affected by atmospheric releases principally from the building and processing boiler, yellow cake and vanadium dryers, tailings disposal system, and ore stockpiles. The applicant's consultant's estimates of emissions from each primary source and their release heights are listed in Table 4.2. The staff estimates (Sect. 3) are somewhat different, but the conclusions drawn (below) remain the same. In addition, insignificant quantities will be released from other sources including the coal stockpiles, ore transport systems, and acid leach system. Atmospheric dispersion coefficients (χ/Q) for each release height are listed in Appendix H, Tables H.1 through H.4. Assuming all processes are operating simultaneously, annual atmospheric concentrations of particulates, SO_2, and NO_x at the property boundary in the direction of the prevailing wind were calculated by the staff to be approximately 13, 9, and 4 $\mu g/m^3$ respectively. These concentrations are well below applicable Federal and State air quality standards (Table 4.1). For reasons stated earlier, the particulate concentrations are quite conservative. The applicant calculated the atmospheric concentrations of the major pollutants using the CRSTER program, a program used by the U.S. Environmental Protection Agency.[4] Calculations were for five distances: 2, 4, 6, 8, and 10 km (3.2, 6.4, 9.7, 12.9, and 16.1 miles). Concentrations were the largest at the 2-km (3.2-mile) distance and are as follows: particulates, annual average = 0.26 $\mu g/m^3$, 24-hr average = 3.7 $\mu g/m^3$; SO_2, annual average = 1.1 $\mu g/m^3$, 24-hr average = 15.4 $\mu g/m^3$, 3-hr average = 66.6 $\mu g/m^3$; NO_x, annual average = 0.51 $\mu g/m^3$.

Although operation of the mill facility should not have any significant impact on air quality, Utah's Air Conservation Regulations[5] require that air pollution control equipment and processes be selected and operated to provide the highest efficiencies and the lowest discharge rates that are reasonable and practical. While the degree of control is subject to approval by the State Air Conservation Committee, the control must be a minimum of 85%. Utah regulations also restrict the sulfur content of coal and oil, used as fuels, to no greater than 1.0 and 1.5% respectively.

Table 4.1. Federal and State of Utah air quality standards

Pollutant	Averaging time[a]	Primary standard	Secondary standard
Nitrogen dioxide[b]	Annual	0.05 ppm (100 $\mu g/m^3$)	0.05 ppm (100 $\mu g/m^3$)
Sulfur dioxide	Annual	0.03 ppm (80 $\mu g/m^3$)	
	24 hr	0.14 ppm (365 $\mu g/m^3$)	
	3 hr		0.5 ppm (1300 $\mu g/m^3$)
Suspended particulates	Annual geometric mean	75 $\mu g/m^3$	60 $\mu g/m^3$
	24 hr	260 $\mu g/m^3$	150 $\mu g/m^3$
Hydrocarbons (corrected for methane)	3 hr 6 to 9 AM	0.24 ppm[c] (160 $\mu g/m^3$)	0.24 ppm (160 $\mu g/m^3$)
Photochemical oxidants	1 hr	0.08 ppm (160 $\mu g/m^3$)	0.08 ppm (160 $\mu g/m^3$)
Carbon monoxide	8 hr	9 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)
	1 hr	35 ppm (40 mg/m^3)	35 ppm (40 mg/m^3)

[a] All standards except annual average are not to be exceeded more than once a year.
[b] Nitrogen dioxide is the only one of the nitrogen oxides considered in the ambient standards.
[c] Maximum 3 hr concentration between 6 and 9 AM.
Source: ER, Table 2.7–19.

Table 4.2. Emission rates, sources, and release heights of major air pollutants associated with operation of the White Mesa mill

Air pollutant and source	Emission rate (g/sec)	Release height (m)
Suspended particulate		
Boiler	1.0	27.4
Yellow cake dryer	0.05	13.7
Vanadium dryer	0.06	13.7
Tailings	1.01	1.0
Ore stockpiles	1.08	3.0–6.0
SO_2		
Boiler	4.0	27.4
Yellow cake dryer	0.25	13.7
Vanadium dryer	0.25	13.7
NO_x		
Boiler	2.0	27.4
Yellow cake dryer	0.06	13.7
Vanadium dryer	0.06	13.7

Sources: Dames and Moore, "Responses to Comments from the U.S. Nuclear Regulatory Commission, June 7, 1978, White Mesa Uranium Project Environmental Report," Denver, June 28, 1978; Dames and Moore, "Supplemental Report, Meteorology and Air Quality, Environmental Report, White Mesa Uranium Project, San Juan County, Utah, for Energy Fuels Nuclear, Inc.," Denver, Sept. 6, 1978; Dames and Moore, "Responses to Comments Telecopied from NRC to Energy Fuels Nuclear, 25 September 1978," Denver, Oct. 4, 1978.

Regulations promulgated by the U.S. Environmental Protection Agency[6] require any major source of air pollutants to comply with the Prevention of Significant Deterioration (PSD) regulations. The White Mesa Uranium Project is currently being evaluated by the appropriate regulatory authorities to ascertain if the project is defined as a major source. If the project is deemed to be a major source, then the applicant will be required to file for the appropriate PSD permit and to comply with all regulations therein. Initial indications are that the atmospheric concentrations of pollutants associated with mill operation will be well within the PSD allowable increments.

Southeastern Utah, known for its scenic qualities (Sect. 2.5.2.2), attracts many visitors. Stack emissions (primarily steam) will be visible to the public traveling Highway 163 east of the site. However, they are not expected to be visible from major recreational areas in the vicinity. The closest historical site included in the National Register of Historic Places (National Register) is located about 10 km (6 miles) north of the proposed mill site (Table 2.17).

4.2 LAND USE

4.2.1 Land resources

4.2.1.1 Nonagricultural

The proposed White Mesa Uranium Project is not expected to alter the basic pattern of land ownership in the area (Table 2.15). Area land uses will change, however, as a result of the proposed mill. About 600 ha (1480 acres) are owned by Energy Fuels Nuclear, Inc.; roughly 195 ha (484 acres) will be directly used during operations (Sect. 2.5.1) for milling, ore buying, and tailings disposal. Increased residential and commercial land use is expected in neighboring communities to serve mill-produced population growth (Sects. 4.8.1 and 4.8.2). The volume of traffic using the highways in this area is also expected to grow substantially (Sect. 4.8.5), and mineral extraction is expected to increase in the project area in response to the mill's demand for uranium ore (Sect. 4.8.1.2).

4.2.1.2 Agricultural

Construction and operation of the facility will disturb about 20 ha (50 acres) directly (Table 4.3). In addition, the tailings will cover a total of about 135 ha (333 acres), and 39 ha (98 acres) will be used for stockpile and borrow areas. Because the tailings disposal system will be constructed as six separate cells (two cells for evaporation and four for tailings disposal), with a full tailings cell being reclaimed as a new cell is opened, a total maximum surface area of about 89 ha (222 acres) will be disturbed at any one time by the tailings system. Also, a maximum of about 15 ha (36 acres) of borrow area will be exposed at any given time. Therefore, total land area disturbed at any one time by construction and operation of the mill facilities will be about 141 ha (343 acres). However, until all operations have terminated, at least 195 ha (484 acres) will be unavailable for grazing. Based on the capacity of the tailings cells, the mill has a potential to operate 15 years. The duration of the impact will be somewhat longer than this depending on the time required for construction, the length of time between disturbance and reclamation, and the length of time it takes for a suitable vegetative cover to become established on each reclaimed area. Therefore, a realistic estimate of the amount of time the land will be disturbed is about 20 years.

Upon termination of the mill operations, all remaining disturbed areas will be reclaimed to ultimately restore the land to its original grazing use (Sect. 3.3.2). Loss of nearly 195 ha (484 acres) of grazing land each year the land is disturbed represents less than 0.1% of the private rangeland in San Juan County (Table 2.16). With successful reclamation (Sect.3.3.2), this land could be returned to its original grazing capacity.

4.2.2 Historical and archeological resources

As discussed in Sect. 2.5.2.1, a historical survey was conducted. Of the six historical sites identified during that survey, five were considered to be eligible for inclusion in the National Register of Historic Places (National Register). Pursuant to 36 CFR Part 63.3, a request on March 28, 1979, for determinations of eligibility for the historic sites was submitted and is currently under review. Of the five sites considered eligible, only one ("Earthen Dam") will be adversely affected by the mill project, and mitigation will be specified if the site is in fact eligible. (See the proposal for a Memorandum of Agreement in Appendix E.)

10.4 ALTERNATIVE OF USING AN EXISTING MILL

The option of utilizing existing ore processing mills requires the evaluation of numerous factors, including (1) the method and distance of mine-to-mill transport, (2) variations in ore grade, (3) quality of haul roads, (4) total tonnage to be transported, (5) haulage schedules, (6) traffic and weather conditions, (7) possible interim transfer and storage costs, (8) handling and milling costs, and (9) environmental costs and benefits.

The nearest currently operating uranium ore processing facilities (in relationship to the applicant's Hanksville and Blanding ore buying stations) are located in Moab, Utah; La Sal, Utah; and Uravan, Colorado. The approximate highway distances of these mills from the Hanksville and Blanding stations are, respectively, Moab, 189 km (118 miles) and 134 km (84 miles); La Sal, 243 km (152 miles) and 74 km (46 miles); and Uravan, 339 km (212 miles) and 170 km (106 miles).

Although the mill located in La Sal (Humeca) is reasonably close to the Blanding ore buying station, it would have drawbacks as an ore processing alternative for the following reasons:

1. The Humeca mill utilizes an alkaline leach process. Although tests conducted by the applicant indicated that some of the ores bought by its ore buying stations could be successfully treated by alkaline leaching, higher recovery rates could be obtained with acid for the majority of the ores. Because most of the ores are low grade (about 0.125%), any significant lowering of recovery rates would decrease the economic feasibility of ore shipment from the scattered, small mining operations.

2. Currently, only ore from a company-owned and company-operated mine is being processed; therefore, it is questionable whether the mill has the capacity, processing capability or the willingness to accept additional ore.

The mills at Moab and Uravan utilize acid leaching (the Moab mill also has an alkaline leach circuit); therefore, with process adjustments, acceptable recovery rates could be obtained. However, primarily because of high haulage costs and the limited capabilities of the mills to process additional ore, the staff has concluded that processing the ores at either or at both of these mills is not feasible. Assuming that (1) transportation costs are 10¢ per ton-mile[6] and (2) the average grade of the ore bought at the applicant's Hanksville and Blanding ore-buying stations will be 0.125%, the staff estimates that, if the ore is shipped to these currently operating mills, costs of producing each pound of U_3O_8 would increase by the following amounts for additional transportation costs alone (i.e., does not include incremental cost for toll milling):

1. Moab mill – $3.20 per pound.

2. Humeca mill (La Sal) – $3.04 per pound.

3. Uravan mill – $7.84 per pound.

Transporting the ores to existing mills could reduce the total land requirements for processing the ores. However, the environmental costs associated with uranium ore processing and tailings disposal would not be decreased and would only be shifted away from the Blanding area to the area of the mill receiving the ore. If the proposed mill is not constructed, there is a high probability that other mills (or expansions in capacity of existing mills) will be proposed in the area to process the ore now programmed for the applicant's mill. If no mills (or expansions) are constructed, a substantial economic base for the Hanksville-Blanding area will be removed because many of the small independent mines would not be economically viable.

Exhibit 3

ENERGY FUELS

Energy Fuels Resources (USA) Inc.
225 Union Blvd. Suite 600
Lakewood, CO, US, 80228
303 974 2140
www.energyfuels.com

August 10, 2016

Sent VIA OVERNIGHT DELIVERY

Mr. Scott Anderson
Director
Division of Waste Management and Radiation Control
Utah Department of Environmental Quality
195 North 1950 West
P.O. Box 144880
Salt Lake City, UT 84114-4820

Re: Transmittal White Mesa Uranium Mill Reclamation Plan, Revision 5.1

Dear Mr. Anderson:

Pursuant to discussions with the Division of Waste Management and Radiation Control ("DWMRC") regarding the Stipulated Consent Agreement for the Cell 2 cover activities, enclosed are two copies of the White Mesa Uranium Mill Reclamation Plan, Revision 5.1. Also enclosed are two CDs each containing a word searchable electronic copy of the document.

If you should have any questions regarding this transmittal please contact me at 303-389-4160 or Kathy Weinel at 303-389-4134.

Yours very truly,

ENERGY FUELS RESOURCES (USA) INC.
Harold R. Roberts
Executive Vice President Conventional Operations

CC: David C. Frydenlund
Kathy Weinel
David Turk
Logan Shumway
Scott Bakken

Reclamation Plan

White Mesa Mill

Blanding, Utah

Radioactive Materials License No. UT1900479

Revision 5.1

August 2016

Prepared by:
Energy Fuels Resources (USA) Inc.
225 Union Blvd., Suite 600
Lakewood, CO 80228

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2 EXISTING FACILITY

The following sections describe the construction history of the Mill; the Mill and Mill tailings management facilities; Mill operations including the Mill circuit and tailings management; and both operational and environmental monitoring.

2.1 Facility Construction History

The Mill is a uranium/vanadium mill that was developed in the late 1970s by Energy Fuels Nuclear, Inc. ("EFN") as an outlet for the many small mines that are located in the Colorado Plateau and for the possibility of milling Arizona Strip ores. At the time of its construction, it was anticipated that high uranium prices would stimulate ore production. However, prices started to decline about the same time as Mill operations commenced.

As uranium prices fell, producers in the region were affected and mine output declined. After about two and one-half years, the Mill ceased ore processing operations altogether, began solution recycle, and entered a total shutdown phase. In 1984, a majority ownership interest was acquired by Union Carbide Corporation's ("UCC") Metals Division which later became Umetco Minerals Corporation ("Umetco"), a wholly-owned subsidiary of UCC. This partnership continued until May 26, 1994 when EFN reassumed complete ownership. In May 1997, Denison (then named International Uranium (USA) Corporation) and its affiliates purchased the assets of EFN. EFRI purchased Denison in July 2012 and is the current owner of the facility.

2.1.1 Mill and Mill Tailings System

The Source Materials License Application for the Mill was submitted to the NRC on February 8, 1978. Between that date and the date the first ore was fed to the Mill grizzly on May 6, 1980, several actions were taken including: increasing Mill design capacity, permit issuance from the United States Environmental Protection Agency ("EPA") and the State of Utah, archeological clearance for the Mill and tailings system, and an NRC pre-operational inspection on May 5, 1980.

Construction on the Mill tailings system began on August 1, 1978 with the movement of earth from the area of Cell 2. Cell 2 was completed on May 4, 1980, Cell 1 on June 29, 1981, and Cell 3 on September 2, 1982. In January 1990 an additional cell, designated Cell 4A, was completed and initially used solely for solution storage and evaporation. Cell 4A was only used for a short time and then taken out of service because of concerns about the synthetic lining system. In 2007, Cell 4A was retrofitted with a new State of Utah approved lining system and was authorized to begin accepting process solutions in September 2008. Cell 4A was put back into service in October 2008. Cell 4B was constructed in 2010 and authorized to begin accepting process solutions in February 2011.

2.2 Facility Operations

In the following subsections, an overview of Mill operations and operating periods are followed by descriptions of the operations of the Mill circuit and tailings management facilities.

2.2.1 Operating Periods

The Mill was operated by EFN from the initial start-up date of May 6, 1980 until the cessation of operations in 1983. Umetco, as per agreement between the parties, became the operator of record on January 1, 1984.

Exhibit 4

ENVIRONMENTAL REPORT

WHITE MESA URANIUM PROJECT
SAN JUAN COUNTY, UTAH

FOR

ENERGY FUELS NUCLEAR, INC.

PREPARED BY

DAMES & MOORE

JANUARY 30, 1978

DAMES & MOORE

ENVIRONMENTAL AND
APPLIED EARTH SCIENCES

ENVIRONMENTAL REPORT

WHITE MESA URANIUM PROJECT

SAN JUAN COUNTY UTAH

DAMES & MOORE

energy fuels nuclear, inc.
executive offices • suite 445 • three park central • 1515 arapahoe • denver, colorado 80202 • (303) 623-8317

May 15, 1978

Mr. E. A. Trager
United States Nuclear Regulatory Commission
Fuel Processing & Fabricating Branch
Division of Fuel Cycle & Material Safety
7915 Eastern Avenue
Silver Springs, Maryland 29096

RE: Docket No. 40-8681
White Mesa Uranium Mill

Dear Mr. Trager:

Submitted herewith is the revised "Environmental Report, White Mesa Uranium Project, San Juan County, Utah". This revision includes the initial report dated January 30, 1978 prepared by Dames & Moore and, as Appendix "I", an additional study entitled "Investigation of Alternative Tailings Disposal Systems, White Mesa Uranium Project" dated April, 1978, prepared by Western Knapp Engineering, a Division of Arthur G. McKee & Company.

Also included in Appendix "I" is a cover letter prepared by Energy Fuels Nuclear, Inc.'s staff giving their comments and a summary evaluation of the alternatives presented.

The revisions are made on the enclosed replacement and additional pages listed below:

Environmental Report, Appendix H, Page 4
Environmental Report, Appendix I, Entire Section

We are enclosing fifteen (15) of each replacement page and request that you insert them in the respective sections. Thank you for your assistance in this matter.

Very truly yours,

Muril D. Vincelette

Muril D. Vincelette
Vice President-Operations

DKS/jp

Enclosures

xc: Mr. R. Scarano

ENVIRONMENTAL REPORT

WHITE MESA URANIUM PROJECT

SAN JUAN COUNTY, UTAH

FOR

ENERGY FUELS NUCLEAR, INC.

Prepared By

DAMES & MOORE

January 30, 1978

09973-015-14

be used to process the ore, including grinding, two-stage leaching, solvent extraction, precipitation and thickening, drying and packaging. Recovery of U_3O_8 is expected to be approximately 94 percent of that contained in the ore. The mill is planned to have a 2,000 tons-per-day capacity and a projected life of 15 years. Coal will probably be used as fuel for both process heat and heating of buildings.

The tailing retention system will consist of three partially excavated 70-acre cells. Each tailing cell will be surrounded by an embankment and lined with an artificial membrane to prevent seepage. Each cell is designed to contain a 5-year production of tailing and each will be constructed and used sequentially. Tailing stabilization and reclamation will be accomplished as soon as possible after each cell is filled, beginning about the fifth year of project operation for the first cell, about five years later for the second cell, and at the end of the project for the third cell. The tailing retention system will be located adjacent to the mill site. A slurry pipeline will transport tailing by pumping from the mill to the tailing cells.

Fresh water for the mill and potable needs will be supplied by wells. The total fresh water requirement is estimated to be 500 gpm. Of this, an average of 380 gpm will be required for mill make-up water.

A septic tank will be used to treat sanitary wastes and the discharge will go to a leach field. Chemical wastes from the laboratory will go to the tailing retention system.

Electricity will be supplied by Utah Power & Light Public Utility by way of an existing electric power line on the site to the mill. The total electrical capacity requirement for the mill is estimated to be 2800 KVA.

The present schedule anticipates initiation of mill construction by January 1979 and completion of construction and commencement of

Exhibit 5

DENISON MINES

Denison Mines (USA) Corp.
1050 17th Street, Suite 950
Denver, CO 80265
USA

Tel : 303 628-7798
Fax : 303 389-4125

www.denisonmines.com

June 1, 2009

Mr. Charles Garlow, Attorney-Advisor
OECA, Air Enforcement Division
U.S. Environmental Protection Agency
1200 Pennsylvania Ave. N.W. – MC2242A
Washington, DC 20460

Dear Mr. Garlow:

Re: Request to Provide Information Pursuant to the Clean Air Act
Denison Mines (USA) Corp.-White Mesa Uranium Mill, Blanding Utah

This is Denison Mines (USA) Corp's. ("Denison's") response to the United States Environmental Protection Agency's ("EPA's") Request For Information dated February 24, 2009. Each of EPA's questions is provided below in italics, followed by Denison's response in regular font.

The individuals responsible for responding to this request are David C. Frydenlund, Vice President Regulatory Affairs and Counsel, Steven D. Landau, Manager, Environmental Affairs and Harold R. Roberts, Executive Vice President, US Operations of Denison.

1. Please list each uranium mill and uranium mill tailings impoundment located in the United States of America that has been, or is currently, owned or operated by Denison or affiliated corporations located in the United States of America. Include the exact location of each uranium mill by map and legal property description:

Denison Response:

Denison owns and operates the White Mesa Uranium Mill (the "Mill") and its tailings impoundments (Cells 2, 3 and 4A), which are located in central San Juan County Utah approximately 6 miles south of the city of Blanding (see Figures 1-1 and 1-2 of the enclosed Reclamation Plan for the Mill). Within San Juan County, the Mill site is located on fee land and mill site claims, covering approximately 5,415 acres, encompassing all or part of Sections 21, 22, 27, 28, 29, 32, and 33 of Township 37S, Range 22E, and Sections 4, 5, 6, 8, 9, and 16 of Township 38S, Range 22E, Salt Lake Base and Meridian (See Figure 1-2 of the enclosed Reclamation Plan). A full legal description of the fee lands comprising the Mill site is contained in Section 3.1 of the enclosed Reclamation Plan.

The Mill produces uranium in the form of U_3O_8 and vanadium, principally in the form of V_2O_5, as a co-product from its uranium/vanadium ores. Historical production activity at the Mill is shown in Table 1 below:

Table 1-Historic Mill Production

Year(s)	Received Ore (Tons)	Production	
		lbs. U_3O_8	lbs. V_2O_5
1977-1983	1,511,544	6,005,721	13,008,155
1984	0	0	0
1985-1990	2,037,209	18,759,338	18,943,167
1991-1994	0	0	0
1995	163,046	1,472,614	0
1996	43,553	661,722	0
1997	1,995	619,193	0
1998	63,296	3,000	0
1999	90,308	652,100	1,512,801
2000-2001	0	0	0
2002	135,724	0	0
2003	36,469	0	0
2004	7,594	0	0
2005	2,399	46,092	0
2006	3,185	230,959	0
2007	76,889	254,442	0
2008	265,228	888,574	1,225,017

c. *The number and size (in acres), dimensions, locations within the facility or plant site, capacity in gallons and lining material of each "existing mill impoundment", as that term is used in 40 C.F.R. Subpart W, and any other waste holding areas such as evaporation or settling ponds.*

Denison Response:

<u>Number of "Existing Impoundments" and any Other Waste Holding Areas such as Evaporation or Settling Ponds</u>

At 40 CFR Subpart W an "existing impoundment" is defined as "any uranium mill tailings impoundment which is licensed to accept additional tailings and is in existence as of December 15, 1989."

In Denison's case only Cells 2 and 3 meet that definition. Cell 2 was in existence and licensed to accept tailings as of December 15, 1989. Cell 2 is currently at capacity and is not authorized to receive additional tailings at this time. Cell 2 is therefore not in operation and is in the beginning stage of final closure. Cell 3 was also in existence and licensed to accept tailings as of December 15, 1989. Cell 3 is currently near capacity but is still authorized and continues to receive tailings. Cell 3 is therefore currently in operation.

Cell 4A was constructed in 1989, with substantial completion on November 30, 1989. However, it was not licensed for use by NRC until March 1, 1990. Cell 4A was therefore not licensed to accept tailings as of December 15, 1989 and is therefore not an "existing impoundment" within cell.

6) North Dike Splash Pads – three 20-foot wide splash pads have been constructed on the north dike to protect the primary FML from abrasion and scouring by tailings slurry. These pads consist of an extra layer of 60 mil HDPE membrane that was installed in the anchor trench and placed down the inside slope of Cell 4A, from the top of the dike, under the inlet pipe, and down the inside slope to a point 5-feet beyond the toe of the slope.

7) Emergency Spillway – a concrete lined spillway was constructed near the western corner of the north dike to allow emergency runoff from Cell 3 into Cell 4A. This spillway was limited to a 6-inch reinforced concrete slab set directly over the primary FML in a 4-foot deep trapezoidal channel. No other spillway or overflow structure was constructed at Cell 4A. All stormwater runoff and tailings wastewaters not retained in Cells 1, 2, and 3, will be managed and contained in Cell 4A, including the Probable Maximum Precipitation and flood event.

d. *For each existing mill impoundment, evaporation pond, and settling pond indentified in response to request 3.c., identify the date(s) each was:*
   i. *Constructed;*
   ii. *Used for the continued placement of new tailings;*
   iii. *Placed on "standby status; and*
   iv. *Closed, and during what periods they were operational.*

Denison Response:

The information requested is provided in Table 3 below. For completeness, we have also included information for Cell 1, which is an evaporation pond and is not a tailings impoundment, and for Cell 4A, which is not an "existing impoundment":

Table 3-Cell Construction and Operating Periods

Cell Designation	Date of Final Construction	Tailings Placement Period	Period of Standby Status	Date closed
Cell 1	1981	Used as an evaporative pond from 1981 to the present. Tailings have not been disposed of in Cell 1	None	NA
Cell 2	1980	1980-Mid 1980's	1984	Final Closure Process began in 2008[2]
Cell 3	1982	1982-Present[3]	1984, 1991-1994, 2000-2001	NA

[2] Cell 2 no longer receives tailings but has been provided with an interim cover as the first phase of the final closure process.
[3] Cell 3 was used for evaporative purposes until the solids capacity in Cell 2 had been utilized, at which time tailings solids were discharged into Cell 3.

Cell Designation	Date of Final Construction	Tailings Placement Period	Period of Standby Status	Date closed
Cell 4A	1989	1990	1991 Until re-lining in 2008	NA
Cell 4A Re-lined	2008	2008 to present	None	NA

4. *For each existing mill impoundment, evaporation pond, and settling pond identified in response to 3.d. above*
   a. *identify whether the "continuous disposal method", as defined in 40 C.F.R. Section 61.252(b)(2), is used;*

Denison Response:

The Mill has never used the "continuous disposal method" for tailings disposal.

   b. *describe the mechanical methods used to dewater tailings, the process used to dispose of tailings, the precise location of any and all disposal areas used for dewatered tailings, and the method of covering such tailings;*

Denison Response:

The Mill has never used the "continuous disposal method" for tailings disposal.

   c. *Provide all disposal records maintained by you, including any records that reflect the manner of disposal and method of covering such tailings;*

Denison Response:

Denison does not maintain active disposal records for typical production scenarios. Instead, the tailings resulting from the production periods described in answer 3.b. (Table 1) were disposed of into the tailings impoundments that were operating during those periods, as described in answer 3.d. (Table 3).

The Mill utilizes local soil as interim cover for tailings sands that are exposed above the pond solution level. These soils have natural background levels of activity and are deposited uniformly over the area of concern in order to reduce radon emanation at tailings "beach" areas. When a Cell ceases operations and begins final closure, such interim cover is extendaed over the entire surface area of the Cell. Such interim cover is the "minimum three feet of random fill (platform fill)" required under the Mill's Reclamation Plan. A copy of the Mill's Reclamation Plan is enclosed with this letter.

Annual testing in accordance with 40 CFR 61, Subpart W has demonstrated the success of this effort in maintaining radon emissions below the 20 p/Ci/m^2-s standard.

Exhibit 6

Copy To Paul &
Tom T.
File
ACT/037/045

energy fuels nuclear, inc.
executive offices • suite 900 • three park central • 1515 arapahoe • denver, colorado 80202 • (303) 623-8317

JIM
FEB 08 1983

January 27, 1983

RECEIVED
FEB 07 1983
DIVISION OF
OIL, GAS & MINING

Utah Department of Natural Resources
Division of Oil, Gas and Mining
1588 West North Temple
Salt Lake City, Utah 84116

Gentlemen:

Attached is a copy of a letter recently forwarded to the U.S. Nuclear Regulatory Commission regarding curtailment of activities and eventual shutdown of the White Mesa Mill, near Blanding, Utah.

Because your office was involved in approving surety for the mill, it was felt you would be interested in receiving a copy of this notice. In addition, if any further action on our part is in order at this time, we would appreciate being so advised.

Sincerely yours,

C. E. Baker

C. E. Baker, Manager
Regulatory Compliance

CEB/kak

Enclosure

cc: G. W. Grandey
M. D. Vincelette
D. K. Sparling
D. E. Smith

energy fuels nuclear, inc.
executive offices • suite 900 • three park central • 1515 arapahoe • denver, colorado 80202 • (303) 623-8317

January 25, 1983

Mr. Dan Gillen
Uranium Mill Licensing Branch
U.S. Nuclear Regulatory Commission
7915 Eastern Avenue
Silver Spring, Maryland 20910

Re: SUA-1358, Docket No. 40-8681

Dear Mr. Gillen:

This is to advise you of a planned curtailment of activities and eventual shutdown at the White Mesa Mill.

On or about February 1, 1983, the feeding of ore to mill process, other than "cleaning up" around the ore pads, will be discontinued. Once the ore pads are clean, work will commence on clearing out the various circuits in the mill. In-circuit inventories of uranium and vanadium will be recovered, and barren solids and solutions will be transferred to the tailings area in the normal manner.

By approximately February 6, all remaining slurry, pulp and solutions in the grind circuit, pre-leach, leach tanks, and pre-leach thickener will be processed.

By approximately February 12, all tanks and vessels in the grind, pulp storage, pre-leach, pre-leach thickener, and leach circuits will be drained and cleaned.

By approximately February 19, major equipment in the grind circuit through the leach circuit will be prepared for stand-by status.

By approximately February 22, all solutions will be processed, and tanks in the CCD circuit, including the clarifier, will be drained, cleaned, and filled with water.

By approximately February 28, yellowcake slurry in the precipitation and yellowcake thickeners will be dried and packaged, and the tanks drained, cleaned, and filled with water.

An hourly work force of approximately 85 people will be maintained for the first ten days in February. On February 11, 35 of these people will be laid-off and another 40 will be laid-off at the end of the month.

On or about March 1, recycling of tailings solution through the solvent extraction circuits for recovery of uranium and vanadium will commence. This activity will require approximately 16 workers for about an eight-month period. An additional 21 people will be scheduled for stand-by or routine assignments in the laboratories, safety and environmental group, and mill general.

After the eight-month period commencing March 1, the stand-by staff will be maintained at approximately 20 individuals for an indefinite period, depending on uranium market conditions.

We trust this information will allow you to understand the circumstances surrounding the planned curtailment. We will be contacting you in the future to determine the feasibility of discontinuing certain in plant radiation safety monitoring due to inactivity in certain areas of the mill and associated lack of routine personnel access.

Until such time as relief from monitoring is granted, Energy Fuels will maintain an adequate radiation safety staff to assure compliance with the terms and conditions of the mill license.

Sincerely yours,

C. E. Baker
Manager, Regulatory Compliance

CEB/kak

CERTIFIED MAIL
Return Receipt Requested

cc: G. W. Grandey
M. D. Vincelette
D. K. Sparling

Exhibit 7

File ACT/037/045

energy fuels nuclear, inc.
executive offices • suite 900 • three park central • 1515 arapahoe • denver, colorado 80202 • (303) 623-8317

March 12, 1984

Mr. Tom Tetting
State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining
4241 State Office Building
Salt Lake City, Utah 84114

Re: Annual Operations and Progress Report, White Mesa Uranium Mill, ACT/037/045, San Juan County, Utah

Dear Mr. Tetting:

Pursuant to your February 15, 1984 request for a 1983 Annual Operations and Progress Report for the White Mesa Uranium Mill, the following information is being submitted in lieu of Form MR-3.

The White Mesa Mill processed 50,454 tons of ore in 1983. The Mill was shut down at the end of January and remained down except for some re-processing of tailings solutions through the summer months.

No additional tailings construction took place during 1983. Some tailings reclamation was done with the placement of 1-2 ft of soil cover over six acres of the Cell 2 Tailings pond to prevent the blowing of dried tailings sand.

Enclosed you will find an updated map of the mill and tailings area, as well as an aerial photograph of the area taken August 23, 1983.

As of January 1, 1984 a 70% interest in the White Mesa Mill was sold to Union Carbide Corp. Union Carbide will be the operator of the mill pending transfer of the NRC Source Material License. All future correspondence regarding the mill should be directed to:

Union Carbide Corp.
White Mesa Uranium Mill
P. O. Box 699
Blanding, Utah 84511

Attn: T. N. Washburn

If you have any questions, please feel free to call.

Very truly yours,

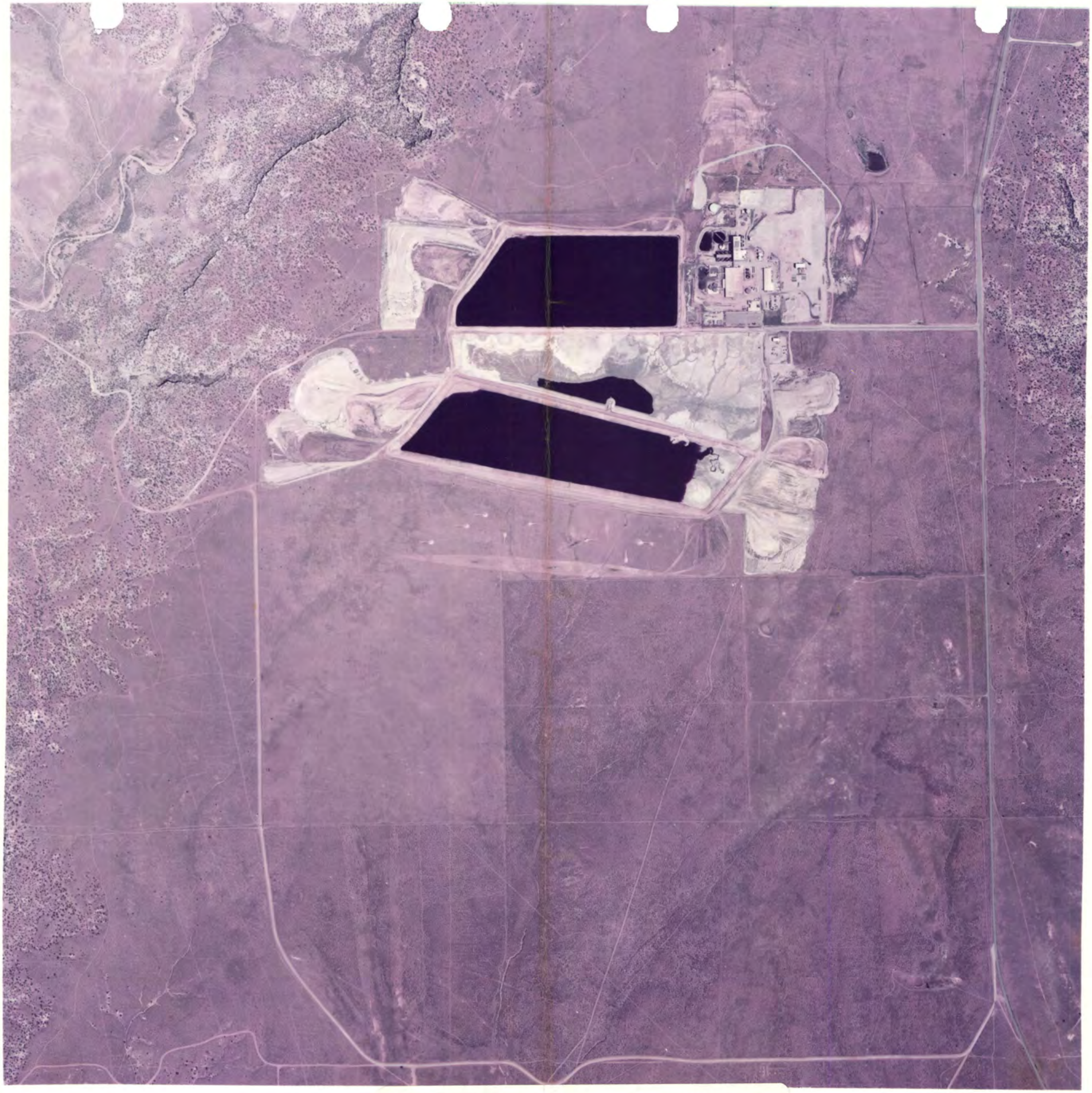
Harold R. Roberts

H. R. Roberts,
Senior Project Engineer

HRR/jf

Enc.

xc: MDV, GWG, DKS, TWashburn w/o enc.



WHITE MESA MILL - Photo taken 8/23/83

Exhibit 8

Synfuels funding...

Price tag for the first, nearly-complete phase, is put at $600 million.

Union Oil appears on the verge of success with its smaller-sized operation, while some of the bigger projects announced two or three years ago are just plans gathering dust.

UNION SETS EXAMPLE

Perhaps taking a lesson from Union and because some big companies have become more reluctant to come up with the megabucks necessary for initial development on a grand scale, many of the proposals the SFC received in its third round solicitation were for smaller projects. The trend away from the massive projects was obvious.

Witness the Cathedral Bluffs Shale Oil Company project, mentioned above, and the once-grand Ashland-Bechtel project in Breckenridge County, Kentucky.

When Ashland was still a partner, plans called for a plant to produce 50,000bpd of liquid fuels from coal. Remaining sponsor Bechtel is now asking federal funding help for a scaled-down plant which would produce 11,300 barrels of oil daily.

The number of applications received in the third solicitation was higher than anticipated. Karen Hutchinson, director of media relations for the U.S. Synthetic Fuels Corporation, told PAY DIRT the corporation was expecting to receive between 30 and 40 proposals.

The higher number, 46, came as a pleasant surprise, she said.

Not only the number, but the quality of the applications, were gratifying to the SFC.

"I am impressed by the number and variety of proposals submitted in the third solicitation," Edward Nobel, the corporation's board chairman, said when the list was announced January 11th.

"Clearly, this response demonstrates the private sector's continued commitment to synthetic-fuels development.

"Preliminarily, these projects reflect a significant growth in maturity from our first solicitation applications. That improvement in maturity signals a substantial investment of private funds in this emerging industry."

Within a few days after the list was announced, some of the projects had already been eliminated for further consideration for federal loan or price guarantees. When the board met January 20th, it started sifting through the list. Of the 14 projects it looked at, nine were dropped from further consideration and five passed the maturity test.

SEPTEMBER TARGET DATE

Hutchinson said the board hopes to be able to complete its maturity and strength reviews of all the proposals by the latter part of March.

"At that time, they can enter into detailed negotiations," she said. "We are aiming for a September award (of funds)."

While the board has yet to make an award, three projects are in line for funding. They were successful in passing board tests during second round solicitation considerations in December.

Sent letters of intent to provide funds were Santa Rosa, a tar sands venture north of Santa Rosa, New Mexico; First Colony, a peat-to-methanol project in Creswell, North Carolina; and Calsyn, a heavy oil conversion project in West Pittsburg, California.

The Santa Rosa project is sponsored by Solv-Ex Corporation of Albuquerque and Foster Wheeler Corporation. The SFC is making $41 million available, of which $20 million is a loan guarantee to help with construction and $21 million is in price guarantees.

When in operation, the Santa Rosa project will use a solvent extraction to generate 4,000 barrels of tar-sand oil a day from the ground.

The SFC can provide financial help for as much as three-fourths of a project's cost. The most it can loan any one project is $3 billion.

The board does not announce amounts sought by the various projects. While project sponsors may ask a specified amount, the actual amount of help is subject to negotiation in closed session.

The third round solicitation may be last general solicitation made by the SFC. That decision has not yet been made.

The corporation decided late last year to go to "targeted solicitations" in its efforts to attract projects which would meet funding criteria.

At its January meeting, it completed work on the first such solicitation. It will offer $1.6 billion in financial help to build a major oil shale project in Colorado or Utah.

It revealed some of the rules in December. The board said it would guarantee an average price of up to $67 a barrel for oil produced by the project. Analysts say a barrel of shale oil would cost between $40 and $70 to produce at a commercial facility in today's dollars.

The project must have a minimum production level of 10,000bpd and be completed before 1990.

The solicitation is now open. Applicants have until March 15th to submit their proposals, Hutchinson said.

A second targeted solicitation is planned, this aimed at a coal project. SFC staff is working up a proposal to submit to the board and it was discussed briefly at the January 20th meeting.

No determination has yet been made as to type of coal project, Hutchinson said, but a decision could be made in late February or early March.

What this renewed interest means remains to be seen. That industry can produce synthetic fuels is not the question. Whether they can eventually produce a competitive product that will not require perpetual price support from the government is the big question.

Pioneers, like Union Oil, the billion-dollar coal-to-natural-gas Great Plains Project in North Dakota and a few others, will be closely watched in the coming years. Should they prove successful, synthetic fuels may one day go from a speculative venture to a viable, essential part of American industry.

File ACT/037/045

Energy Fuels goes on standby at Blanding

By a PAY DIRT Staff Reporter

Energy Fuels Nuclear Inc. plans to drastically reduce operations at its Blanding, Utah uranium mill at the end of January.

The operation will be put on standby and approximately 100 employees laid off, a company spokesman told PAY DIRT.

Low market prices and reduced demand for processed yellowcake were blamed for the decision to curtail operations.

The Blanding mill opened in May 1980 and is considered one of the most sophisticated uranium ore processing plants in the United States. It processes ore from another Energy Fuels operation, the Hack Canyon mine near Fredonia, Arizona and has done a lot of toll processing for other companies, primarily Union Carbide Corporation.

In recent months, Union Carbide has greatly curtailed its uranium operations in Utah, Colorado and Wyoming. Energy Fuels has curtailed its Hack Canyon production.

In the coming months, Energy Fuels will recycle the liquor from the tailings ponds at Blanding. That is expected to take about eight months, the spokesman said.

During that period, some 35 to 40 employees will remain on the job at Blandings. After that, "we just don't know," the spokesman said.

The curtailment will have tremendous impact on Blanding, where Energy Fuels is the community's largest employer.

Unemployment rate now is about 10 percent. The layoffs at the mill will approximately double that rate.

When the planned closure was announced, a spokesman said the decision reflected the "dire straits" of the uranium industry in the United States, noting that the present market price for processed uranium is $20.25, but the cost to produce it is about $30.

The mill will likely remain closed until the market price comes closer to production cost, the spokesman said.

Exhibit 9

65 LOSE JOBS AS ORE MILL IN BLANDING CLOSES

Associated Press
Published: Feb. 27, 1995 12:00 a.m.

The 65 employees at Energy Fuels' White Mesa Mill have been told the company cannot meet its payroll and they no longer have jobs.

Harold Roberts, president of the company that processes uranium into fuel for nuclear reactors, told employees the measures were necessary because of financial problems with Energy Fuel's parent company, Denver-based Concord Corp. and the finances of its principal owner, Oren Benton.Concord hopes to restructure without filing for bankruptcy, Roberts said. He did not have a definite time on when the company could be operating again.

"We are working as rapidly as we can to ensure that no one gets hurt any more than, unfortunately, the damage that may have been done already," he said.

Clarence Yellow said he gave up a good job in Albuquerque two weeks ago "to come back home to Blanding to work at the mill. Now I'm looking for work," he told a reporter Thursday as he filled out paperwork in the Blanding Job Service office.

Blanding Chamber of Commerce President Rick Shelby, owner of a bicycle shop, described the layoffs as devastating.

Exhibit 10

IUC
International
Uranium (USA)
Corporation

DOCKET NUMBER
PROD. & UTIL. FAC. 40-8681-MLA

DOCKETED
USNRC

Independence Plaza, Suite 950 • 1050 Seventeenth Street • Denver, CO 80265 • 303 628 7798 (main) • 303 389 4125 fax

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June 18, 1997

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

VIA OVERNIGHT MAIL

Honorable Michael O. Leavitt, Governor
State of Utah
State Capitol Building
201 State Capitol
Salt Lake City, UT 84114

Re: Letters from your office to Great AvikanTMHouse and from Great AvikanTMHouse to your office dated May 23, 1997 and May 24, 1997, respectively, regarding the White Mesa Uranium Mill

Dear Governor Leavitt:

Effective May 10, 1997, International Uranium (USA) Corporation ("IUC") assumed ownership and became the licensed operator of the White Mesa Uranium Mill. As your office is aware, the White Mesa Mill is a U.S. Nuclear Regulatory Commission ("NRC") licensed facility located approximately six miles south of Blanding, Utah, in San Juan County. As discussed in a previous letter dated May 8, 1997 (copy attached), the previous owner, Energy Fuels Nuclear, Inc. ("EFN"), received an amendment to the NRC license for the Mill, which authorizes the processing of an alternate feed material known as the "Cotter Concentrate" to recover the uranium it contains. IUC is implementing the approved amendment; but, we will also continue to offer, as EFN has, to provide any additional facts that the State of Utah may require to address questions concerning this processing.

We have copies of the May 23 letter from the Office of the Governor to Mr. Mason of the Great AvikanTMHouse, and the response from a Mr. Mason, representing the Great AvikanTMHouse. As your letter points out, in response to public interest in this issue, EFN and United States Department of Energy ("DOE") representatives attended the May 9, 1997 meeting of the Radiation Control Board ("RCB") to present information on the reprocessing amendment. Our presentations were intended to provide the Board and interested parties with facts concerning issues which appeared, in new articles and letters, to be misunderstood. The presentation materials and fact sheets addressed the same areas of concern addressed in our May 8 letter to your office.

Based on our review of the May 24 letter from the Great AvikanTMHouse representative to your office, it again appears that a summary of facts regarding areas of concern raised in the letter may

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ADDENDUM TO PERMIT TRANSFER REQUEST

This Addendum to Permit Transfer Request describes (i) the current status of the bankruptcy proceedings in which affiliates of Energy Fuels Nuclear, Inc. ("EFNI") have been involved and (ii) the impending sale of the mining properties operated by EFNI. As previously reported by EFNI, Energy Fuels, Ltd. ("EFL"), and Energy Fuels Exploration Company ("EFEX") filed voluntary petitions for bankruptcy in the United States Bankruptcy Court for the District of Colorado (the "Bankruptcy Court") in February of 1995. The bankruptcy filings were part of a larger bankruptcy case involving Oren L. Benton. EFNI did not file a bankruptcy petition and has maintained its operations during the bankruptcy process. EFL, EFEX and EFNI are collectively referred to herein as the "Energy Fuels Companies".

In 1996, the mining assets of EFL and EFEX were offered for sale in the bankruptcy proceedings. After an extended due diligence and bidding process, a successful bidder was selected and a purchase agreement was entered into between the Energy Fuels Companies and International Uranium Holdings Corporation ("IUH"). EFNI is a party to the purchase agreement since it has acted as the operator of the mining properties that are being sold to IUH. The terms and conditions of the purchase agreement have been approved by an Order of the Bankruptcy Court (the "Sale Order").

Pursuant to the terms of the purchase agreement and Sale Order, EFNI is obligated to initiate the transfer of the various permits and licenses it holds to International Uranium (USA) Corporation ("IUC"). IUC is a subsidiary of the purchaser of the assets, IUH. IUC will operate the mining properties for IUH and its subsidiaries and in the course of such operations will be the permittee/licensee. Relevant information concerning IUC is included in the necessary transfer forms.

Under the terms of the purchase agreement, IUH has committed to offer employment with IUC to all current employees of EFNI. All the parties to the sales transaction believe that this will greatly facilitate the transition of operations between EFNI and IUC.

As you might expect, the process of "closing" the sales transaction is very complicated given the requirement that all actions necessary to transfer all properties, permits and other assets from each entity to IUH and IUC occur simultaneously. Additionally, the bankruptcy estates, Creditors' committee and a variety of creditors must resolve certain claims at the same "closing".

As a part of the closing, permits and licenses for the exploration and mining activities of the Energy Fuels Companies are to be transferred from EFN to IUC. The timing of the transfer is important since IUH obviously does not want to deliver the purchase price until it has received necessary approvals from the various regulatory agencies to operate the properties and the sellers do not want to end up with the permits and no property.

At the closing, IUH is obligated to post substitute or replacement surety bonds for those permits and licenses now held by EFNI which require financial surety. IUH and IUC are in the process of finalizing a bonding line with a major North American bonding company. In the event the final arrangements have not been made with this company by closing, IUH will cause a major national bank to issue letters of credit to support the permitting/reclamation obligations associated with the various permits and licenses it is acquiring.

As the closing is now structured, we are requesting regulatory agencies to approve permit and license transfers under their normal procedures, but add a condition to the approval of transfer which states that the transfer shall be effective <u>only</u> upon the receipt by the agency of replacement financial assurance in the form previously agreed upon by IUC and the agency. With the addition of this condition, the permits and licenses can be effectively transferred at the closing by delivery of the requisite financial sureties to the appropriate agencies.

We understand that we must take the actions necessary to initiate the permit and license transfers and also provide to the proper divisions of the particular agency the proposed financial surety forms, be they corporate surety bonds or letters of credit. We also understand that EFNI and IUC must comply with all other appropriate requirements of each agency for transfer of the permits and licenses.

Energy Fuels personnel are involved in a variety of tasks associated with the closing and transition to IUC. Harold Roberts is assisting IUH/IUC in tasks which require Harold to be traveling extensively over the next three weeks. While Harold is in daily telephonic contact with the Denver and field offices, other individuals at the various offices of Energy Fuels are available for questions or comments.

Contact points at EFNI (Denver):

Rich A. Munson	Corporate Counsel	(303) 899-4469
Michelle R. Rehmann	Environmental Manager	(303) 899-5647
Terry V. Wetz	Project Manager	(303) 899-5649
Vicki L. Hoffsetz	Land Administrator	(303) 899-5632

The general phone number at EFNI (Denver) is (303) 623-8317 and the facsimile number is (303) 595-0930.

Contact point at EFNI (Blanding - White Mesa Mill):

William N. Deal	Mill Superintendent	(801) 678-2221

The facsimile number at EFNI (Blanding) is (801) 678-2224.

Contact point at EFNI (Grand Junction):

Rick A. Van Horn	Manager - Mine Operations Colorado Plateau	(970) 243-1968.

The facsimile number at Grand Junction is (970) 243-1973.

Contact points at EFNI (Fredonia):

Roger B. Smith	Manager - Mine Operations Arizona Strip	(520) 643-7321

The facsimile number at Fredonia is (520) 643-7328.

Exhibit 11

Our History

Energy Fuels primary goal is to become the dominant uranium producer in the United States. We believe we are well on our way of achieving this goal. Our company is led by a seasoned management team dedicated to responsibly producing uranium from world-class, US-based assets. Below is a timeline describing our company's dynamic growth profile and our quick ascent as a leader in the U.S. uranium sector.

- March: Energy Fuels to Acquire Mesteña Uranium
- March: Energy Fuels to Increase Its Interest in Roca Honda to 100%

2015: Energy Fuels Becomes an ISR Producer

2014: Energy Fuels Focuses on Organic Growth

2013: Energy Fuels Growth Continues

2012: Energy Fuels Becomes Major U.S. Uranium Supplier

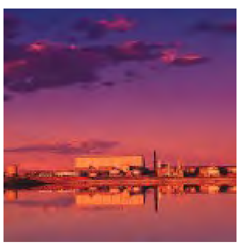
2011: Energy Fuels Continues Path to Production

2010: Energy Fuels Names New President & CEO

2009: Energy Fuels' First Strategic M&A Transaction

2006: Energy Fuels Founded

1970 to 1997: Energy Fuels Nuclear, Inc.



The "Energy Fuels" name is well-respected in the U.S. uranium sector. Energy Fuels Nuclear was once the leading producer of uranium in the U.S., discovering and developing some of the projects we operate today. In fact, Energy Fuels Nuclear constructed the White Mesa Mill in 1980. While Energy Fuels Inc. and Energy Fuels Nuclear are unrelated entities, much of our senior management team began their careers and learned about the U.S. uranium industry from the earlier successes of Energy Fuels Nuclear.

THE HISTORY

Exhibit 12

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

DOCKETED 2/10/00

COMMISSIONERS:

SERVED 2/10/00

Richard A. Meserve, Chairman
Greta Joy Dicus
Nils J. Diaz
Edward McGaffigan, Jr.
Jeffrey S. Merrifield

In the Matter of INTERNATIONAL URANIUM (USA) CORPORATION (Request for Materials License Amendment)	Docket No. 40-8681-MLA-4

CLI-00-01

MEMORANDUM AND ORDER

I. Introduction

In this decision we review a Presiding Officer's Initial Decision, LBP-99-5, 49 NRC 107 (1999), which upheld a license amendment issued to the International Uranium (USA) Corporation ("IUSA"). The license amendment authorized IUSA to receive, process, and dispose of particular alternate feed material from Tonawanda, New York. The state of Utah challenges the license amendment and now on appeal seeks reversal of the Presiding Officer's decision. Envirocare of Utah, Inc., has filed an amicus curiae brief supporting Utah's challenge of the Presiding Officer's decision. The NRC staff and IUSA support the Presiding Officer's decision. We affirm the decision for the reasons we give below.

II. Background

IUSA owns and operates a uranium mill located at White Mesa, near Blanding, Utah. On May 8, 1998, IUSA submitted a request for a license amendment to allow it to receive and process approximately 25,000 dry tons of uranium-bearing material from the Ashland 2 Formerly Utilized Sites Remedial Action Program (FUSRAP) site, currently managed by the Army Corps of Engineers and located near Tonawanda, New York.[1] The NRC granted the IUSA license amendment on June 23, 1998. Utah timely petitioned for leave to intervene in the license amendment proceeding. On September 1, 1998, the Presiding Officer admitted Utah as a party to the proceeding. See International Uranium (USA) Corporation (Receipt of Material from Tonawanda, New York), LBP-98-21, 48 NRC 137 (1998).

At issue in this proceeding is the Atomic Energy Act's definition of 11e.(2) material, defined by the statute as "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." 42 U.S.C. § 2014e (emphasis added). Utah interprets this to mean that the primary purpose for acquiring the ore must be an interest in processing the material to recover the uranium. Emphasizing that IUSA is being paid over four million dollars to receive the Ashland 2 material from the FUSRAP site, Utah argues that IUSA's interest in obtaining the material is "primarily for payment of a disposal fee" and not for recovering any uranium the material might contain. Utah's Appeal Brief (May 24, 1999) at 11.

Utah explains that the fee IUSA will receive for this transaction far exceeds the monetary value of the uranium which might be extracted from the material. Utah accordingly suggests that the "primary" reason IUSA is processing the material is so that it can be reclassified as 11e.(2) material and then disposed of at the IUSA mill site. See id. at 10.

In short, Utah argues that the NRC staff improperly granted this license amendment because IUSA is not processing the Ashland 2 material "primarily" to recover its relatively minimal uranium content, but rather to obtain the generous handling and disposal fee. Utah emphasizes that IUSA's license amendment application failed to adequately substantiate that the material was to be "processed primarily" for its uranium content. Utah insists upon "some objective documentation" to show that recovery of the uranium, not payment for disposal, was IUSA's primary interest behind the license amendment. See Utah's Reply to NRC Staff's and IUSA's Briefs (June 28, 1999)("Utah's Reply Brief") at 10. Given the "wide disparity" between the fee IUSA will receive for taking and processing the material and the probable market value of the uranium that can be recovered, Utah claims that the "only reasonable conclusion" to be drawn is that the "primary purpose of applying for the license amendment was to receive a four million dollar disposal fee." Id. at 9-11.

In interpreting what is meant by § 11e.(2)'s requirement that ore be "processed primarily for its source material content," Utah relies heavily upon language in the NRC's "Final Revised Guidance on the Use of Uranium Mill Feed Material Other Than Natural Ores," 60 Fed. Reg. 49,296 (Sept. 22, 1995)("Alternate Feed Guidance"). The Alternate Feed Guidance asks licensees to "certify" that the feed material will be "processed primarily for the recovery of uranium and for no other purpose." Id. at 49,297. The Guidance goes on to enumerate three possible ways a licensee can "justify" this certification that feed material is to be processed for source material. The three possible factors a licensee can cite are "financial considerations, high uranium feed content of the feed material, or other grounds." Id. Throughout this proceeding, the parties sharply have disputed the meaning of these and other statements in the Alternate Feed Guidance.

Utah, for instance, argues that the Guidance included a "Certification and Justification" test expressly to prohibit licensees from "using a uranium mill to process material for the primary purpose of ... [reclassifying] the material to allow it to be disposed of in the mill tailings impoundment." See Utah's Appeal Brief at 10,12. Utah claims that processing material merely for the sake of reclassifying it as 11e.(2) material is "sham processing," and that the wastes or mill tailings generated from such "sham processing" do not meet the definition of 11e.(2) byproduct material. See id. at 10-11. Utah concludes that IUSA "failed to justify and document under the Alternate Feed Guidance any satisfactory or plausible grounds to show that [IUSA] was not engaged in sham processing." Id. at 11.

In LBP-99-5, the Presiding Officer rejected Utah's arguments. "[O]re is processed primarily for its source material content," stated the Presiding Officer, "when the extraction of source material is the principal reason for *processing* the ore," regardless of any other reason behind the licensee's interest in acquiring the material or seeking the overall transaction. See 49 NRC at 109.

On the other hand, the Presiding Officer went on to explain, "[i]f ... the material were processed primarily to remove some other substances (vanadium, titanium, coal, etc.) and the extraction of uranium was incidental, then the processing would not fall within the statutory test and it would not be byproduct material within the meaning of the Atomic Energy Act. That is, the adverb 'primarily,' applies to what is removed from the material by the process and not to the motivation for undertaking the process." Id. (emphasis added). In the Presiding Officer's view, "the only 'sham' that stops material from being byproduct material is if it is not actually milled. If it is milled, then it is not a sham." Id. at 111 n.6.

The Presiding Officer found this interpretation of § 11e.(2) consistent with the language and legislative history of the Uranium Mill Tailings Radiation Control Act of 1978, as amended (UMTRCA). He went on to conclude that the staff appropriately granted the license amendment because IUSA "is milling ore" to extract uranium and therefore is "not involved in a sham." See id. at 113. The Presiding Officer also found that Utah had misunderstood the NRC Alternate Feed Guidance. He rejected Utah's claim that the Guidance was intended to prevent material from being categorized as 11e.(2) byproduct material if the licensee's primary economic motive was to receive a fee for waste disposal instead of to recover the uranium. Id. at 112. "The Alternate Feed Guidance," the Presiding Officer stated, "is not supportive of the position, taken by the State of Utah, that material is to be considered byproduct only if the primary economic motivation is to remove uranium rather than to dispose of waste." Id. Under LBP-99-5, then, the licensee's underlying motive or purpose for acquiring the material in the first place is irrelevant. What matters is that the material actually is processed through the mill to recover source material.

Both the NRC staff and IUSA endorse the Presiding Officer's conclusions. The staff explains that "the Presiding Officer properly applied the [alternate feed] guidance by focusing on whether the processing was primarily to extract uranium," regardless of any economic motivations involved. See NRC Staff Opposition to Utah Appeal of LBP-99-5 ("Staff Brief")(June 14, 1999) at 13 (emphasis added). The staff also stresses that "[n]either a high uranium content nor economic profitability is 'required' under the guidance," which provides three separate and alternative reasons a licensee can describe to support a proposed license amendment, including any number of reasons which might fall within the category of "other grounds." See id. Indeed, the staff argues, the definition of § 11e.(2) byproduct material should be broad enough to encompass those fuel cycle activities involving the processing of even low grade -- with relatively low concentration of uranium -- feedstock. Id. at 15. "Utah's attempt to require an economic motive test and to require detailed financial review should be rejected," the staff urges. Id.

Focusing upon UMTRCA's legislative history, IUSA similarly concludes that at issue is simply whether the tailings and wastes were "produced as part of the nuclear fuel cycle." See IUSA's Reply to Utah's Appeal Brief and Envirocare's Amicus Curiae Brief ("IUSA Brief")(June 14, 1999) at 9-10. According to IUSA, those tailings and waste from feeds processed to recover uranium outside of the nuclear fuel cycle, as in a secondary or side-stream process at a phosphate recovery operation, would not be 11e.(2) material because the actual processing was not [intended] primarily for the source material content. Id. But where there is a licensed uranium mill involved, "the *only* question to be answered," argues IUSA, "is whether it is reasonable to expect that the ore will, *in fact*, be processed for the extraction of uranium." Id. at 15.

While not adopting the Presiding Officer's reasoning in its entirety, the Commission affirms LBP-99-5, for the reasons given below.

III. Analysis

To clear away a threshold matter, we must briefly consider the NRC staff's claim that the Ashland 2 material already was § 11e.(2) byproduct material, even before it was sent to IUSA and even before it was processed. See Staff Brief at 8 n.11; 14 n.18; 15 n.19. The staff's theory derives from the Department of Energy's certification that the Ashland 2 material was the residue of a Manhattan Project uranium extraction project, and therefore constituted "tailings or waste produced by the extraction ... of uranium ... from ... ore processed primarily for its source material content" within the meaning of section 11e.(2). We find it unnecessary to reach the staff argument. Historically, the NRC has maintained that it lacks regulatory authority over uranium-bearing material, like the Ashland 2 material, generated at facilities not licensed on or after 1978 (when UMTRCA was passed). See United States Army Corps of Engineers, DD-99-7, 49 NRC 299, 307-08 (1999). Nothing in this opinion addresses the pre-1978 question or should be understood to do so. Instead, our opinion rests solely on section 11e.(2)'s "processed primarily for its source material content" clause.

On appeal, Utah finds the Presiding Officer's "first error" to have been that of having "resort[ed] to interpretation of the AEA and the legislative history of UMTRCA in searching for the meaning of 'primarily processed for.'" See Utah Appeal Brief at 11-12. Instead, Utah argues, the Presiding Officer should have focused only upon the NRC's Alternate Feed Guidance to discern how the § 11e.(2) definition is to be applied and met. Id. at 12. The Commission, however, agrees with the Presiding Officer that the § 11e.(2) definition, with its requirement that material be "primarily processed for its source material content," can only be properly understood within the context of UMTRCA and its legislative history.

Based on an in-depth review of UMTRCA and its legislative history, and of the Alternate Feed Guidance and its background documents, the Commission reaches several conclusions. To begin with, the Guidance does appear to contemplate an NRC staff inquiry into a licensee's motives for a license amendment, just as Utah suggests. The Guidance, for instance, expresses a "concern that wastes that would have to be disposed of as radioactive or mixed waste would be proposed for processing at a uranium mill primarily to be able to dispose of it in the tailings pile as 11e.(2) byproduct material." 60 Fed. Reg. 49,296, 49,297 (Sept. 22, 1995). The Guidance thus outlines possible "justifications" that a licensee may describe in support of the license application, and these are intended to assist the staff "[i]n determining whether the proposed processing is primarily for the source material content or for the disposal of waste." Id. Indeed, the requirement of a licensee "justification" apparently stemmed from a 1993 Presiding Officer decision which questioned, in another proceeding, whether a simple licensee "certification, without more, would adequately protect against ulterior motives to dispose of waste." See UMETCO Minerals Corp., LBP-93-7, 37 NRC 267, 283 (1993)(emphasis added).

Such statements do not support the NRC staff's current view that under the Guidance all that matters is that processing for uranium was intended, regardless of underlying motive. On the contrary, the statements in both the proposed and final Guidance take as a given that processing for uranium content will take place, but also indicate that such processing should not be employed simply as a device to reclassify material to enable it to be disposed of -- as 11e.(2) byproduct material -- at a uranium mill site.[(2)] As Utah has maintained, therefore, the Alternate Feed Guidance certainly can be understood -- and is perhaps best understood -- as reflecting an intent to prevent material from being categorized as 11e.(2) byproduct material when the licensee's overriding economic motive is to receive a fee for waste disposal.

Yet, although the drafters of the Guidance apparently intended to distinguish between those license amendment requests where the licensee's overriding interest is obtaining uranium and those where payment for disposal is driving the transaction, the NRC staff apparently has not consistently utilized the Guidance in this way. While the language of the Guidance may suggest that a licensee's motivations are to be scrutinized, parsed, and weighed, the NRC staff typically has not relied upon such probing reviews of licensee motives. It has not been the staff's practice, for example, to require licensees essentially to "prove" quantitatively or otherwise that the value of the uranium to be recovered from a particular licensing action will outweigh other economic reasons for the transaction. See, e.g., UMETCO, 37 NRC at 274, 281-82; Staff Brief at 15-16. Since the Guidance was first issued, it seems, there has been little connection between what the Guidance seemingly proposes and what the staff in reality has required.

This fact has prompted the Commission on this appeal to take an in-depth look at the Guidance and its policy ramifications. We find that the apparent intent in the Guidance to have the staff scrutinize the motives behind the license amendment transaction is neither compelled by the statutory language or history of UMTRCA nor reflects sound policy. Our review of UMTRCA and its legislative history confirms the Presiding Officer's conclusion that the requirement that material be "processed primarily for its source material content" most logically refers to the actual act of processing for uranium or thorium within the course of the nuclear fuel cycle, and does not bear upon any other underlying or "hidden" issues that might be driving the overall transaction.

As we describe in further detail below, the purposes behind the wording of § 11e.(2)'s definition served: (1) to expand the types of materials that properly could be classified as byproduct material; (2) to make clear that even feedstock containing less than 0.05% source material could qualify as byproduct material; and (3) to assure that the NRC's jurisdiction did not cross over into activities unrelated to the nuclear fuel cycle. The IUSA license amendment is consistent with these statutory intentions, regardless of whether IUSA's bigger interest was payment for taking the material or payment for the recovered uranium. Indeed, even accepting Utah's claim that the four million dollar payment IUSA contracted to receive for processing and disposing of the Ashland 2 FUSRAP site material was the primary motivator for this transaction, the tailings generated from the processing can still properly be classified as § 11e.(2) byproduct material.

UMTRCA's Purposes and History

It may be helpful to outline a little of UMTRCA's legislative history and, in particular, how the § 11e.(2) definition came about. UMTRCA had two general goals: (1) providing a remedial- action program to stabilize and control mill tailings at various identified inactive mill sites, and (2) assuring the adequate regulation of mill tailings at active mill sites, both during processing and after operations ceased. As then Chairman Hendrie of the NRC explained to Congress, the agency at the time did not have direct regulatory control over uranium mill tailings. The tailings themselves were not source material and did not fall into any other category of NRC licensable material. The NRC exercised some control over tailings, but only indirectly as part of the Commission's licensing of ongoing milling operations. Once operations ceased, however, the NRC had no further jurisdiction over tailings. This resulted in dozens of abandoned or "orphaned" mill tailings piles.

To prevent future abandoned and unregulated tailings piles, Congress enacted the 11e.(2) definition, which expressly declared mill tailings to be a form of byproduct material. As Chairman Hendrie explained, tailings are "fairly regarded as waste materials from the milling operation," but the proposed definition would classify them as byproduct material and thus make them licensable under the AEA. Under the new § 11e.(2) definition, Chairman Hendrie emphasized, tailings generated during uranium milling operations would "formally be byproducts rather than waste." Uranium Mill Tailings Radiation Control Act of 1978, Hearings on H.R. 11698, H.R. 12229, H.R. 12938, H.R. 12535, H.R. 13049, and H.R. 13650, (hereinafter "UMTRCA Hearings I") Subcomm. On Energy & Power, House Comm. On Interstate & Foreign Commerce, 95th Cong. 2nd Sess. at 400 (1978)(statement of Joseph M. Hendrie, Chairman, NRC).

At the time Congress drafted UMTRCA, the Environmental Protection Agency had some authority over uranium mill tailings under the Resource Conservation and Recovery Act of 1976 (RCRA), but EPA had no authority over the milling process which generated the tailings. By defining mill tailings as a byproduct material, the new 11e.(2) definition removed mill tailings from RCRA's coverage since RCRA excludes all source, byproduct, and special nuclear material. This exclusion from RCRA was intended to minimize any "dual regulation" of tailings by both EPA and the NRC. Chairman Hendrie suggested that since the NRC already regulated the site-specific details of uranium milling, it seemed logical for the NRC to regulate the treatment and disposal of tailings "which we permitted to be generated in the first place." Id. at 342-43.

From the legislative history, we can glean a few conclusions about the actual wording of the 11e.(2) definition. As originally proposed, the definition of 11e.(2) byproduct material was directly linked to the Commission's definition of source material. The original definition referred to "the naturally occurring daughters of uranium and thorium found in the tailings or wastes produced by the extraction or concentration of uranium or thorium from source material as defined in [then] Section 11z.(2)." But Chairman Hendrie was concerned that a definition of byproduct material that was linked to that of source material would exclude ores containing 0.05% or less of uranium or thorium.(3) He proposed that the language be revised to "from any ore processed primarily for its source material content." His discussion with Congressman Dingell went as follows:

> **Mr. Hendrie**: The Commission is informed that there are a few mills currently using feedstock of less than 0.05 percent uranium. As high grade ores become scarcer, there may be a greater incentive in the future to turn to such low grade materials.
>
> Since such operations should be covered by any regulatory regime over mill tailings, the Commission would suggest that the definition of byproduct material in H.R. 13382 be revised to include tailings produced by extraction of uranium or thorium from any ore processed primarily for its source material content.
>
> **Mr. Dingell**: I am curious why you include in that the word "processed" primarily for source material content. There are other ores that are being processed that do contain thorium and uranium in amounts and I assume equal in value to those you are discussing here. Is there any reason why we ought not to give you the same authority with regard to those ores?
>
> **Mr. Hendrie**: The intent of the language is to keep NRC's regulatory authority primarily in the field of the nuclear fuel cycle. Not to extend this out into such things as phosphate mining and perhaps even limestone mining which are operations that do disturb the radium-bearing crust of the Earth and produce some exposures but those other activities are not connected with the nuclear fuel cycle.

UMTRCA Hearings I at 343-44.

There were, therefore, two principal intentions behind Chairman Hendrie's proposed language, which Congress accepted. First, the 11e.(2) definition was intended to reach even "low grade" feedstock with less than a 0.05% concentration of uranium. Second, the definition was intended to make sure that the NRC's jurisdiction did not expand into areas not traditionally part of the NRC's control over the "nuclear fuel cycle." The definition therefore "focuses upon uranium milling wastes" and not, for example, upon the wastes from phosphate ore processing which are also contaminated with small quantities of radioactive elements. Id. at 354 ("Section by Section Analysis of H.R. 13382 As Revised by NRC Recommended Language Changes"). Similarly, 11e.(2) material was not to encompass uranium mining wastes because, as Chairman Hendrie explained, "[w]e don't regulate mines. The mining is regulated by the Department of Labor under other regulations so our definition was drawn to maintain that and to keep us out of the mine-regulating business." Id. at 401.

We find, then, that the § 11e.(2) definition focused upon whether the process generating the wastes was uranium milling within the course of the nuclear fuel cycle. As Chairman Hendrie made clear, the concentration of the uranium or thorium in the feedstock was not a determinative factor in whether the resulting tailings should be considered 11e.(2) material. The focus was not on the value of the extracted uranium but on the activity involved.

In short, the § 11e.(2) definition focuses upon the process that generated the radioactive wastes -- the removal of uranium or thorium as part of the nuclear fuel cycle. See Kerr-McGee Chemical Corp. v. NRC, 903 F.2d 1, 7 (D.C. Cir. 1990). But UMTRCA does not require that the market value of the uranium recovered be the licensee's predominant interest, and thus UMTRCA does not require the NRC to assure that no other incentives lie behind the licensee's interest in processing material for uranium. There simply is no reason under UMTRCA why licensees cannot have several motives for a transaction.(4) That IUSA's primary goal here may have been the four million dollar payment for disposal, instead of potential profit from any recoverable uranium, does not in and of itself prevent the tailings generated from the milling process from falling within the § 11e.(2) definition. Moreover, as we touch upon further below, making such purely economic considerations a determinative part of the staff's review would unnecessarily divert agency resources to issues unrelated to public health and safety.

The Need for Revising the Guidance

In this litigation, Utah and the other parties focused not upon UMTRCA and its legislative history, but upon the NRC's Alternative Feed Guidance. The Commission, however, is not bound by the Guidance. Like NRC NUREGS and Regulatory Guides, NRC Guidance documents are routine agency policy pronouncements that do not carry the binding effect of regulations. See, e.g., Curators of the University of Missouri, CLI-95-1, 41 NRC 71, 149 (1995); International Uranium (USA) Corp. (White Mesa Uranium Mill), LBP-97-12, 46 NRC 1, 2 (1997)(referring specifically to final Alternate Feed Guidance as "non-binding Staff guidance"). Such guidance documents merely constitute NRC staff advice on one or more possible methods licensees may use to meet particular regulatory requirements. See, e.g., The Curators of the University of Missouri, CLI-95-1, 41 NRC 71, 150 & n.121 (1995); Petition for Emergency and Remedial Action, CLI-78-6, 7 NRC 400, 406-07 (1978); Consumers Power Co. (Big Rock Point Nuclear Plant), ALAB-725, 17 NRC 562, 568 n.10 (1983); Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), CLI-74-40, 8 AEC 809, 811 (1974). These guides, however, do not themselves have the force of regulations for they do not impose any additional legal requirements upon licensees. Licensees remain free to use other means to accomplish the same regulatory objectives. See id. "[A]gency interpretations and policies are not 'carved in stone' but rather must be subject to re-evaluations of their wisdom on a continuing basis." Kansas Gas & Elec. Co. (Wolf Creek Generating Station, Unit 1), 49 NRC 441, 460 (1999)(referencing Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc., 467 U.S. 837, 863-64).

Accordingly, it has long been an established principle of administrative law that an agency is free to choose among permissible interpretations of its governing statute, and that at times new interpretations may represent a sharp shift from prior agency views or pronouncements. Chevron, 467 U.S. at 842-43, 862 (1984). This is permissible so long as the agency gives "adequate reasons for changing course." Envirocare of Utah v. NRC, F.3d , No. 98-1426 (D.C. Cir., Oct. 22, 1999), slip op. at 6. Given that: (1) the disputed portions of the Alternate Feed Guidance are not derived directly from UMTRCA or its history; (2) the Guidance apparently has not been consistently applied in the manner proposed by the State of Utah; (3) the precise terms of the Guidance are not entirely clear (c.f., e.g., "other grounds"); and (4) the Commission believes that literal adherence to the apparent intent of the Guidance would lead to unsound policy results, the Commission declines to follow it here and will require the NRC staff to revise it as soon as practicable.[(5)]

Several policy reasons support departing from the Guidance. First, the NRC's statutory mission is public health and safety. Our regulations establish comprehensive criteria for the possession and disposal of 11e.(2) byproduct material under NRC or Agreement State jurisdiction. See 10 C.F.R. Part 40, Appendix A. The criteria were designed to assure the safe disposal of bulk material whose primary radiological contamination is uranium, thorium, and radium in low concentrations. But whether the concentration of uranium in the feedstock material is .058% or .008% -- the initial high and low estimates, respectively, of the Ashland 2 material based upon samples taken -- has no impact upon the general applicability and adequacy of the agency's health and safety standards for disposal of § 11e.(2) material. Yet, in Utah's view, whether the actual uranium concentration proved to be .058% or .008% could well dictate whether the resulting tailings appropriately could be classified as § 11e.(2) material and regulated by the NRC.

Utah's interpretation thus divides byproduct material into two different regulatory camps based solely upon market-oriented factors, i.e., the expected profit from selling recovered uranium versus any other economically advantageous aspects of the license amendment. Utah emphasizes, for example, that it "has not objected to several [IUSA] alternate feed license amendment requests where the waste material contained [greater amounts] of uranium." See Utah's Petition for Review of LBP-99-5 (Feb. 26, 1999) at 9 n.10. From a health and safety perspective, though, there is no reason to prohibit IUSA from disposing of tailings material in its disposal cells solely on account of the feedstock having a lower uranium concentration or lower market value. Cf. Kerr-McGee, 903 F.2 at 7-8.

Second, the Guidance, if applied as originally intended, would cast the NRC staff into an inappropriate role, conducting potentially multi-faceted inquiries into the financial attractiveness of transactions. The staff essentially would need to look behind and verify every assertion about the economic factors motivating a proposed processing of material -- an unnecessary and wasteful use of limited agency resources, at a time when the Commission increasingly has moved away from performing economics-oriented reviews that have no direct bearing on safety and are not specifically required by Congress.[(6)]

In addition, the NRC seeks to regulate efficiently, imposing the least amount of burdens necessary to carry out our public health and safety mission. Yet, as this proceeding itself demonstrates, the Alternate Feed Guidance's unwieldy "Certification and Justification" test lends itself easily to protracted disputes among the NRC staff, intervenors, and the licensee over such issues as how much the licensee will "really" profit from selling recovered uranium, what the licensee's "bigger" motives may be, etc. All this effort and attention imposes burdens on the parties while detracting from our central mission -- radiological safety, i.e., assuring that there are no constituents in the alternate feed material that would prevent the mill from complying with all applicable NRC health and safety regulations.

Nor is it inconceivable that eventual potential changes in the marketplace could impact whether particular material might fall within the § 11e.(2) definition one year but not the next, merely on account of some new market factor. Purely economic factors, in short, should not determine how radioactive material is defined. Whether IUSA was paid a "substantial sum," as Utah emphasizes, a nominal sum, or had to pay a sum to acquire the Ashland 2 material has no bearing on health and safety issues. Therefore, this is not appropriately the Commission's concern and also should have no bearing on whether the resulting tailings meet the statutory definition of byproduct material under § 11e.(2).

While it may be true, as Utah states, that when Congress enacted UMTRCA there was no "thought of using offsite active uranium mills to process and dispose of industrial cleanup waste from FUSRAP sites," Utah's Reply Brief at 5, several Congressmen did express an interest in having private corporations take and reprocess materials as a means to offset the federal government's ultimate disposal costs for cleaning up UMTRCA's designated Title I sites. See, e.g., UMTRCA Hearings on H.R. 13382, H.R. 12938, H.R. 12535, and H.R. 13049 ("UMTRCA Hearings II") Subcomm. On Energy & the Environment, House Comm. On Interior & Insular Affairs (1978) at 82 (statement of Rep. Weaver)(some "companies might be interested in sharing the cost of stabilization of tailings in return for access to minerals remaining in the piles").(7) Then Chairman Hendrie voiced no objection, stating that "[i]f they want to reprocess the piling to make a complete recovery of the resource there, I think that is fine from a conservation standpoint. It also puts them back in the active business of milling." See UMTRCA Hearings II at 82.

Here, the Ashland 2 material has been approved for processing and disposal, and the resulting byproduct material will be disposed of pursuant to the same health and safety standards that apply to any other 11e.(2) material in an NRC-licensed mill: 10 C.F.R. Part 40, Appendix A. Though Utah may be dissatisfied with those standards, an adjudicatory proceeding is not the appropriate forum to contest generic NRC requirements or regulations. See, e.g., Duke Energy Corporation (Oconee Nuclear Station, Units 1, 3, and 3), CLI-99-11, 49 NRC 328, 334 (1999).

We note, additionally, that early in the proceeding Utah expressed concern that the Ashland 2 material, contrary to the NRC staff's findings, possibly contained listed hazardous waste. But while the accuracy of the license application can appropriately be the subject of an adjudication, notwithstanding staff findings, here subsequent events have rendered Utah's hazardous waste concern moot. Following negotiations with IUSA and, after analyzing investigations and data from the Ashland 2 site, Utah formally withdrew its allegation that the Ashland 2 material may contain listed hazardous waste. See Utah's Appeal Brief at 3 n.2. Instead, although Utah is upset that the staff's allegedly "scanty" review took only "about six weeks," its own review failed to uncover any errors in the staff's conclusion that the material contains no listed hazardous waste. Utah's remaining generalized complaint about how the staff reached its conclusion is not a litigable issue, given that Utah now concurs with the staff's conclusion and no longer alleges the presence of any listed hazardous waste.

Nevertheless, such disputes about the presence of hazardous waste are likely to recur, and the issue is a significant one, implicating three concerns: (1) possible health and safety issues, (2) the potential for an undesirable, complex NRC-EPA "dual regulation" of the same tailings impoundment, and (3) the potential for jeopardizing the ultimate transfer of the tailings pile to the U.S. government, for perpetual custody and maintenance. See generally UMTRCA, Title II, § 202 (Section 83 of the AEA). In view of our decision that the Alternate Feed Guidance requires revision to reflect our decision on the 11e.(2) definition, we will direct the staff to consider whether the Guidance also should be revised to include more definitive and objective requirements or tests to assure that listed hazardous or toxic waste is not present in the proposed feed material. We note, for example, that in a recent license amendment proceeding, the Presiding Officer declared it simply "impossible" for him to "ascertain the basis for the Staff determination that this material is not hazardous." International Uranium (USA) Corp. (White Mesa Uranium Mill), LBP-97-12, 46 NRC 1, 5 (1997). Similarly, in another earlier proceeding, the Presiding Officer found that the "Staff's new guidance for determining whether feed material is a mixed [or hazardous] waste appears confusing," and accordingly suggested there be more "specific protocols ... to determine if alternate feed materials contain hazardous components." UMETCO, 37 NRC at 280-81. The Commission concludes that this issue warrants further staff refinement and standardization.

In conclusion, applying the Commission's statutory interpretation of § 11e.(2) byproduct material, the Commission finds that the IUSA license amendment properly was issued and that the mill tailings at issue do constitute § 11e.(2) byproduct material. From the information in the record, we believe that it was reasonable for the NRC staff to have concluded that: (1) processing would take place, and (2) uranium would be recovered from the ore. Utah itself has acknowledged that "[i]n three different estimates, taken from DOE documents, the average uranium content of the material ranged from a high of 0.058% to a low of 0.008%." See Utah's Appeal Brief at 4; see also Utah's Brief in Opposition to IUSA's License Amendment (Dec. 7, 1998)("Utah's Brief in Opposition") at 8, and Attachment at 7-8. Utah's own expert estimated that up to $617,000 worth of uranium might be recovered from the Ashland 2 material. See Utah's Brief in Opposition at 8, and Attachment at 9. Utah's primary argument all along has been that the monetary value of the recovered uranium would be much lower than the 4 million dollar payment IUSA would receive, not that no source material would be recovered through processing. See, e.g., id., Attachment at 9 (where Utah's expert stressed that the value of the uranium-238 that could be extracted from the Ashland 2 material "represents a fraction (1.6 to 15 percent) of the $4,050,000 that [IUSA] will receive from Material Handling & Disposal Services fees"); Utah's Reply Brief at 11 (the "disposal fee received by [IUSA] ... is almost 60 times the value of the uranium recovery").

Not only was it reasonable to conclude that uranium could be recovered from the Ashland 2 material, but it was also reasonable to conclude that the processing would indeed take place. IUSA had a contractual commitment to do so; its contract with the Army Corps of Engineers required IUSA to process the material prior to disposal. See IUSA Brief at 18, 25. In addition, as the Presiding Officer noted, "IUSA has a history of successfully extracting uranium from alternate feed material and has developed credibility with the NRC ... for fulfilling its proposals to recover uranium from alternate feeds." 49 NRC at 112. This was not an instance, then, where there was no reasonable expectation that the mill operator would in fact process material through the mill to extract recoverable uranium. Moreover, it is also the Commission's understanding that the Ashland 2 material has in fact been processed in the IUSA mill and that approximately 8,000 pounds of uranium were extracted. While that quantity of uranium was on the low end of IUSA's estimates, it nevertheless represents more than a minute or negligible recovery of uranium.(8)

The Commission concludes, therefore, that the Presiding Officer's interpretation of the § 11e.(2) definition reflects a sensible reading of the UMTRCA statute and legislative history -- one we hereby embrace -- and that the record overall supports the issuance of the license amendment.

III. Conclusion

For the foregoing reasons, LBP-99-5 is affirmed.

IT IS SO ORDERED.

For the Commission

[original signed by]

____
Annette L. Vietti-Cook
Secretary of the Commission

Dated at Rockville, Maryland,
this 10th day of February, 2000.

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1. IUSA made a similar request to receive, process, and dispose of uranium-bearing material from the nearby Ashland 1 and Seaway Area D FUSRAP sites. That license amendment is the subject of a separate NRC adjudicatory proceeding (Docket No. 40-8681-MLA-5) currently held in abeyance pending the outcome of this appeal.

2. In fact, when the Guidance was first proposed, there was a description of how owners of low-level or mixed waste, facing the high costs of disposal, might find it "very attractive" to "pay a mill operator substantially less to process [the material] for its uranium content and dispose of the resulting 11e.(2) material," rather than to pay for disposal at a low-level or mixed waste facility. See "Uranium Mill Facilities, Request for Public Comments on Guidance on the Use of Uranium Mill Feed Materials Other Than Natural Ores," 57 Fed. Reg. 20,525, 20,533 (May 13, 1992)("Proposed Guidance"). The Proposed Guidance labeled such transactions "sham disposals," and implied they "would not meet the definition of 11e.(2) byproduct material." Id. at 20,533.

3. "Source material" has been defined by the Commission to exclude ores containing less than 0.05% of uranium or thorium. 10 C.F.R. § 40.4.

4. See also, e.g. Kerr-McGee, 903 F.2d at 7 (where the court suggested that the word "primarily" in the § 11e.(2) definition could be read to mean "substantially," and thus the tailings from the coproduction of source material and rare earths could still be deemed 11e.(2) byproduct material so long as one of the reasons for processing the ore was for extracting source material). The court's reasoning in Kerr-McGee is consistent with the UMTRCA history, which reflects that it has long been the case, for instance, that both vanadium and uranium might be extracted during a processing of material, and indeed that the amount of recoverable vanadium may very likely be much greater than that of the recoverable uranium. See, e.g., UMTRCA Hearings I at 155 (where private company reprocessing material was extracting 2 ½ pounds of vanadium for every ½ pound of uranium extracted); see also UMTRCA Hearings III at 136 ("We recover ... about 1,000 pounds a day of uranium, about 4,000 pounds of vanadium"). There was never any suggestion in the legislative history that if the amount or value of the vanadium proved higher than that of the uranium, the tailings could not be categorized as 11e.(2) byproduct material.

5. The Commission has promulgated no regulation implementing the Guidance. Thus, the Commission's rejection of the Guidance does not present a situation where the Commission has altered "suddenly and sub silentio settled interpretations of its own regulations." Natural Resources Defense Council, Inc. v. NRC, 695 F.2d 623, 625 (D.C. Cir. 1982). See generally Syncor Int'l Corp. v. Shalala, 127 F.3d 90 (D.C. Cir. 1997); Paralyzed Veterans of America v. D.C. Arena L.P., 117 F.3d 579 (1997), cert. denied, 523 U.S. 1003 (1998); United Technologies Corp. v. EPA, 821 F.2d 714 (D.C. Cir. 1987).

6. See, e.g., Final Rule, Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. 28,467, 28,484 (June 5, 1996); Kansas Gas & Elec. Co. (Wolf Creek Generating Station, Unit 1), CLI-99-19, 49 NRC 441 (1999).

7. See also, e.g., UMTRCA Hearings 1 at 89-90 (written statement of Rep. Johnson); Hearings On S.3008, S.3078, and S.3253 ("UMTRCA Hearings III") Subcomm. On Energy Prod. & Supply, Senate Comm. On Energy & Natural Resources (1978) at 59 (statement of Sen. Haskell)(if private companies reprocessed some of the tailings, that would be regulated under the NRC's regulations).

8. Moreover, even if we had adhered to and sought to apply the Guidance's tests for licensee "motives," the record does not show that IUSA processed the Ashland 2 material as a means to change non-11e.(2) material into § 11e.(2) material. IUSA was aware that the NRC staff had accepted a DOE certification declaring that the Ashland 2 FUSRAP material met the 11e.(2) byproduct material definition. Based upon the DOE certification, the staff had concluded that "the material could be disposed of directly in the White Mesa tailings impoundments," without any need of processing at the mill. See Technical Evaluation Report at 6, attached to Amendment 6 to Source Material License Sua-1358 (June 23, 1998). The staff thus claims that "sham disposal" was not a concern "since it did not appear that the material was being processed to change its legal definition, and as such was truly being processed for its uranium content." See Staff Aff. of Joseph Holonich at 7. Whether the Ashland 2 material actually already was § 11e.(2) byproduct material under UMTRCA remains unclear. See supra at 6-7. Nevertheless,

IUSA was aware that DOE, the Army Corps of Engineers, and the NRC staff all had categorized the material as such, and that the staff indeed had stated that this was material that could have been disposed of without any further processing. This suggests that IUSA had a genuine interest in processing the material for the uranium and not simply an interest in "reclassifying" the material by processing it. The subtle and complex nature of this inquiry, however, reinforces our view that discerning a licensee's motives for a license amendment transaction is a difficult, virtually impossible and, in any event, unnecessary exercise. Accordingly, our approach in this decision rejects ultimate business motivations as irrelevant to the § 11e.(2) definition.

Exhibit 13

INTERNATIONAL
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October 17, 2001

VIA EXPRESS COURIER

40-8681

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Fuel Cycle Licensing Branch
Mail Stop T-8A33
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U.S. Nuclear Regulatory Commission
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Re: Information on Drummed Uranium Material
Amendment Request to Process an Alternate Feed Material from Molycorp at White Mesa Uranium Mill
Source Material License No. SUA-1358

Dear Mr. Leach:

International Uranium (USA) Corporation ("IUSA") submitted on December 13, 2000 a request to amend Source Material License No. SUA-1358 to authorize receipt and processing of a uranium-bearing material from the Molycorp, Inc. ("Molycorp") facility located in Mountain Pass, California (the "Mountain Pass Facility"). This material resulted from the mineral recovery of natural ore for the production of lanthanides. IUSA also submitted supplemental information to NRC on January 2, 2001 relating to this amendment request. The material addressed in IUSA's amendment request and supplemental information letter will be removed by Molycorp's Lanthanide Division from three former impoundments at their mine and mill site at the Mountain Pass facility. The amendment request and January 2, 2001 letter referred to the material to be removed from the three Molycorp impoundments as the "Uranium Material." That Uranium Material is referred to herein as the "Pond Uranium Material." This letter addresses a small quantity of additional material from the Mountain Pass facility, currently stored in approximately 36 drums at that facility, which IUSA requests be included in the foregoing requested license amendment. This additional material is referred to herein as the "Drummed Uranium Material."

The Drummed Uranium Material is similar to the Pond Uranium Material in source, chemical composition, radiological composition, and physical properties, and is expected to be indistinguishable from the Pond Uranium Material during and after processing at the White Mesa Mill (the "Mill"), and in its impacts on Mill tailings. This letter provides a detailed comparison of the Pond Uranium Material with the Drummed Uranium Material, and demonstrates that the

NMSS01 Public

Drummed Uranium Material is sufficiently similar that it can properly be included with the Pond Uranium Material in the same license amendment.

Historical Summary of Sources

As described in the January 2, 2001 letter, Molycorp has operated a surface mining and milling operation for the mineral recovery and chemical separation of lanthanides and other rare earths from bastnasite ores since the 1950's. From 1965 through 1984 Molycorp constructed and operated three lead sulfide ponds for the evaporation of lead sulfide sludges from the clarifier/thickener operation. The lead sulfide sludges contain uranium, which is also precipitated in the thickener. All three of the lead sulfide ponds were taken out of service prior to 1985. All of the Pond Uranium Material comes from these ponds and is associated with these pre-1985 activities.

From 1985 onward, the same uranium-bearing lead sulfide stream that had previously been transferred to the ponds, was managed as follows. From 1986 through 1995, this material was filtered and accumulated in drums. In 1995, Molycorp treated the drum contents with stabilization cement and sodium silicate to stabilize the lead content. For the period from 1995 to 1998, the stabilized material was returned to the Molycorp mineral recovery circuit for further recovery of lanthanides. During the same period, a portion was also shipped off site to recovery facilities and/or land disposal facilities. A Molycorp flow sheet and text, which describe the operations that generated the Drummed Uranium Material, are provided in Attachment 1.

The stabilized material that was returned to the Molycorp mineral recovery circuit was reintroduced just prior to the hydrochloric acid leaching step, and continued through the remainder of the circuit with the roasted bastnasite ores. These activities ceased in March 1998. The reintroduction area, containing only the equipment where the stabilized material was repulped and slurried, was decommissioned under the oversight of the State of California environmental authority after March 1998. The residuals from these decommissioning activities, containing the original stabilized drum contents treated with leach acid, were returned to drums. The approximately 36 drums (approximately 11 tons) from this area constitute the "Drummed Uranium Material."

The portion of the stabilized drummed material that Molycorp had previously shipped off site to other facilities was estimated to contain less than 0.05 percent total uranium and thorium. That material exhibited the RCRA TCLP characteristic for lead, and was shipped as RCRA characteristic waste D008. None of this previously shipped material will be included in the Drummed Uranium Material to be shipped to the Mill.

The Drummed Uranium Material to be shipped to the Mill is estimated to contain greater than 0.05 percent total uranium and thorium. Amendment 10 to Molycorp's Radioactive Material License, issued by the State of California, indicates that all the drummed stabilized lead sulfide sludges at the Mountain Pass facility have been classified as uranium and thorium source material. A copy of Molycorp's License Amendment 10 is provided in Attachment 2. Molycorp personnel have conducted ongoing telephone communications with the State of California environmental authorities, throughout 2001, regarding modifications to Molycorp's decommissioning work plans. According to Molycorp personnel, based on those communications, the Drummed Uranium Material will be classified as uranium and thorium source material.

The December 13, 2000 amendment request sought authorization to process approximately 21,300 tons (16,400 CY) of Pond Uranium Material at the Mill as an alternate feed/ore. This letter requests that up to approximately 50 additional drums (approximately 16 tons) of Drummed Uranium Material be included in the same license amendment as the Pond Uranium Material for processing as an alternate feed/ore at the Mill, to ensure that all of the Drummed Uranium Material is also included in the requested amendment.

Radiochemical Data

Molycorp estimates that the Drummed Uranium Material has an approximate uranium content ranging from 0.10 percent to approximately 0.14 weight percent (0.12 to 0.18 percent U_3O_8), or greater, with an estimated overall average grade of 0.12 percent uranium (0.14 percent U_3O_8) for the entire volume of Drummed Uranium Material. This average uranium content is very similar to the Pond Uranium Material, which was estimated to have a uranium content ranging from 0.002 to 0.49 weight percent (0.0024 to 0.59 percent U_3O_8) and an approximate average of 0.15 weight percent uranium (0.18 percent U_3O_8). Data provided by Molycorp on the radiochemical content of the Drummed Uranium Material is included in Attachment 3.

According to data provided by Molycorp, the Drummed Uranium Material may have an approximate total thorium content ranging from 11 to 288 mg/kg (ppm). According to data provided by Molycorp, the Pond Uranium Material may have an approximate total thorium content ranging from 62 to 5954 mg/kg (ppm).

Consequently, as demonstrated by the Molycorp data, the Drummed Uranium Material is expected to be comparable in uranium content, but may be significantly lower in thorium content, than the Pond Uranium Material.

Hazardous Constituent Data

The December 13, 2000 amendment request demonstrated that the Pond Uranium Material was not and did not contain RCRA listed hazardous waste as defined in 40 CFR 261 et. seq. As will be described under the Chemical Composition and Hazardous Waste Protocol Sections, below, the Drummed Uranium Material also is not, and does not contain, RCRA listed hazardous waste.

Exhibit 14

Request to Amend
Source Material License SUA-1358
White Mesa Mill
Docket No. 40-8681

September 20, 1996

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Rockville, MD 20852

INTRODUCTION

Energy Fuels Nuclear, Inc. ("EFN") operates an NRC-licensed uranium mill located approximately six miles south of Blanding, Utah. The mill processes natural (native, raw) uranium ores and feed materials other than natural ores. These alternate feed materials are generally processing products from other extraction procedures, which EFN will process primarily for the source material content. All waste associated with this processing is, therefore, 11e.(2) byproduct material; or, as stated in the alternate feed analysis noticed in Federal Register Volume 57, No. 93:

> "The fact that the term 'any ore' rather than 'unrefined and unprocessed ore' is used in the definition of 11e.(2) byproduct material implies that a broader range of feed materials could be processed in a mill, with the wastes still being considered as 11e.(2) byproduct material".

This application to amend NRC Source Material License SUA-1358 requests an amendment to allow EFN to process a specific alternate feed primarily for its source material content, and to dispose of the associated 11e.(2) byproduct material.

1.0 MATERIAL COMPOSITION AND VOLUME

Allied Signal, Inc. of Metropolis, Illinois, ("Allied") will repackage (as necessary), prepare, and load for shipping material described as uranium-bearing potassium diurinate ($K_2U_2O_7$) in a solution of potassium hydroxide/potassium fluoride ("KOH/KF") in water ("Material"). This Material is currently contained in approximately 11,000 drums. Approximately 110 loads, or 4,000 to 5,000 of 55-gallon drums (900 tons), of dry material will be shipped in drums, and approximately 98 loads will be shipped in slurry form (in tanker trucks) to the White Mesa Mill ("the Mill"). Specific gravity of the slurry is approximately 1.5 to 1.6. Approximately 5,000 cu. ft. of compacted drums, resulting from the repackaging of the Material, having been washed, pelletized, and wrapped, will also be sent to the Mill. It has been standard practice to dispose of drums in which alternate feed material is contained as 11e.(2) byproduct material as they are emptied for processing of the Material; however, in this case, environmental and waste minimization considerations demand that some of the Material be emptied from drums and shipped in tankers as slurry. The drums, however, remain an element of this recycling process. Further, as discussed below in subsection 1.3, these drums are considered to have become 11e.(2) byproduct when U_3O_8 (yellowcake) was placed in the drums for shipment to Allied.

Exhibit 15

Request to Amend
Source Material License SUA-1358
White Mesa Mill
Docket No. 40-8681

March 16, 2000

Prepared by:
International Uranium (USA) Corporation
1050 17th Street, Suite 950
Denver, CO 80265

Contact: Michelle R. Rehmann, Environmental Manager
Phone: (303) 389.4131

Submitted to:
United States Nuclear Regulatory Commission
2 White Flint North, Mail Stop T-7J9
11545 Rockville Pike
Rockville, MD 20852

S:\MRR\Linde\LindeAR

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INTRODUCTION

International Uranium (USA) Corporation ("IUSA") operates the NRC-licensed White Mesa uranium mill (the "Mill") located approximately six miles south of Blanding, Utah. The mill processes natural (native, raw) uranium ores and feed materials other than natural ores. These alternate feed materials are generally processing byproducts from other extraction procedures, which IUSA processes at IUSA's licensed uranium mill, primarily for their source material content. All waste associated with IUSA's processing is therefore 11e.(2) byproduct material.

This application to amend NRC Source Material License SUA-1358 requests an amendment to allow IUSA to process a specific alternate feed, and to dispose of the resulting 11e.(2) byproduct material in accordance with the Mill operating procedures.

Yellowcake produced from the processing of this material will not cause the currently-approved yellowcake production limit of 4,380 tons per year ("TPY") to be exceeded. In addition, and as a result, radiological doses to members of the public in the vicinity of the Mill will not be elevated above levels previously assessed and approved.

1.0 MATERIAL COMPOSITION AND VOLUME

IUSA is requesting an amendment to Source Material License SUA-1358 to authorize receipt and processing of certain uranium-bearing byproducts, which byproducts originally resulted from the processing of natural ore for the extraction of uranium. For ease of reference, this byproduct material is referred to herein as the "Uranium Material". The Uranium Material is located at a property being managed under the Formerly Utilized Sites Remedial Action Program ("FUSRAP") in Tonawanda, New York, known as the Linde property. The Linde property is one of four properties that comprise the Tonawanda Site. NRC has already granted license amendments to IUSA to process material from two of the other properties within the Tonawanda site, Ashland 1 and Ashland 2 which contained uranium byproduct material originally generated at the Linde property. The Uranium Material is not a residue from a water treatment process.

The Uranium Material will be transported by a U.S. Army Corps of Engineers ("USACE", or the "Corps") contractor, as part of the FUSRAP Program, from the Linde property to the Mill. A historic summary of the sources of the Uranium Material is provided below. This history was derived from the documents listed on page 4 of this Amendment Request.

1.1 Historical Summary of Sources

As described above, the Linde property is one of several properties within the Tonawanda, New York FUSRAP site, which includes Linde, Ashland 1, Ashland 2, and Seaway. The regional setting of Linde, Ashland 1, Ashland 2, and Seaway is shown in Figure 1-2 of Attachment 1. Figure 1-3 shows the specific locations of the Linde, Ashland 1, Ashland 2, and Seaway properties.

Union Carbide Corporation's former Linde Air Products Division purchased the Linde property and constructed a ceramics plant at the location in 1942. One of the ceramics processes conducted by Union Carbide Linde Division at this location consisted of extraction of uranium from ores to produce uranium salts, for coloration of product glasses. Based on their experience, Union Carbide was placed under contract with the Manhattan Engineering District ("MED") from 1942 to 1946 to extract uranium from seven different ore sources: four African pitchblende ores and three domestic ores. Laboratory and pilot plant studies were conducted from 1942 to 1943. From 1943 to 1946, Linde conducted full scale processing of 28,300 tons of ore. The Linde Division contract with the MED ended in the early 1950's.

The domestic ores processed at Linde were in fact residuals from commercial processing at other facilities which removed vanadium. The vanadium removal process also removed radium and other daughter products in the decay chain. As a result, the domestic uranium ores supplied to Linde had reduced concentrations of radium relative to the uranium and thorium levels. The African ores contained uranium in equilibrium with all the daughter products in its decay chain.

Figures D-1 through D-4, of the United States Department of Energy ("USDOE") Preliminary Site Assessment in Attachment 1, show the three-phase processes used for domestic and foreign ores. Triuranium octoxide ("U_3O_8") was separated from the feedstock by acid digestion, precipitation, and filtration. The solid, gelatinous filter cake from this step was discarded as solid waste in a temporary tailings pile on the Linde site. Insoluble precipitates from the solution steps were combined with the filter cake for disposal on site. Approximately 8,000 tons of filter cake and precipitates were later relocated to Ashland 1. U_3O_8 was converted to uranium dioxide and uranium tetrafluoride at the Linde site. Residuals from these two steps were reprocessed. A more detailed discussion of the ore composition, recovery processes, and waste disposal practices is provided in Attachment 1.

Five buildings at the site were involved in MED activities. Building 14 had been constructed by Union Carbide in the mid-1930's. Buildings 30, 31, 37, and 38 were constructed at the location by MED, and their ownership was transferred to Linde when the MED contract ended.

Residues from uranium ore processing at the Linde facility were disposed of and/or stored at the Ashland 1, Ashland 2 and Seaway properties. The majority of Linde facility residues were disposed of on the Ashland 1 property between 1944 and 1946. No material was transferred from Linde to Ashland 1 after this period. In 1974, the subsequent owner of the Ashland 1 property excavated a portion of the Linde residues and soils from the Ashland 1 site, and relocated them to the Ashland 2 property. NRC has already approved amendments to IUSA's license for processing of the portion of the Linde residues and soil moved to Ashland 1 and Ashland 2.

After transfer of residues to Ashland 1 was completed, Linde added manufacturing operations at the Linde facility that very likely contributed additional contaminants to materials remaining on the Linde site, but would not have affected materials already transferred to Ashland 1 and/or Ashland 2.

From 1955 to 1991, the Linde Division operated a gas equipment design and manufacturing facility on the property. The operation included design, manufacture, testing, and repair of gas compressors, chillers, filters and other equipment for installation at customer sites. The Linde Division was divested from Union Carbide in 1991, and changed its name to Praxair. Praxair discontinued manufacturing operations in 1991 but maintained engineering design offices on the property. There is no record of any processing activities other than uranium processing, occurring on the property, either before or after the MED activities.

Renovation of the facility over the years has resulted in consolidation of the MED wastes and radioactively contaminated soils remaining at the property. In 1977, MED contaminated soil was removed from the construction area for the new building 90, and placed in two windrows along the northern property line. The windrows were consolidated into one pile between 1979 and 1982, and covered in 1992.

The USDOE and the U.S. Environmental Protection Agency ("EPA") negotiated a Federal Facilities Agreement ("FFA") governing remediation of the Linde property. In 1997, Congress transferred management responsibility for the sites in the FUSRAP program, including the Linde Site, to the USACE. All actions by the USACE at the Linde Site are being conducted subject to the administrative, procedural and regulatory provisions of the Comprehensive Environmental Response Compensation and Liability Act ("CERCLA") and the existing FFA.

USACE issued a Proposed Plan for the Linde Property in 1999 (USACE, March 1999) and a Final Record of Decision ("ROD") in 2000 (USACE, March 2000). As a result, sufficient characterization information on the nature and extent of contamination is already available to assess the composition and sources of Uranium Material to be excavated.

Over the years, erosion and weathering have spread contamination from the residuals handled and disposed of at Linde to adjacent soils, increasing the volume of Uranium Materials to be removed during the remedial excavation. Physically, the Uranium Material is a moist material consisting of byproducts from uranium processing operations (i.e., "tailings"), mixed with site soils (Remedial Investigation ("RI") Report USDOE, 1992). According to the USACE Buffalo District, the USACE estimates the volume of soil to be excavated from the entire Linde property to range from approximately 35,000 to 70,000 cubic yards ("CY") or somewhat more, depending on conditions encountered during excavation. These volumes are estimates only. It is difficult to estimate the extent to which surrounding soils have been contaminated by the tailings, and hence the potential volumes, with precision. Pre-excavation estimates at other FUSRAP sites in Tonawanda have been as low as one-half the actual excavated volume. Therefore, to ensure that IUSA will not have to reapply for an increased volume from this site in the future, this request is for up to 100,000 CY of Uranium Material.

As described in detail below, 100,000 CY would not come near the Mill's currently approved yellowcake production limit of 4,380 TPY, and as, even without reprocessing, the composition of the Uranium Materials is very similar to the Mill's existing tailings, added volumes of Uranium Material will have no adverse effect on public health, safety, and the environment.

USACE expects to excavate and deliver the Linde Site materials over a period of ten to fourteen months or longer. IUSA has previously received NRC approval for a license amendment to process Uranium Material from the St, Louis FUSRAP site. As described in the IUSA Request for Amendment for the St. Louis material, the USACE may be expected to excavate and ship approximately 20,000 to 80,000 CY per year of Uranium Material from the St. Louis Site, and IUSA would expect to process this material over several years. If the entire volume of Linde material were received during a period that overlapped with shipments of the St. Louis material, the processing of the total estimated volume of 180,000 CY in one year would not come near the Mill's currently approved yellowcake production limit of 4,380 TPY.

Additional information on the Linde property is contained in Attachments 1 and 2. Attachment 1 includes the following items describing the Uranium Materials and the Linde property operational history:

1. A detailed site history of the Tonawanda Site, including the Linde property, is provided in Chapter 1 of the Remedial Investigation Report for the Tonawanda Site (USDOE, December 1992) (the "RI").

2. Additional detail on the uranium extraction process is provided in Section 7.0 of the Preliminary Assessment and Site Investigation for Linde Air Products Division of Union Carbide (USDOE, September 1987).

Attachment 2 includes the following items describing the composition of the Uranium Materials:

1. Chapters 3 and 4 of the Remedial Investigation Report for the Tonawanda Site (USDOE, December, 1992) describe uranium concentrations and metals and organic contaminant concentrations in surface and subsurface samples at the Linde property.

2. Portions of the Radiological Survey of the Ashland Oil Company (Former Haist Property), Tonawanda, New York (U.S. Department of Energy, May 1978) describe uranium concentrations in core samples and approximate distributions of tailings stored on the Linde property.

3. A summary of the concentrations of chemical contaminants is provided in the Linde Site Preliminary Material Characterization Report (USACE/IT, February 2000).

4. Portions of the Preliminary Plan for the Linde Site (USACE, March 1999) describe site history and radiological contamination.

5. Portions of the Record of Decision for the Linde Site (USACE, March 2000) describe the regulatory framework and remediation goals relative to the radiological and chemical contamination at the site.

Exhibit 16

State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WASTE MANAGEMENT
AND RADIATION CONTROL
Scott T. Anderson
Director

April 26, 2016

Binesh Tharakan
U.S. NRC Region IV
Division of Nuclear Materials Safety
1600E. Lamar Blvd
Arlington, TX 76011-4511

RE: Transportation Incident at the White Mesa Mill Involving an 11e.(2) Shipment

Dear Mr. Tharakan:

On March 29, 2016, Energy Fuels Resources Inc.'s (EFRI) White Mesa Uranium Mill contacted the Division of Waste Management and Radiation Control to report a leaking shipment of 11e.(2) material that had arrived at its facility. The Radiation Safety Officer of the Mill described the material as a white paste like substance. The 11e.(2) shipment originated from the Cameco-Smith Ranch facility (a Nuclear Regulatory Commission (NRC) licensed facility) in Wyoming and was sent to the Mill to be disposed in the Mill's tailings cells.

The Mill's radiation safety staff documented the leak with photographs, radiological surveys and a written description. Documentation of the leak indicates that 11e.(2) material leaked onto the transport container, the transport conveyance and U.S. Highway 191 near the Mill. During transport, a winter storm with rain and snow went through Wyoming, Colorado and Utah when this incident occurred (March 28 and 29, 2016). Therefore, there is a high probability that any road contamination would have been washed away and making it impossible to determine when the leaking of the transport began.

A further description of the incident from EFRI dated April 4, 2016, including radiological survey results, is enclosed.

The following regulations are applicable to this incident:

1. 49 CFR 173.427(c)(1) – *Transportation requirements for low specific activity (LSA) Class 7 (radioactive) material and surface contaminated objects (SCO).*

(Over)

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Mailing Address: P.O. Box 144880 • Salt Lake City, UT 84114-4880
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www.deq.utah.gov
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2. 49 CFR 173.443 - *Contamination control*
3. 10 CFR 71.43(f) – *General standards for all packages*
4. 10 CFR 71.71 - *Normal conditions of transport*

Contrary to 49 CFR 173.427(c)(1), 10 CFR 71.43(f) and 10 CFR 71.71, the Cameco-Smith Ranch Facility sent an 11e.(2) shipment to the White Mesa Mill in a roll-off container that did not contain the material under routine (normal) conditions of transport.

Contrary to 49 CFR 173.443, leakage from that container resulted in removable contamination on the outside of the container that exceeded DOT contamination limits for Alpha and an exterior dose rate greater than 0.5 mrem per hour.

This is the second incident of this type that has been reported to the Division with the first being reported on August 21, 2015. The Division requests that NRC take appropriate regulatory action with Cameco-Smith Ranch to prevent recurrence. Please find enclosed the EFRI report of the incident, photographs and shipping papers.

If you have any questions, please call Ryan Johnson at (801) 536-4255.

Sincerely,

Scott T. Anderson, Director
Division of Waste Management and Radiation Control

STA/RMJ/ka

Enclosures: Documentation Letter, dated April 4, 2016 (DRC-2016-006042)
Cameco Smith Ranch Shipping Paperwork (DRC-2016-006041)
Photographs (DRC-2016-006044)
Email from Ryan Johnson, dated March 29, 2016 (DRC-2016-006045)

c: Worthy Glover, Jr., MMHRM, CPM, Health Office San Juan Public Health Department
Rick Meyer, Environmental Health Director, San Juan Public Health Department
David Ariotti, P.E., DEQ District Engineer
Ms. Linda Gersey, U.S. NRC Region IV, Division of Nuclear Materials Safety
Ryan S. Schierman, State of Wyoming, Wyoming Department of Environmental Quality, Natural Resources Program Manager
Jennifer Opila, Colorado Department of Public Health & the Environment, Hazardous Materials & Waste Management Division, Radiation Program, Program Manager

Exhibit 17

ENERGY FUELS

Energy Fuels Resources (USA) Inc.
6425 South Highway 191, PO Box 809
Blanding, UT. US, 84511
435 678 2221, fax 435 678 2224
www.energyfuels.com

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Division of Radiation Control

"DRC-2013-003465"

November 8, 2013

VIA UPS GROUND

Mr. Rusty Lundberg
Division of Radiation Control
State of Utah Department of Environmental Quality
195 North 1950 West
Salt Lake City, Utah 84114-4850

Re: Energy Fuels Resources (USA) Inc. White Mesa Mill, Blanding, Utah License Number UT1900479; Annual Summary of Disposal of 11e.(2) Byproduct Waste Material

Dear Mr. Lundberg:

Please find attached the annual summary of 11e.(2) Byproduct Waste Material which was disposed of at Energy Fuels Resources (USA) Inc.'s White Mesa Mill, Blanding, Utah for the year 2012.

This information is provided in accordance with License Condition 10.5 F. of Radioactive Materials License Number UT1900479. Should you have any questions regarding this information, please do not hesitate to call me at the mill at 435.678.2221.

Sincerely,

David Turk
Manager Environmental Health and Safety
Energy Fuels Resources (USA) Inc.

cc: David C. Frydenlund
Harold R. Roberts
Jo Ann Tischler

Energy Fuels Resources (USA) Inc. 11e.(2) Receipts for 2012

Generator	Received Tons 2012	Received Cubic Yards 2012	Tons Received from Inception	Cubic Yards Received from Inception	Comments
Crow Butte Resources	44.40	180.00	425.99	1100.00	Active
IEC	0.00	0.00	4826.37	4920.00	Closed
Mestena Uranium, L.L.C - Alta Mesa ISL Project	329.80	412.80	2950.71	2892.65	Active
Cameco - Highland	645.90	1663.54	1260.65	2876.57	Active
Cameco - North Butte	0.00	0.00	94.24	211.10	Active
Cameco - Smith Ranch Property	645.90	1663.54	940.64	1853.48	Active
UEC - South Texas Mining	1109.10	871.50	4920.80	3938.50	Active
UEC - Goliad	0.00	0.00	0.00	0.00	Active
UEC - La Palangana	74.30	95.50	167.90	171.50	Active
URI, Inc. - Rosita	0.00	0.00	489.27	588.79	Active
URI, Inc. - Kingsville Dome ISR Project	202.60	177.60	651.56	888.26	Active
URI, Inc. - Vasquez ISR Project	0.00	0.00	34.13	45.70	Active
USX - Texas Uranium operations	0.00	0.00	5099.99	4636.35	Closed

Exhibit 18

EU-NORM
1st International Symposium

5-8 June 2012
Tallinn, Estonia

PROCEEDINGS

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NORM Related Production of Rare Earth Metals in Estonia

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[2]*Radiation Safety Department, Environmental Board, Estonia*

Abstract

Since 1970's rare earth, Nb and Ta metals and their compounds are produced in the plant, located at Sillamäe, Estonia. In imported mineral ores, which are used as commercial feedstock materials, NORM concentrations (both ^{238}U and ^{232}Th decay chain radionuclides) vary greatly, however they are usually high enough to cause exposure to workers and even sometimes concerns to the public. During processing operations radionuclides become mobilized, migrate to dusts, scales and process residues, leading to the enrichment in these materials. This means that the materials used and NORM waste produced as the by-product of processing, require proper management taking account the safety concerns. At workplaces doses to workers from external exposure, from radon/thoron and dusts in the air are or might be significantly higher than the dose limit for a member of the public. For this reason, these production activities are regulated as a radiation practice.

The paper gives an overview of performed studies and assessments on the impact of NORM, including material and waste streams, radiation exposures during pre-processing, chemical processing, generation of NORM waste, waste management and disposal, their environmental impact, etc. A comprehensive discussion on the establishment of the Estonian regulatory framework for NORM and the arising practical problems is also presented.

1. Introduction

In last decades multiple studies have identified the radiological concerns requiring regulatory control in specific NORM industries. EU has introduced the regulation of 'work activities' within its Directive 96/29/EURATOM (EC, 1996) and issued the recommendations for the implementation (EC, 1997). Production of niobium and tantalum, as well as of rare earths, belongs to work activities involving both potentially significant exposure of workers at the work-place (EC, 1999) and potential significance with regard to public exposure as a result of wastes and discharges (EC, 2003). The minerals in niobium (Nb) ores, various concentrates, oxides, etc., raw materials contain enhanced levels of NORM, mostly of ^{238}U, ^{232}Th and their decay products. Tantalum (Ta) occurs usually in combination with niobium and rare earths.

A major production facility of Nb, Ta and rare earths, Molycorp Silmet AS, is located at Sillamäe, North East Estonia. The large industrial complex produces the above materials (Nb, Ta metals and light rare earth metals as well as their compounds) from various imported ores and by-products.

The present paper discusses the establishment of the Estonian regulatory framework for NORM, the brief history of the facility at Sillamäe, performed studies and assessments on the impact of NORM at the Silmet facility, problems related to the generation of NORM waste, waste management and disposal, their environmental impact.

2. Radiation Act and related legislation

Estonia is a member state of the European Union since 1st May 2004. Thus, the regulations of the Union are in force in Estonia. When necessary, the Estonian regulations have been modified to take into account the EU regulations. The Radiation Act as the principal legal instrument of the radiation protection infrastructure was brought into force in 1997, while a new upgraded version was enforced in 2004 (Radiation Act, 2004). The Act bases on the concepts, principles, terms, and limits laid down in the International Basic Safety Standards (IAEA, 1995) and Directive 96/29/EURATOM (EC, 1996). The basic internationally approved principles, e.g., justification of practices, optimization of protection and safety, limitation of individual doses, adoption of justified and optimized interventions, the primary responsibility of the licensee, and authorization of practices, are explicitly formulated as provisions of the Act. The EU criteria for the exemption of practices from the requirements of the Act are adopted.

The Act sets requirements for identification and regulation of the work activities relevant to NORM. The general radiation safety principles apply also to the management of radioactive waste, including NORM waste, as well as those arising from decommissioning of a nuclear facility. According to the definitions given in the article 3 of the Radiation Act, radioactive waste is any material or object which contains or is contaminated by radionuclides, the activity or activity concentration of which exceeds the established clearance levels and for which no future use is foreseen.

The licensee in radiation practice is required to take any measures to render harmless radioactive wastes arising from its operation. The Regulation of the Minister of Environment No 10 (2005) issued under the Radiation Act specifies the requirements for radioactive waste management. Radioactive waste will be categorized by activity or specific activity, by half-life, by type of radiation and by heat generation as a result of radioactive decay. In conditioning and storing of radioactive waste their producer has to take into account, beside their type, also physical, chemical and biological properties of radioactive waste. Radioactive waste categorization includes NORM waste, which are defined as radioactive waste arising from processing of natural radionuclides, the activity concentration of which is higher than the exemption levels.

Article 59 of the Radiation Act sets that the dispersion, clearance and management of NORM waste, including the way of their storage, interim storage and disposal shall be determined by the license conditions. The Government Regulation No 163 (2004) enforces exemption levels for radionuclide activity and activity concentration in accordance with the terms and levels equal to those stipulated in the BSS (IAEA, 1995) and the EU Directive (EC,1999, 2003). Exemption levels are considered as basic criteria for decisions on licensing radiation practices. No license is needed for operations with activities or activity concentrations of radionuclides below the exemption levels. Examples of the exemption levels relevant to the raw material and waste containing NORM are given in Table 1.

Table 1. Exemption levels for NORM radionuclides

Radionuclide	Activity (Bq)	Activity concentration (kBq/kg)
^{210}Pb, ^{226}Ra, ^{235}U, ^{238}U	10^4	10
^{228}Th, ^{230}Th	10^4	1
^{232}Th nat, ^{238}Unat	10^3	1

For multiple radionuclides or mixtures in the materials, the sum of their activity or specific activity ratios to the corresponding exemption levels should be less than 1.

Environmental impact assessment procedure is required for radioactive waste management facilities, as they are considered in the legislation as activities with a significant environmental impact (EIA, 2005).

In 2009 in the course of reorganization, the Estonian Radiation Protection Centre, the former authority since 1996, was merged as a department with the Environmental Board. It is empowered to authorize practices by licensing, to assess practices and sources, to maintain the dose and source registers, to monitor and to assess radiation levels, to implement international conventions and agreements, to notify about the radiation accidents, etc. The other body, the Environmental Inspectorate, is provided to carry out regular inspections of the licensed radiation practices.

3. History of the Silmet facility

The large industrial complex at Sillamäe, about 190 km East from Tallinn, was launched as a top secret facility in 1948 for mining and milling of local alum shale (*dictyonema argillite*) containing ~ 0.03 % of U. Before Estonia regained independence, the facility under different names, including the Sillamäe Metallurgy Plant, was managed by the former USSR Ministry of Medium-Scale Engineering and it produced uranium for military and civil use. Later the mines were closed and much richer uranium ore of up to 1 % of U was imported from the Eastern European countries. Waste arising from uranium production was stored in a depository located near the Sillamäe plant, 20 - 50 m from the waterline of the Baltic Sea. After processing as a total of about 4 million tons of uranium ore, the uranium production was closed in 1977.

In the beginning of the 1970s the facility was modified for production of niobium, tantalum and rare earth metals, using loparite as a NORM-containing raw mineral from the Kola Peninsula. Later (till now) rare earths were produced from rare earth chloride mix. Composition of raw materials varies depending on the deposit, as niobium/tantalum are usually combined with iron, tin, titanium, manganese, radioactive elements (uranium, thorium) and their decay products. The composition and amount of technological waste from the processing depends on the share of each raw material type in its total amount. As the waste contained small amounts of thorium and uranium as well as their decay products, which were not recovered, the arising NORM waste were dumped together with other waste to the pond on top of uranium tailings depository near the plant. Since 1990 the main activity of the plant has been the continuation of the production of Nb and Ta metals and light rare earth metals as well as their compounds from various imported ores, e.g., columbite and chloride melts. In 1992 the facility becomes the state joint-stock company RAS Silmet, later AS Silmet and now Molycorp Silmet AS, which continues the production of Nb, Ta and rare earths.

With the establishment of the radiation protection infrastructure in Estonia, the NORM related working activities at the Silmet facility were considered of radiological concern, which required regulation as a licensed radiation practice. The performed studies, showed that at workplaces doses to workers from external exposure, from radon/thoron and dusts in the air were or might be higher than the established dose limits for a member of the public (see, e.g., Mustonen, R., et al., 2000). In addition, an analysis showed that the use of the former uranium tailings depository for dumping of the NORM waste might cause some radiological concerns to the members of the public (Realo, 2000).

4. Need for new NORM-waste management system

Until 2004 all radioactive waste from the rare earth and the rare metal production was dumped in the tailings pond. The first environmental impact assessment for the tailing pond was done in 1994 (Ehdwall et al, 1994, Nordlinder. S, et al. 1995). Mostly because of the impacts caused by releases and discharges of chemical pollutants from the depository and from the pond on its top, an international PHARE remediation project was initiated and the use of depository was terminated. The remediation project was successfully finished in 2008. As a result, the need arouse to work out a new waste management option for the produced NORM waste. For creation of the new waste management system according to the Radiation Act and waste laws, international agreements and other legal acts, a number of assessments and studies there have been carried out.

It became clear that future radioactive waste arising would be caused exclusively by the production process of the Silmet facility (CASSIOPEE, 2002). The volume and activity of radioactive waste to store or respectively to dispose of would depend on from the following:

- content of NORM radionuclides in the raw materials,
- amount of processed raw materials,
- waste management system.

In the period 2001-2003 the developed radioactive waste management system included radioactive waste separation at an early stage of the technological process. The volume of future radioactive waste arising was estimated to be maximum 2000 t/y before vitrification. The specific α-activity of about 7000 Bq/g was estimated for non-vitrified radioactive waste. It was considered that all radioactive waste should be treated and conditioned together and after packaging in the special containers, it would be stored in an interim storage facility of a modular type. After 50-100 years of the interim storage period the waste could be used as feedstock for further processing or disposed of in a final repository (Behre Dolbear & Company, 2002). In case of the final disposal, the waste vitrification option was considered. The vitrified radioactive waste would be dumped into the existing oil-shale ash storage of the local power plant located at the Western side of the former tailings pond dam. This solution represented practically a final near-surface disposal of vitrified long-lived radioactive waste.

5. Environmental impact assessment for NORM waste management

The EIA process for all waste management systems of the facility (including also other forms of waste produced at the plant) was initiated in 2001 (E-Konsult, 2003). As the EIA report provided limited information about the proposed management system for the NORM waste and about the proposed guarantees or assessments for financing of the management options, a special EIA process of the NORM waste management was started in 2003 (E-Konsult, 2004). To meet the public concerns, the EIA program was amended and points covering the possibilities for the future waste management were included. This EIA process was finished in June 2004 and the proposed NORM waste management system was approved.

As the starting point of the EIA process it was taken into account that annually up to 2000 t of NORM waste with activity concentrations of 3000-4000 Bq/g were produced. The estimated amounts and activities of waste are given in Table 2. It was planned that this waste in the drums should be stored temporarily outdoors before the interim storage facility would be finished. In the same time it was expected that after 50 year storage period there would be enough material collected to be of interest to the reprocessing companies, e.g., in Russia or elsewhere.

Table 2. Estimate of NORM-waste in 2003

Production line	Average amount of waste per 1 t of processed raw material (kg)	Average activity concentrations of waste (Bq/g)	Estimated annual amounts of waste (t)
Rare earth metals	300-350	4300	1400
Rare metals	170-200	2300	600

Three different storage packages were investigated:

1. concrete containers with the dimensions of 1.63x1.63x1.35 m, which could contain up to 2.1 tons of the solidified NORM-waste. Putting these containers in 4 layers, would allocate up to 3.15 t of waste on 1 m^2 of the storage,
2. containers used in sea transportation, where the waste would be put in the plastic bags,
3. metal drums with the plastic inside cover of the volume of 0.43 m^3 for or 0.38 t of waste.

As the waste contains ^{235}U and ^{232}Th with their decay products, including radon, after several assessments and practical experiments the preference was givent to the last option. Radon was estimated as the major factor in causing doses for the radiation workers. The studies resulted in the conclusion that the best solution was the use of double package, which should avoid the leakage of radon for at least 10 y.

The first stage of the EIA process resulted in rather high dose estimates to the radiation workers, e.g., with annual doses over 20 mSv at some operations. A significant overestimation of doses, as it appeared later, was mostly due to the fact that at the start only few real data were available and that many default values and extremely conservative assumptions were used in the assessments. After data corrections and considering realistic protective measures, more realistic dose assessments were performed. As a result of these additional improvements the estimated average annual doses to the radiation workers remained under 4 mSv. The maximum annual doses of about 15 mSv/y, requiring limited working hours in that area were identified for the workers at the packaging facility.

In the safety assessment a number of accident scenarios were also considered:

1. falling and breaking of the drum containing the solid NORM waste in the packaging area or during the transportation;
2. falling and breaking of the drum containing the solid NORM waste in the interim storage;
3. fire in the storage of raw material or in the interim storage of NORM waste;
4. release of the material in the production process.

Based on the assessments and changes on the market, the Silmet plant started to import raw materials with significantly lower NORM radionuclide concentrations, which had resulted in the decrease of produced annually waste volumes by more than 10 times. E.g., they managed to find raw material for the rare earth metal production, which contained NORM below the exemption levels. Nevertheless, the production of Nb and Ta still uses radioactive raw material and the NORM waste generation continues.

6. Radiation practice license

Based on the radiation practice licence No 08/004, the Silmet plant is allowed to generate annually no more than 48 t of radioactive NORM containing waste with the activity concentration lower than 300 kBq/kg. At the facility, the generation of NORM waste is not constant in time and it depends to a great extent on the specific production line and the ore used. There is more than 31 t of NORM waste with the average ^{238}U and ^{232}Th activity concentrations of 98.8 kBq/kg and 36 kBq/kg, respectively, in the temporary storage. The composition and amount of the processing waste depends on the fraction of each raw material type in the total amount and on their Th, U and their progeny composition.

Under the Radiation Act, the producer of radioactive waste should transfer the arising waste to the radioactive waste management operator in at least 5 years. Unfortunately, there is no radioactive waste management operator for NORM waste in Estonia. At the moment, the NORM waste produced by the Silmet plant is temporarily stored and the company is continuing the search for possible management solutions in the future. Unfortunately, so far without any success, as the amount of produced NORM waste is too small for further processing, while their activity concentrations significantly vary. One of the most realistic proposed management options might be the clearance of NORM waste under specified conditions.

7. Possible clearance option

The Silmet facility has a functioning power plant, which uses local oil-shale for producing of energy. The estimated annual production of oil-shale ash is around 100 000 t. The Estonian Environmental Board has allowed the use of oil-shale ash in the construction of the Sillamäe harbour, which is built close to the remediated waste depository. In the Environmental Impact Assessment of the Sillamäe Harbour it is estimated that the harbour building needs about 8.45 million m^3 of filling material, including about 2-3 million m^3 of oil-shale ash. Taking account the activity concentrations of NORM in oil-shale ash in Table 3 (Realo et al, 1996) and similarity of physical properties of oil-shale ash and the NORM waste produced in Sillamäe, a clearance option for possible management of the latter has been proposed. The clearance option bases on the assumption that the NORM waste and oil-shale mix (110000 tons of oil-shale ash together with 48 tons of NORM-waste) could be used (instead of oil-shale ash only) in the construction of the harbour.

Table 3. Activity concentrations of radionuclides in the Estonian oil-shale ash

Radionuclide	Activity concentrations (Bq/kg)
^{226}Ra	48 ... 78
^{238}U	48 ... 64
^{235}U	2.2 ... 3.0
^{232}Th	23 ... 30
^{40}K	530 ... 1100

The clearance levels of 1 kBq/kg for both ^{235}U and ^{232}Th based on the Radiation Act. The legislation also states that clearance of radioactive waste is possible if:

- the caused annual dose to the public is lower than 0.01 mSv;
- the caused collective annual dose is lower than 1 manSv;
- in the case of the NORM-containing material and waste, the public to the public is lower than 0,3 mSv/y.

The assessment of the annual public and collective doses caused by using the oil-shale and NORM waste mix in the construction of the Sillamäe harbour was performed (Lust, 2009). For the assessment of clearance options of NORM waste an assumption that future radioactive waste arising is caused exclusively by the production of the AS Silmet plant was taken into account. The doses were assessed for both workers and the public considering the following scenarios:

1) transportation of NORM waste;
2) inhalation in the process of NORM waste management;
3) ingestion in the process of NORM waste management;
4) fire in the waste management facilities;
5) doses to the harbour workers;
6) dose to the farmer, who lives and farms on the harbour area.

The main results of the assessment are the following. For the workers the highest doses arise via inhalation pathway. The highest doses for the public are characteristic of the farmer, who lives and produces in the area filled using the above mix. However, even in the case of the farmer the clearance requirement of NORM, i.e., annual doses lower than 0.3 mSv, is fulfilled with the probability of 95%. Taking into account that the harbour is been built next to the remediated radioactive waste tailings depository, it is hard to believe that farming is a very realistic scenario.

8. Conclusions

The outcome of active discussions and dialog between the operator and the regulator was the development of the waste management system for NORM waste, which, however, currently covers only the short range activities. Based on the performed assessments it was proved that in case using the NORM waste and oil-shale ash mix in the construction of the Sillamäe harbour, the clearance requirements would be fulfilled. Additionally, it can be easily proved that of the proposed management option is the optimal solution considering the type, radionuclide composition and amount of the radioactive waste. The final solution for the NORM-waste management is still under discussion.

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Radioactive impact on estuarine sediments affected by Acid Mine Drainage (AMD) and effluents from NORM phosphate fertilizer industries

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Abstract

In this paper is studied the estuary of Huelva formed by the Tinto and Odiel rivers, which are seriously affected by acid mine drainage (AMD) due to the long-term mining activities done in Iberian Pyrite Belt, and, as a consequence, their waters present an very low pH (< 3), and for that they contain very high heavy metals concentrations. Additionally, a large industrial complex is located in the surroundings of this estuary, which includes five phosphate rock processing plants that produce a waste called phosphogypsum (PG) containing high U-series radionuclides concentrations.

This estuary is governed by two mixing processes: 1) salt-induced mixture process, typical of the majority of estuaries, and 2) pH-induced mixture process, consisting in an acid neutralization as result of the mixture of acidy fluvial water coming from the drainage basins when reach the estuary. These mixture processes affect to the behavior of both heavy metals and natural radionuclides that reach the estuarine waters. The analysis of the radionuclides concentrations have allowed us to demonstrate that the behavior of these elements are very affected by these mixing processes, and to affirm that U-, Ra- and Th-isotopes levels in the current sediments are very dependent of the hydrochemical properties of the waters (mainly pH and chlorinity). This study has global significance for other polluted environmental systems that are impacted by AMD and PG.

1. Introduction

Estuaries are zones of complex interaction between fluvial and marine processes, where there are large mass exchanges, and big changes in the salinity, nutrients, sedimentary conditions and living organisms. The use of radioactive tracers is a valuable tool to analyze the transfer mechanisms between the different involved system phases (Zöllmer and Irion 1993).

The estuary formed by the Tinto and Odiel rivers presents a great interest due to it is very conditioned by two hydrochemical facts. The first one comes from fact that both rivers are seriously affected by acid mine drainage (AMD) from long-term mining activities developed in the Iberian Pyrite Belt, which produce in these rivers the transport of high amounts of heavy metals and radionuclides due to their extremely low pH (2.5-3.5) (Grande et al 2003). Secondly, in their mouths there is a large industrial complex which includes several phosphate rock processing plants that produce annually about 2.5 million tons of a by-product, called phosphogypsum (PG), containing enhanced U-series radionuclides levels (about 200 Bq kg^{-1} of ^{238}U, 650 Bq kg^{-1} of ^{226}Ra, and 450 Bq kg^{-1} of ^{230}Th). Until 1998, about 20 % of the generated PG was discharged directly into the estuarine waters, while the remaining 80 % was pumped in suspension with sea water (20 % PG plus 80 % seawater) to be disposed in large piles located on the Tinto river salt-marshes (Bolivar et al 2002). Since 31st December 2010, all P_2O_5 production plants were closed and for that the phosphogypsum production was stopped. Currently there is an environment al plan under study to restore the PG piles, and it is estimated to take 10 years to complete this plan.These facts explain that estuary of Huelva is one of the most polluted estuarine systems in the world.

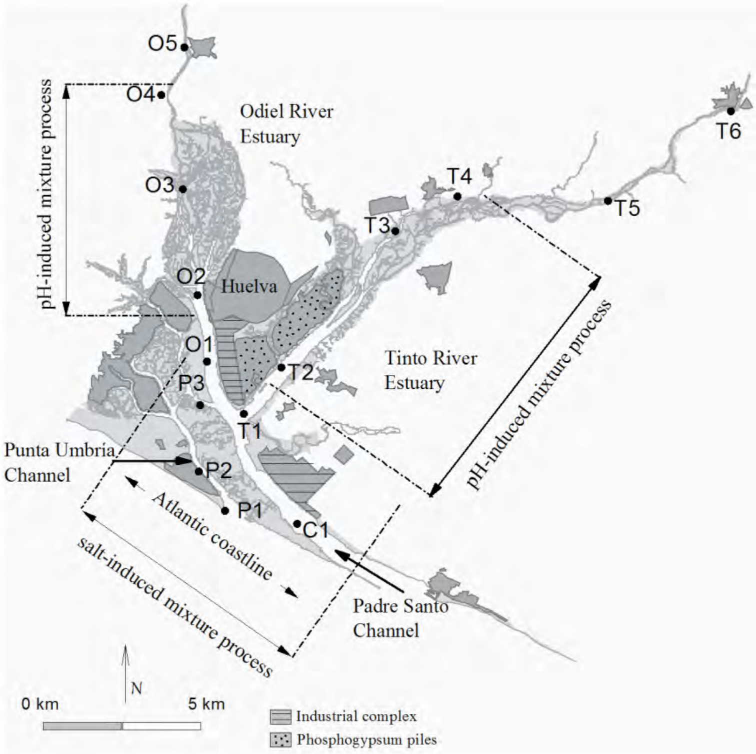

Figure 1. Map of the estuary of the Tinto and Odiel rivers with sampling points

It has been demonstrated that hydrochemical characteristics of the water in this estuary suffer two mixture processes, the salt-induced mixture process, and the pH- induced mixed. A strong tidal influence controls the salt-induced process, and it has been extensively studied by measuring the changes in the salinity of the mixing water. Specifically the process follows the mixture between seawater (pH over 8 and chlorinity above 21 g L^{-1}) and estuarine water (with pH around 6.0 - 7.0 and chlorinity average over 10 - 15 g L^{-1}). This is located in Padre Santo and Punta Umbría Channels, but can reach the upper sectors of the estuary during high tides (Fig. 1). The pH-induced mixture process is the neutralization resulting from the mixing of estuarine water (pH = 6.0 - 7.0) with the fluvial water (pH < 3), containing very high concentrations of dissolved materials, including metals and radionuclides. This neutralization process by dilution of water is restricted to estuarine areas of both rivers, and produces a positive gradient in the pH with a strong directionality outwards from the system (Carro et al 2006).

Taking in consideration previous facts, main aim of this work has been to report the behavior of different natural radionuclides in the surface sediments from an estuarine system very affected by both salt-induced and pH-induced water mixing processes.

2. Materials and methods

2.1. Sampling

Fifteen sampling stations were selected to study this system along Tinto River estuary (sampling points with code "T"), Odiel River Estuary (code "O"), where is clearly produced both the pH-induced and salt-induced mixing processes. Moreover, sampling points in Padre Santo Channel (code C1) connecting Punta Umbría Channel (code P) with the Odiel Channel have been selected since they are estuary sectors with mainly marine influence, and for that in principle very low influenced by the AMD of the mining rivers and the PG piles (Fig.1). In selected sampling stations surface sediments were collected using sediment traps during each season (4 times a year). Samples were collected at the end of May 2007 (spring), December 2007 (autumn), March 2008 (winter) and September 2009 (summer). In addition to the sediment samples, superficial water samples were collected and the pH and conductivity were measured in situ.

2.2 Radionuclide determinations

Alpha-emitting radionuclides of U-isotopes were determined by alpha-particle spectrometry using ion-implanted silicon detectors in geometry with 25 % absolute efficiency. To the isolating of the radioelements (U, Th and Po), a sequential well-established radiochemical method based on extraction chromatography (UTEVA resins) was applied (Oliveira and Carvalho 2006).

^{226}Ra and ^{228}Ra were determined by gamma-ray spectrometry using a coaxial ultra pure germanium detector (HPGe ORTEC) with ~20 % relative efficiency and FWHM of 1.10 keV at 122 keV and 1.90 keV at 1333 keV. The photopeaks used in the radionuclides determination were: ^{226}Ra (352 keV - ^{214}Pb), ^{228}Ra (911 keV - ^{228}Ac). The efficiency calibration used in the gamma measurements is described in detail in our earlier papers (Pérez-Moreno et al., 2002).

3. Results and discussion

3.1 Physical-chemical parameters

In Figure 2 the pH and conductivity in water samples of Odiel-Tinto rivers estuary, Padre Santo and Punta Umbría channels are shown. In relation to the bulk densities of sediments for each season varied with a wide range, from 0.36 to 1.49 g cm^{-3}. For each season, the densities are similar for both Odiel and Tinto estuaries, with the highest values in summer and lowest in autumn.

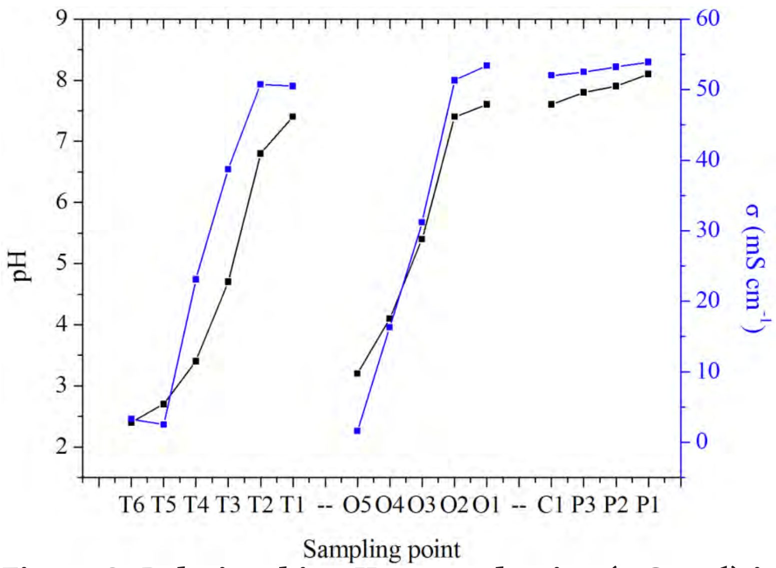

Figure 2. Relationship pH vs. conductivy (mS cm^{-1}) in water samples.

A progressive increase in pH towards the mouth of both rivers is observed in the estuary due to pH-induced and salt-induced mixture processes. The pH values ranged from 1.9 (Tinto River, T6-summer) up to 8.1 (sample C1-spring), showing high and similar gradients in the estuary for both rivers (pH varied between acid values lower than 3 and neutral conditions, higher than 7). On the contrary, the pH in both

Padre Santo and Punta Umbría channels showed few variations, oscillating between 7.0 and 8.1, fact coming from the proportion of seawater is very high.

As it is expected, the lowest pH is observed during autumn when the fluvial inputs are greater being more intensive the AMD, observing that location 3 (T3 and O3) reaches pH around 3-4, whereas during summer (lowest or null flows), the pH of the estuary is more uniform, with values higher than 5.4 in most of the stations (Fig. 2). This fact can be justify by the low fluvial contribution in summer allowed fast neutralizations of the acid water in the upper sector of the mixing zone.
On the other hand, as it is expected in figure 2 is observed that conductivity presents an similar pattern that pH, which is ratified by the good linear regression fit obtained between both parameters, σ (mS cm^{-1}) = - (18±4) + (8.3± 0.7)·pH, and observing that conductivity and pH increase towards the mouth of both rivers reaching typical values of seawater in the sample situated out of estuary (sample P1). One of the main features of the rivers that end in this estuary is their high dissolved sulphate concentrations due to the severe acid drainage mine they are receiving (Carro et al., 2006). This peculiarity is consistent with the high conductivity values measured in the fluvial zone of both estuaries (O5, T6 and T5), with values between 1-5 mS cm^{-1}, which is one order of magnitude higher than the typical surface waters (< 0.1 mS cm^{-1}) (Carro et al., 2006) (Fig. 2). As we move towards the Padre Santo and Punta Umbria channels, an increase in the marine component of the water occurs reaching values around 50 mS cm^{-1} (samples P1) which are typical of seawaters.

3.2 Uranium-isotopes

The annual average ^{238}U activity concentration at every sampling point is shown in figure 3. The ^{238}U and ^{234}U activity concentrations spatially vary over a wide range, from 6.6 to 2580 Bq kg^{-1} throughout the study period. Some differences can be seen between both the Odiel and Tinto channels. So, Tinto River estuary supports a greater burden of uranium, because it carries a higher concentration of uranium that will precipitate when both the river water and leached PG stacks water mixes with the estuarine water. In both estuaries the lowest values of activity concentrations of uranium are found in summer, when the rivers and PG piles have the smallest discharges. However, the highest values in both Tinto and Odiel estuaries are found in winter (followed by autumn), which correspond with the seasons of highest rainfall. This effect is more significant in the Tinto Channel. Due to the AMD received for both rivers, the activity concentrations for both ^{238}U and ^{232}Th nuclides in their surface waters generally range in the interval 0.1 - 1 Bq L^{-1}, which are 1 - 3 or 3 - 5 orders of magnitude, respectively, higher than worldwide typical rivers (Ketterer et al., 2011).

The highest activity concentrations are found in the Tinto Channel due to additional contribution of acid waters coming from PG piles due to the rain, which contain very high concentrations of U-series radionuclides as ^{238}U (50-200 Bq L^{-1}), ^{226}Ra (0.5-2.0 Bq L^{-1}), ^{210}Pb-^{210}Po (1-20 Bq L^{-1}), or ^{230}Th (1-5 Bq L^{-1}) (unpublished data). Rainwater that fall on the surface of the un-restored PG stack (more than 400 ha) dissolves a fraction of pollutant contained in PG, and so they are released into the estuary with high acidity (pH < 2), and contain high levels of radionuclides (especially U to be the most soluble at this low pH, although its concentration in PG is lower than other radionuclides, and other pollutants.By considering an average rainfall of 550 L m^{-2} and that 50% of this amount reaches the estuary, it can be estimated that annually about 0.3 million tons of these acid polluted waters are released into the Tinto Channel containing radionuclides concentrations of about 10^{2} Bq L^{-1} for ^{238}U and 10^{0} - 10^{1} Bq L^{-1} for the rest of radionuclides from U-series (^{226}Ra, ^{230}Th, ^{210}Pb) (Bolívar et al., 2009). The effect of this PG-laden water releases are shown in the peak of ^{238}U concentration in the sediments found in points located near the PG stacks (points T2 and T3).

With regard to the sampling sites in the fluvial zone (O5, T6 and T5; Fig. 3), the values of uranium concentration in sediments are typical of unperturbed rivers (UNSCEAR, 1988), with about two orders of magnitude lower U than the estuarine sediments affected by the pH-induced processes. In these locations both rivers have highly acidic waters with a high loading of radionuclides, but they will not precipitate until these waters are mixed with the estuarine waters and pH increases to > 4.

Towards the sampling stations O4 and T4 the pH-induced process begins and the pH increases from 1.9 (fluvial zone) to 4.4 (O4 or T4), and finding similar changes found for all seasons. Higher values of uranium in these sampling points, T4 (421 Bq kg^{-1} for ^{238}U) and O4 (115 Bq kg^{-1} for ^{238}U) were found compared to unperturbed sediments of the fluvial zone (Fig. 3). UO_2^{2+} uranyl ion the is the most soluble specie in the Tinto and Odiel rivers (pH ~ 2-3), but an abrupt change of pH in this zone will produce the co-precipitation of uranium as metallic hydroxides, or sulphate salts, which will scavenge a very significant fraction of the dissolved metals (including the U one) carried out by the acid water of the rivers.

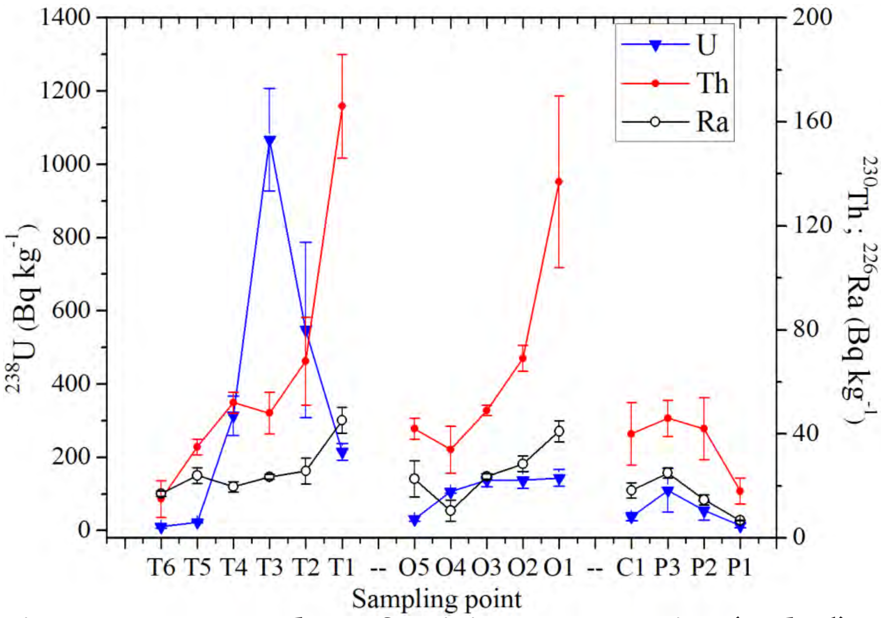

Figure 3. Average values of activity concentration (Bq kg^{-1}) of ^{238}U, ^{230}Th and ^{226}Ra in the sampling points.

In the sampling stations O3 and O2; T3 and T2 the pH-induced process continues. In this zone an abrupt change of pH (from 4.5 to 7) occurs in all seasons. Such a marked change in pH is expected to result in significant precipitation of U and, therefore, in a significant enhancement of its concentration in the sediments. The ^{238}U concentration was found to be the highest in T3 among all the sampling sites in the Tinto River, with an average concentration of 1342 Bq kg^{-1}, but for its equivalent point (O3) in Odiel River, the average concentration is much smaller (150 Bq kg^{-1}) (Fig. 3). This could be due to; a) the differences in the dissolved U concentrations in these waters (Tinto U concentration is twice than the Odiel one), and/ or b) presence of acidic water releases from PG piles. Moreover while we move to offshore and the pH values are going up, the removal of uranium may also take place associated with adsorption of U^{6+} onto organic matter and Fe/Mn compounds (McKee et al., 1987), or phosphate complexes which compete with carbonate to complex U in the range 4-7.5 and the partial reduction of uranium VI to IV, a more insoluble form (Toole et al., 1987).

In locations T1 and O1, sited at the end of both estuaries (Tinto and Odiel, respectively), the values of pH, for the four samplings campaigns, range from 7.1 to 7.8 (average 7.4), and ^{238}U activity concentrations (215 Bq kg^{-1} ^{238}U for T1, and 144 Bq kg^{-1} ^{238}U for O1) are similar at both points. The salt-induced coagulation and precipitation is expected to be minimal at this zone. The exchange of sediment from this zone to the shelf is likely a significant mechanism of sediment transport to the shelf regions. In addition, ^{238}U concentrations in the Punta Umbria Channel, which has a very low water exchange with the Odiel Channel, the radionuclide activity concentrations found were similar than in unperturbed sediments (Bolivar et al., 1995). Opposite of, the samples from P3 (El Burro Channel) were found to have slightly higher U concentration (171 Bq kg^{-1} of ^{238}U), which is expected because this channel exchanges water between the Odiel Channel (polluted) and the Punta Umbria Channel (un-polluted) (Fig. 3).

The impact of the new waste management policy resulting in no PG releases into Odiel Channel can be evaluated by the temporal analysis of the radionuclide concentrations evolution in sediments. Firstly, in the Tinto estuary the average ^{238}U activity concentration for the whole estuary in the sediments was constant in the years 1999 (policy changed in 1998), 2001 (Absi, 2004) and 2008, with ^{238}U concentrations of 219 ± 97 Bq kg^{-1}, 252 ± 112 Bq kg^{-1} and 380 ± 123 Bq kg^{-1}, respectively, while in the Odiel estuary these average concentrations decreased continuously from 343 ± 96 Bq kg^{-1} (1999 year) till 113 ± 11 Bq kg^{-1} (2008 year). The value found in 2000 is very similar to the average activity concentration found in our study, indicating that the sources of U in the Odiel estuary have been significantly reduced, but in the Tinto estuary the U sources have remained constant over time, and the new policy waste management has not resulted in a significant decrease in U concentration due to the release of radionuclides from 450 ha of un-restored PG piles.

3.3 Thorium-isotopes

In for the case of thorium isotopes, we observed that their concentrations throughout the study area are similar to uncontaminated estuarine sediments, except at certain points where ^{230}Th concentrations increase significantly (Fig. 3).

The ^{232}Th concentrations are relatively uniform along the study area and similar to the typical values obtained in unperturbed sediments (30 - 60 Bq kg^{-1}) (Martín et al., 1978). This is because of relatively less amount of leaching of ^{232}Th and PG does not contain high concentrations of ^{232}Th. On the contrary, ^{230}Th presents higher levels (from 5.9 to 232 Bq kg^{-1}), increasing from the fluvial zone towards the end of the estuary, and reaching the maximum values for all seasons at point 1 for both rivers (zone of salt induced processes, with averages of 175 Bq kg^{-1} for T1 and 153 Bq kg^{-1} in O1), which is the estuarine area where there are high and uniform values of pH (around 7.0). This is due to scavenging of Th by suspended particulate matter when the pH is ~7.

3.4 Radium-isotopes

In figure 3 and 4 is observed that the distribution pattern of both ^{226}Ra and ^{228}Ra is very similar throughout study area. The activity concentration of ^{226}Ra increases from the fluvial zone up to the end of the estuary, with a maximum at T1 and O1 in all seasons (average of 45 Bq kg^{-1} in T1 and 41 Bq kg^{-1} in O1), locations that represent only salt-induced processes (pH = 6.5 - 7). This ^{226}Ra behavior is similar to the ^{238}U and ^{230}Th ones discussed earlier, but ^{228}Ra does not present a clear pattern along both Tinto and Odiel channels, showing similar concentrations than unperturbed sediments (30 - 60 Bq kg^{-1}), the amount of radionuclides derived from the ^{232}Th-series both in AMD and PG piles are not significant. This very low impact found for Ra-isotopes comes from two facts; firstly, the very low solubility of Ra in aqueous solutions containing high concentrations of sulphates (as it is our case), and secondly, it is very established that radium tends to remain in dissolution for the majority of estuaries (Somayajulu and Goldberg, 1966; Martín et al., 1978).

Several studies in global estuarine systems have documented that radium is non-conservative in estuaries, with the release of Ra when Ra-laden suspended particulate matter in rivers are delivered into the river mouth and thus, higher dissolved ^{226}Ra concentrations were found. For example, studies in several natural estuaries like Hudson estuary (Li et al., 1977), or Amazon estuary (Key et al., 1985) showed similar results. In figure 3 the average of ^{226}Ra concentration in sediments increases with pH towards the mouth of the estuary. This fact could be due to one or more of these two reasons: i) sediments with higher concentrations of ^{226}Ra are trapped near the confluence of both channels, as was seen for ^{238}U and other ^{238}U-series members; and ii) release of ^{226}Ra from suspended particulate matter which subsequently undergo pH-induced coagulation and eventual precipitation to the sediments (Aguado, 2003).

Reduction in the ^{226}Ra in sediments along the estuary since 1998 has been documented, primarily due to the elimination of the direct phosphogypsum releases into the estuarine system. The activity concentration of ^{226}Ra significantly decreased in the sediments from both Odiel and Tinto channels, falling from an average of around 700 Bq kg^{-1} in both channels before 1998 up to ~ 70 Bq kg^{-1} in 2005 (Villa et al., 2009), and finally reaching 28 ± 3 Bq kg^{-1} in 2008 year (our study). Therefore, the enhanced ^{226}Ra levels in the points 1 are likely due to resuspension of older polluted sediments. From the distribution of Ra in sediments, two observations can be made: first, the effect of the new waste management policy from 2008 year can be discerned in the current concentration of ^{226}Ra attaining typical values of background levels in sediments (20 - 50 Bq kg^{-1}, UNSCEAR, 1988). Second, it is noticeable from the concentrations found along the sampling points (Fig. 3), there is a fairly homogenization of the little remaining pollution in the sediments that still exist in the estuary.

3.5 Activity ratios

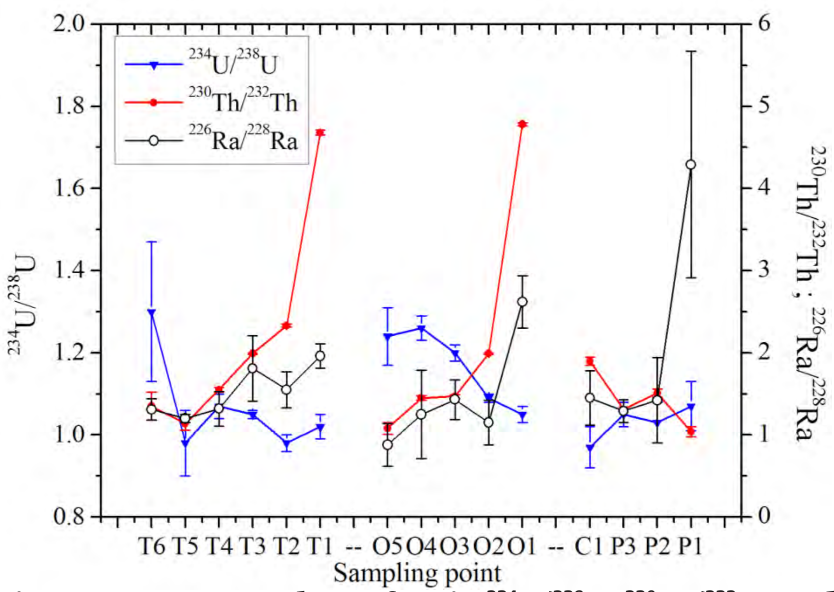

Figure 4. Average values of ratio $^{234}U/^{238}U$, $^{230}Th/^{232}Th$ and $^{226}Ra/^{228}Ra$ in the sampling points.

Some of the discussions presented earlier can be validated by using activity ratios as $^{234}U/^{238}U$, $^{230}Th/^{232}Th$, $^{226}Ra/^{228}Ra$ ratios (Fig. 4). The $^{234}U/^{238}U$ activity ratios in our samples ranged from 0.89 to 1.58 in the Tinto River estuary and 1.01 to 1.39 in the Odiel River estuary. This result is in agreement with the activity ratios reported for different worldwide rivers (Scott, 1982). Overall, the $^{234}U/^{238}U$ activity ratios are slightly higher in Odiel River estuary compared to that in Tinto. Higher values are found in the fluvial zone and the values in the estuary are influenced by the U precipitation and the values in seawater (seawater AR is 1.14). Precise measurements with ICP-MS will aid in tracing the pathways and transport of U in the river/estuarine system.

The $^{230}Th/^{232}Th$ activity ratio varied between 0.6 and 5.0, with the highest values in Odiel River estuary in Spring. Although the amount of ^{232}Th derived from PG piles and the AMD discharge are likely negligible, high variations appear to be due to variations in ^{230}Th derived from both PG and AMD. The average activity ratios of ^{230}Th/^{232}Th increase uniformly up to point 1 where it reaches a value of around 5, a value significantly higher than the one found in uncontaminated estuarine sediments from Huelva (Bolivar et al., 1995) and worldwide (Somayajulu and Goldberg, 1966). The surface sediment contamination of ^{230}Th samples from points 1, can proceed from two routes; either by direct transport from PG and AMD, or by resuspension of contaminated sediments, or by the adsorption of dissolved ^{230}Th on to suspended particulate matter before the implementation of policy (Bolívar et al., 2002). If we consider that the main pathway of contamination is through direct deposition of particulate phosphogypsum, resulting in high ^{238}U and its daughter products a high fraction of the sediments must be contaminated by this by-product. Since we are finding high concentrations in selected areas, the resuspended material could be a source of contamination in this estuary. The contamination by radionuclides from U-series of the sediments is also supported from the observed values of ^{226}Ra/^{228}Ra in figure 4, where a slow increase of this ratio can be seen in samples T1 and O1, demonstrating that radium is not removed from sediments.

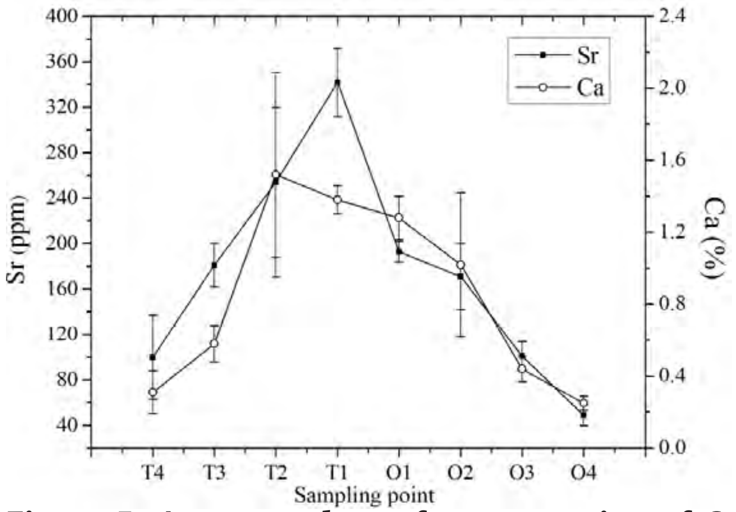

Figure 5. Average values of concentration of Sr (ppm) and Ca (%) in the sediments samples in the sense of the waterflow from T3 to O4.

To finish this extended abstract, to comment that in Figure 5 are observed significant peaks for both Sr and Ca in the points T2 and T1 (the points closest to the PG stacks), which could come from the PG piles leaching released generated by the rainy waters, and not from inputs from the acid rivers. To ratify this hypothesis, it is known (data unpublished) that average concentration of Sr and Ba in PG are very high and around 4×10^4 and 9×10^4 ppm, respectively, producing in its leaching waters that go into Tinto River estuary high levels of these elements (2×10^1 and 5×10^2 ppm, respectively), and being them very much higher that the found ones in the another source of pollution, the Tinto River waters (0.280 and 76.6 ppm for Sr and Ca, respectively). Taking into account the previous data, and the similar chemical behavior of these three elements (Ra, Sr, Ca), the same pattern found suggests that they share with the same source for their origin.

4. Conclusions

The hydrogeochemical characteristics of the water in both Tinto and Odiel rivers estuaries where analyzed, founding that acid fluvial water and marine water are mixed allows us to define the intervention of two geochemical processes: a typical process of salt-induced mixture bound to a neutralization process of acid water.

The temporal and spatial variations of indicators as pH and chlorinity regulate the behavior of U-, Th- and Ra-isotopes. This fact is produced by the adsorption (or co-precipitation) of the dissolved uranium onto the particulate matter in zones where is produced pH values between 4.0 - 5.0. In fact, the highest values of ^{238}U concentration are reached in these zones (values up 2520 Bq kg $^{-1}$), which are about fifty times higher than ones un-perturbed sediments. The maximum concentrations for ^{230}Th and ^{226}Ra are produced for higher values of pH (about 6.0 - 7.0) and the concentrations are much lower than those of uranium. So a non-conservative behavior of uranium has been verified in this estuary, and consequently the estuary of Huelva acts as a sink for U and other natural radionuclides. This effect is less important for Th- and Ra-isotopes.

And, as final remark, the enhanced levels from U-series in recent sediments from the estuary of Huelva, and very specially for U-isotopes, are mainly three sources: (1) leaching of phosphogypsum stacks located nearby, (2) the flows incoming from the Odiel and Tinto rivers that contain very high levels coming from the acid mine drainage existing along the Iberian Pyrite Belt, and (3), the waters from the Atlantic ocean entering into the estuary containing a significant concentration of U-isotopes (40 mBq L^{-1}) which could precipitate during the mixing pH processes.

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Exhibit 19

COLORADO
Department of Public Health & Environment

Colorado Discharge Permit System (CDPS)
Fact Sheet To Permit Number CO0047554
UNION PACIFIC RAILROAD, MOFFAT TUNNEL WEST PORTAL, GRAND County

Andrea Stucky
8/31/2018

TABLE OF CONTENTS

I. TYPE OF PERMIT

A. Permit Type: Renewal

B. Discharge To: Surface Water

II. FACILITY INFORMATION

A. SIC Code: 4011 Railroads, line haul operating

B. Facility Location: Union Pacific Railroad Moffat Tunnel West Portal,
Latitude: 39.88750°N, Longitude: 105.76222°W

C. Permitted Feature: 001A, after treatment and prior to entering the Fraser River
39.88750° N, 105.76222° W

The location(s) provided above will serve as the point(s) of compliance for this permit and are appropriate as they are located after all treatment and prior to discharge to the receiving water.

D. Facility Flows: 0.5 MGD

E. Major Changes From Last Renewal:

- This permit renewal only contains the West Portal. The East Portal is permitted under individual permit CO0048986.
- Continuous Effluent Temperature monitoring has been added.
- EC and SAR requirements are added.
- The TSS variance is no longer in place for this facility.

4300 Cherry Creek Drive S., Denver, CO 80246-1530 P 303-692-2000 www.colorado.gov/cdphe/wqcd
John W. Hickenlooper, Governor | Larry Wolk, MD, MSPH, Executive Director and Chief Medical Officer

- Continuous influent turbidity monitoring and a contingent TSS requirement has been added to the permit. See the text for additional information.
- Diesel range organics and total petroleum hydrocarbons have been added to the permit with a report requirement.
- Submission of a best management practices plan has been added to the permit to describe normal operations, tunnel cleaning operations and maintenance activities.

Since the division has no record that the facility received notice of their permit being available for the first public comment period, the permit went to public notice as a second draft. The first public comment period was from May 13, 2016 through June 24, 2016. Comments were received by Grand County and East Grand Water Quality Board in response to the first public comment period.

The second public notice period for the second draft was from August 12 to September 12, 2016. Comments were received from Union Pacific, Grand County, and East Grand Water Quality Board. These comment were incorporated into the third draft. After the second public notice period, the tunnel had additional cleaning and repair operations in September 2016 resulting in additional releases of discolored water into the Fraser River. As a result, the division will implement an influent turbidity limitation of 175 NTU. If the facility exceeds the influent turbidity limit, a contingent TSS sampling and monitoring event (in addition to the Reg. 62 monthly requirement) will be required. TSS monitoring must continue at two-hour intervals until the influent turbidity decreases below the limitation. Additionally, monitoring for diesel range organics (DRO) and total petroleum hydrocarbons (TPH) have been added to Limit Set A. These were added after the division learned about the maintenance and cleaning activities. Based on the changes in monitoring requirements to the permit after the second public notice period, the division has developed this third draft permit.

III. RECEIVING STREAM

A. Waterbody Identification: COUCUC10a, the Fraser River

B. Water Quality Assessment:

An assessment of the stream standards, low flow data, and ambient stream data has been performed to determine the assimilative capacities for the Fraser River for potential pollutants of concern. This information, which is contained in the Water Quality Assessment (WQA) for this receiving stream(s), also includes an antidegradation review, where appropriate. The Division's Permits Section has reviewed the assimilative capacities to determine the appropriate water quality-based effluent limitations as well as potential limits based on the antidegradation evaluation, where applicable. The limitations based on the assessment and other evaluations conducted as part of this fact sheet can be found in Part I.A of the permit.

Permitted Feature 001A will be the authorized discharge point to the receiving stream.

IV. FACILITY DESCRIPTION

A. Industry Description

This facility is a railroad tunnel owned by the Moffat Tunnel Improvement District which is administrated by the Colorado Department of Local Affairs in accordance with C.R.S. 32-8-101. The right of way for the tunnel and approaches were permitted by the federal government to the District in the 1920's. Union Pacific Railroad (UPRR) conducts railroad operation through the tunnel under a 1926 lease from the District, which is currently scheduled to expire in 2025. This lease includes conditions where the operator "agrees to assume and pay all claims, damages, demands, and liabilities which may arise or be incurred…resulting from or connected with the operation, maintenance or repair of said railroad tunnel." UPRR does not agree or concede that this "operation and maintenance" clause of the lease obligates UPRR to be responsible for groundwater drainage from the tunnel during the term of the lease, but UPRR has agreed to assume such responsibility solely for purposes of and during the term of this permit.

The building of the Moffat Tunnel by the District has resulted in an alteration to the natural groundwater flow in this area, by creating a void through the rock that altered the natural hydrogeologic system. The result of this is groundwater seepage into the tunnel that must be discharged as a point source to state waters. This discharge contains natural concentrations of metals, suspended solids that were created as a result of building processes, suspended solids from coal fines from the railroad operations, and any metals that are attached to those coal fines. No train or vehicle fueling, maintenance, or equipment cleaning is conducted at the tunnel. Groundwater seepage into the tunnel runs down the sides of the tunnel to the track ballast, and is collected in a buried drainage system. This system drains to both the West and East Portals. The East Portal is permitted under a different individual permit. Note that the discharge from the tunnel has been ongoing since its creation in 1927.

B. Sources to the Treatment Plant

Sources include groundwater seepage into the tunnel which is collected through a drainage system and discharged to surface water at either the West or East Portal. UPRR conducts periodic tunnel maintenance and cleaning operations that has resulted in slugs of discolored water.

C. Chemical Usage

The permittee stated in the 2015 Compliance Schedule Progress Report that the new wastewater treatment plant will utilize four chemicals in their treatment process. The MSDS sheets have been reviewed and the following chemicals have been approved for use and are summarized in the following table.

Table IV-1 - Chemical Additives

Chemical Name	Purpose	Constituents of Concern
Aluminum chloro-hydrate	Coagulant	Aluminum
Sodium hypochlorite	Membrane cleaning	Chlorine
Citric acid	Membrane cleaning	pH
Caustic soda	Membrane cleaning	Sodium hydroxide

Chemicals deemed acceptable for use in waters that will or may be discharged to waters of the State are acceptable only when used in accordance with all state and federal regulations, and in strict accordance with the manufacturer's site-specific instructions.

D. Wastewater Treatment Description

UPRR constructed a wastewater treatment facility on the West Portal Outfall, which was completed in April 2017. The constructed treatment plant consists of a coagulation process and membrane microfiltration followed by an ion exchange process. For solids, a sludge thickening process and a centrifuge will be used for final dewatering. The dewatered sludge will be transported to an approved landfill approximately once per month.

Pursuant to Section 100.5.2 of the Water and Wastewater Facility Operator Certification Requirements, this facility will require a certified operator. If the facility has a question on the level of the certified operator it needs then the facility will need to contact the Facility Operator Certification Program of the Division.

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Exhibit 20

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Received
APR 29 2016
Water Quality Control

April 22, 2016

Eric Oppelt
Colorado Department of Public Health and Environment
WQCD-WQP-B2
4300 Cherry Creek Dr S
Denver CO 80246-1530

Subject: 2016 Compliance Report for Moffat Tunnel Permit CO-0047554

Dear Mr. Oppelt:

Union Pacific Railroad (UPRR) would like to submit this memorandum to satisfy the requirements of the compliance schedule under permit CO-0047554 which covers discharges from Moffat Tunnel to South Boulder Creek and the Fraser River. The current permit includes the following compliance schedule in part A.3. Through a permit modification in 2011, the compliance schedule was extended through 2017 to accommodate further studies and evaluations in order to find the most appropriate solution(s) for the conditions at Moffat Tunnel. The modified compliance schedule has been summarized below with status information included for reference:

- **Facility Evaluation Plan** – UPRR submitted this document to meet the initial requirement of a report that provided details on the progress UPRR had made toward determining the feasibility and potential percent reductions associated with a number of control measures (**April 30, 2012**)
- **Facility Evaluation Plan** – UPRR submitted this memorandum that further detailed the feasibility and potential percent reductions that UPRR had associated with control measures that were investigated to date (**April 30, 2013**)
- **Implementation Schedule** – UPRR submitted this initial report that outlines the chosen option(s) to meet the final effluent limitations (**April 30, 2014**)
- **Status/Progress Report** – UPRR submitted a report showing the progress made toward implementing the chosen option(s) (**April 30, 2015**)
- **Status/Progress Report** – UPRR is submitting this report showing the progress made toward compliance with the final effluent limitations (**April 30, 2016**)

UNION PACIFIC RAILROAD
1400 Douglas Street
Omaha, Nebraska 68179

Section 1

Introduction

1.1 Background

The Moffat Tunnel was built in the 1920s through a public-private funding partnership with the Moffat Tunnel Improvement Commission to connect traffic east and west of the Continental Divide, under James Peak, and allow for a more direct avenue for interstate commerce. The train tunnel is owned by the State of Colorado and through the years has been operated by the Denver Rio Grande Railroad (1920s-1980s), Southern Pacific Railroad (1980s-1990s), and is currently operated by Union Pacific Railroad (UPRR). UPRR uses the tunnel solely for mixed freight train traffic with approximately 10 trains passing through the tunnel daily as of 2016 (including UPRR, Burlington Northern Santa Fe Railway, and Amtrak). No other industrial activity occurs at the site. UPRR operates the tunnel under a lease from the Colorado Division of Local Affairs (DOLA). The lease is set to expire in 2025.

West Portal

East Portal

Figure 1-1 shows the location of the Moffat Tunnel. The East Portal of the tunnel is located 50 miles west of Denver and approximately 10 miles west of the town of Rollinsville. The East Portal is located at an elevation of approximately 9,200 feet and conditions at the East Portal are those associated with high mountain terrain and access is often difficult during winter months. UPRR staff working at Moffat Tunnel (typically one to two people) are located on the east side of the tunnel; there are currently no occupied facilities located at the West Portal.

The Moffat Tunnel runs under the Continental Divide for 6.2 miles. Water enters the tunnel through several mechanisms, including groundwater seepage along the floor and walls of the tunnel and precipitation (rain/snow melt) through weepholes near the East Portal. The water that enters the tunnel drains via gravity to channels that run parallel to, or directly underneath, the track structure. The drains were incorporated into the original tunnel construction to move water away from the track structure. Because the tunnel has an apex, water drains to both the East and West Portals. At the East Portal, water is discharged from the tunnel through a sedimentation pond and into South Boulder Creek. At the West Portal, water is discharged from the tunnel to the Fraser River.

Water has been draining from the tunnel at relatively consistent natural rates since the time it was built in the 1920s. Flows from the West Portal are higher than those from the East Portal and are also more consistent over the course of the year due to significantly less infiltration from precipitation events and snowmelt at the West Portal.

In October of 2014, UPRR submitted a request to CDPHE for calculation of preliminary effluent limits (PELs) for the future East Portal CDPS permit. The request included information and relevant data regarding updated regulatory low flow calculations for South Boulder Creek as well as additional ambient and effluent water quality data. CDPHE agreed that the regulatory low flow calculations should be updated to more accurately reflect the flow regime in the receiving water and subsequently include updated regulatory low flows in the PEL calculations they provided in a letter to UPRR dated February 23, 2015. Updated flow analyses reflecting the perennial nature of South Boulder Creek were also included in the 2016 WQA and subsequently, the Draft Permit for the East Portal was published in March 11, 2016 (CO-0048986).

Due to the seasonal influence of snowmelt and stormwater runoff on the flow rates in the East Portal discharge, UPRR submitted a request for seasonal effluent limits be included in the forthcoming East Portal permit using seasonal high and low flow design flow discharge rates that more accurately represent the discharge scenarios in the East Portal. The PEL and WQA calculations performed by CDPHE leading up to the issuance of Draft Permit CO-0048986 incorporated the suggested seasonal flow values for the East Portal and resulted in seasonal effluent limits.

The revised data inputs in the PEL and WQA calculations result in the draft effluent limits set forth in the draft East Portal discharge permit (CO-0048986) differing considerably from the effluent limits for the East Portal outfall in the current CDPS permit. Changes in applicable water quality standards and procedural guidelines also impacted the effluent limit calculations and resulted in inclusion of effluent limits or reporting requirements for several parameters not included in the current CDPS permit (aluminum, uranium, molybdenum). UPRR and CDPHE are continuing to review data in an attempt to establish appropriate and scientifically-sound limits for the East Portal.

As a result of the addition of seasonal effluent limits and the overall differences in effluent limits for the East Portal from the current permit to the draft permit CO-0048986, a variety of additional potential treatment options may now be available. While the draft permit CO-0048986 included the same compliance schedule included in the current 2013 permit, UPRR provided comment to the draft permit requesting issuance of a compliance schedule that allows adequate time to develop treatment options that, similar to the treatment options already being implemented for the West Portal outfall, allow for the most effective and efficient means of meeting the effluent limitations provided in the draft permit. A five year timeline for development of future treatment options more typical of a newly issued CDPS permit was suggested in the comment letter provided by UPRR.

2.2 West Portal Water Treatment

As described in the 2015 Annual Compliance Report (CDM Smith 2015), UPRR is proceeding with the installation of a water treatment system at the West Portal to attain compliance with the final effluent limitations by April 30, 2017. The treatment process is based on filtering/precipitating the total and dissolved metal ions present in the drainage water that exceed the discharge limits to the Fraser River. The precipitates are then removed using an ultrafiltration (UF) process that removes suspended solids in the drainage water.

Micro and ultra-membrane filters are able to capture particles that are approximately 0.1 micron and 0.01 micron or greater in size, respectively, and reduce the need to add excess coagulants to remove the precipitated metals. A microfiltration system was tested at the East Portal in October of 2010 and an ultrafiltration system was recently tested at the West Portal in 2016 to verify that the dissolved metals could be precipitated and removed from the drainage water along with the turbidity associated with coal dust and sediment flushed from the ballast by the drainage water.

Turbidity levels in the water from the West Portal's drainage channel can exceed 500 NTU, and are comprised of fine suspended solids originating from historical build-up of fine solids associated with train traffic, as well as silt, sand, and products of ballast erosion. The drainage water also contains metals such as lead, cadmium, zinc, copper, iron, manganese, mercury, and uranium. The flow rates and total suspended solids (TSS) of the drainage waters are given in **Table 2-1**.

Table 2-1. Treatment Design Criteria

Parameter	West Portal Value
Average Daily Maximum Flow Rate (gpm)	210
Maximum Flow Rate (gpm)	300
Average TSS (mg/L)	45
Maximum TSS (mg/L)	140

2.2.1 Treatment Plant Design

Based on the results of the pilot testing, a treatment system using coagulation and membrane filtration was selected for treatment of the drainage water at the West Portal. The pilot study confirmed that a coagulation process followed by microfiltration was more effective than conventional media filtration for reducing the dissolved metals included in the discharge permit to near the detection limits. This approach was able to reduce all contaminants of interest to below permit limits. The design of the treatment facility includes an optional ion exchange process (IX) as a future polishing step to further remove the naturally occurring uranium, if necessary. The design also includes a solid waste dewatering process using sludge thickening via a dissolved air flotation (DAF) system and a centrifuge for final dewatering. Clarified liquids generated by the solids dewatering processes are recycled to the raw water or backwash equalization tank in the treatment process. Figures for the design layout of the water treatment facility as well as a process flow diagram are included in **Appendix A**.

The treatment facility has been designed to be fully automated but operator oversight is recommended for safety and routine checks and adjustments of equipment. An operator would be required to be on-call, and able to reach the facility within 24 hours in the event of equipment failure or process upset. The sludge dewatering system is a centrifuge batch process that will be automated but because of the batch nature of the process and mechanical components, this system is expected to require at least weekly operator attention. The system is designed to send an alarm signal if operator intervention is required. A sludge storage tank located at the West Portal will provide 2 to 4 days of sludge storage (approximately 2,300gallons) to give the on-call operator time to put the centrifuge back in service. The overall treatment system will be equipped with a supervisory control and data acquisition (SCADA) system to allow for remote monitoring and control of the plant.

The dewatered solids from the treatment process will be transported to an approved landfill approximately once per month via a 10-15 yard roll-off dumpster. Chemicals will be delivered approximately once per month. The proposed coagulation chemical is aluminum chloro-hydrate (ACH). Other potential chemicals include sodium hypochlorite (commercial strength bleach), sodium bisulfite, and citric acid, and caustic soda which will be used for scheduled periodic membrane cleaning events and an anionic polymer to assist with sludge thickening and dewatering characteristics. Water quality sampling and analysis is expected to be conducted once per month during chemical restocking and sludge haul-off. IX resin will be replaced (by the IX system supplier) at an approximate frequency of once to twice per year, if necessary. There will be a maintenance contract with the IX system supplier to dispose of the spent resin, which would contain high levels of uranium.

Exhibit 21

AGREEMENT
BETWEEN THE
UNITED STATES NUCLEAR REGULATORY COMMISSION
AND THE
STATE OF UTAH
FOR
DISCONTINUANCE OF CERTAIN COMMISSION REGULATORY AUTHORITY AND RESPONSIBILITY WITHIN THE STATE PURSUANT TO SECTION 274 OF THE ATOMIC ENERGY ACT OF 1954, AS AMENDED

WHEREAS, The United States Nuclear Regulatory Commission (hereinafter referred to as the Commission) is authorized under section 274 of the Atomic Energy Act of 1954, as amended (hereinafter referred to as the Act), to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission within the State under Chapters 6, 7, and 8, and section 161 of the Act with respect to byproduct materials as defined in sections lle.(1) and (2) of the Act, source materials, and special nuclear materials in quantities not sufficient to form a critical mass; and

WHEREAS, The Governor of the State of Utah is authorized under Utah Code Annotated 26-1-29 to enter into this Agreement with the Commission; and

WHEREAS, The Governor of the State of Utah certified on November 14, 1983, that the State of Utah (hereinafter referred to as the State) has a program for the control of radiation hazards adequate to protect the public health and safety with respect to the materials within the State covered by this Agreement, and that the State desires to assume regulatory responsibility for such materials; and

WHEREAS, The Commission found on March 12, 1984, that the program of the State for the regulation of the materials covered by this Agreement is compatible with the Commission's program for the regulation of such materials and is adequate to protect the public health and safety; and

WHEREAS, The State and the Commission recognize the desirability and importance of cooperation between the commission and the State in the formulation of standards for protection against hazards of radiation and in assuring that State and Commission programs for protection against hazards of radiation will be coordinated and compatible; and

WHEREAS, The Commission and the State recognize the desirability of reciprocal recognition of licenses and exemptions from licensing of those materials subject to this Agreement; and

WHEREAS, This Agreement is entered into pursuant to the provisions of the Atomic Energy Act of 1954, as amended;

NOW, THEREFORE, It is hereby agreed between the Commission and the Governor of the State, acting in behalf of the State, as follows:

ARTICLE I

Subject to the exceptions provided in Articles II, IV, and V, the Commission shall discontinue, as of the effective date of this Agreement, the regulatory authority of the Commission in the State under Chapters 6, 7, and 8, and Section 161 of the Act with respect to the following materials:

A. Byproduct materials as defined in section lle.(1) of the Act;

B. Source materials; and

C. Special nuclear materials in quantities not sufficient to form a critical mass.

ARTICLE II

This Agreement does not provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of:

A. The construction and operation of any production or utilization facility;

B. The export from or import into the United States of byproduct, source, or special nuclear material, of any production or utilization facility;

C. The disposal into the ocean or sea of byproduct, source, or special nuclear waste materials as defined in regulations or orders of the Commission;

D. The disposal of such other byproduct, source, or special nuclear material as the Commission from time to time determines by regulation or order should, because of the hazards or potential hazards thereof, not be so disposed of without a license from the Commission;

E. The land disposal of source, byproduct and special nuclear material received from other persons; and

F. The extraction or concentration of source material from source material ore and the management and disposal of the resulting byproduct material.

ARTICLE III

This Agreement may be amended, upon application by the State and approval by the Commission, to include the additional area(s) specified in Article II, paragraph E or F, whereby the State can exert regulatory control over the materials stated therein.

ARTICLE IV

Notwithstanding this Agreement, the Commission may from time to time by rule, regulation, or order, require that the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing source, byproduct, or special nuclear material shall not transfer possession or control of such product except pursuant to a license or an exemption from licensing issued by the Commission.

ARTICLE V

This Agreement shall not affect the authority of the Commission under subsection 161 b. or i. of the Act to issue rules, regulations, or orders to protect the common defense and security, to protect restricted data or to guard against the loss or diversion of special nuclear material.

ARTICLE VI

The Commission will use its best efforts to cooperate with the State and other agreement States in the formulation of standards and regulatory programs of the State and the Commission for protection against hazards of radiation and to assure that State and Commission programs for protection against hazards of radiation will be coordinated and compatible. The State will use its best efforts to cooperate with the Commission and other agreement States in the formulation of standards and regulatory program of the State and the Commission for protection against hazards of radiation and to assure that the State's program will continue to be compatible with the program of the Commission for the regulation of like materials. The State and the Commission will use their best efforts to keep each other informed of proposed changes in their respective rules and regulations and licensing, inspection and enforcement policies and criteria, and to obtain the comments and assistance of the other party thereon.

ARTICLE VII

The Commission and the State agree that it is desirable to provide for reciprocal recognition of licenses for the materials listed in Article I licensed by the other party or by any Agreement State. Accordingly, the Commission and the State agree to use their best effort to develop appropriate rules, regulations, and procedures by which such reciprocity will be accorded.

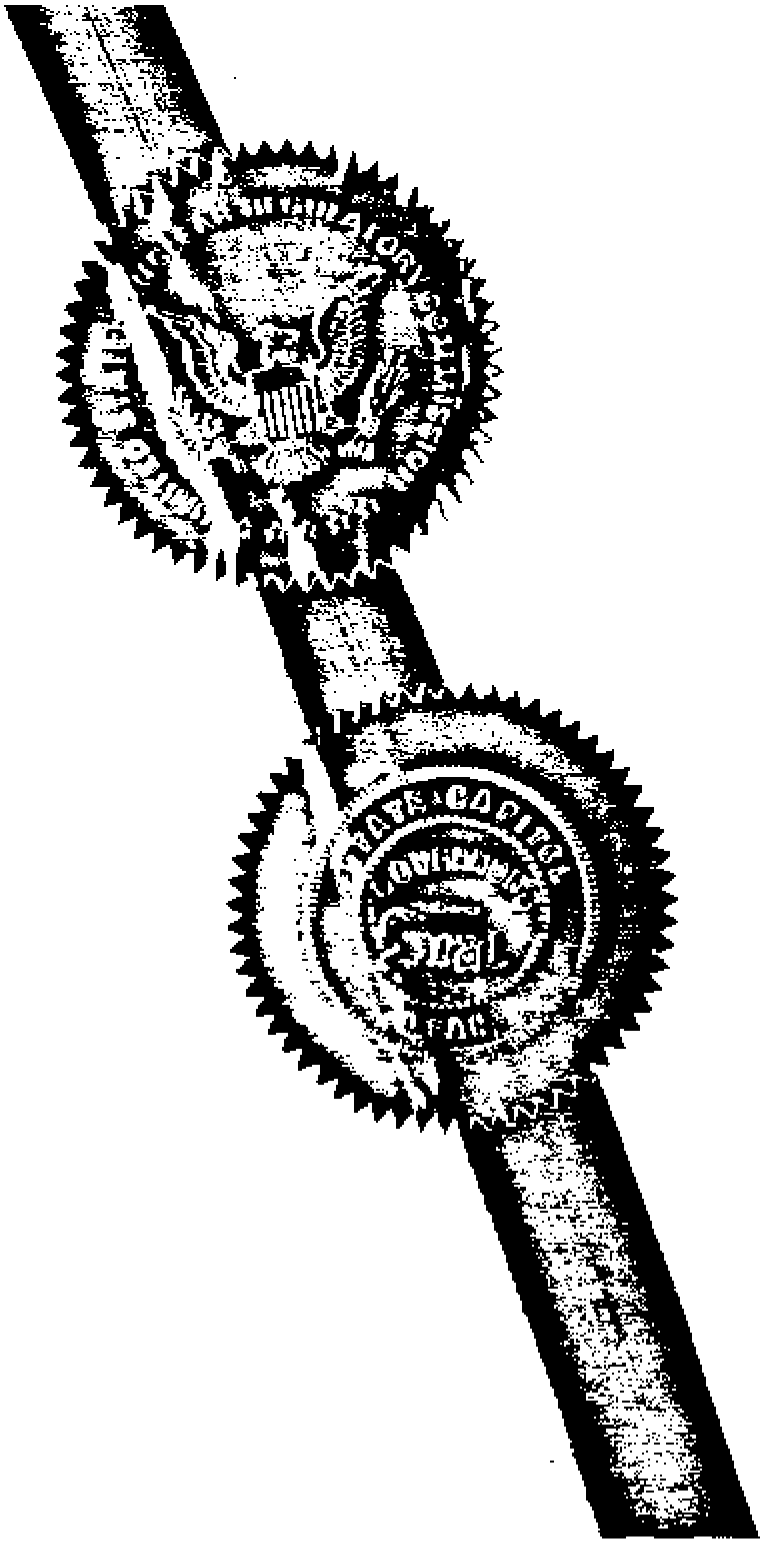
ARTICLE VIII

The Commission, upon its own initiative after reasonable notice and opportunity for hearing to the State, or upon request of the Governor of the State, may terminate or suspend all or part of this Agreement and reassert the licensing and regulatory authority vested in it under the Act if the Commission finds that (1) such termination or suspension is required to protect the public health and safety, or (2) the State has not complied with one or more of the requirements of section 274 of the Act. The Commission may also, pursuant to section 274j of the Act, temporarily suspend all or part of this agreement if, in the judgement of the Commission, an emergency situation exists requiring immediate action to protect public health and safety and the State has failed to take necessary steps. The Commission shall periodically review this Agreement and actions taken by the State under this Agreement to ensure compliance with section 274 of the Act.

ARTICLE IX

This Agreement shall become effective on April 1, 1984, and shall remain in effect unless, and until such time as it is terminated pursuant to Article VIII.

Done at Salt Lake City, in triplicate, this 29th day of March, 1984.



FOR THE UNITED STATES
NUCLEAR REGULATORY COMMISSION

Nunzio J. Palladino, Chairman

FOR THE STATE OF UTAH

Scott M. Matheson, Governor

Exhibit 22

"Elements of a Utah Agreement State Program for Uranium Mills Regulation",
Divisions of Radiation Control and Water Quality
Utah Department of Environmental Quality

August 26, 2000

Policy Statement

The State of Utah recognizes the importance of and supports the uranium mining and milling industry. The State recognizes that to remain viable at this time, uranium mills must be able to engage in activities other than milling conventional mined uranium ores, such as processing alternate feed materials for the recovery of uranium alone or together with other minerals. The State also recognizes its responsibility to ensure that all such activities are accomplished in a manner that is protective of human health and the environment. It has been a long-standing policy for the State to seek primacy for environmental programs. In this regard, the State believes that a cooperative uranium mills and tailings regulatory program will be of benefit to both the regulated community and Utah citizens. The advantages that the State can offer over the current Nuclear Regulatory Commission program include better communication with and participation of the public in uranium recovery issues, elimination of duplicative regulatory responsibilities, providing a more cost effective program for the regulated community, and establishing control of materials not currently being regulated (e.g. Pre-1978 uranium mill tailings), while maintaining a regulatory program that is adequate and compatible with existing and future NRC regulations and policy. The elements within this discussion paper provide the framework for how the State of Utah would regulate uranium mills and tailings as an Agreement State.

Statutory Changes

The Radiation Control Act would be amended to allow the Radiation Control Board to establish rules for the licensing, operation, decontamination, decommissioning, and reclamation of sites, structures, and equipment used in conjunction with possession, use, transfer, or delivery of source and byproduct material and the disposal of byproduct material(uranium or thorium mill tailings and related wastes).

The Radiation Control Act would be amended to add a representative of the uranium milling industry to the Radiation Control Board.

Rulemaking

The Division of Radiation Control (DRC) will adopt 10 CFR Part 40 and new Part 41, if and when promulgated, by reference with necessary changes to reflect primacy of the Utah program (e.g., recognition of the Executive Secretary, etc.). With the adoption by reference of the NRC regulatory program, it is recognized that guidance has been published that is intended to provide clarification to the various regulatory elements. The Division will follow the published NRC guidance unless doing so will compromise protection of human health and the environment.

DRC recognizes that it cannot make a fundamental change to an Atomic Energy Act provision (e.g., the definition of byproduct material). DRC further recognizes that pursuant to provisions of the Radiation Control Act (19-3-104 (6) and (7)), it can adopt rules more stringent than federal law only after a public hearing and a written finding based on evidence in the record that the federal regulations are not adequate to protect public health and the environment.

DRC will reach agreement with impacted mills, outside of rulemaking, desiring to process alternate feed on an acceptable uranium content level. Productive discussions in this regard are underway. Any agreement would be "approved" by the Utah Radiation Control Board, enforced by incorporation into a license condition.

The State of Utah will clarify during rulemaking that there is no distinction between pre and post-1978 uranium and thorium tailings and wastes that would otherwise satisfy the definition of 11e.(2) byproduct material.

Funding

DRC will use a combination of annual operating fees and review fees. There will be no "inspection fees" as part of the review fees. The Division or Department will not seek a change to "radioactive waste disposal fees" either in the Radiation Control Act or in the Department of Environmental Quality fees schedule to fund the program. The costs of developing the State programs and developing guidance and regulations from time to time will not be passed on to the licensees as part of the annual operating fees or review fees or otherwise.

Staffing

Staffing will consist of the establishment of four new positions within the Division. Staffing utilized for the licensing and oversight of the Envirocare site will be drawn from existing oversight staff for that facility. A health physicist position will be established with the responsibility for radiation safety inspections of the mills and inspection of all radioactive material licensees in Southern Utah (some 28 licensees). An engineer position will be established to assist in the inspection and licensing of new facilities, upgrade of existing facilities, and closing facilities. A groundwater hydrologist position will be established to provide for inspection and licensing review relating to groundwater monitoring and corrective actions for the mills. Administrative support to the section will be provided by an Office Technician III. Management of the mill team will be under the responsibility of the Environmental Monitoring and Low-Level Waste Section. The Section name will be changed to Environmental Monitoring, Uranium Recovery, and Waste Management Section.

Inspection program

There will be at least four facilities that will require inspection: Lisbon (Rio Algom), White Mesa (International Uranium), Shootaring Canyon (Plateau Resources), and Clive (Envirocare of Utah). There will also be the possibility of inspection responsibilities for the Moab Mill Reclamation Site if cleanup responsibility has not yet been transferred to the Department of Energy. Currently, Envirocare of Utah in Tooele County is subject to quarterly inspections by the NRC using staff from offices in Arlington, Texas sometimes supplemented by NRC Headquarters staff from Rockville, Maryland. Envirocare inspections would be assigned to the "Envirocare team" and incorporated into the overall oversight and inspection schedule now in use for low-level radioactive waste.

A health physicist will be hired to inspect each of the mills at least on a quarterly basis. The mill inspection frequency schedule will be reviewed regularly and adjusted as needed for different circumstances (e.g., good compliance, standby not operating, etc.) The health physicist will be housed in the DRC offices in Salt Lake City but will travel to Southern Utah at least one week per month to accomplish both regular (quarterly) and oversight inspections. This health physicist will also be responsible for the inspection of 28 other radioactive material licensees in Southeast and Southwest Utah. The engineer and groundwater hydrologist will provide inspection support as needed to the health physicist in such areas as groundwater sampling evaluations, split groundwater sampling, oversight of new engineering construction, or oversight of closing facilities.

The State inspection program would incorporate all the elements of the current radioactive materials inspection program relevant to Part 40 uranium recovery facilities which is subject to periodic program review by the NRC. Enforcement actions will be in accordance with the Utah Radiation Control Rules and existing enforcement guidance (used for the radioactive materials and low-level waste program). All enforcement actions can be appealed to the Utah Radiation Control Board and thereafter to the appropriate court.

Licensing program

The licensing process would follow the elements of the current radioactive materials program which is subject to periodic program review by the NRC. License renewal, amendments, reclamation plans or revisions to reclamation plans or new licenses may be subject to public comment and/or public hearing. Criteria of R313-17-1 through 4 would apply. DRC would follow current policy as to the differentiation between minor and major amendments and the need for public comment.

Existing NRC licenses will be transferred to the State upon program relinquishment by the NRC and they will be converted into a "state license" which will include appropriate Utah regulatory citations in lieu of "Part 40" language and will incorporate the Utah administrative process (e.g., Executive Secretary) where necessary. The license conditions will remain unchanged except for the above until a license amendment request or license renewal. The current expiration date of the license will remain the same. The license transfer will not give rise to a requirement to make any changes to existing facilities.

The State will recognize already established performance-based license conditions for uranium mills and tailings. The State is willing to consider future performance-based license conditions on a case by case basis with each licensee. An issue that will need to be addressed is the appropriate method for substantive involvement of the public while still achieving the operational objectives of performance based licensing.

Groundwater Authority

The Division of Radiation Control should continue to administer both groundwater permitting and radioactive materials licensing for disposal facilities and uranium mills. This process can be streamlined and made more effective by utilizing existing provisions of the Utah Water Quality Act which we believe would allow the Water Quality Board and Executive Director to designate the Director of the Division of Radiation Control as an Executive Secretary to administer provisions of this Act for the identified facilities (see UCA 19-5-106 and 19-5-104 (1),(k). This option offers several advantages including no statutory changes to the Radiation Control Act would be required, the DRC Director would be designated as an Executive Secretary of the Water Quality Board and given legal authority to issue, administer and enforce specific groundwater permits under the Utah Water Quality Act, and no separate involvement of the Division of Water Quality staff would be required although they would remain available to consult with the DRC Director regarding interpretation of rules and any other technical or procedural matters.

Additional advantages include that it would be more clear to the regulatory community regarding which agency and individuals they must deal with, thus eliminating dual involvement, permits would be issued under the current groundwater rules and policies adopted by the Water Quality Board to insure consistency with other entities regulated for the protection of groundwater by the Board, and the Division of Radiation Control would not need to undertake a separate rule making to define a groundwater protection program for these specific facilities.

Finally, appeals of permit or enforcement decisions will be conducted in accordance with the Water Quality Act through the Water Quality Board or the Executive Director of DEQ as specified in the Statute. This will insure consistency with other facilities and groundwater protection actions. Mining representation and expertise is already established in statute for the Board. This approach insures consistency with the radioactive materials licensing because the same staff will be doing both. The DRC Director will need to be careful to insure that the proper signature authority is used for the various actions that might be taken. This approach prevents fragmentation of the state groundwater protection program and maintains consistency.

Task Force Recommendation to the Department of Environmental Quality

The following motion, proposed by Bill Sinclair, was moved for a vote by David Bird, seconded by George Hellstrom.

We, the members of the Department of Environmental Quality Groundwater Authority Agreement State task force support the State of Utah in pursuing Agreement State status for uranium recovery regulation on the terms established in the revised "Elements of a Utah Agreement State Program for Uranium Mills Regulation, Divisions of Radiation Control and Water Quality, agreed to at the July 26, 2000 meeting of the task force.

Unanimously supported by task force members:
Paul Goranson, Rio Algom
Fred Craft, Plateau Resources
George Hellstrom, Envirocare of Utah, Inc.
David Bird, Utah Mining Association
David Frydenlund, International Uranium
Harvey Merrell, Grand County Council
Teryl Hunsaker, Tooele County Commission
Stephen Nelson, Utah Radiation Control Board
William J. Sinclair, Division of Radiation Control, UDEQ
Don Ostler, Division of Water Quality, UDEQ

Exhibit 23

AMENDMENT TO AGREEMENT BETWEEN THE UNITED STATES NUCLEAR REGULATORY COMMISSION AND THE STATE OF UTAH FOR DISCONTINUANCE OF CERTAIN COMMISSION REGULATORY AUTHORITY AND RESPONSIBILITY WITHIN THE STATE PURSUANT TO SECTION 274 OF THE ATOMIC ENERGY ACT OF 1954, AS AMENDED

WHEREAS, the United States Nuclear Regulatory Commission (hereinafter referred to as the Commission) entered into an Agreement on March 29, 1984 (hereinafter referred to as the Agreement of March 29, 1984) with the State of Utah under Section 274 of the Atomic Energy Act of 1954, as amended (hereafter referred to as the Act) which became effective on April 1, 1984, providing for discontinuance of the regulatory authority of the Commission within the State under Chapters 6, 7, and 8 and Section 161 of the Act with respect to byproduct materials as defined in Section 11e.(1) of the Act, source materials, and special nuclear materials in quantities not sufficient to form a critical mass; and,

WHEREAS, the Commission entered into an amendment to the Agreement of March 29, 1984 (hereinafter referred to as the Agreement of March 29, 1984, as amended) pursuant to the Act providing for discontinuance of regulatory authority of the Commission with respect to the land disposal of source, byproduct, and special nuclear material received from other persons which became effective on May 9, 1990; and,

WHEREAS, the Governor of the State of Utah requested, and the Commission agreed, that the Commission reassert Commission authority for the evaluation of radiation safety information for sealed sources or devices containing byproduct, source or special nuclear materials and the registration of the sealed sources or devices for distribution, as provided for in regulations or orders of the Commission; and, WHEREAS, the Governor of the State of Utah is authorized under Utah Code Annotated 19-3-113 to enter into this amendment to the Agreement of March 29, 1984, as amended, between the Commission and the State of Utah; and,

WHEREAS, the Governor of the State of Utah has requested this amendment in accordance with Section 274 of the Act by certifying on January 2, 2003 that the State of Utah (hereinafter referred to as the State) has a program for the control of radiological and non-radiological hazards adequate to protect the public health and safety and the environment with respect to byproduct material as defined in Section 11e.(2) of the Act and facilities that generate this material and that the State desires to assume regulatory responsibility for such material; and,

WHEREAS, the Commission found on August 4, 2004, that the program of the State for the regulation of materials covered by this Amendment is in accordance with the requirements of the Act and in all other respects compatible with the Commission's program for the regulation of byproduct material as defined in Section 11e.(2) of the Act and is adequate to protect public health and safety; and,

WHEREAS, the State and the Commission recognize the desirability and importance of cooperation between the Commission and the State in the formulation of standards for protection against hazards of radiation and in assuring that the State and the Commission programs for protection against hazards of radiation will be coordinated and compatible; and,

WHEREAS, this Amendment to the Agreement of March 29, 1984, as amended, is entered into pursuant to the provisions of the Act.

NOW, THEREFORE, it is hereby agreed between the Commission and the Governor of the State, acting on behalf of the State, as follows:

Section 1. Article I of the Agreement of March 29, 1984, as amended, is amended by adding a new paragraph B and renumbering paragraphs B through D as paragraphs C through E. Paragraph B will read as follows:

"B. Byproduct materials as defined in Section 11e.(2) of the Act;"

Section 2. Article II of the Agreement of March 29, 1984, as amended, is amended by deleting paragraph E and inserting a new paragraph E to implement the reassertion of Commission authority over sealed sources and devices to read:

"E. The evaluation of radiation safety information on sealed sources or devices containing byproduct, source, or special nuclear materials and the registration of the sealed sources or devices for distribution, as provided for in regulations or orders of the Commission."

Section 3. Article II of the Agreement of March 29, 1984, as amended, is amended by numbering the current Article as "A" by placing an A in front of the current Article language. The subsequent paragraphs A through E are renumbered as paragraphs 1 through 5. After the current amended language, the following new Paragraph B is added to read:

"B. Notwithstanding this Agreement, the Commission retains the following authorities pertaining to byproduct material as defined in Section 11e.(2) of the Act:

1. Prior to the termination of a State license for such byproduct material, or for any activity that resulted in the production of such material, the Commission shall have made a determination that all applicable standards and requirements pertaining to such material have been met;

2. The Commission reserves the authority to establish minimum standards governing reclamation, long-term surveillance or maintenance, and ownership of such byproduct material and of land used as a disposal site for such material. Such reserved authority includes:

   a. The authority to establish terms and conditions as the Commission determines necessary to assure that, prior to termination of any license for such byproduct material, or for any activity that results in the production of such material, the licensee shall comply with decontamination, decommissioning, and reclamation standards prescribed by the Commission; and with ownership requirements for such materials and its disposal site;

   b. The authority to require that prior to termination of any license for such byproduct material or for any activity that results in the production of such material, title to such byproduct material and its disposal site be transferred to the United States or the State of Utah at the option of the State (provided such option is exercised prior to termination of the license);

c. The authority to permit use of the surface or subsurface estates, or both, of the land transferred to the United States or the State pursuant to 2.b. in this Section in a manner consistent with the provisions of the Uranium Mill Tailings Radiation Control Act of 1978, as amended, provided that the Commission determines that such use would not endanger public health, safety, welfare, or the environment;

d. The authority to require, in the case of a license for any activity that produces such byproduct material (which license was in effect on November 8, 1981), transfer of land and material pursuant to paragraph 2.b. in this Section taking into consideration the status of such material and land and interests therein, and the ability of the licensee to transfer title and custody thereof to the United States or the State;

e. The authority to require the Secretary of the Department of Energy, other Federal agency, or State, whichever has custody of such byproduct material and its disposal site, to undertake such monitoring, maintenance, and emergency measures as are necessary to protect public health and safety, and other actions as the Commission deems necessary; and

f. The authority to enter into arrangements as may be appropriate to assure Federal long-term surveillance or maintenance of such byproduct material and its disposal site on land held in trust by the United States for any Indian Tribe or land owned by an Indian Tribe and subject to a restriction against alienation imposed by the United States."

Section 4. Article IX of the 1984 Agreement, as amended, is renumbered as Article X and a new Article IX is inserted to read:

"ARTICLE IX

In the licensing and regulation of byproduct material as defined in Section 11e.(2) of the Act, or of any activity which results in the production of such byproduct material, the State shall comply with the provisions of Section 274o of the Act. If in such licensing and regulation, the State requires financial surety arrangements for reclamation or long-term surveillance and maintenance of such byproduct material:

A. The total amount of funds the State collects for such purposes shall be transferred to the United States if custody of such byproduct material and its disposal site is transferred to the United States upon termination of the State license for such byproduct material or any activity that results in the production of such byproduct material. Such funds include, but are not limited to, sums collected for long-term surveillance or maintenance. Such funds do not, however, include monies held as surety where no default has occurred and the reclamation or other bonded activity has been performed; and

B. Such surety or other financial requirements must be sufficient to ensure compliance with those standards established by the Commission pertaining to bonds, sureties, and financial arrangements to ensure adequate reclamation and long-term management of such byproduct material and its disposal site."

This amendment shall become effective on August 15, 2004, and shall remain in effect unless and until such time as it is terminated pursuant to Article VIII of the Agreement of March 29, 1984, as amended.

Done at Rockville, Maryland, in triplicate, this 10th day of August 2004.

FOR THE UNITED STATES
NUCLEAR REGULATORY COMMISSION

Nils J. Diaz, Chairman

Done at Salt Lake City, Utah, in triplicate, this 16th day of August 2004.

FOR THE STATE OF UTAH

Olene S. Walker, Governor

Exhibit 24

Freight Calculator: Air and Sea Shipping Costs

Instant international freight rate estimates for shipping by sea, air, and truck.

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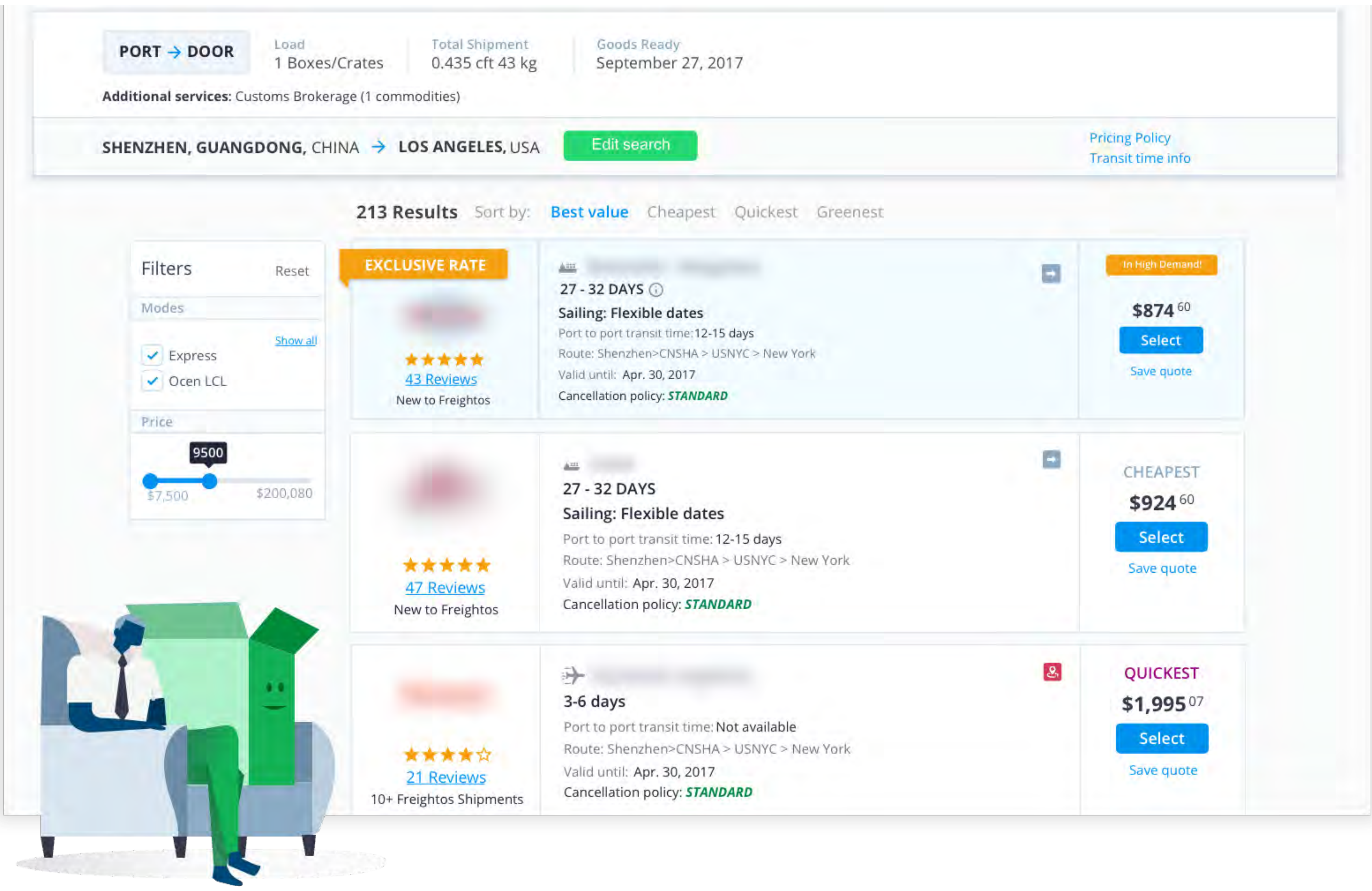

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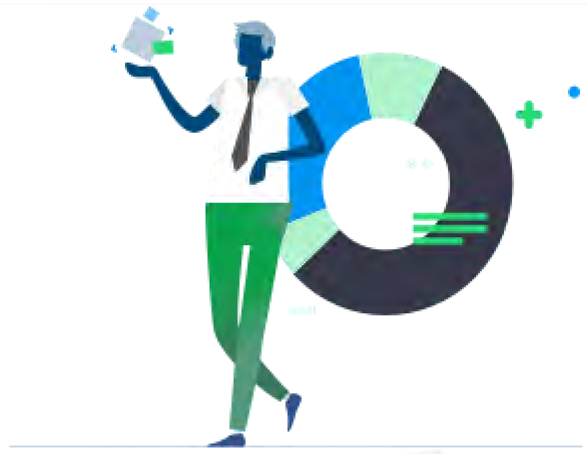

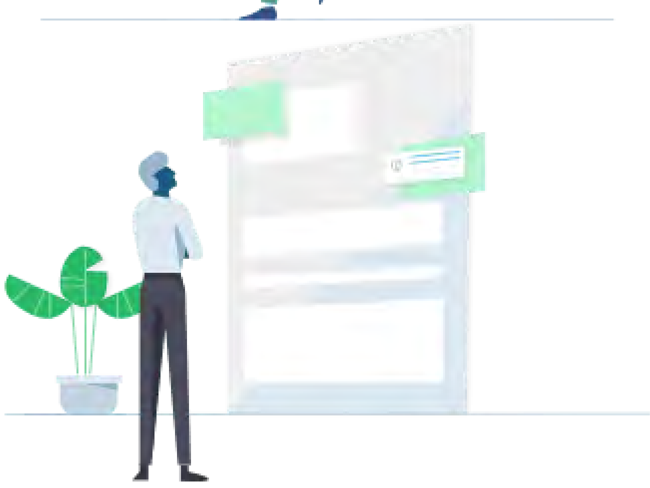

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Exhibit 25

News Payment Page

Freight Calculator

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1. SELECT METHOD OF SHIPPING

Containerized

Break Bulk

Project Cargo/ Heavy Lift

Truck

Air

2. SELECT LOCATIONS

Tallinn, Estonia

Houston, United States

Minerals & Metallurgy

Before entering the Commodity Value, please select the Load Type of either FCL or LCL.

$1,000

3. SELECT LOAD

- [x] FCL

Container Type 20 FT

- [ ] LCL
- [ ] Refrigerated

4. ACCESSORIAL CHARGES

- [x] Hazardous
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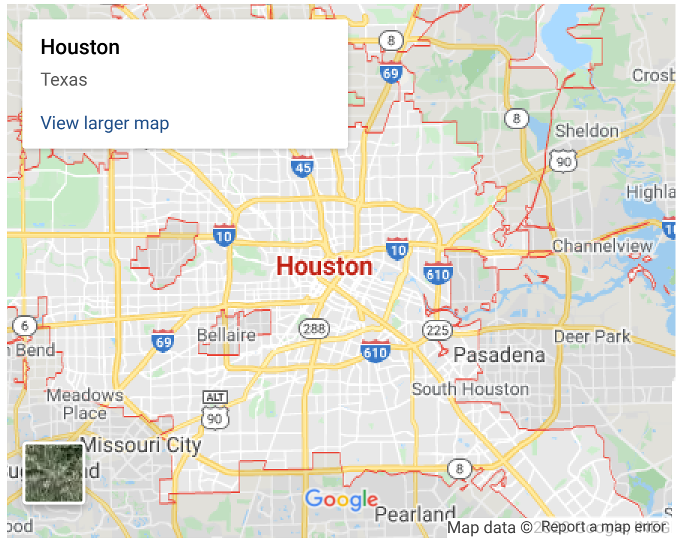

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Exhibit 26

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1888

Environmental Impact Statement for the Reclamation of the Sequoyah Fuels Corporation Site in Gore, Oklahoma

Final Report

Office of Federal and State Materials and Environmental Management Programs

APPENDIX F

COST ANALYSIS

Table F-1 No Action Alternative

Activity/Cost Element	Direct Cost ($000s)	Notes/Assumptions/Parameters			
1. Long term site control fund[1]	$18,420				
		Derivation of Long-term Annual Maintenance Costs			
		Staff	No.		**2007[2]**
		Manager/Engineer	0.25	FTE	$31,276
		Technicians	2	FTE	$72,978
		Security Guards	2	FTE	$83,404
		Administration	0.25	FTE	$10,425
		O&M			
		Utilities			$10,425
		Analytical Cost			$52,127
		Materials, supplies			$52,127
		NRC fees			$52,127
		Mowing			
		6 mowings (96 h @ $36.5)	96	$36.49	$3,503
		Total:			$368,394
2. Long-term Groundwater Recovery and Treatment	$1,355	13 yrs. @ $104,250/yr. (undiscounted)			
Total Cost	**$19,775**				

Standard construction work units of measurement used in all tables

Notes:

1 The long-term site control fund represents the capitalized value of the annual long-term maintenance cost of $368,394. The value of the fund size was calculated by dividing the annual amount by a 2% discount rate ($368,394 / 0.02 =$18,419,700). The annual long-term maintenance costs include annual sampling of 25 monitoring wells and analysis for uranium, nitrate and arsenic, preparation of an annual report, and mowing six times per year.

2 2007$ updated using November 2007 Consumer Price Index, U.S. Bureau of Labor Statistics.

Table F-2 Alternative 1: On-Site Disposal of Contaminated Materials (the Licensee's Proposed Action)

Estimated Costs for On-Site Disposal		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor Mobilization and demobilization	$694	5% of lines, 4, 5, 6, 7, 8, 9 and 11.
4. Monitoring Well Removal and Replacement	$–	Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Cost for Placing Super Sacks in Disposal Cell	$50	
7. Other Sludge, Removal, Treatment and On-Site Disposal	$3,122	See note (4)
8. Soil Remediation	$1,716	See Table F-2b
9. Building and Equipment Demolition	$3,994	See note (5)
10. Termination Survey	$391	See note (6)
11. Site Restoration	$1,931	See note (7)
12. Groundwater Remediation	$1,199	See note (8)
13. Engineering Construction Management	$2,246	15% of lines 3 through 11.
14. Post-Closure Monitoring Program	$84	See note (9)
15. SFC Staff	$7,612	See note (10)
16. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
17. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
Subtotal:	$29,623	
Contingency (@ 10% of direct costs)	$2,962	
Grand Total:	**$32,585**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement of other sludges in the cell (1,433,015 cu-ft @ $2.179/cu-ft.). Sum of non-raffinate sludge and sediments from Material Characteristics Table F-2a.

(5) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(6) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(7) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(8) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(9) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(10) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-2a Material Characteristics Sheet

Description	Volume (cubic feet)	In Cell Volume (cubic feet)	Density g/cm^3	Total Weight (lbs)	Total Weight (tons)
Sludges and Sediments					
Raffinate sludge	1,064,000	247,009	1.360	2.10E+07	10,478
Pond 2 residual materials	635,000	762,000	1.710	8.13E+07	40,640
Emergency basin sediment	14,600	14,600	1.511	1.38E+06	688
North ditch sediment	20,770	20,770	1.511	1.96E+06	979
Sanitary lagoon sediment	10,365	10,365	1.511	9.77E+05	488
Fluoride holding basin #1	171,400	171,400	1.540	1.65E+07	8,233
Fluoride holding basin #2	186,000	186,000	1.540	1.79E+07	8,934
Fluoride settling basins and clarifier	114,300	114,300	1.540	1.10E+07	5,490
Buried calcium fluoride	96,380	96,380	1.540	9.26E+06	4,629
Buried fluoride holding basin #1	57,200	57,200	1.540	5.49E+06	2,747
subtotal:	**2,370,015**	**1,680,024**	**15**	**166,613,236**	**83,307**
Liner Soils and Subsoils					
Clarifier liners	332,400	332,400	1.760	3.65E+07	18,247
Calcium fluoride basin liner	95,285	95,285	1.760	1.05E+07	5,231
Emergency basin soils	162,500	162,500	1.760	1.78E+07	8,920
North Ditch soils	87,500	87,500	1.760	9.61E+06	4,803
Sanitary Lagoon liner	56,356	56,356	1.760	6.19E+06	3,094
subtotal:	**734,041**	**734,041**	**9**	**80,588,001**	**40,294**
Buried Material/Drums					
Pond 1 spoils pile	437,400	437,400	1.760	4.80E+07	24,010
Interim storage cell	154,887	154,887	1.760	1.70E+07	8,502
Solid waste burials (No. 1)	43,000	43,000	1.760	4.72E+06	2,360
Solid waste burials (No. 2)	8,100	8,100	1.760	8.89E+05	445
DUF4 drummed container trash	2,200	2,200	0.545	7.48E+04	37
Other drummed container trash	5000	5000	0.545	1.70E+05	85
Empty contam. Drum	2,000	2,000	0.883	1.10E+05	55
subtotal:	**652,587**	**652,587**	**9**	**70,990,325**	**35,495**
Structural Materials[1]					
Main process building	2,178,000	436,600	3.204	8.73E+07	43,630
Solvent extraction building	180,000	36,000	3.204	7.20E+06	3,598
DUF4 building	281,000	56,200	3.204	1.12E+07	5,616
ADU/Misc digestion building	75,000	2,500	3.204	5.00E+05	250
Laundry building	12,500	3,000	3.204	6.00E+05	300
Centrifuge building	15,000	6,000	3.204	1.20E+06	600

Table F-2a Material Characteristics Sheet

Description	Volume (cubic feet)	In Cell Volume (cubic feet)	Density g/cm^3	Total Weight (lbs)	Total Weight (tons)
Bechtel building	27,000	5,400	3.204	1.08E+06	540
Solid waste building	18,000	3,600	3.204	7.20E+05	360
Cooling tower	30,000	6,000	3.204	1.20E+06	600
RCC evaporator	18,750	3,750	3.204	7.49E+05	375
Incinerator	7,500	1,500	3.204	3.00E+05	150
Concrete and asphalt	511,795	511,795	3.204	1.02E+08	51,144
Scrap metal	100,000	50,000	0.883	2.75E+06	1,377
Chippel Pallets	3,000	3,000	0.300	5.61E+04	28
subtotal:	**3,457,545**	**1,125,345**	**40**	**217,131,023**	**108,566**
Subsoils and Bedrock					
Contaminated materials	811,685	811,685	1.760	89,112,285.89	44,556
TOTAL	**8,025,873**	**5,003,682**		**624,434,871.35**	**312,217.44**

Standard construction work units of measurement used in all tables

Notes;

[1] Existing volume values are for existing building volumes. In-cell volumes are estimated at 20% of built structure.

Table F-2b Soil Remediation and Consolidated Debris Cost (Alternatives 1 and 3)

Derivation of Soil Remediation and Consolidated Debris Costs			
Waste Element	Cubic Feet of Material	Unit Cost per cubic foot 2007 $	Total Cost
Contaminated Subsoils & Bedrock	811,685	$0.782	$634,663
DUF4 Trash Drums	2,200	$12.511	$27,523
CaF2 Basin Clay Liners	95,290	$0.688	$65,567
Solid Waste Burials	51,100	$1.522	$77,780
Pond 1 Spoils Pile	437,000	$0.688	$300,691
Interim Soils Storage Cell	154,887	$0.688	$106,575
Clarifier Clay Liners	332,400	$0.688	$228,718
Drummed LLW	5,000	$12.511	$62,553
Sanitary Lagoon Soil	56,400	$0.688	$38,808
Emergency Basin Soil	162,500	$0.688	$111,813
North Ditch Soil	87,500	$0.688	$60,207
Crushed Drums	2,000	$0.688	$1,376
Total	2,197,962		$1,716,273

Table F-3 Alternative 2, Option 1: Off-Site Disposal of All Contaminated Materials

Transport of all materials by rail to EnergySolutions (Clive, Utah)

Estimated Direct Costs for Off-Site Disposal to EnergySolutions (Alternative 2-1)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$569	5% of lines, 4, 5, 6, 7, 8, 9 and 11.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure		Not required for the off-site disposal option
6. Dewater Raffinate Sludge		Task Complete
7. Other Sludge, Removal & Treatment & Loading for Transport	$3,122	See note (3)
8. Soil Remediation	$3,877	See Table F-3a
9. Building and Equipment Demolition	$3,994	See note (4)
10. Shipping and Off-Site Disposal	$177,191	See note (5)
11. Termination Survey	$391	See note (6)
12. Site Restoration	$1,931	See note (7)
13. Groundwater Remediation	$1,199	See note (8)
14. Engineering Construction Management	$28,661	15% of lines 3 through 12.
15. SFC Staff	$7,612	See note (9)
16. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
Total Direct Cost:	$231,258	
Contingency (@ 10% of direct costs)	$23,126	
Grand Total:	**$254,384**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Volume 1,433,015 cu-ft @ $2.179/cu-ft (sum of non-raffinate sludge and sediments from Material Characteristics Table F-2a).

(4) From SFC Environmental Report.

(5) Calculated by multiplying 463,850 tons times $382/ton (cost quote EnergySolutions 2007).

(6) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(7) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(8) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(9) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-3a Soil Remediation and Consolidated Debris Costs (Alternative 2)

Derivation of Soil Remediation and Consolidated Debris Costs			
Waste Element	**Cubic Feet of Material**	**Unit Cost/ cubic foot 2007 $**	**Total Cost**
DUF4 Trash Drums	2,200	$12.563	$27,638
Subsoils and Bedrock	3,574,000	$0.782	$2,794,541
CaF2 Basin Clay Liners	95,290	$0.688	$65,567
Solid Waste Burials	51,100	$1.522	$77,780
Pond 1 Spoils Pile	437,000	$0.688	$300,691
Interim Soils Storage Cell	154,887	$0.688	$106,575
Clarifier Clay Liners	332,400	$0.688	$228,718
Drummed LLW	5,000	$12.563	$62,813
Sanitary Lagoon Soil	56,400	$0.688	$38,808
Emergency Basin Soil	162,500	$0.688	$111,813
North Ditch Soil	87,500	$0.688	$60,207
Crushed Drums	2,000	$0.688	$1,376
Total	4,960,277		3,876,526

Table F-4 Alternative 2, Option 2: Off-Site Disposal of All Contaminated Materials

Transport of all materials by rail to WCS (Andrews, Texas)

Estimated Direct Costs for the Off-Site Disposal to WCS (Alternative 2-2)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$569	5% of lines, 4, 5, 6, 7, 8, 9 and 11.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure		Not required for the off-site disposal option
6. Dewater Raffinate Sludge		Task Complete
7. Other Sludge, Removal & Treatment & Loading for Transport	$3,122	See note (3)
8. Soil Remediation	$3,877	See Table F-3a
9. Building and Equipment Demolition	$3,994	See note (4)
10. Shipping and Off-Site Disposal	$89,253	See note (5)
11. Termination Survey	$391	See note (6)
12. Site Restoration	$1,931	See note (7)
13. Groundwater Remediation	$1,199	See note (8)
14. Engineering Construction Management	$15,471	15% of lines 3 through 12.
15. SFC Staff	$7,612	See note (9)
16. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
Total Direct Cost:	$130,130	
Contingency (@ 10% of direct costs)	$13,013	
Grand Total:	**$143,143**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS

(3) Volume 1,433,015 cu-ft @ $2.179/cu-ft (sum of non-raffinate sludge and sediments from Material Characteristics Table F-2a).

(4) From SFC Environmental Report.

(5) Calculated based on scaling the EnergySolutions price quote by the relative rail distances between WCS and EnergySolutions, Inc. Calculated using the ratio of the WCS rail distance (km) to the EnergySolutions rail distance (km); equal to: (1221 km / 2424 km) x (382/ton) x (463,850 tons).

(6) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(7) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(8) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(9) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-5 Alternative 3, Option 1-1: Partial Off-site Disposal of Contaminated Materials

Raffinate sludge transported by truck to White Mesa (Blanding, Utah) and other sludges and sediments transported by truck to Pathfinder Mines Corp. (PMC, Mills, Wyoming).

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-1-1)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport of raffinate sludge to White Mesa	$1,985	See note (5)
8b. Raffinate sludge processing cost at White Mesa	$1,310	= [10,478 tons x $125/ton processing cost].
8c. Transport of other sludges and sediments to PMC	$407	See note (6)
8d. Disposal of other sludges and sediments at PMC	$455	= [2155 tons x $210.9/ton PMC disposal cost]
8e. Recovered Materials Rebate (-) Raffinate Sludge	$(738)	See note (7)
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (8)
11. Termination Survey	$391	See note (9)
12. Site Restoration	$1,931	See note (10)
13. Groundwater Remediation	$1,199	See note (11)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12 (less 8).
15. Post-Closure Monitoring Program	$84	See note (12)
16. SFC Staff	$7,612	See note (13)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
19. White Mesa license amendment	$100	
Total Direct Cost:	$32,961	
Contingency (@ 10% of direct costs)	$3,296	
Grand Total:	**$36,257**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).

(5) See Appendix F Table F-17 for mean carrier transport price quotes in $/ton by final destination. Table value = [10,478 tons of raffinate sludge x mean transport price quote of $189.4/ton]. Mean transport price reflects quotes received from seven carriers.

(6) See Appendix F Table F-17 for mean carrier transport price quote in $/ton by final destination. Table value = 2,155 tons of sediment (includes Emergency Basin + North Ditch + Sanitary Lagoon) going 1675 km using $189/ton. Mean transport price reflects quotes received from seven carriers.

(7) Reflects potential rebate provided by mill for market value of recovered uranium constituents using March 2008 price for uranium. See Table F-18.

(8) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(9) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(10) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(11) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(12) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(13) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-6 Alternative 3, Option 1-2: Partial Off-site Disposal of Contaminated Materials
Raffinate sludge transported by truck to White Mesa (Blanding, Utah) and other sludges and sediments transported by truck to EnergySolutions (Clive, Utah).

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-1-2)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport raffinate sludge to White Mesa	$1,985	See note (5)
8b. Raffinate sludge processing cost at White Mesa	$1,310	Value = [10,478 tons of raffinate sludge x $125/ton processing cost].
8c. Transport other sludges and sediments to EnergySolutions	$517	See note (6)
8d. Disposal of other sludges and sediments at EnergySolutions	$493	= $228.9/ton disposal cost x 2155 tons
8e. Recovered Materials Rebate (-) Raffinate Sludge	$(738)	See note (7)
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (8)
11. Termination Survey	$391	See note (9)
12. Site Restoration	$1,931	See note (10)
13. Groundwater Remediation	$1,199	See note (11)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12.(less 8)
15. Post-Closure Monitoring Program	$84	See note (12)
16. SFC Staff	$7,612	See note (13)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
19. White Mesa license amendment	$100	
Total Direct Cost:	$33,109	
Contingency (@ 10% of direct costs)	$3,311	
Grand Total:	**$36,420**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).

(5) See Appendix F Table F-17 for mean carrier transport price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge x mean price quote of $189.4/ton]. Mean transport price reflects quotes received from seven carriers.

(6) See Appendix F Table F-17 for mean carrier transport price quote in $/ton by final destination. Table value = 2,155 tons of sediment (includes Emergency Basin + North Ditch + Sanitary Lagoon) going 2190 km multiplied times $239.9/ton. Mean transport price reflects quotes received from seven carriers.

(7) Reflects potential rebate provided by mill for market value of recovered uranium constituents using March 2008 price for uranium. See Table F-18

(8) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(9) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(10) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(11) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(12) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(13) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-7 Alternative 3, Option 1-3: Partial Off-site Disposal of Contaminated Materials

Raffinate sludge transported by truck to White Mesa (Blanding, Utah) and other sludges and sediments transported by truck to WCS (Andrews, Texas).

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-1-3)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport raffinate sludge to White Mesa	$1,985	See note (5)
8b. Raffinate sludge processing cost at White Mesa	$1,310	= [10,478 tons x $125/ton processing cost]
8c. Transport other sludges and sediments to WCS	$284	See note (6)
8d. Disposal of other sludges and sediments at WCS	$231	= $107/ton disposal cost x 2155 tons.
8e. Recovered Materials Rebate (-) Raffinate Sludge	$(738)	See note (7)
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (8)
11. Termination Survey	$391	See note (9)
12. Site Restoration	$1,931	See note (10)
13. Groundwater Remediation	$1,199	See note (11)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12 (less 8)
15. Post-Closure Monitoring Program	$84	See note (12)
16. SFC Staff	$7,612	See note (13)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
19. White Mesa license amendment	$100	
Total Direct Cost:	$32,613	
Contingency (@ 10% of direct costs)	$3,261	
Grand Total:	**$35,875**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).

(5) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge x mean transport price quote of $189.4/ton]. Mean transport price reflects quotes received from seven carriers.

(6) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [2155 tons of raffinate sludge x mean transport price quote of $131.6/ton]. Mean transport price reflects quotes received from seven carriers.

(7) Reflects potential rebate provided by mill for market value of recovered uranium constituents using March 2008 price for uranium. See Table F-18

(8) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(9) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(10) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(11) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater as necessary.

(12) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(13) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-8 Alternative 3, Option 2-1: Partial Off-Site Disposal of Contaminated Materials

Raffinate sludge transported by truck to Rio Algom (Grants, New Mexico) and other sludges and sediments transported by truck to Pathfinder Mines Corp. (Mills, Wyoming).

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-2-1)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport of raffinate sludge to Rio Algom	$1,638	See note (5)
8b. Disposal of raffinate sludge at Rio Algom	$2,096	= [10,478 x $200/ton disposal cost]
8c. Transport of other sludges and sediments to PMC	$407	See note (6)
8d. Disposal of other sludges and sediments at PMC	$455	= $210.9/ton disposal cost x 2155 tons
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (7)
11. Termination Survey	$391	See note (8)
12. Site Restoration	$1,931	See note (9)
13. Groundwater Remediation	$1,199	See note (10)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12 (less 8).
15. Post-Closure Monitoring Program	$84	See note (11)
16. SFC Staff	$7,612	See note (12)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
Total Direct Cost:	$34,038	
Contingency (@ 10% of direct costs)	$3,404	
Grand Total:	**$37,441**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).

(5) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge x mean price quote of $156.3/ton]. Mean transport price reflects quotes received from seven carriers.

(6) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Value = 2,155 tons of sediment (includes Emergency Basin + North Ditch + Sanitary Lagoon) going 1675 km using $189/ton. Mean transport price reflects quotes received from seven carriers.

(7) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(8) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(9) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(10) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater as necessary.

(11) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(12) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-9 Alternative 3, Option 2-2: Partial Off-Site Disposal of Contaminated Materials

Raffinate sludge transported by truck to Rio Algom (Grants, New Mexico) and other sludges and sediments transported by truck to EnergySolutions (Clive, Utah).

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-2-2)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport raffinate sludge to Rio Algom	$1,638	See note (5)
8b. Disposal of raffinate sludge at Rio Algom	$2,096	= [10,478 x $200/ton disposal cost]
8c. Transport other sludges and sediments to EnergySolutions	$517	See note (6)
8d. Disposal of other sludges and sediments at EnergySolutions	$493	= $228.9/ton disposal cost x 2155 tons.
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (7)
11. Termination Survey	$391	See note (8)
12. Site Restoration	$1,931	See note (9)
13. Groundwater Remediation	$1,199	See note (10)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12 (less 8).
15. Post-Closure Monitoring Program	$84	See note (11)
16. SFC Staff	$7,612	See note (12)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
Total Direct Cost:	$34,186	
Contingency (@ 10% of direct costs)	$3,419	
Grand Total:	**$37,605**	

Standard construction work units of measurement used in all tables

Notes: details may not add exactly to grand total due to independent rounding.

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).

(5) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge x mean price quote of $156.3/ton]. Mean transport price reflects quotes received from seven carriers.

(6) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = 2,155 tons of sediment (includes Emergency Basin + North Ditch + Sanitary Lagoon) going 2190 km using $239.9/ton. Mean transport price reflects quotes received from seven carriers.

(7) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(8) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(9) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(10) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(11) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(12) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-10 Alternative 3, Option 2-3: Partial Off-Site Disposal of Contaminated Materials

Raffinate sludge transported by truck to Rio Algom (Grants, New Mexico) and other sludges and sediments transported by truck to WCS (Andrews, Texas).

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-2-3)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport raffinate sludge to Rio Algom	$1,638	See note (5)
8b. Disposal of raffinate sludge at Rio Algom	$2,096	= [10,478 x $200/ton disposal cost]
8c. Transport other sludges and sediments to WCS	$284	See note (6)
8d. Disposal of other sludges and sediments at WCS	$231	= $107/ton disposal cost x 2155 tons.
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (7)
11. Termination Survey	$391	See note (8)
12. Site Restoration	$1,931	See note (9)
13. Groundwater Remediation	$1,199	See note (10)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12 (less 8).
15. Post-Closure Monitoring Program	$84	See note (11)
16. SFC Staff	$7,612	See note (12)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
Total Direct Cost:	$33,690	
Contingency (@ 10% of direct costs)	$3,369	
Grand Total:	**$37,059**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).

(5) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge x mean price quote of $156.3/ton]. Mean transport price reflects quotes received from seven carriers.

(6) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = 2,155 tons of sediment (includes Emergency Basin + North Ditch + Sanitary Lagoon) going 1038 km using $131.6/ton. Mean reflects quotes received from seven carriers.

(7) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(8) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(9) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(10) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(11) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(12) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-11 Alternative 3, Option 3-1: Partial Off-Site Disposal of Contaminated Materials

Transport raffinate sludge and other sludges and sediments via truck to EnergySolutions (Clive, Utah)

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-3-1)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport of raffinate sludge and other sludges and sediments to EnergySolutions	$3,030	See note (5)
8b. Disposal of raffinate sludge and other sludges and sediments at EnergySolutions	$2,891	= [10,478+2155] x $228.9/ton disposal cost
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (6)
11. Termination Survey	$391	See note (7)
12. Site Restoration	$1,931	See note (8)
13. Groundwater Remediation	$1,199	See note (9)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12 (less 8).
15. Post-Closure Monitoring Program	$84	See note (10)
16. SFC Staff	$7,612	See note (11)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
Total Direct Cost:	$35,364	
Contingency (@ 10% of direct costs)	$3,536	
Grand Total:	**$38,900**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.
(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.
(3) Cell design included in 2006 Reclamation Plan.
(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).
(5) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge + 2155 tons of sediment] x mean price quote of $239.9/ton]. Mean transport price reflects quotes received from seven carriers.
(6) Source: SFC Environmental Report 2006, includes demolition and placement in cell.
(7) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.
(8) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.
(9) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.
(10) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.
(11) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-12 Alternative 3, Option 3-2: Partial Off-Site Disposal of Contaminated Materials

Transport raffinate sludge and other sludges and sediments via truck to WCS (Andrews, Texas)

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-3-2)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport of raffinate sludge and other sludges and sediments to WCS	$1,662	See note (5)
8b. Disposal of raffinate sludge and other sludges and sediments at WCS	$1,351	= [10,478+2155] x $107/ton disposal cost
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (6)
11. Termination Survey	$391	See note (7)
12. Site Restoration	$1,931	See note (8)
13. Groundwater Remediation	$1,199	See note (9)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12 (less 8).
15. Post-Closure Monitoring Program	$84	See note (10)
16. SFC Staff	$7,612	See note (11)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @$104,250/year
Total Direct Cost:	$32,456	
Contingency (@ 10% of direct costs)	$3,246	
Grand Total:	**$35,701**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).

(5) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge + 2155 tons of sediment] x mean price quote of $131.6/ton]. Mean transport price reflects quotes received from seven carriers.

(6) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(7) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.

(8) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(9) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(10) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(11) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-13 Alternative 3, Option 3-3: Partial Off-Site Disposal of Contaminated Materials

Transport raffinate sludge and other sludges and sediments via truck to Pathfinder Mines Corp. (PMC, Mills, Wyoming)

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-3-3)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport of raffinate sludge and other sludges and sediments to PMC	$2,388	See note (5)
8b. Disposal of raffinate sludge and other sludges and sediments at PMC	$2,665	= [10,478+2155] x $210.9/ton disposal cost
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (6)
11. Termination Survey	$391	See note (7)
12. Site Restoration	$1,931	See note (8)
13. Groundwater Remediation	$1,199	See note (9)
14. Engineering Construction Management	$2,222	15% of lines 3 through 12 (less 8).
15. Post-Closure Monitoring Program	$84	See note (10)
16. SFC Staff	$7,612	See note (11)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
Total Direct Cost:	$34,495	
Contingency (@ 10% of direct costs)	$3,449	
Grand Total:	**$37,944**	

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.

(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.

(3) Cell design included in 2006 Reclamation Plan.

(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).

(5) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge + 2155 tons of sediment] x mean price quote of $189/ton]. Mean transport price reflects quotes received from seven carriers.

(6) Source: SFC Environmental Report 2006, includes demolition and placement in cell.

(7) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment/NRC confirmation.

(8) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.

(9) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.

(10) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.

(11) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-14 Alternative 3, Option 4: Partial Off-Site Disposal of Contaminated Materials
Transport both raffinate sludge and other sludges and sediments via truck to White Mesa (Blanding, Utah)

Estimated Direct Costs for the Partial Off-Site Disposal Alternative (Alternative 3-4)		
Activity/Cost Element	**2007 $ (000s)**	**Note/Comment**
1. Complete Reclamation Plan and Supporting Documents	$457	See note (1)
2. NRC Charges for Reclamation Plan Review, EIS Preparation	$900	See note (2)
3. Contractor mobilization and demobilization	$687	5% of lines, 4, 5, 6, 7, 9, 10 and 12.
4. Monitoring Well Removal and Replacement		Task Complete
5. Disposal Cell Construction / Closure	$3,073	See note (3)
6. Other Sludge, Removal, Treatment and On-Site Disposal	$3,023	See note (4)
7. Dewater raffinate sludge		Task Complete
8a. Transport raffinate sludge and other sludges and sediments to White Mesa	$2,393	See note (5)
8b. Raffinate sludge and other sludges and sediments processing cost at White Mesa	$1,579	= [10,478 + 2155] x $125/ton processing cost
8c. Recovered Materials Rebate (-) Raffinate Sludge + Other	$(773)	See note (6)
9. Soil Remediation and On-Site Disposal	$1,716	See Table F-2b
10. Building and Equipment Demolition	$3,994	See note (7)
11. Termination Survey	$391	See note (8)
12. Site Restoration	$1,931	See note (9)
13. Groundwater Remediation	$1,199	See note (10)
14. Engineering Construction Management	2,222	15% of lines 3 through 12 (less 8).
15. Post-Closure Monitoring Program	$84	See note (11)
16. SFC Staff	$7,612	See note (12)
17. Long-Term Site Control Fund	$798	Per 10 CFR 40, Appendix A, Criterion 10 ($250K, 1978 escalated to 2007 $).
18. Long-term Groundwater Recovery and Treatment	$1,355	13 years @ $104,250/year
19. White Mesa License Amendment	$100	
Total Direct Cost:	$32,741	
Contingency (@ 10% of direct costs)	$3,274	
Grand Total:	**$36,015**	

Standard construction work units of measurement used in all tables

Notes:

(1) Includes responses to RAIs and revisions to the Reclamation Plan, groundwater Corrective Action Plan and preparation of an Alternate Concentration Limit Application.
(2) Includes review and approval of Reclamation Plan and groundwater Corrective Action Plan and completion of EIS.
(3) Cell design included in 2006 Reclamation Plan.
(4) Excavation, treatment and placement in the cell of sludges not being shipped off-site (1,387,280 cu-ft @ $2.179/cu-ft, see Materials Characteristics Table F-2a).
(5) See Appendix F Table F-17 for mean carrier price quote in $/ton by final destination. Table value = [10,478 tons of raffinate sludge + 2155 tons of sediment] x mean price quote of $189.4/ton]. Mean transport price reflects quotes received from seven carriers.
(6) Reflects potential rebate provided by mill for market value of recovered uranium constituents using current price for uranium. See Table F-19. Includes uranium recovered from both raffinate sludge and other sediments and sludge
(7) Source: SFC Environmental Report 2006, includes demolition and placement in cell.
(8) 2000 soil samples @ $100 each, plus gamma walkover survey 500 hours @ $50/hr, plus $150K assessment / NRC confirmation.
(9) Cost to grade, place topsoil and re-vegetate excavations and other affected areas. Based on dozing approximately 17,500,000 cu-ft of dike material into impoundments at $0.074 per cu-ft, grading 83 acres @ $3128/acre, applying 6 inches of topsoil to 124 acres (2,701,000 cu-ft at $0.115/cu-ft) and seeding 124 acres at $534/acre.
(10) $100,000 per year for 7 years plus $100,000 for recovery systems installation plus $350,000 for intercept trench expansion. Includes treatment of storm water and wastewater, as necessary.
(11) Post-closure monitoring includes the cost of purging, sampling and analysis for 25 wells for an additional sampling event for the first 3 to 5 years after cell closure, cell settlement monitoring, radon emission measurement and cell cover inspection and repair.
(12) SFC at current level of six employees plus management augmentation during decommissioning.

Table F-15 Alternative 3, Comparison of Total Transport Costs per Load

Carrier	Total Cost Per Load [1]				
	White Mesa Blanding, UT	**Energy Solutions Clive, UT**	**WCS Andrews, TX**	**PMC, Mills, WY**	**Rio Algom, Grants, NM**
Carrier 1	$4,942	$6,055	$4,505	$4,610	$4,572
Carrier 2	$2,889	$3,864	$1,679	$2,943	$2,153
Carrier 3	$3,473	$4,569	$2,187	$3,775	$2,552
Carrier 4	$4,783	$6,246	$2,930	$4,796	$3,589
Carrier 5	$2,800	$3,000	$2,150	$2,800	$2,600
Carrier 6	$3,360	$4,464	$2,799	$3,404	$3,307
Carrier 7	$5,289	$6,612	$2,910	$5,122	$3,945
Minimum	$2,800	$3,000	$1,679	$2,800	$2,153
Mean	$3,934	$4,973	$2,737	$3,921	$3,245
Maximum	$5,289	$6,612	$4,505	$5,122	$4,572
Standard Deviation	$1,040	$1,355	$910	$930	$862

Notes:
[1] Price quotes reflect actual quotes received from licensed carriers based on material specifications for the transport of a combined 12,633 tons of raffinate sludge and other sludges and sediments. Rates include base rate and fuel charges.

Figure F-1 Alternative 3, Comparison of Total Transport Costs per Load to Final Destinations

[Min, Mean and Max]

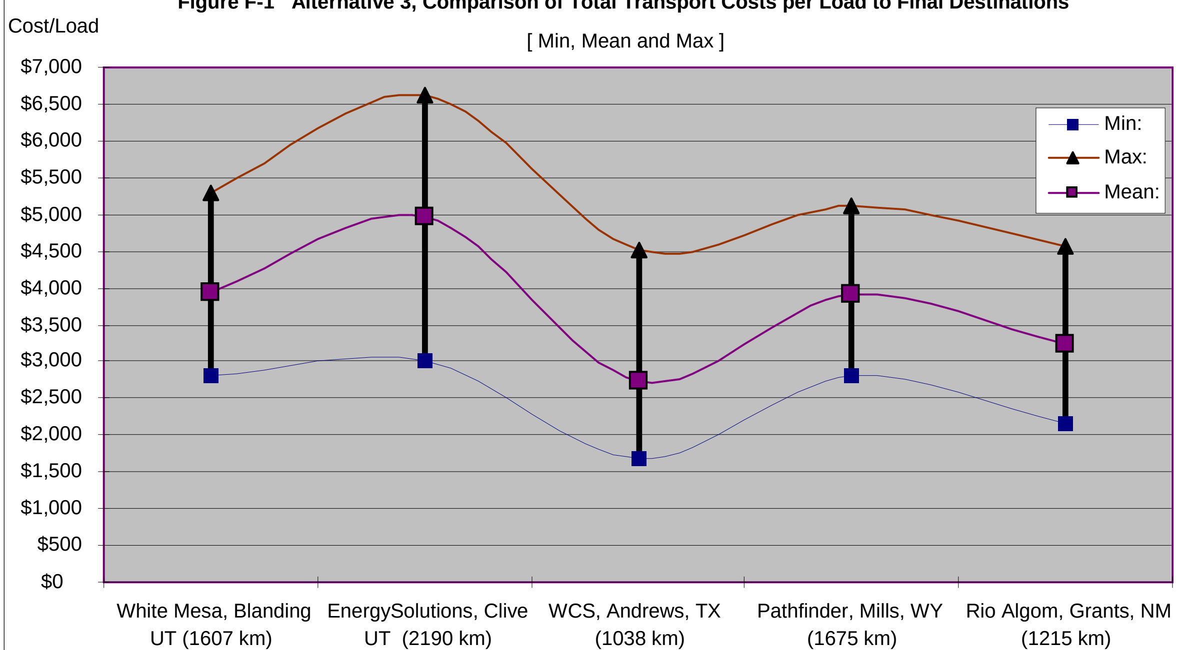


Table F-16 Alternative 3, Total Estimated Transport Costs by Final Destination – Based on One Final Destination – Does Not Reflect Blended Costs of Shipping to Multiple Destinations

Carrier	Maximum Weight/ Payload[1] (lbs)	Tons of Waste/ Payload[2] (tons)	Estim. No. Truck Loads[3]	Total Costs: White Mesa Blanding, UT	Energy Solutions Clive, UT	WCS Andrews, TX	PMC, Mills, WY	Rio Algom Grants, NM
1	46,000	22	574	$2,837,889	$3,477,085	$2,587,154	$2,647,189	$2,625,294
2	45,000	22	588	$1,697,215	$2,270,426	$986,306	$1,729,238	$1,264,906
3	43,500	21	609	$2,114,675	$2,781,501	$1,331,613	$2,298,168	$1,553,888
4	42,500	20	624	$2,983,859	$3,896,547	$1,827,871	$2,991,969	$2,238,986
5	45,500	22	581	$1,626,304	$1,742,469	$1,248,769	$1,626,304	$1,510,140
6	40,000	19	665	$2,233,948	$2,967,800	$1,861,225	$2,263,363	$2,198,842
7	43,000	21	616	$3,259,130	$4,074,384	$1,793,198	$3,156,435	$2,431,255
			Min:	$1,626,304	$1,742,469	$986,306	$1,626,304	$1,264,906
			Mean:	$2,393,289	$3,030,030	$1,662,305	$2,387,524	$1,974,759
			Max:	$3,259,130	$4,074,384	$2,587,154	$3,156,435	$2,625,294
			Std Dev:	$669,524	$906,496	$368,483	$629,529	$480,579

Notes and Assumptions:

Assumed Tonnages:
Raffinate sludge 10,478 tons and other sludges and sediments 2,155 tons: Total 12,633 tons

[1] Includes industry estimate of 2,000 lbs for ancillary equipment/pallets, etc.
[2] Tons of Waste = maximum weight per payload less 2,000 lbs for ancillary equipment/pallets, etc. divided by 2,000 lbs per ton.
[3] Total tons of waste (12,633 tons) divided by tons of waste per payload.

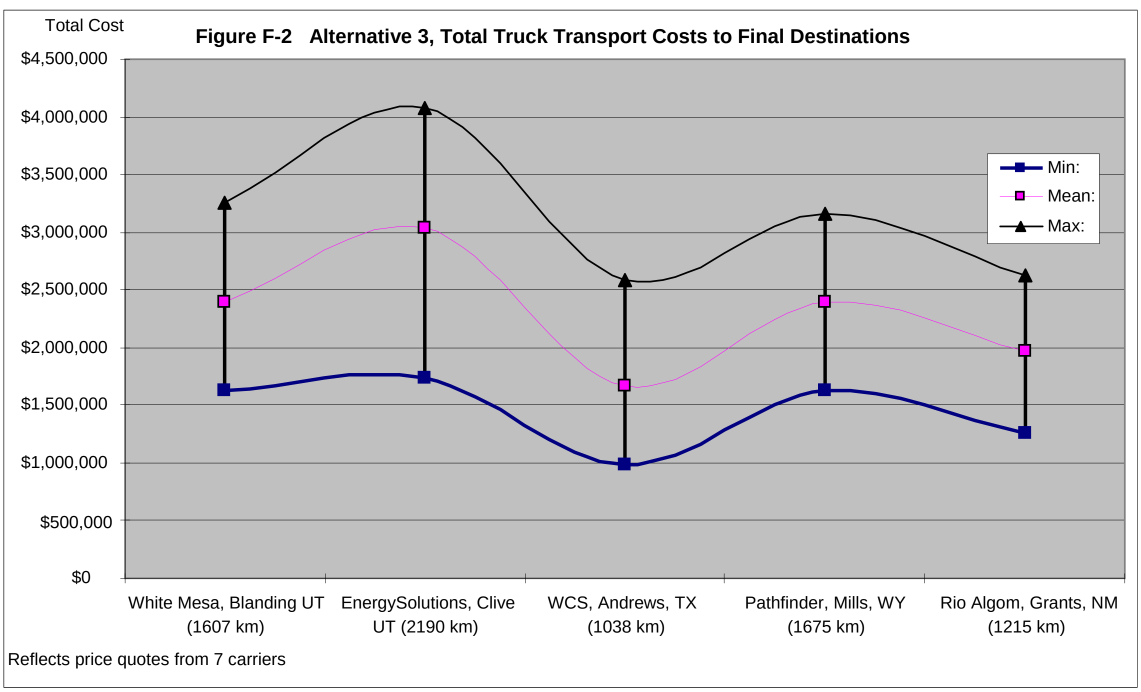
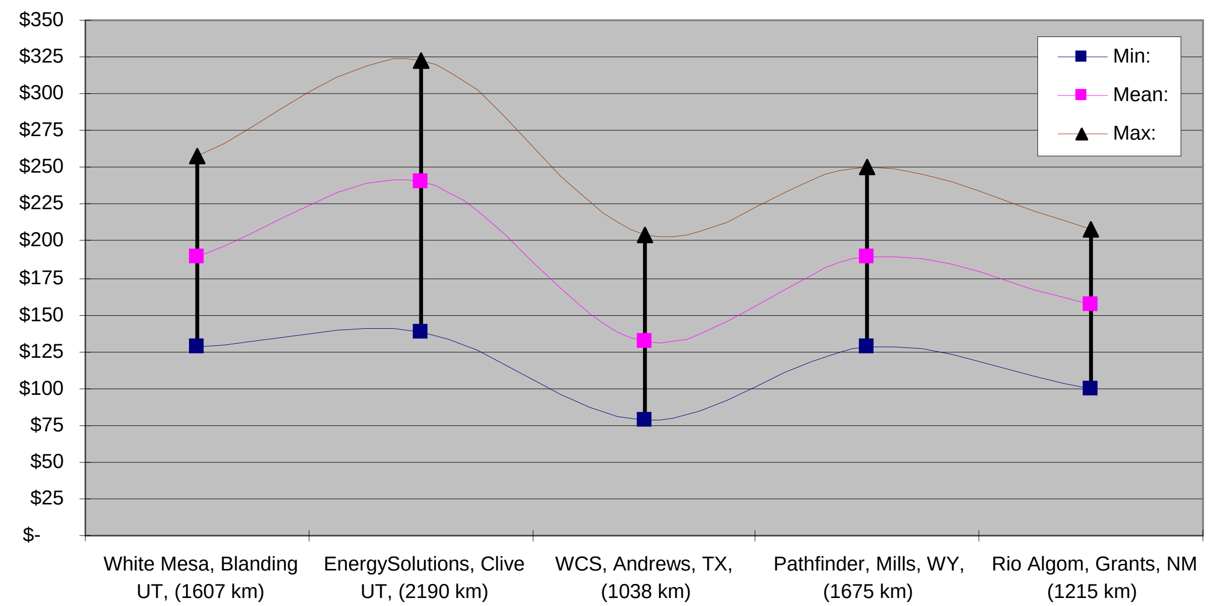


Table F-17 Alternative 3, Comparison of Total Transport Costs per Ton of Waste

Carrier	Total Cost per Ton of Waste				
	White Mesa Blanding, UT	Energy Solutions Clive, UT	WCS Andrews, TX	PMC, Mills, WY	Rio Algom Grants, NM
Carrier 1	$225	$275	$205	$210	$208
Carrier 2	$134	$180	$78	$137	$100
Carrier 3	$167	$220	$105	$182	$123
Carrier 4	$236	$308	$145	$237	$177
Carrier 5	$129	$138	$99	$129	$120
Carrier 6	$177	$235	$147	$179	$174
Carrier 7	$258	$323	$142	$250	$192
Minimum:	$129	$138	$78	$129	$100
Mean:	$189	$240	$132	$189	$156
Maximum:	$258	$323	$205	$250	$208
Standard Deviation:	$51	$67	$42	$46	$41

Figure F-3 Alternative 3, Transport Costs per Ton for Truck Shipment to Final Destinations



Reflects price quotes from 7 carriers

Table F-18 Estimated Potential Rebate for Uranium Recovery from Raffinate Sludge

	Rebate Calculation Elements:	Value	Unit	Source/notes:
A	**Estimated Uranium Content of Sludge**			
1	Estimated tons of raffinate sludge	10,478	tons	Materials volumes and radionuclides 4-11-2007.xls.
2	Uranium content of dewatered raffinate sludge	95,232	lbs	[SFC RAI Response 01_08.pdf], 12/26/07, RE:0752-A, "Raffinate Uranium Content Based on Composite Sample from Each Storage Cell"
3	Estimated Recovery Percentage	75%	%	NRC, 1/23/08, record of Telcon, 9/24/07
4	Recovered uranium from raffinate sludge	71,424	lbs	= row 2 x row 3
5	Recovery rate (in lbs per ton of total feed stock)	6.82	lbs/ton	= row 4 / row 1
B	**Price Assumptions [1]**			See Note 1
6	Weekly Spot Ux U3O8 Price as of March 18, 2008	$70.00	$/lb	http://www.uxc.com/review/uxc_Prices.aspx
7	Estimated lower boundary price	$50.00	$/lb	" ", The Ux Consulting Company, LLC
C	**Revenue Estimate**			
8	Total estimated recoverable uranium x Weekly Spot Price (3/18/08)	$4,999,655	$	= row 4 x row 6
9	Total estimated recoverable uranium x estimated lower boundary price	$3,571,182	$	= row 4 x row 7
D	**Cost Estimate**			
10	Unit processing cost per ton of feed stock	$125	$/ton	NRC, 1/23/08
11	Estimated processing cost	$1,309,750	$	= row 1 x row 10
D	**Estimated Rebate @ 20% of Net Revenue (Net Revenue=Revenue less Processing Costs)**			
12	Estimated rebate using current spot price	$737,981	$	= [row 8 – row 11] x .20. The 20% rebate assumption is based on an industry standard, see Record of Telcon, 9/24/07
13	Estimated rebate using lower boundary price	$452,286	$	= [row 9 – row 11] x .20. The 20% rebate assumption is based on an industry standard, see Record of Telcon, 9/24/07

Notes:

[1] The Ux U3O8 Price is one of only two weekly uranium price indicators that are accepted by the uranium industry, as witnessed by their inclusion in most "market price" sales contracts, i.e., sales contracts with pricing provisions that call for the future uranium delivery price to be equal to the market price at or around the time of delivery.

Table F-19 Estimated Potential Rebate for Uranium Recovery from Raffinate Sludge and Other Sludges and Sediments

	Rebate Calculation Elements:	Value	Unit	Source/notes:
A	**Estimated Uranium Content of Raffinate Sludge**			
1	Estimated tons of raffinate sludge	10,478	tons	Materials volumes and radionuclides 4-11-2007.xls.
2	Uranium content of dewatered raffinate sludge	95,232	lbs	[SFC RAI Response 01_08.pdf], 12/26/07, RE:0752-A, "Raffinate Uranium Content Based on Composite Sample from Each Storage Cell"
3	Estimated Recovery Percentage	75%	%	NRC, 1/23/08, record of Telcon, 9/24/07
4	Recovered uranium from raffinate sludge	71,424	lbs	= row 2 x row 3
5	Recovery rate (in lbs per ton of total feed stock)	6.82	lbs/ton	= row 4 / row 1
	Uranium content of Other Sludges and Sediments			
6	Emergency Basin Sediment + North Ditch Sediment + Sanitary Lagoon sludges and sediments	3,862	U-kg	Materials volumes and radionuclides 4-11-2007.xls.
7	Emergency Basin Sediment + North Ditch Sediment + Sanitary Lagoon sludges and sediments	8,514	lbs	Converted to pounds using 2.2046 lbs/kg.
8	Estimated recovered uranium from sludges and sediments (75% of total)	6,386	lbs	75% of row 7
9	Raw tons of other sludges and sediments	2155	tons	Tons to be processed to extract estimated U-kg
B	**Price Assumptions [1]**			See Note 1
10	Weekly Spot Ux U3O8 Price as of March 18, 2008	$70.00	$/lb	http://www.uxc.com/review/uxc_Prices.aspx
11	Estimated lower boundary price	$50.00	$/lb	" ", The Ux Consulting Company, LLC
C	**Revenue Estimate**			
12	Total estimated recoverable Uranium x Weekly Spot Price (3/18/08)	$5,446,653	$	= [row 4 + row 8] x row 10
13	Total estimated recoverable Uranium x Est. lower boundary price	$3,890,466	$	= [row 4 + row 8] x row 11
D	**Cost Estimate**			
14	Unit processing cost per ton of feed stock	$125	$/ton	NRC, 1/23/08
15	Estimated total processing cost	$1,579,170	$	= [row 1 + row 9] x row 14
D	**Estimated Rebate @ 20% of Net Revenue (Net Revenue=Revenue less Processing Costs)**			
16	Estimated rebate using current spot price	$773,497	$	= [row 12 – row 15] x .20. The 20% rebate assumption is based on an industry standard, see Record of Telcon, 9/24/07
17	Estimated rebate using lower boundary price	$462,259	$	= [row 13 – row 15] x .20. The 20% rebate assumption is based on an industry standard, see Record of Telcon, 9/24/07

Notes:

[1] The Ux U3O8 Price is one of only two weekly uranium price indicators that are accepted by the uranium industry, as witnessed by their inclusion in most "market price" sales contracts, i.e., sales contracts with pricing provisions that call for the future uranium delivery price to be equal to the market price at or around the time of delivery.

Exhibit 27

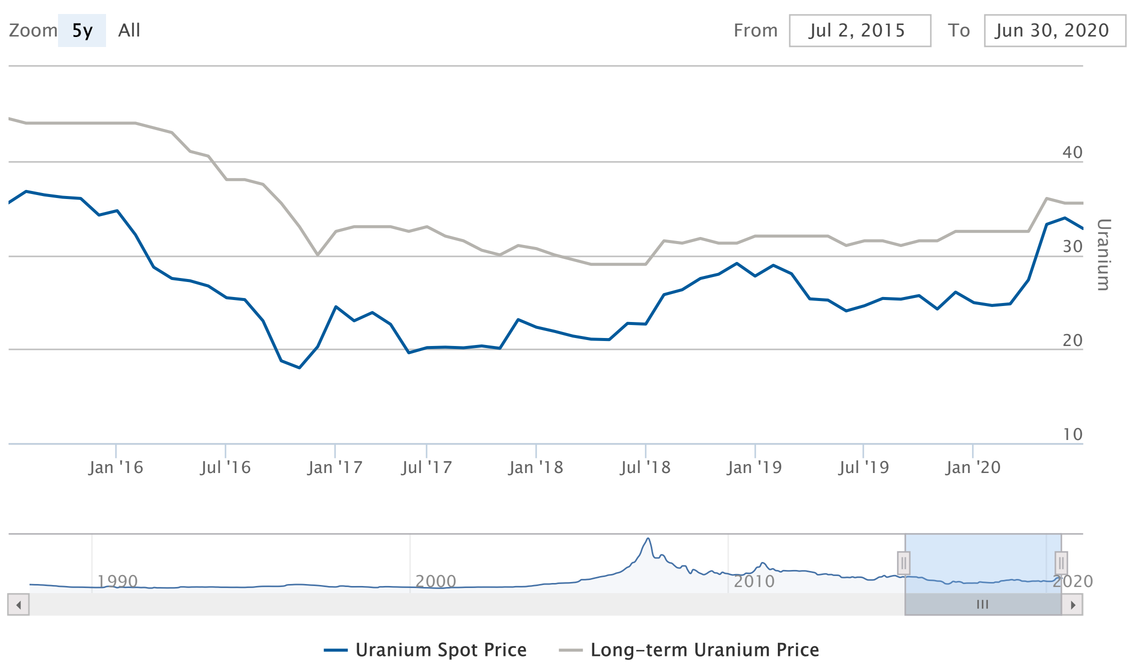
Cameco

Uranium Price

Uranium does not trade on an open market like other commodities. Buyers and sellers negotiate contracts privately. Prices are published by independent market consultants UxC, LLC (UxC) and TradeTech.

TradeTech
$33.25 US$/lb June 29, 2020

UxC*
$32.80 US$/lb June 22, 2020



Spot Price

	2016	2017	2018	2019	2020
Jan	34.70	24.50	21.88	28.90	24.63
Feb	32.15	23.00	21.38	28.00	24.80
Mar	28.70	23.88	21.05	25.33	27.35
Apr	27.50	22.63	21.00	25.20	33.25
May	27.25	19.60	22.73	24.05	33.93
Jun	26.70	20.15	22.65	24.60	32.80
Jul	25.45	20.20	25.78	25.38	-
Aug	25.25	20.13	26.30	25.30	-
Sep	23.00	20.33	27.50	25.68	-
Oct	18.75	20.08	27.95	24.25	-

Nov	18.00	23.13	29.10	26.05	-
Dec	20.25	22.32	27.75	24.93	-

Long-term Price

	2016	2017	2018	2019	2020
Jan	44.00	32.50	30.00	32.00	32.50
Feb	44.00	33.00	29.50	32.00	32.50
Mar	43.50	33.00	29.00	32.00	32.50
Apr	43.00	33.00	29.00	32.00	36.00
May	41.00	32.50	29.00	31.00	35.50
Jun	40.50	33.00	29.00	31.50	35.50
Jul	38.00	32.00	31.50	31.50	-
Aug	38.00	31.50	31.25	31.00	-
Sep	37.50	30.50	31.75	31.50	-
Oct	35.50	30.00	31.25	31.50	-
Nov	33.00	31.00	31.25	32.50	-
Dec	30.00	30.67	32.00	32.50	-

Cameco calculates industry average prices from the month-end prices published by UxC and TradeTech.

Cameco calculates long-term industry average prices from the month-end prices published by UxC and TradeTech. Long-term prices prior to May 2004 are not industry-averages, but from TradeTech only.

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Uranium Watch

P.O. Box 1306
Monticello, Utah 84535
435-260-8384

July 10, 2020

via electronic mail

Ty Howard
Director
Division of Waste Management and Radiation Control
Utah Department of Environmental Quality
P.O. Box 144880
Salt Lake City, Utah 84114-4850
dwmrcpublic@utah.gov

Re: Public Comments on White Mesa Mill Radioactive Materials License No. UT1900470, License Amendment #10

Dear Mr. Howard:

Below please find Public Comments on Radioactive Materials License No. UT1900470, Amendment #10, and Modification to Groundwater Quality Discharge Permit No. UGW370004; Energy Fuels Resources (USA) Inc.; White Mesa Uranium Mill, San Juan County, Utah.

These comments are submitted by Uranium Watch and on behalf of Yolanda Badback, White Mesa Concerned Community; John Weisheit, Conservation Director, Living Rivers Scott Williams, Director, HEAL Utah; and Bradley Angel, Executive Director, Greenaction for Health and Environmental Justice. Uranium Watch is a public interest non-profit located in Monticello, San Juan County, Utah. White Mesa Concerned Community is a public interest non-profit located White Mesa, San Juan County, Utah. Living Rivers is a public interest non-profit located in Moab, Utah.[1] HEAL Utah is a public interest non-profit located in Salt Lake City, Utah.[2] Greenaction for Health and the

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[1] http://www.livingrivers.org/index.cfm

[2] https://www.healutah.org/

Environment is a public interest non-profit located in San Francisco, California.[3]

1. General Comments

1.1. Commenters request, for the reasons set forth below, that the Division of Waste Management and Radiation Control (DWMRC, or Division) deny the Energy Fuels Resources (USA) Inc. (Energy Fuels, or Licensee) request to receive and process and Silmet Material,[4] receive and process the Moffat Tunnel Material,[5] and expand the use of the mill to receive in situ leach (ISL) wastes.[6]

1.2. During more than two decades, the White Mesa Uranium Mill has turned into a disposal site for radioactive wastes from other mineral processing operations, due to the use guidance documents developed by the Nuclear Regulatory Commission (NRC) and adopted by the NRC and the State of Utah, Department of Environmental Quality (DEQ). Guidance documents are not statutes or regulations. They have no legal force and effect. The Division is not legally bound by the NRC Guidance[7] that Energy Fuels and the Division state is the governing document for the processing of wastes from other mineral processing operations (also known as "alternate feed material).

What Energy Fuels and the Division are bound by are the Atomic Energy Act (AEA) and the applicable NRC and Environmental Protection Agency (EPA) regulations. There is nothing in the Atomic Energy Act of 1954, as amended by the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA)[8]; the NRC and EPA regulations promulgated

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[3] https://greenaction.org/

[4] Application by Application by Energy Fuels Resources (USA) Inc. for an amendment to State of Utah Radioactive Materials License No. 1900479 for the White Mesa Uranium Mill to authorize processing of NPM Silmet OU alternate feed material; April 18, 2019 (DRC-2019-003761).

[5] Application by Energy Fuels Resources (USA) Inc. for an amendment to State of Utah Radioactive Materials License No. 1900479 for the White Mesa Uranium Mill to authorize processing of Union Pacific Railroad, Moffat Tunnel alternate feed material, December 23, 2019 (DRC-2019-017284).

[6] Energy Fuels Resources (USA) Inc., Volume and Procedural Modification Request for 11e.(2) Byproduct Material Disposal, Radioactive Materials License UT1900479, White Mesa Uranium Mill, Blanding, Utah; October 9, 2019 (DRC-2019-012708).

[7] NRC Interim Position and Guidance on the Use of Uranium Mill Feed Material Other Than Natural Ores; November 30, 2000. https://www.nrc.gov/reading-rm/doc-collections/gen-comm/reg-issues/2000/ri00023.html

[8] *Uranium Mill Tailings Radiation Control Act*; Public Law 95-604, 95th Congress; November 8, 1978. 92 STAT. 3021. https://www.govinfo.gov/content/pkg/STATUTE-92/pdf/STATUTE-92-Pg3021.pdf

in response to UMTRCA, and EPA regulations that regulate radon emissions and the construction of tailings impoundments at licensed uranium mills at 40 C.F.R Part 61 Subpart W. There is nothing in the Atomic Energy Act, NRC and EPA regulations, and the history of the AEA and the promulgation of EPA and EPA regulations that supports the use of NRC Guidance to process feed materials other than natural ore and dispose of the resulting wastes in tailings impoundments. The Division does not have the authority to use an NRC Guidance, or any guidance, to amend or make fundamental changes to NRC and EPA regulations.

There is no evidence that the regulations adopted by the NRC governing uranium mills in any manner considered the processing of materials other than natural ores and disposing of the wastes in a uranium mill tailings impoundment when they promulgated the regulations at 10 C.F.R. Part 40,[9] specifically Appendix A,[10] in response to UMTRCA. The NRC did not evaluate the environmental impacts of the processing of such wastes in the 1980 Final Generic Environmental Impact on Uranium Milling[11] accompanying the promulgation of 10 C.F.R. Part 40 regulations applicable to uranium mills and the disposal and perpetual care of 11e.(2) byproduct material.

There is no evidence that the EPA regulations that apply to uranium mills, radon emissions, and the disposal and perpetual care of 11e.(2) byproduct material at 40 C.F.R. Part 192[12] and 40 C.F.R. Part 61 Subpart W[13] ever considered the processing of materials other than natural ores and disposing of the wastes in a uranium mill tailings impoundment when the EPA promulgated these regulations.

These statutes and regulations use plain language and specific, unambiguous regulatory definitions. It was not the intent of Congress and the NRC and EPA to create additional

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[9] 10 C.F.R. Part 40 — Domestic Licensing of Source Material. https://www.nrc.gov/reading-rm/doc-collections/cfr/part040/

[10] Appendix A to Part 40 — Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content. https://www.nrc.gov/reading-rm/doc-collections/cfr/part040/part040-appa.html

[11] *Final Generic Environmental Impact on Uranium Milling*; Project M-25; NUREG-0706; Volumes I - III; October 1980. U.S. Nuclear Regulatory Commission. https://www.nrc.gov/docs/ML0327/ML032751661.html

[12] 40 C.F.R. Part 192 — Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings. https://www.epa.gov/radiation/health-and-environmental-protection-standards-uranium-and-thorium-mill-tailings-40-cfr

[13] 40 C.F.R. Part 61 Subpart W — National Emission Standards for Radon Emissions From Operating Mill Tailings Source. https://ecfr.io/Title-40/Part-61/Subpart-W

environmental health, safety, and environment risks, hazards, and impacts—with no analyses of those risks, hazards, and impacts—by using a guidance document to manipulate regulatory definitions and create a new regulatory program never anticipated by Congress or the NRC and EPA when they adopted UMTRCA and Clean Water Act implementing regulations.

1.3. The Division, in reviewing the Energy Fuels' request to receive and process "alternate feed," provides a lot of information on the history of the NRC Guidance. However, there is scant information regarding the history of UMTRCA, applicable NRC and EPA regulations, the regulation and historical definitions of "ore" and "source material," or any other relevant information that does not support the Division's view. The Division carefully, and improperly, picks and chooses from a wide range or relevant information related to the history and regulation of uranium mills and uranium mill tailings to support its positions.

1.4. The DEQ never provided a specific opportunity for the public to comment on the Utah's use of an NRC Guidance when Utah was in the process of becoming an NRC Agreement State. The DEQ never provided a specific opportunity for tribal entities and the public to comment on a program that would turn the White Mesa Mill into a disposal site for mineral processing wastes from domestic and foreign mineral processing operations when the DEQ decided to use NRC Guidance to, in effect, amend the Atomic Energy Act and NRC and EPA regulation, without the proper statutory authority. This was a back-handed change to a major federal program developed to safely contain and provide for perpetual care the tailings and wastes from the processing of natural ores for their uranium and thorium content. Prior to 1978, there was no federal program to manage and contain those tailings and wastes in a manner protective of public health and safety and the environment.

1.5. The Division must take a hard look at fact that the White Mesa Mill is now becoming a waste disposal site for international radioactive wastes,[14] in addition to the domestic waste materials that have been processed at the White Mesa Mill. The State of Utah must explain why Utah should now become the go-to place for the disposal of such international radioactive wastes. The State of Utah must provide a legal, technical, and environmental justification, not just for the disposal of materials from Estonia, but from any international source.

The State of Utah cannot justify this to the Ute Mountain Ute Tribe, the tribal members who live a short distance away from the White Mesa Mill and are impacted by radiological and non-radiological emissions from the Mill. The State of Utah cannot continue to ignore the consistent and continuing opposition of the Utah Mountain Ute

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[14] NRC regulations at 10 C.F.R. Part 110.4 define the materials to be imported to the White Mesa Mill from Estonia as "radioactive waste."

Tribe and the White Mesa community to turning the White Mesa Mill into a repository for domestic and international wastes from other mineral operations and waste cleanup projects. The State of Utah has a legal obligation to abide by the Atomic Energy Act and NRC and EPA regulations and legally promulgated regulatory programs, none of which support the processing of radioactive wastes such as the Silmet and Moffat Tunnel materials at White Mesa and turning the Mill into a perpetual repository for wastes from the cleanup of domestic and international radioactive materials.

2. Modification of License Condition 10.5.

The Division proposes to modify License Condition 10.5 (LC 10.5) to increase the amount of in situ leach (ISL)[15] uranium recovery decommissioning debris (defined as 11e.(2) byproduct material) to be placed in the the Mill's tailings impoundments from 5,000 cubic yards (cy) to 10,000 cy from any one ISL facility and allow unlimited amounts of waste from any ISL facility that is owned by Energy Fuels, or an Energy Fuels' subsidiary, to be disposed of at White Mesa. This is provided that there is adequate tailings impoundment volume. Currently, the ISL wastes transported to the White Mesa Mill can only be disposed of in tailings Impoundment 3.

COMMENTS

2.1. The Division did not include the Energy Fuels' "Volume and Procedural Modification Request" (DRC-2019-012708), dated October 9, 2019, in the list of White Mesa Mill License Amendment Requests posted on the DWMRC website.[16] Rather, that request was only available on the e-Docs system,[17] which is slow and rather difficult to navigate. The Division erred in not making this amendment request readily available during the public comment period by posting ont he DWMRC website associated with License Amendment #10.

2.2. The Division failed to develop a Technical Evaluation and Environmental Analysis for this amendment. No such document was provided in the 2020 DWMRC Public Notice.[18] The Amendment # 10 Statement of Basis, Summary of License Changes, page 1, indicates that this is a Major Change in the License. The Division failed to comply

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[15] The change in the term "in situ leach (ISL)" to "in situ recovery (ISR)" was done at the behest of the uranium recovery industry. The industry changed the term "in situ leach" to "in situ recovery" as a public relations gimmick.

[16] https://deq.utah.gov/waste-management-and-radiation-control/energy-fuels-resources-usa-inc

[17] http://eqedocs.utah.gov/

[18] https://deq.utah.gov/waste-management-and-radiation-control/public-notices-energy-fuels-resources-usa-inc

with the Atomic Energy Act [19] and Utah regulatory requirements[20] to develop an Environmental Analysis for major license amendments. Such an analysis must be made available to the public **before** the comment period and public hearing. The Division failed to comply with these statutory and regulatory requirements.

2.3. The Summary of License Changes regarding License Condition 10.5, page 2, states, "Upon examination staff learned that the current license limits were not set in response to demonstrated health effects concerns or other scientific analysis."

Here, the Division does not identify the documents reviewed. According to the June 17, 2010, White Mesa Mill License, Amendment # 4, LC 10.5, was based on the Licensee's submittal to the NRC, dated May 20, 1993. That document is not posted on the DEQ e-Docs system for the White Mesa Mill. Nor have the NRC documents associated with that Amendment, such as the License Amendment or technical or environmental evaluation, been made available. The Division claims that the LC 10.5 limits were not set in response to "demonstrated health effects concerns or other scientific analysis." The Division does not state whether the NRC developed any technical evaluation or environmental or health analyses in connection to this amendment request. The Division should not rely on an inadequate NRC license amendment review in 1993 to support a Division license amendment review in 2020.

2.4. From 1981 to 1994, the regulation of the White Mesa and other uranium mills in Utah was the responsibility of the NRC Uranium Recovery Field Office (URFO) in Colorado.

Many URFO-approved uranium mill license amendments lacked an Environmental Assessment or Environmental Impact Statement, under the National Environmental Policy Act. Rather, URFO, and later NRC headquarter staff, relied categorical exclusions —thereby avoiding any environmental analysis and any assessment of the cumulative impacts of disposing of ISL waste and other materials that were not assessed in the original 1978 White Mesa Mill environmental analysis. Unless the Division can show otherwise, it is unlikely that URFO staff did any analysis of the health effects or other concerns related to the disposal of ISL waste at White Mesa.

2.5. URFO had a troubled history, including the withholding from the public over twenty thousand (20,000) Uranium Mill Tailings Radiation Control Act Title I and Title II documents, in violation of the Atomic Energy Act and NRC regulation. It took the NRC Public Document Room four (4) years to accession the documents URFO withheld to

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[19] 42 U.S. § 2021(o)(3).

[20] Utah Administrative Code; Uranium Mills and Source Material Mill Tailings Disposal Facility Requirements; R313-24-3. Environmental Analysis.
https://rules.utah.gov/publicat/code/r313/r313-024.htm#T3

make them publicly available. It was URFO that decided to allow the Moab Mill tailings to remain on the flood plain of the Colorado River, a determination that the State of Utah adamantly opposed. That URFO decision and the Finding of No Significant Impact regarding the Moab Mill reclamation led to the closure of URFO in 1994. Given that history, it is surprising that the Division would in any manner rely on URFO's determinations and analyses, or lack thereof.

2.6. Even if there had been a health and safety or environmental analysis in 1993, it would be way out of date. It would not have considered cumulated impacts over the past 27 years, nor the impacts from transportation accidents and spills. The 2016 spill of ISL barium sulfate sludge from the Cameco Resources Inc. Smith Ranch ISL operation in Wyoming, is an example of the serious risks associated with the transport of ISL waste. The spill of the Smith Ranch waste, which had been radiologically mis-characterized and mis-packaged at the point of origin, could have been a real radiological, health, safety, and environmental disaster. If the spill, or possibly a much larger spill, had occurred on Hwy. 191 or other highway, as those routes go through towns and population centers such as White Mesa, Blanding, Monticello and Moab, the radioactive sludge could have been spread widely throughout the region and been very difficult to track down and clean up. The more decommissioning debris and sludges that are shipped to the Mill, the greater the likelihood of transportation accidents that would expose people on the transportation routes to radiological hazards.

2.7. The Division failed to provide an analysis of the current capacity of Impoundment 3, the age and condition of the Impoundment 3 liner, potential of leakage and contamination of the groundwater over time, potential spills of ISL sludges and other wastes during transport and at the mill, or an overall analysis of the cumulative impacts associated with the disposal of ISL 11e.(2) byproduct material at the White Mesa Mill. Therefore, there is no basis for the approval the proposed changes to LC 10.5.

2.8. The Division should not approve an increase in the amount of ISL waste at the White Mesa Mill, due to the age of Impoundment 3 and the need to close and reclaim Impoundment 3 as soon as possible. Additionally, the Division failed to provide the required Environmental Analysis, failed to properly notice the proposed license condition changes, and has not complied with the AEA and Utah regulation regarding a major license amendment.

2.9. In sum, the Division must reject the proposed changes to License Condition 10.5 to authorize the disposal of additional amounts of ISL waste at the White Mesa Mill.

2.10. License Condition 10.5.A.(3). The Division proposes an amendment to authorize the disposal of 11e.(2) byproduct material in unlimited quantities from any source within the State of Utah. The Summary for LC 10.5 indicates that this condition would be for the purpose of disposing of small quantities of uranium mill tailings that have been historically used as backfill for construction sites or found in other unexpected places in Utah. The Division defines these materials as "11e.(2) byproduct material." However, only materials that originally came from an UMTRCA Title II commercial uranium recovery operation can be defined as "11e.(2) byproduct material." Materials that come from a site that is an UMTRCA Title I site would be defined as "residual radioactive materials." There are four (4) Title I mill sites, three (3) Title II mill sites,[21] and one Department of Energy Superfund site[22] in Utah. Since most off-site tailings came from Title I sites and the Monticello Superfund site, those tailings would not be defined as 11. (2) byproduct material. The Division should properly characterize the tailings that it intends to authorize for disposal in the White Mesa Mill tailings impoundments.

3. Receipt of the Silmet Material from Estonia. License Condition 10.10.

The Divisions proposes to authorize the Licensee "to receive source material (the Silmet uranium bearing material) from the NPM Silmet OÜ Facility located near Sillamae, Estonia, in accordance with statements, representations, and commitments contained in the License Amendment Request submitted to the Director dated April 18, 2019." The Silmet Material would be processed at the White Mesa Mill for its uranium content, and the resulting wastes disposed of in a tailings impoundment. The Division developed a Technical Evaluation and Environmental Analysis Simlet Alternate Feed Request; Energy Fuels Resources (USA) Inc.; White Mesa Uranium Mill; April 2020.

3.1. Import License.

COMMENTS

3.1.1. The Silmet Material would be imported to the United States from the European country of Estonia. The Division's Silmet Technical Evaluation and Environmental Analysis (TEEA) (page 20) states that the State of Utah Assistant Attorney General concluded that "there is adequate legal basis to support the requested licensing action as to an NRC import license not being required under 10 C.F.R 110.27(a)." The TEEA (page 21) also states that the Division staff evaluation included "A legal analysis from the Utah Attorney General's office to determine if the uranium bearing material can be legally imported to the United States."

The Assistant Attorney General's written legal opinion, or analysis, was not included in the Simlet TEEA and no specific, separate written legal opinion was available in response to a Utah Government Records Access and Management Act (GRAMA) request.

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[21] https://www.energy.gov/sites/prod/files/2018/12/f58/UMTRCAFactSheet.pdf

[22] https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0800867

The Assistant Attorney General does not have the authority to make a legal determination regarding the import of nuclear materials from a foreign country to the U.S. These are not legal determinations that can be made by the State of Utah. They are under the sole authority of the federal government. The NRC, a federal agency, has sole authority for the import and export nuclear materials, including the import of the material from Estonia. Any conclusions or analyses by the Assistant Attorney General regarding the legality of the import or whether an NRC specific import license is required under NRC regulation at 10 C.F.R 110.27(a) have no legal force and effect. This point was made to Uranium Watch staff by an NRC staff person during a phone conference on June 26, 2020.

The Assistant Attorney General should not have issued an opinion on a matter over which the State of Utah has no authority. Division should not make any determinations regarding Energy Fuels' conformance with NRC import license requirements in the context of an amendment to the White Mesa Mill License.

3.1.2. The TEEA appears to rely on a November 1998 NRC license amendment related to the import of uranium bearing materials from Canada. Since 1998, 10 C.F.R § 110.27(a) has been amended 5 times.[23] The TEEA does not state how NRC regulations regarding general and specific import license requirements may have changed since 1998. The Division and the Office of the Attorney General should not have relied on a 22-year old NRC licensing decision to interpret current NRC regulation.

3.1.3. The Division makes no mention of a State of Utah request to the NRC for a determination of whether the import of the Silmet Material would require a specific import license, pursuant to 10 C.F.R § 110.27(c), or the applicability of other import regulations. The Division could have sought an opinion by the NRC Office of General Counsel or other NRC office regarding NRC regulatory requirements regarding import licenses, but did not.

3.1.4. Since the Division and the State of Utah have no authority over the import of the Silmet Material from Estonia, any Division determinations with respect to compliance with NRC import regulations and requirements are invalid.

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[23] Amendments to 10 C.F.R. § 110.27: 65 Fed. Reg. 70291, November 22, 2000; 68 Fed. Reg. 31589, May 28, 2003; 70 Fed. Reg. 37991, July 1, 2005; 75 Fed. Reg. 44089, July 28, 2010; and 77 Fed. Reg. 27114, May 9, 2012.

3.2. Terminology Confusion

COMMENTS

3.2.1. The proposed License Amendment #10, at License Condition 10.10, states:

> The Licensee is authorized to receive source material (the Silmet uranium bearing material) from the NPM Silmet OÜ Facility located near Sillamae, Estonia, in accordance with statements, representations, and commitments contained in the License Amendment Request submitted to the Director dated April 18, 2019.

NRC regulation, at 10 C.F.R. § 40.4, defines source material:

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

During the public hearing on the White Mesa Mill License Amendment #10, held on May 20, 2020, Division staff was unwilling to state whether the "source material" to be imported from Silmet facility in Estonia and received at the Mill, is "source material" under the first definition (that is, uranium or thorium, or any combination thereof), or is source material under the second definition (that is, ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) uranium, (ii) thorium or (iii) any combination thereof).

If the Silmet Material is "source material" under the first definition, then only the uranium and thorium content of the Silmet Material meets the definition of "source material." In that case, it would be incorrect to characterize the Silmet Material as "source material." It would be much more accurate to characterize the Silmet Material as material "containing source material," because only a very small portion of the Silmet material meets the first NRC statutory and regulatory definition of "source material.

If the Silmet Material Material to be imported to the White Mesa Mill from Estonia meets the second definition of "source material" as an ore, then all of the Silmet material would be considered to be "source material."

The Division needs to clarify what type of "source material" is being referred to in the proposed amended License Condition: "The Licensee is authorized to receive source material (the Silmet uranium bearing material) from the NPM Silmet OÜ Facility located near Sillamae, Estonia." If only the uranium and thorium in the Silmet Material is "source material" under the first definition, then the Division should provide figures on the amount and weight of the "source material" and the amount and weight of the non-source material in the Silmet Material.

3.2.2. If the Silmet material is "ore," as that term is used in the NRC statutory and regulatory definition of 11e.(2) byproduct material, then the Division must explain why it would not also be considered to be "ore," as that term is used in the statutory and regulatory definition of "source material." It does not make sense that the Atomic Energy Act and NRC regulation implementing the AEA intended the term "ore" to mean one thing in the definition of "source material" and another thing in the definition of "11e.(2) byproduct material."

3.2.3. Uranium Watch would contend that the Atomic Energy Act and the NRC regulations' use of the term "ore" in the definition of "source material" and the definition of "11e.(2) byproduct material" are the same. The term "ore" was used as a well understood term in common usage. "Ore," like the term "water," did not require a specific regulatory definition. Any change in the definition of one use of the term "ore," impacts the definition of the other. However, there have been no changes to the Atomic Energy Act or NRC regulation that would affect the use of those terms in the NRC or NRC Agreement State regulatory programs. Therefore, the use of those terms must be the same in both definitions.

3.2.4. An NRC guidance does not have legal force and effect. Therefore it is reasonable to assume that the use of the term of "ore" in the definitions of "source material" and "11e.(2) byproduct material" are the same and have not been amended. There is no evidence that the Atomic Energy Act meant ore to mean anything other than a natural or native material from which uranium or thorium is extracted.

3.2.5. If the Division believes that the material exported from Estonia and received at the White Mesa Mill is "source material" under the first definition, then the Division needs to explain how and when that material becomes an "ore," within the definition of "11e.(2) byproduct material," so that the wastes from the processing of that material will meet the statutory and regulatory definition of "11e.(2) byproduct material."

3.2.6. The Division also refers to the Silmet Material as "Alternate Feed Material." To the best of commenters' knowledge, under the Atomic Energy Act and NRC regulation, there are no statutory or regulatory definitions of "Alternate Feed Material." There are no NRC regulations that refer to, and specifically apply to, "Alternate Feed Material."

3.2.7. The Division also characterizes the Silmet Material is a "uranium bearing material." The Division "Technical Evaluation and Environmental Analysis - Silmet Alternate Feed Material" states (page 13) that Energy Fuels submitted an application to receive and process the Silmet uranium bearing material as an “alternate feed.” Neither terms are contained in AEA and NRC statutory or regulatory definitions.

The Division also refers to the Silmet Material as an “ore.” However, in describing the Material as “source material,” the Division in unable or unwilling to state whether the Silmet Material meets the NRC 10 C.F.R § 40.4 definition of “source material” under the the second definition.

3.2.8. The Division should define or describe the Silmet Material based on specific statutory and regulatory definitions and terms. The Division should not rely on various terminologies that lack clear statutory and regulatory bases.

3.2.9. The Silmet TEEA (page 15) states: “DWMRC Staff has concluded that the Silmet uranium bearing material meets the NRC definition of ‘ore.’” The Division does not state whether the Simet Material, therefore, is “source material” under the second NRC statutory and regulatory definition; that is, “(2) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof.”

Since the Division has determined that the Silmet Material is “ore,” and it contains by weight over 0.05% uranium and thorium, why is the Division reluctant to state whether the Silmet Material meets the second regulatory definition of “source material”?

3.3. Technical Evaluation and Environmental Analysis - Silmet Alternate Feed Material

3.3.1. The Silmet Material TEEA, Section 1.1.2 (page 15), (quoting *NRC Interim Position and Guidance on the Use of Uranium Mill Feed Material other than Natural Ores*) states that “if the proposed feed material contains hazardous waste, listed under subpart D Sections 261.30-33 of 40 CFR (or comparable Resource Conservation and Recovery Act (RCRA) authorized State regulations), it wold be subject to the U.S. Environmental Protection Agency (EPA) or State Regulations under RCRA.”

This is very confusing. The Division has stated that the Silmet Material is “ore.” If the material were uranium “ore,” it would not be subject to RCRA provisions, because “ore” is not considered to be a “solid waste” under 40 C.F.R. § 261.4 and, therefore, is not a “hazardous waste.” If the Silmet Material were considered to be “ore,” as that term is used in both the definition of 11e.(2) byproduct material and the second definition of “source material,” it would not be considered to be a solid waste, and the issue of any hazardous waste constituents would be irrelevant.

Since the presence of hazardous waste in the Silmet Material is, obviously, relevant, then the Silmet Material is not "ore," as that term is used in the second definition of "source material." *See* Section 3.2, above.

That means, for the purposes of the Atomic Energy Act and NRC regulation, the term "ore"—as it is used in 2 very important and long-standing regulatory definitions—has 2 different meanings. In one definition (11e.(2) byproduct material), "ore" can include any uranium-bearing wastes from other mineral processing operations, such as the Silmet Material, if—and only if—the material has been processed for its uranium and/or thorium content. In the other definition (the second definition of source material), "ore" does not include uranium-bearing wastes from other mineral processing operations. It does not include material that becomes "ore" retroactively when the material has been processed in a uranium mill to remove the uranium and/or thorium.

The NRC and the Division have not claimed, or cannot claim, that the uranium-bearing wastes from other mineral processing operations, such as the Silmet Material, meet the second definition of "source material," that is, ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof. This creates confusion, if NRC Guidance can be use to amend the Atomic Energy Act and NRC regulations such that the term "ore" means one thing in one regulatory definition and another thing in second, closely related regulatory definition. However, there is nothing in the Atomic Energy Act or NRC regulation that authorizes the NRC or the State of Utah to amend statutory and regulatory definitions with a non-binding Guidance, creating a dissonance in regulatory definitions and programs.

Uranium Watch does not believe that the Atomic Energy Act and NRC regulations intended that 2 important definitions that used the term "ore" meant those terms to have 2 very different meanings. The NRC and the State of Utah do not have the authority to amend regulations outside of the Rulemaking process. The NRC and the State of Utah do not have the authority to create a whole new uranium milling regulatory program outside of the federal Rulemaking process. Therefore, there is no legal authority that authorizes the processing and disposal of the Silmet Material at the White Mesa Mill.

3.4. EPA Regulations

The Environmental Protection Agency (EPA) promulgated regulations that apply to uranium mills and uranium mill tailings impoundments. These relevant standards and regulations are found in 40 C.F.R. Part 192 and 40 C.F.R. Part 61 Subpart W.

COMMENTS

3.4.1. The Uranium Mill Tailings Radiation Control Act of 1978, an amendment to the Atomic Energy Act of 1954, directed the EPA to establish standards that apply the uranium mills and the handling of 11e.(2) byproduct material. Those EPA standards are found at 40 C.F.R. Part 192 — Health and Environmental Standards or Uranium and Thorium Mill Tailings. EPA regulation at 40 CFR Part 192 Subpart D[24] — Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended, states regarding Applicability, "This subpart applies to the management of uranium byproduct materials under section 84 of the Atomic Energy Act of 1954 (henceforth designated "the Act"), as amended, during and following processing of uranium ores, and to restoration of disposal sites following any use of such sites under section 83(b)(1)(B) of the Act."

Part 192 Subpart D defines uranium byproduct material:

> (b) Uranium byproduct material means the tailings or wastes produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction operations and which remain underground do not constitute "byproduct material" for the purpose of this subpart.

Section 192.01 defines "tailings":

> Tailings means the remaining portion of a metal-bearing ore after some or all of such metal, such as uranium, has been extracted.

There is nothing in the Part 192 definitions of "uranium byproduct material" or "tailings" that demonstrates or implies that these terms apply to the tailings or wastes from the processing of materials other than natural ore. There is nothing in these regulatory definitions that demonstrate or imply that these terms apply to the tailings or wastes from "any other matter from which uranium or thorium is extracted in a licensed uranium or thorium mill." There is no evidence that the EPA Standards for Management of Uranium Byproduct Materials were meant to apply to tailings or wastes produced by the extraction or concentration of uranium from any **matter** processed primarily for its source material content.

3.4.2. The EPA "Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites," Final Rule, were promulgated on October 7, 1983, by publication in the *Federal Register* at 48 Fed. Reg. 45926, 45926-45927. *See* Exhibit A. Public input on the establishment of these standards was extensive and included private citizens, public interest groups, members of the scientific community, representatives of industry, and State and Federal agencies.[25] The Final Rule provides information on background information on The Uranium Industry, Hazards Associated With Uranium By-product Materials, Control of Hazards from Tailings, and

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[24] https://www.law.cornell.edu/cfr/text/40/part-192/subpart-D

[25] 48 Fed. Reg. 45926, 45927 (col. 1).

Environmental Standards and Guidance Now Applicable to Uranium Tailings. There is no mention in this background information that the EPA is considering anything other than the processing of natural ores and the disposal of the resulting tailings at licensed uranium recovery sites. There is no consideration given to the radiological and non-radiological constituents found in the Silmet Material and other feed materials other than natural ore that have been processed at the White Mesa Mill. The standards, as developed by the EPA did not contemplate the processing of materials other than natural ore or the radiological and non-radiological impacts and hazards associated with such receipt, storage, processing, tailings disposal, and long term care of these materials. Congress, the EPA, and the public did not contemplate the use of uranium mills as permanent repositories for the wastes from the processing of a wide range of waste materials (including cement, asphalt and other debris) at uranium mills.

3.4.3. In 2010, the EPA undertook a review of Standards for Uranium and Thorium milling facilities, with a focus on in-situ leach uranium recovery operations. As part of that review the EPA held meetings in Casper, Wyoming, and Denver, Colorado. EPA *Uranium and Thorium Standards, Fact Sheet #2, Background on Uranium Mining and Milling,* provided information to the public at these meetings. The information addressed: What is uranium?, How is uranium mined?, What happens once the uranium is mined?, What is milling, and What are the environmental impacts of uranium mining and how are they regulated? The Fact Sheet contains the following relevant statements:

> Uranium ore is mined, then milled to separate the uranium from the ore.
>
> Uranium ore typically contains low concentrations of uranium, making uranium mining volume-intensive.
>
> Milling is a process that removes the uranium from the ore. After the ore is ground up, it is treated with chemical solutions to dissolve the uranium from the ore. This process produces a waste byproduct called mill tailings.

There is no mention in the *Background on Uranium Mining and Milling* Fact Sheet that states or implies that ore is any uranium-bearing material, other than natural ore, that a uranium mill owner wishes to process.

3.4.4. In sum, the EPA "Standards for Management of Uranium Byproduct Materials" do not apply to the processing of materials other than natural ore at licensed uranium mills. The tailings or wastes from the processing of any matter for its uranium content, such as the Silmet Material, do not fall under the EPA definition of 11e.(2) byproduct material. Under EPA standards and regulations applicable to the White Mesa Mill, the wastes from the processing of the Silmet Material are not 11e.(2) byproduct material.

3.4.5. Therefore, the Division must not authorize the processing of the Silmet material at the White Mesa Mill, because EPA standards do not apply to the processing of materials other than natural ore and to the disposal of tailings or wastes from the processing of materials other than natural ore. Under EPA regulations, the tailings and wastes from the processing of the Silmet material do not meet the statutory and regulatory definition of 11e.(2) byproduct material.

3.4.6. The Statement of Basis, Summary of License Changes, March 2020, which is part of the Radioactive Material License No. UT 1900479, Amendment #10, licensing package, provides information about changes in the White Mesa Mill License Conditions. Changes to the License include changes to terminology. The Summary states that changes to License Condition 9.5 "reflect terminology in 40 CFR Part 61 Subpart W, which governs radon emission (conventional or nonconventional impoundment)."

Therefore, the Division recognizes the applicability of 40 C.F.R. Part 61 Subpart W — National Emission Standards for Radon Emissions From Operating Mill Tailings to the White Mesa Mill License provisions. Subpart W (40 C.F.R. §§ 61.250 to 61.256) states, with respect the designation of facilities:

> § 61.250 Designation of facilities.
>
> The provisions of this subpart apply to owners or operators of facilities licensed to manage uranium byproduct materials during and following the processing of uranium ores, commonly referred to as uranium mills and their associated tailings. This subpart does not apply to the disposal of tailings.

Subpart W defines "uranium byproduct material or tailings":

> (g) Uranium byproduct material or tailings means the waste produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction and which remain underground do not constitute byproduct material for the purposes of this subpart.

Subpart W defines "conventional impoundment":

> (h) Conventional impoundment. A conventional impoundment is a permanent structure located at any uranium recovery facility uranium recovery facility which contains mostly solid uranium byproduct material or tailings from the extraction of uranium from uranium ore. These impoundments are left in place at facility closure.

Subpart W defines "uranium recovery facility":

> Uranium recovery facility. A uranium recovery facility means a facility licensed by the NRC or an NRC Agreement State to manage uranium byproduct material or tailings during and following the processing of uranium ores. Common names for these facilities are a conventional uranium mill, an in-situ leach (or recovery) facility and a heap leach facility or pile.

Subpart W defines "non-conventional impoundment":

> (i) Non-conventional impoundment. A non-conventional impoundment is used for managing liquids from uranium recovery operations and contains uranium byproduct material or tailings. . . .

There is nothing in Subpart W or in the history of the promulgation of Subpart W that supports the conclusion that Subpart W applies to the facilities that process materials other than natural ore or to the tailings and wastes from the processing of materials other than natural uranium ore. Subpart W does not apply to a facility that processes materials other than natural ore for its uranium content or to the tailings or wastes from the processing of any matter other than natural ore that may contain uranium.

3.4.7. The EPA undertook a complete review of Subpart W, which took several years. The EPA published proposed changes in rule on May 2, 2014.[26] The final rule was published on January 17, 2017.[27] In that Rulemaking, the EPA did not alter its 1986 definitions of uranium byproduct material. The Final Rule states:

> The definition of uranium byproduct material or tailings in Subpart W, as it was promulgate in 1989 and not modified by this rule, establishes that Subpart W broadly addresses radon emissions from operating structures used to manage wastes produced during and following the concentration or extraction of uranium from ore processed primarily for its source material content.[28]

The EPA did not change its regulations to apply to the tailings and wastes produced during and following the concentration or extraction of uranium from **any matter**

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[26] EPA *Revisions to National Emission Standards for Radon Emissions From Operating Uranium Mills*. 79 Fed. Reg. 25388, May 2, 2014. Docket ID EPA–HQ– OAR–2008–0218.

[27] EPA *Revisions to National Emission Standards for Radon Emissions From Operating Uranium Mills*. 82 Fed. Reg. 5142, 5142-5180; January 17, 2017. https://www.govinfo.gov/content/pkg/FR-2017-01-17/pdf/2016-31425.pdf#

[28] 82 Fed. Reg. 5142, 51474, column 3.

processed for its source material content.

3.4.8. Under Subpart W, the tailings or wastes from the processing a material other than natural ore, such as the Silmet material, are not "uranium byproduct material." A facility that processes material other than natural uranium or thorium ore and the tailings impoundments that receive the waste from that processing are not within the scope of EPA regulation at Subpart W. Therefore, the Division cannot authorize the processing of materials at a facility that does not fall under the provisions Subpart W.

3.4.9. In sum, the Division cannot approve the Energy Fuels request to receive and process the Silmet material, because a facility that processes material other than natural uranium or thorium ore and the tailings impoundments that receive the waste from that processing are not within the scope of EPA regulation at 40 C.F.R. Part 192 and 40 C.F.R. Part 61 Subpart W.

4. Receipt of the Moffat Tunnel Material from Colorado. License Condition 10.12.

The "Application by Energy Fuels Resources (USA) Inc. for an amendment to State of Utah Radioactive Materials License No. 1900479 for the White Mesa Uranium Mill to authorize processing of Union Pacific Railroad, Moffat Tunnel alternate feed material," dated December 23, 2019, was submitted to the Division by Energy Fuels. In response to that application, The Division "proposes to authorize the Licensee "to receive source material (the Moffat Tunnel uranium bearing material) from the Union Pacific Railroad's Water Treatment Plant in Winter Park Colorado, in accordance with statements, representations, and commitments contained in the License Amendment Request submitted to the Director dated December, 2019."

The Moffat Tunnel materials would be processed at the White Mesa Mill for its uranium content, and the resulting tailings or wastes disposed of in a Mill tailings impoundment. The Division developed a report, *Technical Evaluation and Environmental Analysis Moffat Tunnel Alternate Feed Request; Energy Fuels Resources (USA) Inc.; White Mesa Uranium Mill; April 2020.*

COMMENTS

4.1. The comments in the above Sections 3.2, 3.3, and 3.4, as those comments apply to the Energy Fuels' Moffat Tunnel License Amendment Request, are referenced herein.

4.2. The TEEA (pages 18-27) for the Moffat Tunnel Material contains a discussion of whether the Moffat Tunnel Material can be processed as "Equivalent Feed." As with the Division's use of a completely new definition of "ore," there is no definition of "equivalent feed" in the Atomic Energy Act, NRC and EPA regulations promulgated responsive to that Act, or EPA radon emission standards. The Atomic Energy Act and

NRC and EPA regulations applicable to uranium mills and mill tailings never contemplated or considered the impacts of the processing of what the Division refers to as "Equivalent Feed." Therefore, NRC regulations and EPA regulations and standards at 40 C.F.R. Part 192 and 40 C.F.R. Part 61 Subpart W do not apply to facilities that process "Equivalent Feed," or feed materials with any new definition never found in applicable statutes or regulations.

4.3. In sum, the Division cannot continue to support the disposal of materials at the White Mesa Mill, such as the Silmet and Moffat Tunnel materials, after the removal of uranium, that do not meet the EPA definition of 11e.(2) byproduct material, pursuant to the standards and regulations applicable to uranium mills, mill tailings, and radon emissions. Therefore, the Division cannot approve the two license amendment requests to process feed materials other than natural ore.

Thank you for providing this opportunity to comment.

Sincerely,

/s/

Sarah M. Fields
Program Director
sarah@uraniumwatch.org

Attachment: Exhibit A

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 192

[AD-FRL-2431-8]

Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: These are final health and environmental standards to govern stabilization and control of byproduct materials (primarily mill tailings) at licensed commercial uranium and thorium processing sites. These standards were developed pursuant to Section 275 of the Atomic Energy Act (42 U.S.C. 2022), as added by Section 206 of Pub. L. 95-604, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA).

The standards apply to tailings at locations that are licensed by the Nuclear Regulatory Commission (NRC) or the States under Title II of the UMTRCA. The standards for disposal of tailings require stabilization so that the health hazards associated with tailings will be controlled and limited for at least one thousand years. They require that disposal be designed to limit releases of radon to 20 picocuries per square meter per second, averaged over the surface of the disposed tailings, and require measures to avoid releases of radionuclides and other hazardous substances from tailings to water. The standards for tailings at operating mills, prior to final disposal, add two elements and a measure of radioactivity to the ground water protection requirements now specified under the Solid Waste Disposal Act, as amended. Existing EPA regulations and Federal Radiation Protection Guidance currently applicable to tailings remain unchanged. The Agency will monitor continuing development of technical and economic information as the Department of Energy proceeds with disposal of the inactive tailings piles, and revise these standards if this information suggests that modifications are warranted.

This notice summarizes the comments received on proposed standards published on April 29, 1983, and provides a summary of the Agency's consideration of major comments. Detailed responses to comments are contained in the Final Environmental Impact Statement.

DATE: These final standards take effect on December 6, 1983.

ADDRESSES: *Background Documents*—Background information is given in the Final Environmental Impact Statement for Standards for the Control of Byproduct Materials from Uranium Ore Processing (40 CFR Part 192), EPA 520/1-83-008 (FEIS) and the Regulatory Impact Analysis of Environmental Standards for Uranium Mill Tailings at Active Sites, EPA 520/1-83-010 (RIA). Single copies of the FEIS and the RIA, as available, may be obtained from the Program Management Office (ANR-458), Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460; telephone number (703) 557-9351.

Docket: Docket Number A-82-26 contains the rulemaking record. The docket is available for public inspection between 8:00 a.m. and 4:00 p.m., Monday through Friday, at EPA's Central Docket Section (LE-130), West Tower Lobby, Gallery I, 401 M Street, SW., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Mr. Jack Russell, Guides and Criteria Branch (ANR-460), Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460; telephone number (703) 557-8224.

SUPPLEMENTARY INFORMATION:

I. Introduction

On November 8, 1978, Congress enacted Pub. L. 95-604, the Uranium Mill Tailings Radiation Control Act of 1978 (henceforth designated "UMTRCA"). In the Act, Congress stated its finding that uranium mill tailings "* * * may pose a potential and significant radiation health hazard to the public, * * * and * * * that every reasonable effort should be made to provide for stabilization, disposal, and control in a safe and environmentally sound manner of such tailings in order to prevent or minimize radon diffusion into the environment and to prevent or minimize other environmental hazards from such tailings." The Administrator of the Environmental Protection Agency (EPA) was directed to set "* * * standards of general application for the protection of the public health, safety, and the environment * * *" to govern this process of stabilization, disposal, and control.

UMTRCA established two programs to protect public health, safety, and the environment from uranium mill tailings, one for certain designated sites which are now inactive (i.e., at which all milling has stopped and which are not under license) and another for active sites (those sites licensed by the Nuclear Regulatory Commission (NRC) or the State in which the site is located, when this State is an Agreement State of the NRC under Section 274 of the Atomic Energy Act).

Tailings at the inactive uranium milling sites are defined in UMTRCA as residual radioactive materials. The program for inactive sites covers the disposal of tailings and the cleanup of onsite and offsite locations contaminated with tailings. Final cleanup and disposal standards for the inactive sites were published by EPA on January 5, 1983 (48 FR 590). The U.S. Department of Energy (DOE) is responsible for carrying out these activities in conformance with these standards, with the concurrence of the NRC, and in cooperation with the States.

Tailings at active uranium milling sites are defined in UMTRCA as uranium byproduct materials. The program for active sites covers the final disposal of tailings and the control of effluents and emissions during and after milling operations. UMTRCA requires EPA to establish standards for this program, and that standards for nonradioactive hazards protect human health and the environment in a manner consistent with standards established under Subtitle C of the Solid Waste Disposal Act, as amended (SWDA). The NRC or the licensing Agreement State is responsible for assuring compliance with the standards at active mill sites.

On January 4, 1983, Congress amended UMTRCA to provide additional guidance on the matters to be considered in establishing these standards and to establish new deadlines for their promulgation: "In establishing such standards, the Administrator shall consider the risk to the public health, safety, and the environment, the environmental and economic costs of applying such standards, and such other factors as the Administrator determines to be appropriate." The Act (Pub. L. 96-415) established a deadline of October 1, 1983 for promulgation of the standards. These final standards conform to the above requirements.

II. Summary of the Final Rule

This final rule modifies and clarifies some of the provisions of the proposed standards because of information obtained during the comment period and at public hearings (May 31, 1983, in Washington, and June 15-16, 1983, in Denver).

EPA received a wide range of comments on the proposed standards and the supporting documents. Several hundred letters were received and 34 individuals testified and/or submitted comments at the public hearings. Comments were received from a broad spectrum of participants, including private citizens, public interest groups, members of the scientific community, representatives of industry, and State and Federal agencies. EPA has carefully reviewed and considered these comments in preparing the FEIS, the RIA, and in developing these final standards. EPA's responses to major comments are discussed in this "preamble" and comments are discussed in detail in the FEIS. Section III of this preamble summarizes the major considerations upon which these standards are based, and in Section IV we discuss the major issues raised in public comments, our responses to them, and the specific changes in the standards that resulted from our consideration of public comments.

These standards are divided into two parts. The first part applies to management of tailings during the active life of the pile, and during the subsequent "closure period," i.e., after cessation of operations but prior to completion of final disposal, including the period when the tailings are drying out. These are standards that govern milling operations.

The second part specifies the conditions to be achieved by final disposal. Those standards guide the activities carried out during the closure period to assure adequate final disposal. They are standards that govern the design of disposal systems.

The major provisions of the final rule are summarized in the following list, with changes from the proposed rule noted. The final rule:

(1) Applies to management and disposal of byproduct materials at sites where ore is processed primarily to recover its uranium or thorium content.

(2) Applies to the regulatory activities of NRC and the States that license uranium or thorium mills.

(3) Requires that ground water be protected from uranium tailings to background or drinking water levels to preserve its future uses by incorporating the Solid Waste Disposal Act (SWDA) rules.

(4) Requires that disposal of uranium tailings piles be designed so that, after disposal, radon emissions will be limited to 20 picocuries per square meter per second.

(5) Requires that the disposal of uranium tailings be designed to maintain its integrity, in most cases, for at least 1000 years.

(6) Requires liners be used for ground water protection.

(7) Permits the regulatory agency to issue alternate ground water standards when the normally required levels will be satisfied no further from the edge of tailings than the site boundary, or within 500 meters of the tailings, whichever is less (instead of requiring EPA concurrence, as proposed).

(8) Requires corrective action to restore groundwater to its background quality to be in place within 18 months of a determination of noncompliance (instead of the proposed 12 months).

(9) Requires equivalent levels of protection for wet sites (where precipitation exceeds evapotranspiration) as for dry sites (by deleting the exception permitting a nonpermeable cap at wet sites).

(10) Requires the same level of protection at all sites regardless of current local populations.

(11) Establishes equivalent requirements for thorium byproduct materials.

III. Summary of Background Information

A. The Uranium Industry

The major deposits of high-grade uranium ores in the United States are located in the Colorado Plateau, the Wyoming Basins, and the Gulf Coast Plain of Texas. Most ore is mined by either underground or open-pit methods. At the mill the ore is first crushed, blended, and ground to the proper size for the leaching process which extracts uranium. Several leaching processes are used, including acid, alkaline and a combination of the two. After uranium is leached from the ore it is concentrated from the leach liquor through ion exchange or solvent extraction. The concentrated uranium is then stripped or extracted from the concentrating medium, precipitated, dried, and packaged. The depleted ore, in the form of tailings, is pumped to a tailings pile as a slurry mixed with water.

Since the uranium content of ore averages only about 0.15 percent, essentially all the bulk of ore mined and processed is contained in the tailings. These wastes contain significant quantities of radioactive uranium decay products, including thorium-230, radium-226, and decay products of radon-222. Tailings can also contain significant quantities of other hazardous substances, depending upon the source of the ore and the reagents used in the milling process. Most of the tailings are a sand-like material and, because such materials are attractive for use in construction and soil conditioning, have been improperly used in the past, thereby contributing to spreading the radioactive materials offsite. Tailings materials are also subject to wind and water erosion, which may spread radioactive materials offsite.

As of January 1983, there were 27 licensed uranium mills, of which only 14 were operating. By early 1983, the amount of stored tailings had reached about 175 million metric tons (MT). The size of individual tailings piles ranges from about 2 million MT to about 30 million MT.

The future demand for uranium is projected to be almost exclusively for electrical power generation. Based on recent DOE projections, it is estimated that at least an additional 175 million MT of tailings will be generated by the year 2000 in the United States. This projection is for the conventional milling of uranium described above. A small quantity of uranium is also recovered as a secondary product in the extraction of other minerals, such as phosphate and copper, and also by solution (*in situ*) mining methods. Foreign sources of uranium may also influence demand projections for the domestic uranium industry, especially since some foreign deposits are richer in uranium, which permits lower pricing.

The United States Government purchased large quantities of uranium, primarily for use in defense programs, from 1943 to 1970. Many of the producers of this uranium continued operating after 1970 to supply the commercial demand for uranium. In most cases the tailings from Government and commercial purchases were mixed and stored in the same pile. These mixed tailings are now referred to as "commingled" tailings. There are about 51 million MT of defense-related tailings commingled with approximately 74 million MT of other tailings at 13 of the sites which are now licensed for milling uranium ore.

B. Hazards Associated with Uranium Byproduct Materials

The most important of the hazardous constituents of uranium mill tailings is radium, which is radioactive. We estimate that currently existing tailings at the licensed sites contain a total of about 90,000 curies [1] of radium. Radium, in addition to being hazardous itself, produces radon, a radioactive gas whose decay products can cause lung cancer. Because of the long life of thorium-230 (about 75,000 years half-life), the amount of radium in tailings, and therefore, the rate at which radon is produced, will decay to about 10 percent of the current amount in several

[1] A curie is the amount of radioactive material that produces 37 billion nuclear transformations (e.g., disintegrations of radium into radon) per second.

hundred thousand years. Other potentially hazardous constituents of tailings include arsenic, molybdenum, selenium, uranium, and, usually in lesser amounts, a variety of other toxic substances. The concentrations of all of these materials vary from pile to pile.

The radioactivity and toxic materials in tailings may cause cancer and other diseases, as well as genetic damage and teratogenic effects. More specifically, tailings are hazardous to man primarily because: (1) Radioactive decay products of radon may be inhaled and increase the risk of lung cancer; (2) individuals may be exposed to gamma radiation from the radioactivity in tailings; and (3) radioactive and toxic materials from tailings may be ingested with food or water. Our analysis shows the first of these hazards to be by far the most important.

As noted above, the radiation hazard from tailings lasts for many hundreds of thousands of years, and some nonradioactive toxic chemicals persist indefinitely. The hazard from uranium tailings therefore must be viewed in two ways. Tailings pose a present hazard to human health. Beyond this immediate but generally limited health threat, the tailings are vulnerable to human misuse and to dispersal by natural forces for an essentially indefinite period. In the long run the future risks to health of indefinitely-extended contamination from misused and dispersed tailings due to inadequate control overshadows the short-term danger to public health. The congressional report accompanying UMTRCA recognized the existence of long-term risks, and expressed the view that the methods used for disposal should not be effective for only a short period of time. It stated: "The committee believes that uranium mill tailings should be treated * * * in accordance with the substantial hazard they will present until long after existing institutions can be expected to last in their present forms * * *" and, in commenting on the Federally-funded program to clean up and dispose of tailings at the inactive sites, it stated "The committee does not want to visit this problem again with additional aid. The remedial action must be done right the first time." (H.R. Rep. No. 1480, 95th Cong., 2nd Sess., Pt. I, p. 17, and Pt. II, p. 40 (1978).)

For the purpose of establishing standards for the protection of the general public from radiation, we assume a linear, nonthreshold dose-effect relationship as a reasonable basis for estimating risks to health. This means we assume that any radiation dose poses some risk and that the risk of low doses is directly proportional to the risk that has been demonstrated at higher doses. We recognize that the data available preclude neither a threshold for some types of damage below which there are no harmful effects, nor the possibility that low doses of gamma radiation may be less harmful to people than the linear model implies. However, the major radiation hazard from tailings arises not from gamma radiation, but rather is due to alpha radiation from inhaled radon decay products. As pointed out by the National Academy of Sciences' (NAS) Advisory Committee on the Biological Effects of Ionizing Radiation (the BEIR Committee) in its 1980 report, for "* * * radiation, such as from internally deposited alpha-emitting radionuclides, the application of the linear hypothesis is less likely to lead to overestimates of risk, and may, in fact, lead to underestimates."

Our quantitative estimates of the risk due to inhalation of radon decay products are based on our review of epidemiological studies, conducted in the United States and in other countries, of underground miners of uranium and other metals who have been exposed to radon decay products. We have also considered reports by scientific groups, such as *Health Effects of Alpha Emitting Particles in the Respiratory Tract (1976)* and *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation* (1980) by the NAS; the report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) entitled *Sources and Effects of Ionizing Radiation* (1977); Report No. 32, *Limits for Inhalation of Radon Daughters by Workers* (1981) of the International Commission on Radiological Protection (ICRP); and *Risk Estimates for the Health Effects of Alpha Radiation*, by D.C. Thomas and K.G. McNeill (1982), a detailed review prepared for the Atomic Energy Control Board of Canada (AECB). Details of our risk estimates are provided in a previous EPA report, *Indoor Radiation Exposure Due to Radium-226 in Florida Phosphate Lands* (EPA 520/4-78-013), and in the FEIS.

Although the studies of underground miners show that there is a significant risk of lung cancer from exposure to radon decay products, there is uncertainty in its magnitude. Our estimates of the risk due to inhalation of radon decay products exceed those of the ICRP and UNSCEAR by a factor of at least two. However, neither group considered continuous exposure for the duration of a person's lifetime nor documented that they properly projected the risk observed to date in groups of underground miners over the balance of their expected lifetimes. These factors were explicitly considered by the 1980 NAS BEIR Committee. Although the NAS Methodology differs from that employed by EPA, their numerical estimates of risk due to lifetime exposure are essentially identical to those of EPA. The most recent and complete assessment of the miner data, that performed for the AECB, yields a result within 20 percent of the EPA value. Numerical estimates of risk by various other observers differ by up to a factor of eight. We also considered the views of these other observers and discuss their results in the FEIS.

The uncertainties in risk estimates for exposure of miners to radon decay products arise from several sources. Exposures of miners were estimated from the time spent in each location in a mine and the measured radon decay product levels at those locations. However, radon decay product measurements were infrequent and often nonexistent for exposures of miners prior to the 1960's. The uncertainty increases when data for miners are used to estimate risk to members of the general public, because there are differences in age, physiology, exposure conditions, and other factors between the two populations.

We must also make numerous assumptions to estimate the radiation dose to individuals and population groups due to uranium mill tailings, and these introduce additional uncertainties. For example, we make risk estimates for individuals who are assumed to reside at the same location for their life spans, and we further assume that people will continue to have the same life expectancy as the U.S. population did in 1970. Nevertheless, we believe the information available supports estimates of risk which are sufficiently reliable to provide an adequate basis for these proposed standards.

It is not possible to reduce the risk to zero for people exposed to radiation or, for that matter, to many other carcinogens. To decide on a reasonable level of incremental residual risk, we evaluated the practicality and benefits of different levels of control. We also considered technical difficulties associated with implementing different levels of control.

Uranium mill tailings can affect man through four principal environmental pathways:

• *Diffusion of radon-222, the decay product of radium-226 tailings into indoor air.* Breathing radon-222, an inert gas, and its short half-life decay products, which attach to tiny dust particles, exposes the lungs to alpha radiation (principally from polonium–218 and polonium–214). The exposures involved may be large for persons who have tailings in or around their houses, or who live very close to tailings. Additional, but smaller, exposures to alpha radiation may result from long-lived radon–222 decay products (principally lead–210 and polonium–210). Exposure due to radon from tailings in or around buildings is best estimated from direct measurements of its decay products in indoor air.

• *Dispersal of radon and of small particles of tailings material in air.* Radon emitted from tailings is widely dispersed in air, and exposes both nearby residents and those at greater distances. These doses are predominantly to the lungs. Wind erosion of unstabilized tailings creates local airborne tailings material. The predominant dose from airborne tailings is to the bones from eating foods contaminated by thorium–230, radium–226, and lead–210, and is small. Exposure due to airborne transport of radon and particulates from tailings usually can be directly measured only near the pile or impoundment, but may be reliably estimated for larger distances using meteorological transport models.

• *Direct exposure to gamma radiation.* Many of the radioactive decay products in tailings produce gamma radiation. The most important are lead–214, bismuth–214, and thallium–210. Hazards from gamma radiation are limited to persons in the immediate vicinity of tailings piles or removed tailings. Exposure due to gamma radiation from tailings is readily estimated from direct measurements.

• *Waterborne transport of radioactive and toxic material.* Dispersal of unstabilized tailings by wind or water, or leaching, can carry radioactive and other toxic materials to surface or ground water. Current levels of contamination appear to be low at most sites. However, contamination of surface and ground water and consequent intake by animals has been identified at three locations. Potential exposure due to this possibility of ground and surface water contamination is highly site-specific and can generally only be determined by a careful survey program.

Our assessments of risks from tailings deal primarily with risks to man. This is because risks to other elements of the biosphere are judged to be mush less significant, and would therefore be controlled to acceptable levels by measures adequate to protect man. In addition, the following discussion focuses largely on *current* levels of risk to man from tailings through air and water pathways. However, these current risks could be expanded by future misuse of tailings by man and by uncontrolled future effects of natural forces. Our disposal standards reflect consideration of both current and potential future risks from tailings.

1. Air Pathways

We estimated the hazards posed by emissions to air from tailings piles or impoundments and from tailings used in and around houses. For the first case we used standard meteorological transport models and considered exposure of people in the immediate neighborhood of the existing tailings sites, the population in local regions, and the remainder of the national population. For the second, we drew largely upon experience from houses contaminated by tailings in Grand Junction, Colorado. Four sources of exposure were considered: inhaled short-lived radon decay products, gamma radiation, long-lived radon decay products, and airborne tailings particulates.

From this analysis we conclude:

(a) Lung cancer caused by the short-lived decay products of radon is the dominant radiation hazard from tailings. Estimated effects of gamma radiation, of long-lived radon decay products, and of airborne tailings particulates are relatively less significant, although high gamma radiation doses may sometimes occur.

(b) Individuals who have tailings in or around their houses often have large exposures to indoor radon and hence high risks of lung cancer. For example, in 50 percent of a sample of 190 houses with tailings in Grand Junction, Colorado, we estimate that the excess lifetime risk to occupants due to exposure to short-lived radon decay products prior to remediation may have been greater than 4 chances in 100.

(c) Individuals living near an uncontrolled tailings pile or impoundment are also subject to high risks fom short-lived radon decay products of radon emitted directly from tailings. For example, we estimate that people living continuously next to some tailings sites can have incremental lifetime lung cancer risks as high as 2 chances in 100.

(d) Based on models for the cumulative risk to all exposed populations, we estimate that, without control, the radon released directly from all tailings currently in existence at presently (1983) licensed sites would cause about 500 lung cancer deaths per century. This figure does not account for any deaths from misuse or windblown tailings because their number is more difficult to predict, even though risk to individuals from such tailings may be somewhat greater than from direct radon emissions. By the year 2000, we estimate that, without control, the amount of tailings existing then would cause approximately 800 lung cancer deaths per century. Approximately one-half of these deaths are projected to occur less than 50 miles from the piles. This increase is small, due primarily to the large amount of unused capacity at present sites, so that most new tailings could be placed on top of existing tailings. This analysis assumes that this will be the actual case, although it is possible that ground water contamination problems would be severe enough to require some piles to be closed. If this is the case, this estimate would be increased.

There is substantial uncertainty in these estimates because of uncertainties in the rate of release of radon from tailings sites, the exposure people will receive from its decay products, and from incomplete knowledge of the effects on people of these exposures. The values presented here represent best estimates based on current knowledge. In addition, these estimates are based upon current sizes and geographical distributions of populations and estimated production of tailings to the year 2000. As populations continue to increase in the future, and as production continues beyond the year 2000, the estimated impact will be larger.

Many commenters addressed the need to prevent misuse. Most concluded that misuse was the most hazardous aspect of tailings and should receive foremost attention. Although most concluded that misuse should be discouraged through means of passive controls, some concluded that misuse could be adequately controlled by institutional means. We conclude that a primary objective of standards for control of hazards from tailings through air pathways should be isolation and stabilization to prevent their misuse by man and dispersal by natural forces, such as wind, rain, and flood waters. A second objective is to minimize radon emissions from tailings sites. A third objective is the elimination of significant exposure to gamma radiation from tailings.

2. Water Pathways

Water contamination does not now appear to be a significant source of radiation exposure at most sites. However, in addition to radionuclides, nonradioactive toxic substances, such as arsenic, molybdenum, and selenium, can be leached from tailings and contaminate water. Such contamination could affect crops, animals, and people. Process water is used to carry tailings to the piles or impoundments as a slurry. Rainwater also may collect on the tailings. The greatest threat of contamination appears to be from process water discharged with the tailings from the mill, although, in principle, it could be from the gradual effects of rainwater over the indefinite future. Most of this water eventually evaporates or seeps away. Elevated concentrations of toxic or radioactive substances in ground water have been observed at many active sites (seven are identified in the FEIS), and in some standing surface water ponds (but only rarely in surface running water). Any future contamination of water after disposal would arise from the effects of rain or through flooding, from penetration of tailings from below by ground water, or from leaching of tailings transported offsite.

A theoretical analysis performed for the NRC of a large model tailings impoundment with no seepage control showed that contamination of ground water by selenium, sulfate, manganese, and iron might exceed current drinking water standards over an area 2 kilometers wide and 8 to 30 kilometers long. More than 95 percent of this projected contamination was attributed to initial seepage of process water discharged with the tailings during mill operations.

We recognize that the NRC generic model is only one of several that could be applied to transport of contaminants in groundwater. Other models could predict greater or less risks of ground water contamination. An example of greater risk is a plume of contamination that, under certain circumstances, could still move cohesively towards a water supply after the flow of liquid through the tailings has stopped following closure of a pile.

In general, the movement of contaminants through a pile and subsoil to ground water depends on a combination of complex chemical and physical properties, as well as on local precipitation and evapotranspiration rates. Chemical and physical processes can effectively remove or retard the flow of many toxic substances passing through subsoil. However, some contaminants, such as arsenic, molybdenum, and selenium, can occur in forms that are not removed. Typically, ground water can move as slowly as a few feet per year, and only in coarse or cracked materials does the speed exceed one mile per year. For these reasons, contaminants from tailings may not affect the quality of nearby water supply wells for decades or longer after they are released. However, once contaminated, the quality of water supplies cannot usually be easily restored simply by eliminating the source (although, in some cases, removing or isolating the tailings may contribute to improving water quality).

Based on results from the NRC generic model for mill tailings, it is likely that the observed cases of ground water contamination result from seepage of the liquid waste discharges from the mill, and can be controlled by preventing this seepage until the tailings dry out by natural evaporation. Additional future contamination of ground water after these liquid wastes are dried up should be much smaller, and in most cases would be expected to be eliminated by measures required to control misuse of disposed tailings by man and dispersal by wind, rain, and flood waters. These measures should also effectively eliminate the threat of contamination of surface water by runoff or from leaching of tailings transported offsite, and provide a degree of protection of surface and ground water from contamination by flooding. However, at some sites, especially in areas of high rainfall or where ground water tables intersect the tailings, special consideration of potential future contamination of ground water may be needed in designing disposal systems. For example, some commenters suggested incorporation of the SWDA rules for impoundment caps for wet sites. Others pointed out that for new piles careful site selection would provide protection of ground water.

We conclude that the primary objective of standards for control of hazards from tailings through water pathways is to prevent loss of process water through seepage, prior to closure. A secondary objective is to avoid surface runoff and infiltration both before and after disposal.

C. Control of Hazards from Tailings

We consider methods for control so as to assess the achievability, economic impact, and reliability of controls to meet alternative standards. As noted above, the objectives of tailings disposal (and of tailings management prior to disposal) are to prevent misuse by man, to reduce radon emissions and gamma radiation exposure, and to avoid the contamination of land and water by preventing erosion of tailings by natural processes and seepage of waste process water. The longevity of control is particularly important. This can be affected by the degree to which control measures discourage disruption by man; and by the resistance of control measures to such natural phenomena as earthquakes, floods, and windstorms, and to chemical and mechanical processes in the piles or impoundments. ("Piles" commonly means tailings simply piled up on the ground, and "impoundments" means piles constrained by dikes made of other materials. We will use the term "piles" to mean both henceforth.) Prediction of the long-term integrity of control methods becomes less certain as the period of concern increases. Beyond several thousand years, longer-term geomorphological processes and climatic change become the dominant factors. Methods are available for projecting performance for periods up to about 1000 years. A recent report prepared for the NRC ("Design Considerations for Long-Term Stabilization of Uranium Mill Tailings Impoundments," Colorado State University, 1983) provides an up-to-date detailed review of these matters.

Methods to prevent misuse by man and disruption by natural phenomena may be divided into those whose continued integrity depends upon man and his institutions ("active" controls) and those that do not ("passive" controls). Examples of active controls are fences, warning signs, restrictions on land use, inspection and repair of semi-permanent tailings covers, temporary dikes, and drainage courses. Examples of passive controls are thick earthen covers, rock covers, massive earth and rock dikes, burial below grade, and moving tailings piles out of locations highly subject to erosion, such as unstable river banks.

Erosion of tailings by wind, rain, and flooding can be inhibited by contouring the pile and its cover, by stabilizing the surface (with rock, for example) to make it resistant to erosion, and by constructing dikes to divert rapidly moving flood waters. Erosion can be inhibited even more reliably by burying tailings in a shallow pit and/or by locating them away from particularly flood-prone or otherwise geologically unstable sites. Thus, especially in the case of new tailings piles, shallow burial and sites with favorable long-term characteristics should be given preferred consideration.

Methods to inhibit the release of radon range from applying a simple barrier (such as an earthen cover) to such ambitious treatments as embedding tailings in cement or processing them to remove radium, the precursor of radon. Covering tailings with a permeable (porous) barrier, such as compacted earth, delays radon diffusion so that most of it decays in and is therefore effectively retained by the cover. In addition to simple earthen covers, other less permeable materials such as asphalt, clay, or soil cement (usually in combination with earthen covers) could be used. The more permeable the covering material, the thicker it must be to achieve a given reduction in radon release. However, maintaining the integrity of control of radon by thin, very impermeable covers, such as plastic sheets, is unlikely, even over a period as short as several decades, given the chemical and physical stresses present at piles.

The most likely constituents of cover for disposal of tailings are locally available earthen materials. The effectiveness of an earthen cover as a barrier to radon depends most strongly on its moisture content. Typical clay soils in the uranium milling regions of the West exhibit ambient moisture contents of 9 percent to 12 percent. For nonclay soils ambient moisture contents range from 6 percent to 10 percent. The exact value depends upon the material involved, and on local climatic conditions. The following table provides an example of the changes in cover thicknesses that might be required to reduce radon emission to 20 pCi/m²s for the above ranges of soil moisture. Four examples of tailings are shown that cover the probable extreme values of radon emission from bare tailings (100 to 1000 pCi/m²s); the most common value for old tailings is approximately 500 pCi/m²s, and for new tailings is approximately 300 pCi/m²s.

ESTIMATED COVER THICKNESS* (IN METERS) TO ACHIEVE 20 PCI/M²S**

Radon emission from tailings (pCi/m²s)	Percent moisture content of cover			
	6	8	10	12
100	1.7	1.3	1.0	0.7
300	2.8	2.2	1.5	1.1
500	3.4	2.6	2.0	1.5
1000	4.1	3.2	2.4	1.8

* These values were calculated from equation (9) in Appendix P of the Final Generic Environmental Impact Statement on Uranium Milling, U.S. Nuclear Regulatory Commission, NUREG-0706, September 1980. They do not include allowance for uncertainties in tailings moisture content or diffusion properties of the cover.

** A picocurie (pCi) is a trillionth of a curie. One picocurie of material produces just over two transformations per minute. A pCi/m²s is a unit for the release rate of radioactivity from a surface (m=meter, s=second).

These values are for homogeneous covers, and assume the tailings have the same moisture content as the cover. In practice, somewhat thicker covers would be required to provide long-term assurance of satisfying any particular level of control. Some of the factors that must be considered for predicting long-term performance are moisture content of the tailings and cover at equilibrium, and the measured diffusion characteristics of cover materials. The DOE and NRC have conducted studies which provide a basis, at least within a limited range of control and predictability, for addressing these factors in the design of tailings covers based on locally available materials and climate.

Methods that control radon emissions will also prevent transport of particulates from the tailings pile to air or to surface water. Similarly, permeable covers sufficiently thick for effective radon control will also absorb gamma radiation effectively (although thin impermeable covers will not).

Two methods may be considered for protecting ground water at new tailings piles. The first is the placement of a physical barrier, called a liner, between the tailings and the aquifer zone, to prevent water containing hazardous constituents from entering the aquifer. Either clay or plastic liners can be installed at about the same cost. Both have shortcomings. Plastic liners are impermeable, but may be subject to rupture through poor installation or uneven loading. Clay liners are permeable to some constituents, and may require use of additional measures, such as partial neutralization of the tailings, especially at acid leach mills, to satisfactorily protect ground water, but are expected to retain their effectiveness for long periods of time. The second method is treatment of process water to modify its acidity or alkalinity, if such treatment were shown to prevent contamination. At a neutral level many hazardous constituents of tailings liquids become insoluble and thus not available to contaminate ground water. However, not all hazardous constituents are so affected, and the action of rainwater, certain weathering processes, and mineralization of the soil or rock matrix can upset this neutralization over time, thereby releasing contaminants. There is little difference in costs for these two methods. Liners (either clay or synthetic) are currently required by NRC as a matter of good engineering practice for most new tailings impoundments.

EPA does not believe it is environmentally desirable to require all new wastes at existing sites to be placed on new piles, because new piles would increase radon emissions, at least until the pre-existing pile is covered, and would permanently contaminate more land. Satisfying ground water standards at existing tailings sites that do not have liners, however, will require widely varying actions from site to site. Neutralization of existing tailings is not a generally feasible option since it would require excavation of most, if not all of the tailings to assure mixing, and may not immobilize all hazardous constituents. Ground water contamination is known to have occurred at seven sites, and may be occurring at many others. It may not be possible to cleanup the ground water at some sites. In the worst cases a new, lined tailings pile may be required to prevent contamination from new tailings. In other cases, existing tailings piles may release essentially no contaminants to ground water because the type of soil they rest on acts as an effective liner. We have discussed the range of possible costs for cleanup of ground water in the FEIS and RIA. In practice, we expect most tailings piles will fall somewhere between these two extremes. Less expensive corrective action than a new liner may be sufficient to satisfy ground water standards for hazardous constituents at many sites. For example, an active water management program may be employed to reduce the quantity of water in the tailings and thus reduce the driving force for ground water contamination, or back pumping of water around the piles may prevent losses to the surrounding ground environment. Actions such as these are already being taken at certain sites (Cotter Mill, Canon City, CO, and Homestake Mill, Grants, NM, for example).

Control of possible long-term low-level contamination of ground water may sometimes be difficult. In cases where intrusion of contamination into ground or surface water is a potentially significant problem, liners and caps may provide a good degree of protection for at least many decades. However, more permanent protection may, in such cases, require choice of (for new tailings) or removal to (for existing tailings) a site with more favorable hydrological, geochemical, or meteorological characteristics.

Very effective long-term inhibition of misuse by man, as well as of releases to air and surface water, could be achieved by burying tailings in deep mined cavities. In this case, however, direct contact with ground water would be difficult to avoid. The potential hazards of tailings could also be reduced by chemically processing them to remove contaminants. Such processes have limited efficiencies, however, so the residual tailings would still require some control. Furthermore, the extracted substances (e.g., radium and thorium) would be concentrated, and would themselves require careful control.

We analyzed the practicality of a number of possible control methods. These are described in the FEIS and the RIA. The total cost of disposal by surface or shallow burial is affected most strongly by the type of material used to stabilizer the surface of the trailings against erosion and to inhibit misuse by man, and by the water protection features required. Total costs are less sensitive to the amount of cover required to inhibit radon release. In general, costs of covers using man-made materials (e.g., asphalt) are somewhat higher than costs for earthen covers, and the reliability is lower. Active control measures are usually less costly in the short term than are passive measures, but are considered much less reliable in the long term. Deep burial of tailings piles or use of chemical processing to extract radium are much more costly than for surface or shallow burial (below grade) disposal using covers, and the practicality is not demonstrated.

D. Environmental Standards and Guidance Now Applicable to Uranium Tailings

EPA recognizes that it is establishing standards in an area that is already the subject of governmental regulation and has taken into account, where relevant, the existing schemes and levels of protection in developing these standards.

EPA promulgated 40 CFR Part 190, "Environmental Radiation Protection Standards for Uranium Fuel Cycle Operations," on January 13, 1977 (42 FR 2858). These standards specify the upper limits of radiation doses to members of the general public to which normal operations of the uranium fuel cycle must conform. They cover radiation doses due to all environmental releases of uranium by-product materials during the period a milling site is licensed, with the exception of emissions of radon gas and its decay products.

The Nuclear Regulatory Commission promulgated rules in 10 CFR Part 40 on October 3, 1980, which specify licensing requirements for uranium and thorium milling activities, including trailings and wastes generated from these activities (45 FR 65521). These rules specify technical, surety, ownership, and long-term care criteria for the management and final disposition of by-product materials. Some of these rules are affected by these standards. For example, they specified a design objective of 2 pCi/M^{2}s and a longevity of greater than 1000 years for disposal of tailings. Due to congressional actions, these regulations have never been enforced by NRC, although some Agreement States have enforced comparable regulations. We note that the NRC regulations specified design objectives; that is, the values specified were to be achieved based on average performance; whereas these EPA rules specify standards, which designers must plan not to exceed, with a reasonable degree of assurance. The NRC has noted that any changes necessary will be made when these EPA standards are promulgated, and has already suspended those portions of its regulations which are affected by these standards (48 FR 35350; August 4, 1983).

Under the Agreement State program, States can issue licenses for uranium processing activities, including control and disposal of by-product materials. The NRC has enumerated in 10 CFR Part 150 the authorities reserved to it in its relations with Agreement States under the provisions of UMTRCA, and has specified conditions under which Agreement States may issue licenses under UMTRCA (45 FR 65521). NRC's conditions include the specification that State licenses must ensure compliance with EPA's standards. Some Agreement States can adopt more stringent rules than those adopted and enforced by the NRC, including requirements that are more stringent than EPA's standards.

EPA promulgated 40 CFR Part 260 et seq., "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," under Subtitle C of the Solid Waste Disposal Act, as amended on July 26, 1982 (47 FR 32274). Although radioactive materials controlled under the Atomic Energy Act of 1954, as amended, are not covered by the SWDA, UMTRCA requires that the standards proposed herein provide for protection of human health and the environment from nonradioactive hazards in a manner consistent with applicable standards promulgated under Subtitle C of the SWDA. The Act also requires the NRC to ensure conformance to "* * * general requirements established by the Commission, with the concurrence of the Administrator, which are, to the maximum extent practicable, at least comparable to requirements applicable to the possession, transfer, and disposal of similar hazardous material under [Subtitle C of SWDA]."

EPA promulgated 40 CFR Part 440, "Ore Mining and Dressing Point Source Category; Effluent Limitations Guidelines and New Source Performance Standards, Subpart C—Uranium, Radium and Vanadium Ores Subcategory," on December 3, 1983 (47 FR 54598). The purpose of 40 CFR Part 440 is to establish effluent limitations and standards under the Clean Water Act for existing and new sources in a number of ore mining and dressing subcategories. Out of 27 mills in the uranium, radium and vanadium ores subcategory existing at that time, only one was discharging directly to surface water. In view of this, the regulations did not establish best available technology (BAT) limitations for existing sources in this subcategory. The one uranium mill directly discharging effluents is currently regulated by a discharge permit in accordance with previously existing best practicable control technology (BPT) effluent limitations contained in 40 CFR Part 440. The new source performance standards (40 CFR 440.34(b)) were based upon the demonstration of no discharge to surface waters at the 26 other mills. These standards apply to locations where the annual evapotranspiration rate exceeds the annual precipitation rate (as is the case in most uranium milling areas), and require no discharge of process waste water to surface waters from mills using the acid leach, alkaline leach, or combined acid and alkaline leach process for the extraction of uranium. For locations where there is more precipitation than evapotranspiration process waste water can be discharged up to the difference between annual precipitation and evapotranspiration.

Solution extraction, or "*in situ*" mining, is a processing method in which uranium is recovered from ore without moving or disturbing the ore body. In this method holes are drilled at selected points around an ore body and a solvent is pumped into some holes and the resulting solution out other holes. The solvent passes through the ore, dissolves the uranium, and carries it back to the surface. The uranium is then stripped from the solution and concentrated. The solvent, which is stored in holding ponds, can be treated and reused or discarded. Although this method produces no sandy tailings, it does produce sludges that contain many of the same radioactive and nonradioactive substances found in tailings piles. Consequently, the above-ground wastes from *in situ* mining are covered in these proposed standards. We note that because *in situ* mining and conventional milling currently are done in the same regions of the country, disposal of sludges on tailings piles may often be arranged.

Rules for protection of ground water from the underground operations of *in situ* mining are provided by the Underground Injection Control program promulgated under Sections 1421 and 1422 of the Safe Drinking Water Act.

The associated regulations, 40 CFR Parts 144, 145, and 146, impose administrative and technical requirements on such operations, through either approved State programs or EPA-implemented programs. These regulations are not intended to apply to the underground ore bodies depleted by *in situ* uranium mining operations.

In addition to these rules established under UMTRCA, EPA is required to establish emission standards under the Clean Air Act (CAA) for hazardous air pollutants. Although there are no final standards for air emissions applicable to mill tailings piles, a proposed rule for radionuclides has been published in the **Federal Register** (48 FR 15076) on April 6, 1983. The relationship of the Clean Air Act of this rule is discussed in more detail later in this preamble.

Finally, radiation protection guidance to Federal agencies for the conduct of their radiation protection activities was issued by the President on May 13, 1960 and published on May 18, 1960 (25 FR 4402). Federal Radiation Protection Guidance governs the regulation of radioactive materials by the NRC and Agreement States, and includes the following guidance: "* * * every effort should be made to encourage the maintenance of radiation doses as far below [the Federal Radiation Protection Guides] as practicable * * *" and "There can be no single permissible or acceptable level of exposure without regard to the reason for permitting the exposure. It should be general practice to reduce exposure to radiation, and positive effort should be carried out to fulfill the sense of [this Guidance]. It is basic that exposure to radiation should result from a real determination of its necessity." This guidance is currently known as the "as low as reasonably achievable" (ALARA) principle. It is particularly suited to minimizing radiation exposure under conditions that vary greatly from site to site, or from time to time, and is an integral part of NRC and Agreement State licensing determinations.

The standards published here will supplement the above standards, guidance, and regulations in order to satisfy the purposes of UMTRCA to "* * * stabilize and control * * * tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public." UMTRACA does not provide specific criteria to be used in determining that these purposes have been satisfied. EPA's objective, when not preempted by other statutory requirements, has been to propose standards that: (1) Take account of health, safety, and environmental and economic costs and benefits in a way that assures adequate protection of the public health, safety, and the environment; (2) can be implemented using presently available techniques and measuring instruments; and (3) are reasonable in terms of overall costs and benefits.

The legislative record shows that Congress intended that EPA set general standards and not specify any particular method of control. "The EPA standards and criteria should not interject any detailed or site-specific requirements for management, technology or engineering methods * * *" (H.R. Rep. No. 1480, 95th Cong., 2nd Sess., Pt. I, P.17.) UMTRCA gives the NRC and the Agreement States the responsibility to decide what methods will assure these standards are satisfied at specific sites. (However, EPA must concur with NRC regulations established to implement Section 82a(3) of UMTRCA.) Therefore, our analyses of risk, control methods, costs, and other pertinent factors emphasize the general characteristics of uranium mill tailings and the affected sites.

IV. Resolution of Major Issues Raised in Public Comments

A. The Basis for the Standards

1. Health Risk Models

Several commenters expressed the view that the models used by EPA overestimate health risks from breathing radon decay products. Others believe EPA underestimated the risk. For example, the American Mining Congress (AMC) stated that "EPA has systematically overestimated the factors which determine potential health effects from mill tailings. In the aggregate, these overestimates combine to yield an overestimate factor of about 60." These alleged factors are:

Area of model tailings piles	1.4
Radon flux per unit activity	1.8
Transport and dispersionmodels	5.0
Equilibrium for radon decay products	1.7
Risk of lung cancer	3.0
Population near tailings piles	Unknown

The total radon emitted from tailings is approximately proportional to the surface area covered by tailings. EPA used the same area that NRC used in its FGEIS, 80 hectares, to estimate radon emissions. The AMC prefers 50 hectares, and points out that NRC (in NUREG-0757, Feb. 1981) later revised its estimate to 50 hectares. However, current projections of uranium production indicate that very few new mills or piles, if any, will start up between now and the late 1990's. Thus, unless a significant number of existing piles are unable to comply with the requirements of this rule regarding ground water protection, essentially all radon emissions will be from existing piles, which have an average area of about 70 hectares, as shown in the FEIS. In addition, radon may be emitted from on-site areas contaminated by windblown tailings. We conclude the area of piles has been overestimated at most by a factor of 1.16.

The emission rate of radon per unit area of tailings is directly related to the activity of radium-226 in tailings. Several factors which are not well understood influence this emission rate. In the report cited above, the NRC concluded: "Considering the variation observed under differing conditions at a number of sites, the staff has elected to apply conservative specific flux values of 0.3 [pCi of radon-222 per square meter-second/pCi of radium-226 per gram of tailings] for wet tailings and 1.0 for dry tailings and to count moist tailings as dry in making the calculations." EPA agrees with this conclusion and believes no correction which assumes that some tailings are permanently wet is appropriate for this factor.

Regarding transport models, measurements are consistent with the transport and dispersion models we used. This is discussed in detail in the FEIS. The method used by EPA has been the basic work-horse of local dispersion estimation for years. In 1977, the participants of an expert group assessing atmospheric transport of radionuclides concluded that, for distances out to 10 km in reasonably flat terrain, and given good local wind observations: "Accuracy for the usual annual average concentration is about a factor of ± 2." Furthermore, these dispersion estimates are based on an empirical approach that is inherently unbiased and that should therefore be as likely to overpredict as to underpredict.

It should be noted that we are not modeling background concentrations of radon. While it may be experimentally difficult to demonstrate the increment above background due to a tailings pile at distances greater than 1 km, there is no reason to believe that the basic physical principle of conservation of mass does not continue to be valid. Once released to the atmosphere, radon, which is a chemically inert gas, disperses freely until it is removed by radioactive decay. We conclude that our dispersion estimates provide a reasonable basis for calculating atmospheric concentrations of radon.

There appears to be a misconception about the conditions to which EPA's assumption of a 0.7 equilibrium fraction for radon decay products applies. (The "equilibrium fraction" expresses the amount of radon decay products actually present relative to the maximum theoretically possible. This fraction is important, since the health risk is primarily due to radon decay products, not to radon itself.) Most of the data cited by commenters to support a lower equilibrium fraction are for situations in which the source of radon is diffusion into houses from underlying soil. In this situation the initial decay product equilibrium fraction is zero. For the airborne radon from tailings piles considered in EPA's estimates, the decay product equilibrium fraction in outdoor air approaches 1.0, beyond the vicinity of a pile. After taking into account periods of time an individual spends indoors and outdoors, periods of time a house is well-ventilated by outdoor air, and the fate of radon and decay products in outdoor air when it infiltrates a house, we conclude use of an average value of 0.7 for the effective equilibrium fraction for exposure of people to airborne radon from piles is appropriate for distances far from tailings piles. This value is therefore retained for calculations of total impact of radon releases from piles. Very close to tailings piles, however, the decay product equilibrium factor in outdoor air is low. We conclude, therefore, after taking the same indoor/outdoor factors into account, that an average effective decay product equilibrium fraction about one-half as large is probably more appropriate next to piles. This lower value should be applied to estimates of the maximum individual risk next to piles.

The EPA estimate of lung cancer risk from radon decay products is based on studies of uranium and other heavy metal miners, is consistent with the most recent recommendations of the NAS BEIR Committee (1980), and is within 20 percent of the value recommended for use in a recent, exhaustive study conducted in Canada for their Atomic Energy Control Board (1982). We have noted our difficulties with the assumptions which underlie other estimates cited by commenters in our detailed responses to comments in the FEIS. We conclude the EPA value should be used in the absence of any convincing evidence that another value is more appropriate.

EPA used two regional populations for its risk estimates; the first population, identified as for a "remote" site, was hypothetical, and was taken from NRC's "Final Generic Environmental Impact Statement on Uranium Milling" (FGEIS). The second population, identified as for a "rural" site, is that for the Edgemont, S.D. site, and is based on 1970 census data. We assumed that a mix of six "rural" and 17 "remote" sites would properly represent the 23 sites modeled in the DEIS. We have just received the results of a 1983 population survey for all 52 mill tailings sites performed for us by Battelle Pacific Northwest Laboratories. This survey, which was limited to individuals within 5 km of the piles, shows that the total population at the 26 active sites was 2054 within 2 kilometers of all active tailings piles, and 14,737 within 5 kilometers.

We have re-evaluated the local and regional health risk based upon this re-survey of current populations within 5 km and 1970 census results for populations from 5 to 80 km of the 26 active sites. The re-evaluation show a small decrease in calculated local effects, and an increase of equal size in calculated regional effects. (Our estimates of risk to more distant populations, i.e., to the remainder of the United States, are unaffected.) These data indicate that our initial estimate of total health effects to populations is correct. (We note that we have assumed that there will be no increases of populations at these sites over the next 1000 years, a clearly nonconservative assumption.)

In summary, we do not believe the total health effects in the DEIS have been overestimated. The factor of about 1.16 due to a slightly different average pile area is likely to be negated by normal population increases (not accounted for in our estimates) within the first few decades of the lifetime of the hazard posed by these tailings. The estimate of maximum individual risk for a model pile is affected principally by our assumption for the equilibrium fraction for radon daughters, and should be reduced by about a factor of two. We believe this change is insufficient to warrant changing our basic conclusions regarding the risk from tailings.

2. Significance of Risk from Radon Emitted by Tailings Piles

Several commenters argued that EPA has not demonstrated that the risks associated with radon emissions from tailings are significant, and observed that much of the health impact attributed to tailings accrues to very large numbers of people at very low levels of individual risk. They suggested that the proper test of significance is to compare such risks with common hazards, such as the risk from the natural background radiation. For example, they would compare the 6 lung cancers per year that EPA estimates (see FEIS) could result from uncontrolled tailings piles after the year 2000 with: the 21,000 such cancers a commenter estimated as caused annually by background radiation; deaths from motor vehicle accidents (50,000 per year) and home accidents (25,000); tornadoes (130); etc. Based on such comparisons, these commenters concluded that the risks from radon emitted from tailings are not significant,and that EPA's standard should not limit such emissions.

EPA believes these comparisons are misdirected and do not address a central purpose of the legislation that requires this rulemaking, which is to "* * * make every reasonable effort to * * * prevent or minimize radon diffusion into the environment * * * from * * * tailings." EPA recognizes that radiation background and other common hazards cause far greater total annual harm than anyone would reasonably estimate might occur from uncontrolled radon emissions from tailings. However, these other risks are not the subject of this rulemaking. Comparisons of the type suggested may be useful for setting priorities for efforts to reduce the variety of hazards to public health (to the extent that they are avoidable), but they are not useful for deciding the appropriate level of control for a specific source of hazard. That decision must be based upon the specifics peculiar to the hazard under consideration. The existence of other hazards does not, absent Congressional direction, justify EPA's delaying these standards until all other controllable hazards are addressed, or justify EPA's ignoring Congress' will that standards be set.

The fact that the health impact of tailings is in large part attributable to small radiation doses delivered to large numbers of people over long periods of time was recognized when UMTRCA was enacted. The then Chairman of the NRC testified as follows: "The health effects of this radon production are tiny as applied to any one generation, but the sum of these exposures can be made large by counting far into the future, large enough in fact to be the dominant radiation exposure from the nuclear fuel cycle. Whether it is meaningful to attach significance to radiation exposures thousands of years in the future, or conversely, whether it is justifiable to ignore them, are questions without easy answers. The most satisfactory approach is to require every reasonable effort to dispose of tailings in a way that minimizes radon diffusion into the atmosphere." (H.R. Rep. No. 1480, 95th Cong., 2nd Sess., Pt. II, p. 25.) We have concluded that maximum individual lifetime risk (estimated as 2 in 100) and the long-term cumulative impact on populations (potentially many tens of thousands of deaths over the long term) due to radon emissions from tailings are clearly significant enough to justify controls. As discussed in the FEIS, RIA, and a later section of this Preamble, our analysis shows that tailings can, at a reasonable cost, be disposed of in a manner that provides, among other benefits, greatly reduced radon emissions.

3. Standards Based on Current Populations

During the review of the standards for the inactive sites by certain Federal agencies, questions were raised regarding the appropriateness of the control standards for general application to all 24 inactive sites. Some reviewers suggested that less restrictive standards might be appropriate for sites that are in currently sparsely-populated areas. Other reviewers suggested that we consider a radon standard that applies at and beyond the fenced boundary of such a site, i.e., a standard that relies in part on dispersion and institutional maintenance of control over access. EPA requested public comments on these issues for the inactive sites (48 FR 605, January 5, 1983). These issues are most simply stated as: (1) Should the degree of radon control after disposal depend in part on the size of the current local population, and (2) Should implementation of the disposal standards be permitted to depend primarily or in part on maintenance of institutional control of access (e.g., by fences)? We also specifically requested comments on these issues in the April 29, 1983 notice of proposed rulemaking for active mills.

Most commenters who addressed the first of these issues opposed different standards at remote sites (although most industry comments favored less restrictive standards for *all* sites). Many raised the "equity" consideration, i.e., the fairness of protecting a few people less just because of where they live. Others commented that many of these sites are locations where people are unlikely to live, or, conversely, that the sizes of populations in the future are not predictable and cited examples of recent changes. Finally, commenters who addressed the issue of whether EPA is authorized to set different standards based on "remoteness" denied that the Agency has such authority.

In 1983 EPA counted the number of people living close to all the active and inactive mill sites. Of the 52 sites surveyed, only 7 had no people living within 5 kilometers (3 miles). Another 6 sites had 10 or fewer people living within 5 kilometers. Collectively, however, the mill sites have a normally distributed continuous range of local populations, and it is not possible to distinguish a special set of sites. The definition of a remote site is therefore difficult to achieve, unless it is done arbitrarily. In addition, demographers have concluded that it is not possible to determine that a population at a specific location will remain low in the future, if it is low now. Therefore, a choice of two different standards implies a need for institutional oversight of future population shifts and for having to upgrade the disposal at those sites that exceed some criterion of "remoteness." Presumably, the State or Federal custodian would be responsible, not the original owner.

The motivation for considering relaxed standards at "remote" sites is to reduce the cost of disposal. Our analysis shows that any potential cost saving from less restrictive standards at such sites is not commensurate with the loss of benefits. In a later section we report the costs for several relaxed radon standards. These results show, for the case of *no* radon emission limit (case C1) and with no provision for the added costs of institutional control through fencing, land-use control, and land acquisition (to avoid unacceptably high individual doses to nearby residents), and with no provision for increased costs to meet closure requirements under SWDA (discussed below), that 46 percent of the cost of disposal at the level required by these standards (case C3) would be potentially recoverable. We have examined the added costs required for institutional control and conclude that they may vary from about 10 to 50 percent of these potentially recoverable costs, depending mostly on the cost of land acquisition at specific sites. Costs for conformance to RCRA closure requirements for a cap under § 264.228(a)(2)(iii)(E) range from about 50 to 140 percent of these potentially recoverable costs, depending upon whether or not the pile has an impermeable liner under it or not. (This SWDA requirement was excepted under the proposed standards, on the basis that it would interfere with the moisture required for radon control. This basis would no longer exist in the absence of a radon limit.) Any savings through deletion of radon control would be achieved by forgoing approximately one-half of the annual benefit (the entire impact on nonregional national populations), a considerable degree of protection against misuse, and a significant part of the anticipated total term of effective protection from all hazards, due to the greatly reduced thickness of the cover. We have concluded, therefore, independent of other considerations, that when costs for institutional control and compliance with SWDA closure are added and the net saving is applied to only those sites that might be defined as "remote", the potential total cost saved is not significant enough in comparison to the benefits foregone to justify separate standards.

Finally, with regard to the Agency's legal authorization to establish a separate level of protection at remote sites by issuing two sets of standards, UMTRCA clearly contemplates that these standards be adequate for the long term and that they achieve the benefits of radon control. Regarding those objectives, we are aware of no site that is uninhabited and can also reasonably be assumed will remain uninhabited, nor are we aware of any scientific basis for concluding that there is no impact on national populations due to radon emissions from remote sites. We conclude, therefore, that relaxed standards for "remote" sites are not feasible on demographic grounds, are not defensible on legal grounds, and are not attractive, in any case, on the basis of cost-effectively achieving the various public health and environmental goals of this rulemaking.

4. Passive vs. Institutional Controls

As noted above, EPA also requested comments on whether a radon limit applied at the boundary ("fenceline") of the Government-owned property around a tailings pile, i.e., a "dispersion" standard, would be an appropriate form of standard for the sites with low nearby populations. (Such consideration could also apply to some more populated sites.) Such a dispersion standard could be satisfied largely by institutional methods, i.e., by acquiring and maintaining control over land. The proposed disposal standard, by comparison, would require generally more costly physical methods (such as applying thick earthen covers) that directly control the tailings and their emissions with minimal reliance on institutional methods (i.e., it is a "control" standard). EPA also requested comments on the adequacy of such a radon "fenceline" standard to meet the objectives of the UMTRCA.

Comments on this issue ranged from strong support of primary reliance on passive stabilization for periods greater than 1,000 years to protection for only a few decades wih primary reliance on institutional controls. A majority of commenters recommended retaining primary reliance on passive control rather than on institutional control. Those that favored use of institutional control (principally of misuse and maximum individual exposure) argued for limiting public access through use of fences and administrative control of land use. Those opposed cited the lack of reliability of such control, especially through use of fences in remote areas of the western United States.

EPA considers that protection from the long-term hazards associated with radioactive waste should primarily rely on passive control methods. We note, in this regard, the intent of Congress as stated in the congressional report accompanying UMTRCA: "The committee believes that uranium mill tailings should be treated in accordance with the substantial hazard they will present until long after existing institutions can be expected to last in their present forms." In addition, as noted in the proceeding section, the costs of land acquisition to limit maximum individual exposures can easily negate a significant fraction of potential savings through use of thinner covers. However, institutional controls can play a useful secondary role in supplementing passive controls and in assuring during the early period of disposal, that passive controls are adequate to achieve their design objectives.

Section 202 of the UMTRCA requires the Federal Government or the States to acquire and retain control of these tailings disposal sites under licenses. The licensor is authorized to require performance of any maintenance, monitoring, and emergency measures that are needed to protect public health and safety. We believe that these institutional provisions are essential to support any project whose objective is as long-term as are these disposal operations, and for which we have as little experience. This does not mean we believe that primary reliance should be placed on institutional controls; rather, that institutional oversight is an essential backup to passive control. For example, as long as the Federal Government or the States exercise their ownership rights and other authorities regarding these sites, they should not be inappropriately used by people. In this regard, even with the disposal actions required by these standards it would not be safe to build habitable structures on the disposal sites. Federal or State ownership of the sites is assumed to preclude such inappropriate uses.

5. Control of Radon Releases During Milling Operations

The proposed rule anticipated that the regulatory agency apply the "as low as reasonably achievable" (ALARA) principle of Federal Radiation Protection Guidance in establishing management procedures and regulations to control radon from operating mills. This approach was proposed because EPA concluded that a numerical standard to control radon was inappropriate for application during operations. This is because practical methods for reducing radon emissions during operations of existing mills and piles vary in effectiveness with time; it is very difficult to measure, quantitatively, their efficacy; and different methods are appropriate for different sites. The primary means for controlling radon emissions from existing tailing piles during operations are to keep the tailings as wet as possibile or to use phased disposal.

Some commenters indicated that the provisions of the proposed rule were inadequate to assure that the public would be protected. They argued that EPA has the responsibility under both UMTRCA and the Clean Air Act to provide suitable health protection to all members of the public. They suggested that requiring certain work practices or tailings management practices would provide greater public health protection than the provisions of the proposed rule. For example, they note that "staged" or "phased" disposal of tailings and good water management practices could be effective and reasonable.

EPA will consider further the feasibility and practicality of providing greater assurance that radon releases will be minimized during milling operations than would the proposed rule. The Agency has not sufficiently analyzed work practice and tailings management techniques to determine whether they are suitable for this purpose and which alternatives are best. Therefore, the Agency will publish an Advance Notice of Proposed Rulemaking under the Clean Air Act for condideration of the control of radon emission from uranium tailings piles during the operational period of a uranium mill. The ANPR will enable the Agency to gather information on the feasibility, effectiveness, and cost of various alternatives that would control radon releases from operating mills. This will enable EPA to be better informed when judging whether standards are needed, and, if so, the most suitable requirements.

B. Disposal Standards

1. Design Requirements for Long-Term Protection

Comments on this issue were greatly divergent. Some commenters believed controls should be required to last for thousands of years while others thought a few decades would be adequate. Comments from experts in the fields of civil engineering and geomorphology were useful in resolving this issue.

Standard design practice for structures that, should they fail, could lead to loss of life or significant destruction of property is based on the likelihood that a sufficiently disruptive event (e.g., a flood or hurricane) might occur within a specified time. For example, a bridge may be designed to withstand all disruptive events that have more than 1 chance in 100 of occurring within, say, 50 years.

Commenters noted that rushing water caused by very high rainfall events might damage or destroy a tailings containment system that lies in its path (floods that merely cover or wet a pile are not as significant). Therefore, they suggested, the disposal method should be designed to withstand any such rainfall events that have more than a small likelihood of occurring during the period for which control is to be "reasonably assured." Expert commenters noted that floods of greater magnitude than a "1000-year flood," for example, as they are generally defined, have a high likelihood of occurring within 1000 years. Thus, in order to provide reasonable assurance that a pile will withstand all floods that have more than some small chance of occurring within 1000 years, the control system must be designed to withstand much rarer events, such as a "probable maximum flood." In practice, they suggested, adequately protecting piles for even a few hundred years requires designing control systems to withstand all events that are likely to occur within thousands of years. Furthermore, the maximum rainfall that might be expected to occur within thousands of years is very nearly the maximum possible rainfall. Therefore, in practice, the system would have to be designed for approximately the same (i.e., maximum) rainfall whether the control period is 200 years or 1000 years.

As discussed above, we believe protection for only a short period (a few decades) is inconsistent with the intent of Congress. Some commenters argued for periods longer than 1000 years. We believe that the specification of a design period of 1000 years will achieve the objectives of these commenters, while at the same time giving engineers who must carry out these standards a design criterion reasonable to assess. We note that commenters did not identify any specific design features that would flow from a greater than 1000-year criterion that would not already be required to satisfy a 1000-year requirement.

Based on these considerations we conclude that the time over which protection should be provided should be specified as proposed.

A closely related matter is the degree of assurance with which controls can be designed to meet the longevity requirement. Some failure modes can be well quantified (e.g., performance of dikes, etc.) and others may not be as well characterized (e.g., aging characteristics of rock used to stabilize slopes). We recognize that, in some cases, it may therefore be difficult to certify conformance in all respects to a 1000-year requirement for longevity of control. For this reason we have retained the flexibility of the proposed rule to certify for shorter periods (but in no case less than 200 years). We leave the matter of fully defining what constitutes "reasonable assurance" to the implementing governmental agencies, but expect that standard engineering (design) criteria will be used to limit the probability of failure over the required longevity period to a value consistent with other design situations where public health and safety are important concerns.

2. Radon Emission Limit

Quantitative estimates of health effects from tailings can reasonably be made for radon emissions and windblown particulates. Health effects from misuse of tailings and water contamination cannot be quantified because of the extremely high degree of uncertainty associated with the likelihood and extent to which misuse and contamination might occur and the consequent degree to which people will consequently be exposed to radiation and toxic substances. (For example, tailings used as fill in unoccupied areas would not result in direct human exposure. Using tailings as fill for residential buildings carries a high probability of very significantly elevating radiation exposure and risk. The degree to which people might be exposed to contaminants from tailings through waterborne pathways is subject to similarly high uncertainties.)

The likelihood of health effects from exposure to radon and its decay products is, considerably greater than from particulates, even when external radiation and food chain contributions are included in the estimates for particulates. Therefore, the only quantitative estimates of effects discussed are those for radon emissions. We believe, however, that effects from misuse or water contamination could be comparable to those from radon emissions if long-term protection is not afforded.

The primary concern of commenters who thought the proposed radon emission standard was too lax was the risk to nearby individuals. The estimated added lifetime risk of fatal lung cancer for someone living 600 meters from the center of a model pile is 1 in 1000 due to radon from a tailings pile emitting radon at the level of 20 pCi/m^2s, if the cover is designed to just achieve that emission level without employing additional control to provide reasonable assurance of achieving it for 1000 years.

Commenters who thought the proposed radon emission standard is too strict contended that the cost of compliance would be too high, in view of the small contribution radon from tailings makes to a population's total exposure to atmospheric radon. They also generally believed EPA had overestimated the health effects from radon. We have addressed this last concern in an earlier section of this notice.

Selecting a limit for radon emission from tailings involves four public health objectives, in addition to reducing health effects from radon released directly from the pile. These may all be achieved by using a thick earthen cover, which serves to inhibit misuse of tailings, to stabilize tailings against erosion and contamination of land and water, to minimize gamma exposure, and to avoid contamination of ground water from tailings. A radon emission limit of 20 pCi/m^2s or less would require use of a sufficiently thick earthen cover to achieve all of these objectives. A limit of 60 pCi/m^2s or greater could be satisfied in many cases by a cover too thin to effectively inhibit misuse. Such a cover would also permit higher individual risks (up to 3 in 10^3) and would leave 20 percent of the potential health impact on populations uncontrolled. Our analysis shows that a limit of 20 pCi/m^2s is also cost-effective for eliminating most (95%) health effects in regional and national populations from radon released directly from the pile. Such a limit would also reduce maximum individual risks to residents near tailings piles to less than one in 1000. We concluded that levels higher than 20 pCi/m^2s are not justified, based on the cost-effectiveness of reduction of cancer deaths in populations, the high maximum individual risks involved at higher levels, and the likelihood that control to a level of 20 pCi/m^2s is reasonably achievable.

The risk to people who live permanently very close to tailings piles can still be relatively high, up to 1 in 1000 for lifetime residency, for a limit of 20 pCi/m^2s. However, the practicability of providing more radon control by requiring design for lower levels of emission falls rapidly below 20 pCi/m^2s. We note that no pile has ever been protected by such a cover; that is, covers with defined levels of control and longevity are undemonstrated technology. The design of covers to meet a specific radon emission limit at these low levels must be based on measurements of properties of local covering materials and prediction of local parameters, such as soil and tailings moisture, over the long term. Because of uncertainties in measuring and predicting these parameters, the uncertainty of performance of soil covers increases rapidly as the stringency of the control required increases. Thus, in the case of lower levels, the primary issue becomes whether conformance to a design standard for such levels is practicably achievable. There is some field information available regarding the practicality of reduction of radon emissions to levels approaching background. Tests conducted at a pile in Grand Junction, Colorado, showed that test plots of 3-meter thick covers made from four different earthen combinations reduced radon emissions to values ranging from 1.0+1.1 to 18.3+25.2 pCi/m^2s. The efficiencies of these covers ranged from 88.8 percent to 99.7 percent. These results apply to the first two years after emplacement, and do not reflect performance after long-term moisture equilibrium is achieved (some moisture contents were still considerably elevated over prevailing levels). We believe results like these can generally be expected, because the radon control characteristics of earthen materials used for covers will vary from site to site. Three of the four covers studied satisfied 20 pCi/m^2s with a reasonable degree of certainty over the term of the test. The other cover (18.3+25.2 pCi/m^2s) was uncompacted and its poor performance can therefore be discounted. Exactly how much thicker these covers would need to be to reliably achieve a lower limit (e.g., 6 or 2 pCi/m^2s) is not known. Experts commented during hearings on the standards that, although covers can be designed to meet such levels as 20 pCi/m^2s, estimation models are not reliable at significantly lower emission levels.

We concluded that achieving conformance with a radon emission standard that is significantly below 20 pCi/m²s (6 or 2 pCi/m²s, for example) clearly would require designers to deal with unreasonably great uncertainty for this undemonstrated technology. That is particularly so because EPA is already requiring a margin of safety in calling for any control system to meet the designated emission level with reasonable assurance over 1000 years. Given the predictive uncertainties in designing to meet this standard, EPA judged that to force an accounting for a second set of predictive uncertainties by forcing the standard to very low nominal levels would be to exceed the limits of reasonably available technology.

The risk from radon emissions diminishes rapidly with distance from the tailings pile (declining by a factor of three for each doubling of the distance beyond a few hundred meters). There currently are only about 30 individuals living so near to active piles that they might be subject to nearly maximum annual post-disposal risks. We expect that the actual number of people who might experience near maximal lifetime risk will be smaller, since they would have to maintain lifetime residence in the land area immediately adjacent to a tailings piles. In sum, we believe that the probability of a substantial number of individuals actually incurring these maximum calculated risks is small.

We conclude that it is not reasonable to reduce the emission standard below 20 pCi/m²s because of: (1) The uncertainty associated with the feasibility of implementing a requirement for a significantly lower standard, (2) the small increase in total health benefits associated with such thicker covers, and (3) the limited circumstances in which the maximum risk to individuals might be sustained.

As noted above, the 20 pCi/m²s mission limit was selected to meet the stated objectives of reducing the likelihood of misuse, spreading due to erosion, and control of radon emissions after a thorough evaluation of the current existing information on the technical and economic aspects of alternative levels of control. EPA recognizes the limitations inherent in this information, since no pile has yet been disposed of. Better information may well become available within the next several years as DOE proceeds with the disposal program for inactive piles. Therefore, consistent with Section 275(b)(2) of UMTRCA, EPA intends to continue to monitor these efforts over the next several years and will propose revising these standards if subsequent technical and economic information shows modifications are warranted.

The standard requires that disposal be designed to provide "reasonable assurance" that radon emissions will not exceed 20 pCi/m²s (averaged over the disposal area) for 1000 years. Some commenters expressed the opinion that the meaning of this term was not clear. A key word in this requirement is "designed," since we do not intend compliance with a 1000-year requirement to be determined by monitoring. "Reasonable assurance" in the design of covers means the radon emission limit should be expected to be achieved, over the required term, with a degree of assurance commensurate with the "reasonable assurance" of longevity discussed in the preceding section. Thus, in designing the cover the uncertainties in attenuation characteristics of material used should be taken into account in a conservative manner. This will tend to increase the cover thickness required over that calculated from "best estimated" values, which would yield an approximately equal probability of achieving above or below the design level. An example of uncertainty to be considered is that in the long-term equilibrium value of moisture to be expected in the cover material (i.e., over 1000 years), even though the cover material may be sprayed with water when it is laid down and compacted, and layers of coarse materials introduced to inhibit capillary action. Such spraying and layers increase the moisture (and therefore attenuation) of the cover in the near term, but it is the long-term equilibrium moisture content which governs the performance of the cover over most of its useful life. Other factors include uncertainty in measured diffusion characteristics of the particular earthen materials used (for given moisture content), and in the long-term equilibrium moisture content of the tailings themselves. In summary, we intend that the design requirement for "reasonable assurance" should lead to thick durable covers that have a substantial likelihood of maintaining radon emissions below the 20 pCi/m²s limit for 1000 years.

A related matter is implementation of the specification that the standard for radon emission applies to the "average" value of the release rate. This averaging is to be carried out in two ways. First, it applies over the spatial extent of any disposal area. Thus, anticipated variations due to different concentrations of radium in different parts of the pile, or minor cracks or the effects of burrowing animals and plant roots are to be averaged over, since it is the net radon from the entire tailings pile that is of significance to health. Second, the averaging is specified to apply over a time period of at least one year. Thus, daily and seasonal variations in radon emission are to be averaged over, since these are also not of significance to public health. Finally, this averaging may extend over longer periods to accommodate normal fluctuations in soil moisture content due to short-term climatic variations. Thus, the lowest recorded values of soil moisture content should not be used; rather, the average values are appropriate. Such averages should not, however, extend to times as long as the normal human lifespan, since that could result in a significant alteration in the level of protection of public health. Similarly, averaging performance over the entire period of longevity of the cover is not within the meaning of the standard.

3. Relationship to the Clean Air Act Emission Standard Requirements

The Clean Air Act also requires that EPA provide public health protection from air emissions from tailings piles. Further, EPA is publishing an ANPR to consider additional control of radon emissions during the operational phase of mills. This discussion relates to the disposal phase.

The Clean Air Act requires that the Administrator establish a standard at the level which in his judgment provides an ample margin of safety to protect the public health from hazardous air pollutants. The Agency published proposed rules for radionuclides as National Emission Standards for Hazardous Air Pollutants (NESHAPS) on April 6, 1983 (48 FR 15076). The proposed rule addressed all of the sources of emissions of radionuclides that EPA had identified. The proposed rule either provided standards for various source categories or proposed not to regulate them and provided reasons for that decision.

In the proposed NESHAPS for radionuclides EPA did not propose additional standards for uranium mill tailings, because the Agency believed the EPA standards to be established under UMTRCA would provide the same degree of protection as required by Section 112 of the Clean Air Act. The Agency explained that Congress did not describe the degree of protection that provides an ample margin of safety, nor did it describe what factors the Administrator should consider in making judgments on the appropriate standard. The Agency indicated that it did not believe that it was reasonable to establish standards for nonthreshold pollutants like radionuclides at levels that preclude any possible risk. EPA concluded that it should follow an approach that would allow it to consider various factors that influence society's health and well being. Therefore, EPA chose to consider the following factors in deciding whether standards are needed and the appropriate level of such standards:

1. The radiation dose and risk for nearby individuals;
2. The cumulative radiation dose and health impacts in populations;
3. The potential for radiation emissions and risk to increase in the future;
4. The availability, practicality, and cost of control technology to reduce emissions, and
5. The effect of current standards under the Clean Air Act or other applicable authorities.

The first three factors are used to assess the likely impact of emissions on the health of individuals and large populations and to estimate the potential for significant emissions in the future. The fourth factor enables EPA to assess whether state-of-the-art control technologies are currently in use and whether there are any practical means of reducing emissions through control technology or other control strategies. The last factor allows EPA to assess whether regulations or standards that have been established to control other pollutants are also minimizing releases of radionuclides.

The dose and risk for the individuals nearest a site are often the primary considerations when evaluating the need to control emissions of radionuclides. Controlling maximum individual dose assures that people living nearest a source are not subjected to unreasonably high risk. Further, protecting individuals often provides an adequate level of protection to populations living further away from the source.

EPA believes that cumulative dose and health impacts in populations are also an important factor. The cumulative radiation dose and health impact are determined by adding together all of the individual doses and risks that everyone receives from an emission source. This factor can sometimes be more important than the maximum individual risk in deciding whether controls are needed, particularly if an extremely large population may be exposed at low levels. The aggregate dose and population impact can be of such magnitude that it would be reasonable to require a reduction in the total impact even though, if the maximum individual dose were considered alone, one might conclude that no further controls are needed. For mill tailings, although population doses and health impacts were an important part of our consideration, doses to the most exposed individual were equally important.

In addition, EPA considers the potential for emissions and risk to increase in the future, even though the current projected maximum individual and population risks may be very low. In this case, we do not anticipate significant future increases in the size of this industry, although populations around these sites may increase, as the national population increases.

The availability and practicality of control technology are important in judging how much control of emissions to require. EPA believes that the standard should be established at a level that will, at least, require use of best available technology. Additional actions, such as forcing the use of undemonstrated technology, closure of a facility, or other extreme measures may be considered if significant emissions remain after best available technology is in place or if there are significant emissions and there is no applicable demonstrated control technology. EPA defines best available demonstrated technology as that which, in the judgment of the Administrator, is the most advanced level of controls adequately demonstrated, considering economic, energy, and environmental impacts. We concluded that requiring the use of undemonstrated technology was appropriate for mill tailings, since their emissions are significant and there is no applicable demonstrated control technology.

Finally, EPA believes it is reasonable to consider whether other EPA standards are achieving approximately the same goal as the Clean Air Act, i.e., protecting public health with an ample margin of safety. In cases where other standards are providing comparable control, EPA believes it is appropriate not to propose redundant standards under the Clean Air Act. There would be no benefits because the public health would already be protected with an ample margin of safety, but there could be unnecessary costs associated with implementing an additional standard.

The Clean Air Act specifies that the Administrator promulgate emissions standards to protect the public health. The Administrator is also authorized to promulgate design, equipment, work practice, or operational standards, or a combination, if it is not feasible to prescribe or enforce emission standards. The Administrator can conclude that "it is not feasible" if a hazardous pollutant cannot be emitted through a conveyance or the use of the conveyance would be contrary to laws, or if measurement methodologies are not practicable due to technological or economic limitations. As noted above, we will consider the need for such standards for the operational phase of mills.

With respect to these disposal standards, EPA has concluded that design to provide reasonable assurance that the release of radon will not exceed 20 pCi/m^2s for a period of 1000 years is appropriate. The level of the standard was selected after considering potential impacts both on individuals and large population groups. We consider that the uncertainties involved in design to various levels and durations of control are important factors. Potential increases in the number of mill tailings piles due to future needs for uranium were also considered. In addition, the cost and socio-economic impact of the standard and other alternatives were considered. In light of all of these considerations, EPA judges it appropriate that the standard require a level of control not heretofore applied, but for which the design uncertainties that must be accommodated are within the range of practical feasibility.

It would be desirable to reduce potential maximum individual risk further. However, the uncertainties associated with attempting designs to achieve assurance of conformance to a significantly lower standard through use of thicker covers are, we believe, unreasonably great, and would impose large and unpredictable costs. Somewhat thicker covers than bare (or average) compliance with a 20 pCi/m^2s standard would require will, moreover, be called for by the requirement to provide reasonable assurance of compliance. (Other types of control are even more costly and do not provide the comprehensive protection thick covers provide.) Consequently, we have concluded it would be unreasonable to impose a standard below the 20 pCi/m^2s required by this rule.

The Agency believes that the standards for the disposal of uranium mill tailings established in this rule provide protection of public health comparable to that which might be established under the Clean Air Act, because the considerations on which these standards are based are comparable to those the Agency uses in establishing standards under Section 112 of the Clean Air Act. However, the final determination will be made in the

Section 112 rulemaking on radionuclides.

4. Radon Concentration vs. Emission Rate Limits

A radon emission rate limit was proposed as a design standard for the disposal of tailings. Some commenters suggested that we should instead establish a concentration limit for radon in air at locations where people would be exposed. They expressed the view that EPA should establish standards based on health risk alone and that a concentration limit applied where people can live is therefore more suitable.

A design limit for emissions addresses a primary goal of these standards, the placement of a thick, durable earthen cover over the tailings, because the limit relates directly to the thickness of the cover and requires direct control of radon emissions. It also is in a form which conforms to the requirements of the Clean Air Act, which specifies direct control of emissions from a source. Under the suggested air concentration limit, transport calculations would be needed to estimate emission rates for use in determining cover thicknesses. We believe no purpose is served by introducing the uncertainty of this extra (transport) variable into the calculations for cover thickness. In addition, the thickness of the cover required to satisfy such a standard could be arbitrarily reduced (to zero in many cases) by use of fences to restrict access. Such a situation would be unsatisfactory because it would: (1) Require permanent (for 1000 years) control of access by institutional means, and (2) would not require a cover sufficient to deter misuse. In summary, if such a standard is comparable to an emission limit, it is needlessly complex, due to the introduction of transport calculations. If not, it affords less protection by permitting dispersion instead of control.

5. Cleanup Standards

Commenters expressed confusion regarding the purpose and applicability of the proposed § 192.32(b)(2). We intended this section to distinguish disposal areas for tailings piles from other land areas on disposal and/or licensed sites that are sufficiently uncontaminated by tailings as to not require application of the disposal standards of § 192.32(a). The definition of "disposal area" and the language of § 192.32(b) have been revised to clarify these objectives.

Some commenters objected to the proposed definition. On the assumption that it was a cleanup standard they argued it is not necessary to clean up land which will be converted to government ownership upon closure, since a government agency could control use of the land. Also, they argued that even if the government allowed use of the land, including residential use, "no reliable evidence exists to indicate that levels exceeding the proposed cleanup standard would necessarily convert to indoor radon daughter exposures of sufficient magnitude to constitute significant health risks."

EPA believes there are good reasons not to leave contaminated land (other than areas meeting the disposal standards) at former milling sites. First, the contamination may spread further, and thereby necessitate cleanup of adjacent land or properties. High indoor radon levels clearly can result if houses are built on contaminated land. Second, there are significant radiation risks (identified in the FEIS and DEIS) from pathways other than inhalation of indoor radon decay products, including external (gamma) radiation and inhalation of windblown particulates. Finally, the government agency accepting ownership of contaminated land would have to impose additional control and, possibly, incur the costs to maintain such control. EPA has decided not to change the proposed levels which define on-site land that need not satisfy the standards applicable to disposal areas.

Finally, some commenters suggested that we issue standards for the cleanup of any off-site land and buildings that may contain tailings from licensed mills. There was an implication in some comments that establishing the responsibility of any party to perform remedial actions for such sites could be affected by whether or not EPA had issued cleanup standards. EPA has issued cleanup standards (40 CFR Part 192, Subpart B) for the Federal cleanup program for off-site tailings from 24 inactive processing sites that was established under Title I of UMTRCA. Sites for which a license for uranium or thorium production was in effect on or after January 1, 1978, are excluded from coverage under Title I. We note, however, that the standards (40 CFR Part 192, Subpart B) we have already issued for the Title I program would be suitable for application to off-site contamination from active mills.

6. Wet Sites vs. Dry (Arid) Sites

Several commenters from Virginia and Illinois expressed concern regarding the applicability of the standards to wet sites, i.e., locations where annual average precipitation exceeds annual average evapotranspiration. EPA stated in the **Federal Register** notice accompanying the proposed standards that if uranium mining and milling is conducted in wet regions, the adequacy and appropriateness of the standards may have to be reviewed, particularly the water protection requirements. Based on this statement the commenters were concerned that EPA intended to apply less stringent standards for tailings control at wet sites.

Our remarks concerning wet sites in the preamble for the proposed standards were intended only to acknowledge that all current U.S. uranium mills are located in arid and semi-arid areas, and that we have less experience with many of the control measures needed to comply with the standards under wet than under dry conditions.

We have modified the final standards to require environmental and health protection in all regions of the United States. EPA developed the basic ground water protection provisions in these standards for national application to hazardous waste sites. The New Source Performance Standards, 40 CFR 440.34, protect surface water by prohibiting discharges from new mills except for the amount by which precipitation may exceed evapotranspiration. Any discharged water must satisfy concentration standards corresponding to use of the best available demonstrated treatment technology. We have modified our proposal to not apply the requirements of 40 CFR 264.228 that are referenced by 40 CFR 264.221 ("Design and Operating Requirements") in order to avoid the post-closure "bathtub" effect that could otherwise occur in wet locations. For mills locationed in regions of net precipitation the final standard applies 40 CFR 264.228(a)(2)(iii)(E), which requires the closure cover to be less permeable than any liner beneath the tailings so the pile will not fill with water.

We believe these and the other provisions of the final standards provide adequate protection for wet and dry areas, considering differences in both net precipitation and population density.

C. Ground Water Standards

1. Summary of the Proposed Standards

Consistent with the standards EPA issued under the SWDA for hazardous wastes (47 FR 32274–388, July 26, 1982) the standard for tailings piles has two parts: (1) A "primary" standard that requires use of a liner designed to prevent migration of hazardous substances out of the impoundment, and (2) a "secondary" ground water protection standard requiring, in effect, that any hazardous constituents that leak from the waste not be allowed to degrade ground water. The primary standard applies to new portions of new or existing waste depositories. The secondary standard applies to new and existing portions, the point of compliance being at the edge of the waste impoundment. The specific hazardous substances and concentrations (i.e., background levels) that define noncompliance with the secondary standard at each site will be established for uranium mill tailings by NRC and Agreement States. The SWDA rules, however, permit alternate concentration limits to be established when they will not pose "* * * a substantial present or potential hazard to human health or the environment" as long as the alternate concentration limit is not exceeded. The rule also allow "hazardous constituents" to be exempted from coverage by the permit based on the same criterion. EPA determines the alternate concentration standard or exemption under the SWDA; EPA's concurrence would be required under the proposed standards for tailings.

EPA recognized in proposing these standards that UMTRCA continues the dual regulatory system for uranium fuel cycle facilities under which EPA sets health and environmental standards and NRC establishes implementing technical, engineering, and management regulations. Under the SWDA, EPA performs all such regulatory functions for chemical hazardous wastes. UMTRCA promotes uniform Federal regulation of wastes, however, by requireing NRC's regulations for these wastes (i.e., uranium and thorium mill tailings) to be "comparable" to requirements EPA establishes for similar hazards under the SWDA.

2. The Primary Standard

The primary standard, 40 CFR 264.221, can usually be satisfied only be using liner materials (such as plastics) that can retain all wastes. Exemptions permitting use of other liner materials (such as clay) that may release water or small quantities of other substances or, in some cases, permitting no liner may be granted only if migration of hazardous constituents into the ground water or surface water would be prevented indefinitely.

Some commenters stated that no liner technology is available which would achieve the goal of the primary standard, i.e., preventing waste from entering the ground or water. They stated that synthetic liners would tear under the strains of tailings and heavy equipment, or that they could not reliably be properly installed in such large impoundments. Other commenters noted that thicker plastic liners than that have been conventional or double liners would be more successful. A number of commenters argued that clay liners may have important advantages over plastics, but questioned whether clay liners could satisfy the conditions for an exemption.

The rulemaking record does not establish that either clay or plastic liners have unequivocal advantages or disadvantages. EPA considered these technologies when it developed the SWDA liner requirement and decided to require a liner that is capable, as a matter of engineering, of preventing migration of waste into the ground and water. The fact that failures may occur did not justify establishing a less protective standard. Recognizing that such liners may sometimes fail, EPA also issued the secondary standard to limit the consequences of such failures. UMTRCA requires standards for tailings to be consistent with the standards EPA established under SWDA. We have concluded that commenters did not establish that conditions at tailings impoundments are sufficiently different from conditions EPA considered in developing the SWDA standard to justify departures from that standard.

Under these standards, all new waste storage areas (whether new waste facilities or expansions of existing piles) are subject to the primary standard—the liner requirement. If new wastes are added to an existing pile, however, the pile must comply with the secondary standard—the hazardous constituent concentration standards for health and environmental protection. Whether for a new or existing pile, if the secondary standards are found not to be satisfied and subsequent corrective actions fail to achieve compliance in a reasonable time, the operator must cease depositing waste on that pile.

3. The Secondary Standard and the Complementary Roles of EPA and NRC

Commenters correctly noted that virtually all existing tailings piles have contaminated ground water beyond the edge of their impoundments. The reason is that many of these piles were constructed without liners and before NRC increased regulatory requirements in the late 1970's. NRC's recent regulatory practice has been to require remedial actions on a cost/benefit basis when underground contaminant plumes threaten to degrade or have already degraded the potential usefulness of offsite water.

Many commenters, including NRC, argued that the existing practices for tailings piles sufficiently protect health and the environment. They noted that under the proposed standard virtually all existing mill operations would have to either request exemptions and alternate standards and/or begin remedial actions. Commenters stated that regulating by exceptions is inappropriate. NRC and others further argued that an EPA concurrence role for exemptions and alternative standards that would be invoked at virtually all existing mills was inconsistent with UMTRCA's foreclosure of any EPA permitting for tailings under UMTRCA or SWDA.

We have made modifications of the rule to both improve its administration and clarify its objectives.

EPA considered a wide range of alternatives before adopting the secondary standard, including a policy similar to NRC's. When EPA issued the SWDA rules, it recognized that many existing hazardous waste sites had operated for many years without liners and would not immediately satisfy the secondary standard. EPA created the opportunity for exemptions and alternative concentration standards to avoid remedial actions where such exceptions would "not pose a substantial present or potential hazard." In establishing such exemptions or alternative standards, the SWDA rules require EPA to consider specified fate-related and health and environment-related factors (see 40 CFR 264.93(b) and 264.94(b)). "Fate" refers to the destiny of contaminants released from the waste under site-specific hydrogeochemical conditions.

EPA agrees that administrative burdens related to the dual regulatory system under UMTRCA should be minimized. We have concluded that it is appropriate under UMTRCA that the regulatory agencies (NRC and Agreement States) perform or approve analyses of fate, because this involves primarily technical and site-specific judgments. EPA does not believe, however, that it can or should delegate its responsibility for setting health and environmental protection standards. This was the reason for proposing to require EPA's concurrence with exemptions and alternative concentration standards recommended by regulatory agencies for site-specific licenses. Therefore, in determining situations requiring concurrence, EPA will consider the health and environment-related factors in §§ 264.93(b) and 264.94(b).

Administrative burdens can be further reduced by permitting the regulatory agency to exercise discretion, pursuant to the requirements of 40 CFR 264.94(b), for establishing alternate concentration limits, as long as any contamination permitted will remain close to the pile and is within the boundaries of the licensed site. Such situations can be identified solely through analysis of fate, and we have decided not to require concurrence in such cases. This avoids the dual administrative process for alternative concentration standards under conditions where they certainly would be requested and granted. We believe this is appropriate. The contamination would be very limited in extent and concentration, can be expected to eventually dissipate after the site is closed in accordance with our closure standard, and these sites will be under effective government jurisdiction during this period. We have chosen 500 meters as the maximum distance for the purpose of this section of the rule, because it limits contamination to a small area, and, considering the size of disposal areas, will provide an adequate margin of distance to implement corrective action programs if they are required to prevent offsite contamination.

The revised standard for existing piles should be implemented in a manner consistent with the following scenario. Monitoring wells should be established at the edge of the tailings at the compliance point. This monitoring location is unique in providing the earliest practical notice of contaminants migrating from the impoundment. The regulatory agency should determine through further monitoring and fate analysis whether hazardous constituent levels now and in the future will satisfy the secondary standard within 500 meters or any closer site boundary, what corrective actions are appropriate to correct any on-site contamination, and, if some contamination is found to be not practicable to eliminate, the alternate concentration limit at the edge of the tailings to indicate the minimum practicable on-site contamination. If environmental contamination is a realistic possibility (or fact) beyond 500 meters (or the site boundary), remedial actions must be taken, or alternative concentration standards (with EPA concurrence) are required.

Unlike EPA's role in SWDA, EPA's role for controlling hazardous materials from uranium tailings under UMTRCA is limited to setting standards and does not include an implementing responsibility. That responsibility is vested in the NRC and the States as the licensing agencies under Title II of UMTRCA (Section 84a(3)) and will be carried out through regulations set by the NRC, with the concurrence of the Administrator, upon promulgation of these standards by EPA.

Many of the factors that must be considered by NRC in carrying out its responsibilities for enforcing EPA's standards are discussed in the pertinent section of the notice proposing these standards (48 FR 19522–5). For convenience, we repeat here the listing of sections of the SWDA's regulations which relate to the separate EPA and NRC responsibilities. EPA's responsibilities to establish standards under Section 206 of UMTRCA are carried out through adoption of all or part of the following sections of the SWDA regulations:

i. Subpart F:

40 CFR 264.92 Ground water protection standard

40 CFR 264.93 Hazardous constituents

40 CFR 264.94 Concentration limits

(These three sections are modified and adopted as § 192.32(a)(2)).

40 CFR 264.100 Corrective action program

(This section is modified and adopted as § 192.33)

ii. Subpart G:

40 CFR 264.111 Closure performance standard

(This section is adopted as part of § 192.32(b)(1))

iii. Subpart K:

40 CFR 264.221 Design and operating requirements for surface impoundments

(This section is modified and adopted as § 192.32(a)(1))

NRC's responsibilities under UMTRCA are to implement EPA's standards and to "* * * insure that the management of any byproduct material * * * is carried out in such a manner as * * * conforms to general requirements established by the Commission, with the concurrence of the Administrator, which are, to the maximum extent practicable, at least comparable to requirements applicable to the possession, transfer, and disposal of similar hazardous material regulated by the Administrator under the SWDA, as amended." EPA will insure that NRC's regulations satisfy these admonitions through its concurrence role. Relevant SWDA regulations are those embedded in Subparts A (except Section 264.3), B, C, D, E, F, G, H, and K. Examples of areas which NRC must address in discharging these responsibilities involve functions under the six sections listed immediately above which are incorporated into these EPA standards, and the following sections of the SWDA regulations:

i. Subpart F:

40 CFR 264.91 Reequired programs

40 CFR 264.95 Point of compliance

40 CFR 264.96 Compliance period

40 CFR 264.97 General ground water monitoring requirements

40 CFR 264.98 Detection monitoring program

40 CFR 264.99 Compliance monitoring program

ii. Subpart G:

40 CFR 264.117 Post-closure care and use of property

iii. Subpart K:

40 CFR 264.226 Monitoring and inspection (of impoundment liners), as applicable

40 CFR 264.228 Closure and postclosure care, as applicable.

There are several of these SWDA regulations that specify monitoring after closure of an impoundment. Monitoring is a compliance activity conducted to assure that health and environmental standards are being met. The regulatory agency is responsible for establishing such requirements, including post-closure monitoring consistent with the SWDA regulations. The period over which post-closure monitoring is normally required under SWDA is 30 years. The regulatory agency should recognize, however, that monitoring of ground water for shorter or longer periods may be needed for the specific sites where tailings are located and, when appropriate, change this requirement.

A difficult consideration regarding the closure of a tailings impoundment is deciding when disposal must take place. Several factors must be evaluated in this regard, including: (1) The likelihood that a mill will resume operations; (2) the specific condition of the tailings impoundment, such as the fraction of design life remaining, and environmental contamination problems, such as windblown tailings and the likelihood that significant quantities of tailings might be spread by flooding; and (3) the cost of maintaining releases from the inactive pile in conformance with the regulations which apply to operating mills prior to disposal (including maintaining radon emissions at ALARA levels). Evaluating these factors may be difficult and complex. However, although an adequate drying-out period makes possible long-term isolation of the tailings and stabilization of the piles, radon emissions will be greater during this period than before or after disposal. For this reason the regulatory agency should require, once a pile is allowed to begin to dry out, that disposal proceeds in an expeditious fashion, and that new liquids are not introduced to the pile so that a new drying-out period will be incurred.

The period required for the tailings to dry out is highly dependent on local meteorology. This precludes establishing a single fixed time for disposal of the tailings. We have concluded that the regulatory agency should exercise the responsibility of determining when disposal should occur, by site-specifically judging the advantages and detriments associated with all pertinent factors. This responsibility is governed by the need to conform to regulations established to satisfy the SWDA, by 40 CFR Part 190, and by the ALARA requirement on radon emissions.

NRC's closure regulations must be comparable, to the maximum extent practicable, to requirements under the SWDA, wherein short closure periods (90 and 180 days) are specified. Drying out of piles will take much longer. However, disposal should occur promptly when piles are allowed to dry out. In addition, some of the older mill sites already contain essentially completed (filled) tailings piles. The regulatory agency should promptly identify and require disposal of such tailings.

EPA and NRC are coordinating their efforts to insure health and environmental protection from uranium byproduct materials. In particular, we are working closely with the NRC to assure that NRC's general requirements for ground water protection will be comparable, to the maximum extent practicable, to EPA's requirements under the SWDA for similar hazardous materials.

4. Timing of Corrective Actions

The proposed standard requires corrective actions for ground water to be initiated within one year after a noncompliance determination is made. Commenters expressed concern that it may take longer than one year to devise and implement an effective corrective action, for both technical and administrative reasons. Based on these considerations, EPA has revised the time limit for implementation of corrective actions to eighteen (18) months. We also note that § 264.99 of SWDA regulations require submission of corrective action plan within 180 days. This provision remains unaffected by the above revision.

Once corrective actions have begun, the regulatory agency should evaluate their effectiveness and determine whether to continue, alter, or discontinue the actions. Because corrective actions are very site-specific such determinations cannot be made under the same uniform, pre-established schedule for all sites. It is the regulatory agency's responsibility, however, to assure that necessary decisions are rendered in a timely fashion. Acceptable plans for corrective actions should offer a high likelihood of achieving compliance with the standards. Furthermore, corrective actions which, once begun, show inadequate promise of achieving compliance should result in the regulatory agency's promptly disallowing the addition of new tailings to a noncomplying tailings pile.

5. Nonhazardous Materials

Comments were received on two matters regarding the contamination of ground water by nonhazardous materials. (They include chlorides, sulfates, manganese, and total dissolved solids, amoung others.) At high concentrations, these materials can make water unfit for use for other than health related reasons.

One view of these materials held that several of them are more mobile than hazardous materials. Thus, they precede the hazardous material in contaminating ground water. Ground water monitoring for these materials allows the prediction of future ground water contamination by hazardous materials. This detection scheme might therefore provide an early warning of ground water contamination and allow early corrective actions to be taken, thereby effectively preventing ground contamination by hazardous materials.

EPA agrees with this comment. Analyzing water samples for the substances from tailings that are expected to be most mobile in a given ground water environment is a very useful feature of site-specific monitoring requirements. We note that § 264.98 already contains such a requirement and that the implementing regulatory agencies may be expected to establish such (or comparable) requirements.

A second view held that much of the ground water in the Western States is already contaminated with nonhazardous materials to an extent that it is unsuitable for use. These are primarily shallow aquifers (or uppermost aquifers) which would be the first to be contaminated by tailings materials. Since these ground waters are already contaminated, the argument goes, there is no need to prevent additional contamination.

This comment would require changing the ground water protection policy EPA has established for hazardous wastes under the SWDA rules. UMTRCA requires standards for tailings to be consistent with the SWDA standards. EPA has already considered the views expressed in these comments when it established its policy under the SWDA (47 FR at 32286, July 26, 1982). We do not think this rulemaking for byproduct materials is an appropriate forum in which to reconsider EPA's policies for hazardous wastes.

6. Neutralization of Tailings

Some commenters recommended that EPA require neutralization of tailings as a method to protect ground water. Neutralization is chemical treatment that would make the tailings neither acid nor alkaline. When tailings are neutralized many hazardous constituents are taken out of solution and thereby are less prone to move through the earth and into ground water.

An EPA study of tailings neutralization in 1980, discussed in the FEIS, identified several issues regarding neutralization. First, some of the hazardous constituents in tailings form complex compounds that remain in solution over wide ranges of acidity and alkalinity. Selenium, arsenic, and molybdenum—all constituents of tailings—are particularly troublesome in this regard. Adequate control would require careful operation of the neutralization process. Second, the costs of neutralizing the tailings are significant, about the same as installation of a liner. Most of the cost is due to the need for a sludge storage lagoon. Finally, neutralization would not preclude the need for a liner.

The structure of regulation established by UMTRCA consists of generally applicable environmental standards established by EPA and regulations to implement these by NRC. Requirements for specific control methods, such as neutralization, are left to the implementing agency, to be used, as required, to ensure that EPA's general standards are satisfied. In view of the above, EPA has concluded that a standard requiring neutralization of tailings is inappropriate.

D. Procedural Issues

1. Molybdenum and Uranium Improperly Listed Under SWDA Requirements

Comments were received stating EPA improperly proposed listing molybdenum and uranium as hazardous constituents, because SWDA listing procedures were not followed.

EPA listed molybdenum and uranium as hazardous constituents only for purposes of controlling uranium and thorium byproduct materials. EPA does not intend in this rulemaking to add molybdenum and uranium to the SWDA list of hazardous constituents, 40 CFR part 261, Appendix VIII. Therefore, the procedure we followed is proper. Clarification of this matter has been added to § 192.32(a)(2) of the final standard.

2. Inclusion of Thorium in the Standards

Several commenters pointed out that the DEIS contained no background supporting information for the thorium standards (Subpart E) and recommended deleting the thorium standards from this rule. Commenters also stated that there are significant differences in the physical and chemical characteristics and the radiological risk between uranium and thorium. They concluded, therfore, the EPA should not substitute the same requirements for thorium as for uranium, as was proposed.

The FEIS contains appropriate discussions of thorium and a review of the implications of the radiological differences between thorium and uranium for the level of protection provided, the cost of control, and the feasibility of implementation of these standards. These effects are sufficiently small for EPA to conclude that the thorium standards should be promulgated as proposed.

IV. Regulatory Impact Analysis

Under Executive Order 12291, EPA must judge whether a regulation is "Major" and therefore subject to the requirement of a Regulatory Impact Analysis. We have not classified this rule as major, since it will not cause significantly large incremental costs above those which must be incurred in the absence of these regulations. We have prepared a Regulatory Impact Analysis (RIA), however, since there are wide variations in views on the extent of needed environmental controls in the uranium industry.

A. Benefit-Cost Analysis

The RIA examines the benefits and costs of selected alternative disposal standards, for both existing and new tailings piles. As discussed earlier, most of the benefits of tailings disposal cannot be quantified. The benefit we are best able to estimate is the number of lung cancer deaths avoided by controlling the radon emanation from tailings piles. Since the other benefits of disposal—prevention of misuse, ground water protection and prevention of the surface spread of tailings—cannot be quantified (let alone monetized), we could not make a completely numerical determination, within the traditional benefit-cost analysis framework.

We first performed a partial benefit-cost analysis of alternative disposal standards by relating the disposal costs for each alternative to the health effect estimates for direct radon emissions alone. Although this analysis relates only one category of benefit to the entire cost of disposal, it provides useful results to the extent that these benefits are found to be greater than the total cost of control. Second, we performed a cost-effectiveness analysis of alternative standards which assigns different sets of arbitrary weights to the entire range of benefits of tailings disposal. To perform this analysis, we also developed an index which quantifies the relative effectiveness of the disposal methods in providing designated types of control which correspond to the benefit categories. The cost-effectiveness analysis does not address whether the cost increases of tighter controls are worth incurring. Rather, by examining the sensitivity of the results to different choices of weighting schemes for the various benefits, in addition to identifying at what level additional gains in effectiveness start becoming increasingly more expensive, it points out to what degree the choice of standards is sensitive to the relative importance assigned to different types of benefits. Based in part on these analyses, we have made a qualitative judgment that the societal benefits of the standards outweigh the societal costs, considering the long-term continuing train of benefits to society from isolating these hazardous materials from man and the environment.

A range of alternatives was evaluated for protection of public health and the environment. These alternatives included a range of control methods from no control to high levels of control and are summarized below. They do not include different levels of ground water protection, since those requirements must be consistent with standards already established under the SWDA. However, the length of time ground water is expected to be protected is indicated in the assessment of benefits.

Brief descriptions of each alternative follow:

Alternative A. This is the "no standards" case and represents the reference case representing conditions if nothing is done. The piles would remain hazardous for a long time, taking about 265,000 years for the radioactivity to decay to 10 percent of current levels. The radon emission rate is estimated to be 400 pCi/m^2s from a typical pile. The background rate for typical soils is about 1 pCi/m^2s. The concentration of some toxic chemicals in the tailings is hundreds of times background levels in ordinary soils, so that the potential for contaminating water and land is present and continues indefinitely.

Alternative B. These are "institutional care" cases and represent situations in which maintenance is required to assure the standard is satisfied. B1 specifies no radon emission limit, but requires control of wind-blown tailings and gamma radiation. B2 specifies radon control limits of 60 pCi/m^2s and B3 specifies 20 pCi/m^2s; both require control of wind-blown tailings and gamma radiation.

Alternative C. These are "long-term passive control" cases and represent situations in which design is for long-term protection using engineered, passive methods requiring no continued maintenance. The radon emission limits examined are:

C1 none
C2 60 pCi/m^2s
C3 20 pCi/m^2s
C4 6 pCi/m^2s
C5 2 pCi/m^2s

Disposal methods would be designed to be effective for 1000 years in this case, in addition to providing control of wind-blown tailings and gamma radiation.

Alternative D. These cases assume staged disposal. They do not require continued maintenance and achieve control similar to Alternative C, plus improved control of radon during operations at new tailings piles. The radon emission limits examined are:

D2 60 pCi/m^2s
D3 20 pCi/m^2s
D4 6 pCi/m^2s
D5 2 pCi/m^2s

Disposal methods would be designed to be effective for 1000 years in this case, in addition to controlling wind-blown tailings and gamma radiation. Further, additional control of radon is achieved during the operational period at new tailings piles through use of staged disposal.

The costs and the benefits for these alternatives are listed in the accompanying tables. We examined the cost per death avoided from radon emissions for alternative control levels from several viewpoints. This range of viewpoints included the length of time over which health effects should be related to costs and whether nationwide population effects should be included with regional population effects in making benefit-cost comparisons. We conclude that the incremental cost per radon death avoided at a 20 pCi/m^2s emission limit is a reasonable expenditure under all scenarios. The range of incremental costs per death avoided at this control level is from

$130,000 (nationwide health effects estimated for 1000 years) to $2.5 million (regional health effects estimated for only 100 years). For the next, more stringent, level of control, 6 pCi/m^2s, the incremental costs are also higher: $630,000 to $12 million per radon death avoided. These costs are more uncertain and more likely to have been underestimated. For the next, less stringent, level of control, 60 pCi/m^2s, the incremental costs are lower: $70,000 to $1.4 million. Whether or not the expenditure for a control level is acceptable depends on one's view of the relevant factors to be considered in valuing the benefit stream. On a relative basis, the incremental cost increases by at least a factor of 5 for going from the 20 pCi/m^2s limit to 6 pCi/m^2s, and increase by only a factor of 2 for going from 60 pCi/m^2s to 20 pCi/m^2s.

The results of our cost-effectiveness analyses, which incorporate different weighting schemes for all the benefits of disposal, indicate that the incremental costs per unit of overall effectiveness are relatively insensitive to the choice of weighting of benefits. The cost-effectiveness of obtaining increased benefits beyond 60 pCi/m^2s decreases monotonically by up to factors of two for each incremental level of control for all weighting schemes examined.

B. Economic Impact Analysis

In the RIA, we developed cases for analyzing the industry-wide costs and economic impacts associated with tailings disposal methods assumed to be required for compliance with the alternative standards. Each case represented a different combination of disposal methods applied to both existing and new tailings. The estimated economic impacts include potential mill closures (on a model mill basis) and uranium price increases. We estimated the impacts for each case according to different financial scenarios and different assumptions on the ability of companies to pass-through tailings disposal costs to their customers. The results from this analysis are used to represent the costs and impacts of the proposed standards.

We estimate that compliance with the standards, if other regulatory requirements did not exist, would cost the uranium milling industry about 260 million dollars for all tailings which exist today at licensed sites. If we include all those tailings which we estimate will be generated by the year 2000, based on recent DOE projections, the total cost to the uranium milling industry would be from 310 to 540 million dollars. These costs are present worth estimates (discounted at a 10 percent rate) expressed on a 1983 constant dollar basis. The range in cost is due to different assumptions on what actions are needed to meet requirements for ground water protection for new tailings at existing mills.

We estimate that increases in the price of uranium could range from 2 to 7 percent. In light of the currently poor economic condition of the industry and the threat of foreign competition, it is unlikely that mills will be able to pass through substantial portions of the disposal costs. Using our models and under the assumption of an average cash flow, we estimate that if mills are forced to absorb the entire cost of disposal, no mills would cease operation due to these standards. Under the conditions of no pass-through and lower cash-flow, one small model mill may close. However, we estimate that this closure can be avoided with the limited price pass-through stated above.

These costs and economic impacts are not all attributable to these standards, since some of these costs would probably occur in the absence of these standards due to other regulatory requirements at most sites. These include existing NRC licensing regulations and requirements established by agreement States, and regulations required under Section 84(a)(1) and (3) of UMTRCA. We did not estimate the costs imposed by these other requirements because that would require a site-specific investigation and these requirements have been continuously changing in the past few years (mostly toward more stringent requirements). Therefore, we could only estimate the upper bounds of cost and economic impacts imposed by these standards, and could not estimate the net impact of the standards.

This regulation was submitted to the Office of Management and Budget for review as required by Executive Order 12291. We believe the analysis discussed above complies with the intent of the Order. Any comments from OMB to EPA and any EPA response to those comments are available for public inspection at the docket cited above under "**ADDRESSES.**"

C. Regulatory Flexibility Analysis

This regulation would not have a significant impact on a substantial number of small entities, as specified under Section 605 of the Regulatory Flexibility Act (RFA). Therefore, we have not performed a Regulatory Flexibility Analysis. The basis for this finding is that of the 27 licensed uranium mills, only one qualifies as a small entity and this mill will not be impacted by the standards. Almost all the mills are owned by large corporations. Three of the mills are partly-owned by companies that could qualify as small businesses, according to the Small Business Administration generic small entity definition of 500 employees. However, under the RFA, a small business is one that is independently owned and operated. Since these three mills are not independently owned by small businesses, they are not small entities.

D. OMB Regulations on the Paperwork Reduction Act

This rule does not contain any information collection requirements subject to OMB review under the Paperwork Reduction Act of 1980 U.S.C. 3501, et seq.

TABLE I—COSTS OF ALTERNATIVE STANDARDS FOR TAILINGS CONTROL TO THE YEAR 2000 (MILLIONS OF 1983 DOLLARS)

Alternative standard	Present Worth Costs (10 percent discount rate)(*)		Total cost
	Existing tailings	Future tailings	
A	0	1	1
B1	117	83	200
B2	192	95	287
B3	256	111	367
C1	115	95	210
C2	192	112	304
C3	260	128	388
C4	336	146	482
C5	403	165	568
D2	192	156	348
D3	260	160	430
D4	336	186	522
D5	403	204	607

*These cost estimates assume that two-thirds of the future tailings generated at existing mills will be placed in existing impoundments and the other one-third will be placed in new, lined, impoundments. We assume that the average radium contents of existing and future tailings is 400 pCi/g. These costs are our best estimates, but their uncertainty increases as the level of required radon control increases.

TABLE II—BENEFITS OF ALTERNATIVE STANDARDS FOR TAILINGS CONTROL TO THE YEAR 2000 (a)

Alternative standard	Stabilization		Radon Control			Water protection
	Chance of misuse	Erosion avoided (y)	Maximum risk(b) of lung cancer (percent reduction)	Deaths avoided: First 100 years	Deaths avoided: Total	longevity (y)
A	Very likely	0	2 in 10^2(0)	0	0	0
B1	Likely	Hundreds	1 in 10^2(50)	300	1,000	100
B2	Less likely	...do	4 in 10^3(80)	480	1,500	100
B3	...do	...do	1 in 10^3(95)	570	2,000	100
C1	Likely	Thousands	1 in 10^2(50)	300	Thousands	100
C2	Less likely	...do	4 in 10^3(80)	480	Many thousands	Hundreds
C3	Unlikely	...do	1 in 10^3(95)	570	Tens of thousands	1,000
C4	Very unlikely	Many thousands	3 in 10^4(98.5)	590	...do	>1,000
C5	...do	...do	1 in 10^4(99.5)	597	...do	>1,000
D2	Unlikely	Thousands	4 in 10^3(80)	480	Several thousands	1,000
D3	...do	Many thousands	1 in 10^3(95)	570	Tens of thousands	>1,000
D4	Very unlikely	...do	3 in 10^4(98.5)	590	...do	>1,000
D5	...do	...do	1 in 10^4(99.5)	597	...do	>1,000

(a) These estimates include the benefits resulting from control of 26 existing piles and 9 projected new piles. No credit is taken for any engineering safety factors incorporated to provide the required "reasonable assurance" of conformance.
(b) Lifetime risk of fatal cancer to an individual assumed to be living 600 meters from center of a model tailings pile.

This standard is promulgated on the date signed.

List of Subjects in 40 CFR Part 192

Air pollution control, Radiation protection, Hazardous materials, Uranium, Environmental protection, Hazardous constituents, Groundwater protection, Radon, Radium, and Thorium.

Dated: September 30, 1983.

William D. Ruckelshaus,

Administrator.

In 40 CFR Chapter I, Part 192 is amended by adding Subparts D and E as follows:

PART 192—HEALTH AND ENVIRONMENTAL PROTECTION STANDARDS FOR URANIUM AND THORIUM MILL TAILINGS

* * * * *

Subpart D—Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

Subpart E—Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

Authority: Sec. 275 of the Atomic Energy Act of 1954, 42 U.S.C. 2022, as added by the Uranium Mill Tailings Radiation Control Act of 1978, Pub. L. 95–604, as amended.

* * * * *

Subpart D—Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

§ 192.30 Applicability.

This subpart applies to the management of uranium byproduct materials under Section 84 of the Atomic Energy Act of 1954 (henceforth designated "the Act"), as amended, during and following processing of uranium ores, and to restoration of disposal sites following any use of such sites under Section 83(b)(1)(B) of the Act.

§ 192.31 Definitions and Cross-references.

References in this subpart to other parts of the Code of Federal Regulations are to those parts as codified on January 1, 1983.

(a) Unless otherwise indicated in this subpart, all terms shall have the same meaning as in Title II of the Uranium Mill Tailings Radiation Control Act of 1978, Subparts A and B of this part, or Parts 190, 260, 261, and 264 of this chapter. For the purposes of this subpart, the terms "waste," "hazardous waste," and related terms, as used in Parts 260, 261, and 264 of this chapter shall apply to byproduct material.

(b) *Uranium byproduct material* means the tailings or wastes produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction operations and which remain underground do not constitute "byproduct material" for the purpose of this Subpart.

(c) *Control* means any action to stabilize, inhibit future misuse of, or reduce emissions or effluents from uranium byproduct materials.

(d) *Licensed site* means the area contained within the boundary of a location under the control of persons generating or storing uranium byproduct materials under a license issued pursuant to Section 84 of the Act. For purposes of this subpart, "licensed site" is equivalent to "regulated unit" in Subpart F of Part 264 of this chapter.

(e) *Disposal site* means a site selected pursuant to Section 83 of the Act.

(f) *Disposal area* means the region within the perimeter of an impoundment or pile containing uranium by product materials to which the post-closure requirements of § 192.32(b)(1) of this subpart apply.

(g) *Regulatory agency* means the U.S. Nuclear Regulatory Commission.

(h) *Closure period* means the period of time beginning with the cessation, with respect to a waste impoundment, of uranium ore processing operations and ending with completion of requirements specified under a closure plan.

(i) *Closure plan* means the plan required under § 264.112 of this chapter.

(j) *Existing portion* means that land surface area of an existing surface impoundment on which significant quantities of uranium byproduct materials have been placed prior to promulgation of this standard.

§ 192.32 Standards.

(a) *Standards for application during processing operations and prior to the end of the closure period.* (1) Surface impoundments (except for an existing portion) subject to this subpart must be designed, constructed, and installed in such manner as to conform to the requirements of § 264.221 of this chapter, except that at sites where the annual precipitation falling on the impoundment and any drainage area contributing surface runoff to the impoundment is less than the annual evaporation from the impoundment, the requirements of § 264.228(a)(2)(iii)(E) referenced in § 264.221 do not apply.

(2) Uranium byproduct materials shall be managed so as to conform to the ground water protection standard in § 264.92 of this chapter, except that for the purposes of this subpart:

(i) To the list of hazardous constituents referenced in § 264.93 of this chapter are added the chemical elements molybdenum and uranium,

(ii) To the concentration limits provided in Table 1 of § 264.94 of this chapter are added the radioactivity limits in Table A of this subpart,

(iii) Detection monitoring programs required under § 264.98 to establish the standards required under § 264.92 shall be completed within one (1) year of promulgation,

(iv) The regulatory agency may establish alternate concentration limits (to be satisfied at the point of compliance specified under § 264.95) under the criteria of § 264.94(b), provided that, after considering practicable corrective actions, these limits are as low as reasonably achievable, and that, in any case, the standards of § 264.94(a) are satisfied at all points at a greater distance than 500 meters from the edge of the disposal area and/or outside the site boundary, and

(v) The functions and responsibilities designated in Part 264 of this chapter as those of the "Regional Administrator" with respect to "facility permits" shall be carried out by the regulatory agency, except that exemptions of hazardous constituents under § 264.93 (b) and (c) of this chapter and alternate concentration limits established under § 264.94 (b) and (c) of this chapter (except as otherwise provided in § 192.32(a)(2)(iv)) shall not be effective until EPA has concurred therein.

(3) Uranium byproduct materials shall be managed so as to conform to the provisions of:

(a) Part 190 of this chapter, "Environmental Radiation Protection Standards for Nuclear Power Operations" and

(b) Part 440 of this chapter, "Ore Mining and Dressing Point Source Category: Effluent Limitations Guidelines and New Source Performance Standards, Subpart C, Uranium, Radium, and Vanadium Ores Subcategory."

(4) The regulatory agency, in conformity with Federal Radiation Protection Guidance (FR, May 18, 1960, pgs. 4402–3), shall make every effort to maintain radiation doses from radon emissions from surface impoundments of uranium byproduct materials as far below the Federal Radiation Protection Guides as is practicable at each licensed site.

(b) *Standards for application after the closure period.* At the end of the closure period:

(1) Disposal areas shall each comply with the closure performance standard in § 264.111 of this chapter with respect to nonradiological hazards and shall be designed [1] to provide reasonable assurance of control of radiological hazards to

(i) Be effective for one thousand years, to the extent reasonably achievable, and, in any case, for at least 200 years, and,

(ii) Limit releases of radon-222 from uranium byproduct materials to the atmosphere so as to not exceed an average [2] release rate of 20 picocuries per square meter per second (pCi/m^{2}s).

(2) The requirements of Section 192.32(b)(1) shall not apply to any portion of a licensed and/or disposal site which contains a concentration of radium-226 in land, averaged over areas of 100 square meters, which, as a result of uranium byproduct material, does not exceed the background level by more than:

(i) 5 picocuries per gram (pCi/g), averaged over the first 15 centimeters (cm) below the surface, and

(ii) 15 pCi/g, averaged over 15 cm thick layers more than 15 cm below the surface.

§ 192.33 Corrective Action Programs.

If the ground water standards established under provisions of Section 192.32(a)(2) are exceeded at any licensed site, a corrective action program as specified in 264.100 of this chapter shall be put into operation as soon as is practicable, and in no event later than eighteen (18) months after a finding of exceedance.

[1] The standard applies to design. Monitoring for radon-222 after installation of an appropriately designed cover is not required.

[2] This average shall apply to the entire surface of each disposal area over periods of at least one year, but short compared to 100 years. Radon will come from both uranium byproduct materials and from covering materials. Radon emissions from covering materials should be estimated as part of developing a closure plan for each site. The standard, however, applies only to emissions from uranium byproduct materials to the atmosphere.

§ 192.34 Effective date.

Subpart D shall be effective December 6, 1983.

TABLE A

	pCi/liter
Combined radium-226 and radium-228	5
Gross alpha-particle activity (excluding radon and uranium)	15

Subpart E—Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

§ 192.40 Applicability.

This subpart applies to the management of thorium byproduct materials under Section 84 of the Atomic Energy Act of 1954, as amended, during and following processing of thorium ores, and to restoration of disposal sites following any use of such sites under Section 83(b)(1)(B) of the Act.

§ 192.41 Provisions.

The provisions of Subpart D of this part, including §§ 192.31, 192.32, and 192.33, shall apply to thorium byproduct material and:

(a) Provisions applicable to the element uranium shall also apply to the element thorium;

(b) Provisions applicable to radon-222 shall also apply to radon-220; and

(c) Provisions applicable to radium-226 shall also apply to radium-228.

(d) Operations covered under § 192.32(a) shall be conducted in such a manner as to provide reasonable assurance that the annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as a result of exposures to the planned discharge of radioactive materials, radon-220 and its daughters excepted, to the general environment.

§ 192.42 Substitute provisions.

The regulatory agency may, with the concurrence of EPA, substitute for any provisions of § 192.41 of this subpart alternative provisions it deems more practical that will provide at least an equivalent level of protection for human health and the environment.

§ 192.43 Effective date.

Subpart E shall be effective December 6, 1983.

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RE: Public Comment on White Mesa RML Renewal: Modification to Groundwater Quality Discharge Permit No. UGW370004 and Amendment #10 of the 11e.(2) Byproduct License No. UT1900479 for Energy Fuels Resources, Inc. White Mesa Uranium Mill

To whom it may concern:

I write on behalf of the Bikepacking Roots not-for-profit organization and our 5,000+ members in expressing dismay at the interpretations of monitoring well data from down hydraulic gradient of the White Mesa Mill site. These analyses and interpretations would never stand up in peer reviewed scientific journals, and that is absolutely unacceptable when there exists the potential long-term poisoning of local communities and the broader landscape. DEQ completely neglects equally viable interpretations of data specifically from monitoring well MW-30 that could legitimately show groundwater contamination from at least one of the tailings impoundments beginning around 2010. Thus, without further scrutiny of these and other data, no discharge permit amendments or byproduct license amendments should be made for the White Mesa Mill – no increases in groundwater compliance limits (GWCLs), no increase in materials to be added to tailings impoundments, and no acceptance of materials from other countries for processing.

Our mission at Bikepacking Roots is to advocate for the bikepacking experience and for the landscapes through which we ride on behalf of the bikepacking community and our members. The Bears Ears and Grand Canyon regions are both popular among bikepackers, and the potential for future uranium mining in these region's futures, as well as any related contamination of the landscape, are especially concerning. We also have worked extensively with colleagues and organizations on Navajo Nation, and the long-term toxic impacts of uranium mining are all too real there. Given that Energy Fuels Resources owns the uranium mines in the Grand Canyon region (currently flooded with contaminated groundwater) and lobbied heavily for areas underlain by uranium-bearing bedrock to be removed from the original boundaries of Bears Ears National Monument, we find it important to engage in this current process related to the White Mesa Mill.

In writing this comment, I am representing the Bikepacking Roots organization and our members. As a geologist with a background in geochemistry, I personally have the expertise to delve into the data from the White Mesa Mill.

What is particularly dismaying is that in DRC-2019-006502, the DEQ memo reviewing the 2019 Source Assessment Report for MW-30, the DEQ

1. Accepts the linear regression fits through the 2005-2018 groundwater chemistry data despite the fact that the data show a clear change in behavior around 2010. Forcing a linear regression through this full dataset is nothing more than sloppy and deceptive statistical analysis.
2. Accepts the argument that a minor decrease in pH (less than 0.5 pH units) could alter uranium concentrations. This would *only* be the case if the groundwater was nearly saturated with respect to uranium, and that is very much not the case. Minor changes in pH in the historic range of groundwater pH values will *not* change uranium concentrations.
3. Accepts that tailings solution indictor parameters conclusively do not suggest contamination. Below I share an equally plausible interpretation of the same data and plots that point to contamination being able to just as easily explain the geochemistry trends at MW-30
4. Points to "long-standing upward trends" in SAR parameters. Again, uranium, sulfate, chloride, and pH all show a marked change in any trends around 2010. Forcing a linear regression through a longer period does not prove the existence of a long-standing trend.
5. Points to a 2008 University of Utah study that dated the groundwater in MW-30 to being older than the mill construction date of 1980. That may in fact be completely correct. But it is still possible to contaminate "old" water.

Each of these points on their own raises flags about the veracity of the interpretations of groundwater chemistry data coming from any of the monitoring wells at the White Mesa Mill site. But the fact that the validity of five of the six primary conclusions of the 2019 SAR summarized in the DRC-2019-006592 DEQ memo can be called into question is *hugely* problematic. The statistical analyses and interpretations of the 2019 SAR data from MW-30 (and likely other wells) would not stand up to any sort of scientific peer review, and DEQ's seemingly unquestioning acceptance of those analyses and interpretations does nothing to inspire faith in DEQ oversight.

Let's explore a bit of the geochemistry data from MW-30 over the years in a bit more depth, including some past interpretations of those data.

An analysis of historic chloride concentrations in a variety of wells at the White Mesa Mill site using data from 1983 to 2006 demonstrates that "chloride values are similar from 1983 to 2005-2006, indicating that, in spite of the variable magnitude of concentrations across the site, these comparative snap shots demonstrate that there has been little change in concentrations in samples from each well" (BGQR12292006). It was not until 2010 that chloride concentrations in MW-30 began to rise steadily (see MW-30 data plots at the end of comment with pre- and post-2010 periods highlighted for clarity; plots are taken directly from DRC-2019-000747). This increase in chloride concentrations around 2010 occurred at roughly the same time as uranium concentrations in MW-30 began to rise. It was also around 2010 that a steady decrease in sulfate concentrations at MW-30 leveled out. And no notable change in pH at MW-30 occurred at this time. Since 2010 at MW-30, the data show a steady rise in uranium and chloride concentrations and generally steady sulfate concentrations and pH; fluoride trend interpretation is hampered by high scatter pre-2010.

What might all this mean, and how should each of these indicators be interpreted? In the discussion of the merits of various "indicators of potential impact" in BGQR1229-2006 (a 2006 Background Groundwater Quality Report for the White Mesa Mill), chloride is identified as a "primary indicator of potential tailings impact." Fluoride, which has similar chemical properties as chloride, can have solubility controlled along ground water flow paths by the trace mineral apatite, resulting in fluoride being considered secondary to chloride in terms of reliability as an indicator of impact. Similarly, solubility differences between calcium chloride and calcium sulfate mineral species complicates the interpretation of sulfate data.

Returning to the MW-30 data, the steady decrease in sulfate concentrations at MW-30 between 2005 and 2010 levels off. 2010 is approximately the year that uranium and chloride concentrations at MW-30 began to increase steadily. *If* the steady decrease in sulfate concentrations between 2005 and 2010 was due to influences external to the mill site (as argued in the 2019 MW-30 SAR), groundwater contamination from mill operations could responsible for the relatively steady sulfate concentrations since 2010 as sulfate from tailings could have offset that prior decrease in sulfate concentrations (or in other words, the longer-term decrease in sulfate concentration due to environmental factors external to the mill site is masking contamination since 2010).

To summarize this simply, *all the trends observed* in uranium, chloride, and sulfate concentrations at MW-30 could potentially be explained by groundwater contamination from the mill site. The conclusions from the 2019 MW-30 SAR accepted by DEQ are not the *only* viable explanation for these trends, and I would argue that what I have presented is arguably a *more* viable explanation.

As explained in detail in BGQR12292006, the interpretation of indicators of potential impact is complicated by environmental variability in groundwater geochemistry. Thus, if interpretation of monitoring well data shows *any* potential sign of contamination, the onus is on the DEQ to require a far more thorough analysis and investigation than has been done. Decisions regarding potential uranium contamination must not be based on difficult to interpret data, shoddy and deceptive statistical analyses or conclusions that ignore other viable explanations. Far too much is at stake.

Based on all this, we request that

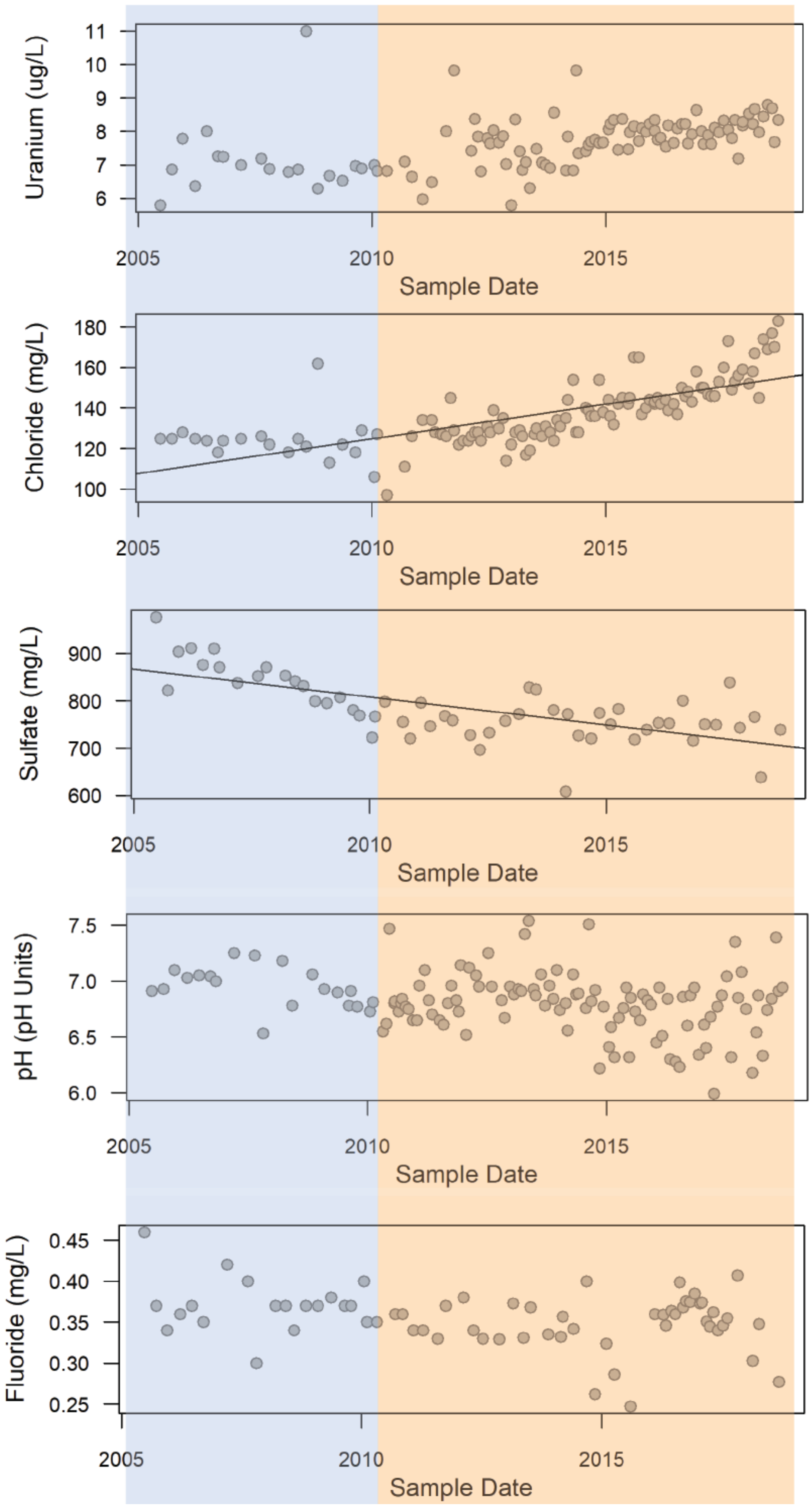
1. No changes be made in the uranium GWCLs be made. It has not been demonstrated convincingly that the increasing trends in uranium are not due to contamination.

2. No license amendment be issued for an increase in the annual limit of material added to the tailings impoundments be granted.
3. No license amendment be issued for the acceptance of alternate feed material from Estonia be granted.

The toxic legacy of uranium contamination is all too visible today across the Colorado Plateau, and particularly on Navajo Nation where so many families face the realities of cancer, birth defects, poisoned wells, and so much more as a result of past uranium mining. And just down hydraulic gradient a few miles from the White Mesa Mill sits the White Mesa Community, poised to intercept *any* groundwater contamination from the mill. One undetected leak is all it would take. And it has not been convincingly demonstrated that the changes in groundwater geochemistry at MW-30 are not evidence of a contamination that began around 2010.

Respectfully,

Kurt Refsnider, Ph.D.
Executive Director


Uranium (ug/L)
11
10
9
8
7
6
2005
2010
2015
Sample Date
Chloride (mg/L)
180
160
140
120
100
2005
2010
2015
Sample Date
Sulfate (mg/L)
900
800
700
600
2005
2010
2015
Sample Date
pH (pH Units)
7.5
7.0
6.5
6.0
2005
2010
2015
Sample Date
Fluoride (mg/L)
0.45
0.40
0.35
0.30
0.25
2005
2010
2015
Sample Date

The Legislative Branch
The Navajo Nation

Seth Damon
Speaker of the 24th Navajo Nation Council

**RESOLUTION OF THE
NAVAJO UTAH COMMISSION
OF THE NAVAJO NATION COUNCIL**

OPPOSING IMPORTATION OF RADIOACTIVE WASTE FROM THE COUNTRY OF ESTONIAN IN EASTERN EUROPE INTO THE WHITE MESA MILL NEAR BLANDING, UTAH.

NUCJUN-821-20

WHEREAS:

1. The Navajo Utah Commission (NUC) is a governmental subdivision of the Navajo Nation and is subject to oversight of the Navajo Nation Council – Naabik'iya'ti' Committee pursuant to Resolution No. NABIAP-21-15; and

2. The Navajo Nation has a government-to-government relationship with the United States of America, as per the Treaty of 1868, June 1, 1868, 15 Stat. 667, and its political status as a federally recognized tribe; and

3. The Navajo Nation and its citizens recognize the importance of the protection of sacred, historic, and important places to Indigenous Peoples; and

4. The *Diné Bi Beehaz'áanii Bitsé Síléí*, the declaration of the foundation of Diné law, predates the formation and establishment of the U.S. Constitution; and

5. The *Diné Bi Beehaz'áanii Bitsé Síléí* (Law) embodies *Diyin bitsáádéé beeha 'áanii (Traditional Law), Diyin Diné bitsáádéé beehaz'áanii* (Customary Law), and *Nahookáá Diné bi beehaz'áanii* (Common Law), which provides sanctuary for the Diné life and culture, our relationship with the world beyond the sacred mountains, and the balance we maintain with the natural world; and

6. These Fundamental Laws of the *Diné* have been codified in Title I of the Navajo Nation Code; and

7. The Navajo Nation and the Navajo Utah Commission are deeply committed to the protection of Indigenous sacred lands, cultural resources, and Native people; and

8. The Navajo Utah Commission recognize that the White Mesa community is located directly adjacent to the White Mesa Mill on Ute Mountain Ute reservation lands; and

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9. The Navajo Nation and the Navajo Utah Commission are committed to making decisions that are in line with the *Diné Bi Beehaz'áanii Bitsé Siléí*, which encompasses *Diyin bitsáádéé beeha 'áanii*, and not only looks at the present, but the past and future well-being of the *Diné* people; and

10. Energy Fuels Resources submitted an application to the Utah Division of Waste Management and Radiation Control in April 2020 to allow the White Mesa Uranium Mill to accept radioactive material from Easter Europe; and

11. Energy Fuels Resources intends to extract uranium from the residual material to produce fuel rods for nuclear power plants; and

12. The Utah Division of Waste Management and Radiation Control is accepting comments until July 10th, 2020 at dwmrcpublic@utah.gov; and

13. The Ute Mountain Ute Tribe, a sovereign nation whose lands the mill sits upon is opposed to Energy Fuels accepting this waste; and

14. Local community members have concerns about the lack of oversight, safety, and contamination of local groundwater resources on and around the White Mesa Mill.

NOW, THEREFORE BE IT RESOLVED THAT:

1. The Navajo Utah Commission is hereby opposing importation of radioactive waste from the country of Estonia in Eastern Europe into the White Mesa Mill near Blanding, Utah.

CERTIFICATION

We, hereby certify that the foregoing resolution was duly considered by Navajo Utah Commission at a duly called meeting by teleconference at which a quorum was present and the same was passed by a vote of 4 in favor, 0 opposed, and 1 abstention, this 23rd day of June 2020.

Kenneth Maryboy, Chairperson
NAVAJO UTAH COMMISSION

MOTION: Herman Farley
SECOND: Henry Stevens, Jr.

Chair not voting