Executive Summary

ES-5, Paragraph 2

EPA groundwater protection standards issued under authority of UMTRCA are required to be followed by ISL licensees of ~~Environmental regulation of ISL systems is overseen by~~ the NRC or its Agreement States. Remediation of groundwater in the wellfield must be conducted to return the groundwater and other systems to as close to pre-extraction conditions, or EPA drinking water maximum contaminant limit levels where possible or practical. If that is not possible, ~~or to the same class of groundwater use~~ ~~use~~ alternate concentration limits (ACL's) in terms of the presence of metals, organics, pH level, and radioactivity, may be approved by the NRC or its Agreement States, with EPA concurrence. ~~as possible~~. ~~This is in accordance with EPA underground injection control or its authorized state's regulations, and with NRC regulatory requirements. Groundwater outside of the well field or EPA exempted aquifers must be protected to standards developed by EPA.~~ In addition to those requirements, ISL operators also must comply with EPA Underground Injection Control regulations.

Chapter 1

Page 1-4, Paragraph 4

As a result of the review comments, significant new information was added to the report on uranium geochemistry and radionuclide environmental transport, as well as on uranium mine, ISL, and mill tailings reclamation methods and requirements. Waste and mining terminology was made more consistent across the report, more definitions of geological, mining, and radiological terms were provided and also included as a glossary in Appendix I, the report tone was changed, and several new references and figures were added. New text was added to this chapter (see above) to clarify the reasons information is included in this report on ISL and milling operations, even though they are for the most part overseen by agencies other than EPA. Responding to reviewers' comments,

Chapter 2

Page 2-9, Paragraph 1

In Situ Leaching (Solution Mining)

Since this is also an extraction process, ISL is regulated by the NRC or its Agreement States; the waste materials and fluids are considered byproduct material (see Appendix VI). However, EPA standards and requirements for uranium extraction facilities developed under UMTRCA, as well as requirements of ~~and ISL operation wells are subject to permitting under~~ EPA's Underground Injection Control (UIC) program are applicable to ISL facilities (See Appendix VI for more information) . ISL operations are discussed here to provide a more complete representation of the impacts from uranium production.

Page 2-10, Paragraph 2

When the ISL process is completed, the ore body and aquifer are placed in a restoration phase, as required by mine permits, NRC and Agreement State regulatory programs. Typically, the aquifer must be restored

to background or EPA drinking water maximum contaminant limit levels where possible or practical, or to ~~its prior classification for water use~~ alternate concentration limits (ACL's) in terms of the presence of metals, organics, pH level, and radioactivity, approved by the NRC and its Agreement States, with EPA concurrence. Therefore, in some cases, restoring it to the preoperation level does not necessarily make it potable. EPA groundwater protection standards issued under authority of UMTRCA are required to be followed by ISL licensees of the NRC and its Agreement States. In addition to those requirements, ISL operators must apply for UIC permits from EPA. Through the UIC aquifer exemption process, EPA and its Delegated States determine if an aquifer or part of an aquifer is exempt from protection as an underground source of drinking water during the mining process ~~because it is currently unusable as a source of drinking water and will not serve as a source of drinking water in the future~~. Approval of this exemption is necessary before a UIC permit may be issued for ISL mineral extraction wells~~. The aquifer exemption is permanent, and so for some operations in some states, there is no requirement for restoration of an aquifer, or part of an aquifer depending on the UIC permit, once it is exempted~~. EPA requires, however, that non-exempted groundwater sources be protected from contamination.

Chapter 3

Page 3-22, Paragraph 4

Not every ISL operation generates large quantities of these wastes, as the quantities are determined by the ore body's geochemical characteristics and its interactions with the leachate solutions. Data collected by EPA in 2000, from reports on files at the NRC and the state agencies in Texas and Wyoming, showed radium-226 in the wastewater can range from background levels to 2,119 pCi/L (78.4 Bq/L), whereas total uranium may be as high as 1,100 mg/L (see Appendix V). NRC and state licensing and permits at uranium solution mining operations sites require cleanup of all surface wastes. Aquifer restoration may or may not be required by the regulating agencies depending upon its ~~previous class of use~~ geologic and hydrologic conditions. Discussion of regulation of ISL facilities can be found in Appendix VI.

Page 3-23, Paragraph 1

Radon (Rn-222) is a key health concern associated with uranium mines and sites where TENORM is found. Radon is part of the uranium decay series, and has the property of being a gas, which means its mobility rate is vastly different from that of radioactive metals. Radon is a decay product of radium-226. When radium is high, radon production is high. The occurrence of radon in underground uranium mines and the occurrence of cancers in Czechoslovakian miners working in such mines formed the basis of one of a number of studies which have established an important epidemiological relationship used for modeling cancer risk from radiation exposures. EPA limits emissions of radon from operating underground uranium mines such that exposures to a member of the public is limited to no more than 10 millirems annually, and the operator must provide a report of their compliance to that requirement to EPA yearly.

Page 3-31, Paragraph 2

Radium-226, thorium-230, and radon-222 (gas), and their decay products are the radionuclides present in uranium mill tailings that are of principal concern to human health and the environment. Under UMTRCA, EPA has the responsibility to establish standards for exposure of the public to radioactive materials originating from mill tailings and for cleanup and control standards for inactive uranium tailings sites and associated vicinity areas. EPA's regulations in 40 CFR 192 apply to remediation of such properties and address emissions of radon, as well as radionuclides, metals, and other contaminants into

surface and groundwater. Under provisions of the Clean Air Act, operators of uranium mills must comply with EPA's radon emission requirements in 40 CFR 61, Part W, including providing an annual report to the Agency on their adherence to the regulations. The NRC or its Agreement States license uranium mills. Under statutory requirements of the AEA and UMTRCA, NRC has issued regulations in 10 CFR Part 51 to provide for environmental protection for domestic licensing and related regulatory functions, while those in 10 CFR art 20 cover radiation protection from hazards of mills and their wastes, and 10 CFR Part 40 cover uranium source licensing provisions. NUREG 1620 (U.S. NRC 2004) provides guidance for the approval of reclamation plans of active uranium mills (reclamation of uranium mill tailings impoundments is covered in Chapter 4 of this report).

Chapter 4

Page 4-12, Paragraph 3

Early experiments in production of underground uranium using the ISL method utilized a variety of different liquids to examine their efficiencies and costs. Used only as a test, it was determined that acidic solution lixiviants (sulfuric acid, nitric acid, and ammonium bicarbonate) destroyed the ore bearing material and mobilized many other unwanted materials. Additionally, the restoration activities were found to be cost prohibitive when attempting to return the aquifer to pre-extraction conditions ~~or previous class of use~~. Consequently, the industry has moved toward using ISL oxygen, carbon dioxide, or sodium bicarbonate solutions, which have become the predominant form of uranium production in the United States, primarily because of their typically low production costs and expected environmental impacts.

Appendix VI

Page AVI-1

USC 7401 et seq.) (1970). Regulations promulgated by the Agency which control radioactive facilities and sites include 40 CFR 61:

- Subpart B, Underground Uranium Mines
- Subpart H, Department of Energy Facilities
- Subpart I, Certain non-DOE Facilities
- Subpart K, Elemental Phosphorous Plants
- Subpart R, Radon from Phosphogypsum Stacks
- Subpart W, Operating Uranium Mill Tailings

Under Subpart B, emissions of radon-222 to the ambient air from an underground uranium mine may not exceed amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/y. Operators must provide a report to EPA annually on their compliance with the standard.

Under Subpart W, operating uranium mills must comply with the radon emission requirements of 20 pCi/(m2-sec) (1.9 pCi/(ft2-sec)) of radon-222, and other provisions under EPA's UMTRCA requirements in 40 CFR 192.32(a). Operators must provide a report to EPA annually on their compliance with the standard.

Page AVI-4, Paragraph 1

Under the regulations, EPA may permit injection wells for uranium ISL operations. EPA's regulations issued under UMTRCA authority provide the principal standards for uranium ISL operations and groundwater protection, while the UIC regulations are considered additional requirements for ISL operations. ~~in doing so~~, Under UIC permits the Agency usually exempts that portion of an aquifer constituting the well field from meeting drinking water standards. However, under EPA standards established under UMTRCA authority, the operator of the ISL restores the well field to either background ~~or class of use conditions,~~ or EPA drinking water maximum contaminant limit levels where possible or practical. When this cannot be accomplished, ~~or to its prior classification for water use~~ alternate concentration limits (ACL's) in terms of the presence of metals, organics, pH level, and radioactivity, may be approved by the NRC or its Agreement States, with EPA concurrence. ~~depending upon the permit, and requirements of EPA or the delegated state, in order to protect the non-exempt portion of the aquifer from contamination. Discussions have been undertaken between the NRC, EPA, and certain uranium producing states, to examine the possibility that an EPA SDWA delegated state could enforce both provisions of EPA's and the NRC's programs (under the AEA) as they relate to regulation of ISL UIC wells.~~

Page AVI-5, Paragraphs 1 and 2

Uranium Mill Tailings Radiation Control Act (UMTRCA)

EPA does not license ~~or regulate~~ uranium mills or ISL facilities. However, it does establish certain environmental standards which must be adopted by the NRC and its Agreement States, and DOE for uranium processing facilities. Current regulations applicable to remediation of both inactive uranium mill tailings and uranium extraction facilities, including vicinity properties and ISL operations, and active uranium and thorium mills, and ISL operations have been issued by the EPA under the Uranium Mill Tailings Radiation Control Act (UMTRCA) (42 USC 2022 et seq.) of 1978, as amended. EPA's regulations in 40 CFR 192 apply to remediation of such properties and address emissions of radon, as well as radionuclides, metals, and other contaminants into surface and groundwater.

Under UMTRCA, EPA has the responsibility to establish standards for exposure of the public to radioactive materials originating from mill tailings, and for cleanup and control standards for inactive uranium processing sites and associated vicinity areas, as well as for active uranium extraction facilities licensed by the NRC or its Agreement States. To the maximum extent possible, those standards were required to reflect the requirements issued by EPA under the Solid Waste Disposal Act (now RCRA), and do so by referencing 40 CFR Part 261 regulations.

Tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content is defined by Section 11e.(2) of the Atomic Energy Act as byproduct material. That material is not considered to be TENORM in the U.S., and is regulated by the NRC or its Agreement States. Under UMTRCA, the NRC must utilize EPA environmental protection standards to develop its regulations for ~~Although the NRC has promulgated radiation protection standards that regulate~~ active and inactive uranium milling and extraction facilities. ~~sites~~, The NRC does not have regulatory authority over conventional type uranium mine wastes (see NRC discussion below).