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40 CFR Part 192
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 192

[EPA–HQ–OAR–2012–0788; FRL–9909–20–OAR]

RIN 2060–AP43

Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule.

SUMMARY: The Environmental Protection Agency (EPA) is proposing to add new health and environmental protection standards to regulations promulgated under the Uranium Mill Tailings Radiation Control Act of 1978 (''UMTRCA'' or ''the Act''). The proposed standards will regulate byproduct materials produced by uranium in-situ recovery (ISR), including both surface and subsurface standards, with a primary focus on groundwater protection, restoration and stability. ISR has a greater potential to directly affect groundwater than does conventional milling. Therefore, by explicitly addressing the most significant hazards represented by ISR activities, these proposed standards are intended to address the shift toward ISR as the dominant form of uranium recovery that has occurred since the standards for uranium and thorium mill tailings were initially promulgated in 1983. The general standards proposed today, when final, will be implemented by the Nuclear Regulatory Commission (NRC). This action also proposes to amend specific provisions in the current Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings rule to address a ruling of the Tenth Circuit Court of Appeals, to update a cross-reference to another environmental standard and to correct certain technical and typographical errors that have been identified since the 1983 promulgation.

DATES: Comments must be received on or before April 27, 2015.

ADDRESSES: Submit your comments, identified by Docket ID No. EPA–HQ–OAR–2012–0788, by one of the following methods:

- *www.regulations.gov:* Follow the on-line instructions for submitting comments.
- *Email: a-and-r-docket@epa.gov.*
- *Fax:* 202–566–9744.
- *Mail:* Air and Radiation Docket, Environmental Protection Agency, Mailcode: 2822T, 1200 Pennsylvania Ave. NW., Washington, DC 20460.
- *Hand Delivery:* EPA West Building, Room 3334, 1301 Constitution Ave. NW., Washington, DC 20004. Such deliveries are only accepted during the Docket's normal hours of operation; special arrangements should be made for deliveries of boxed information.

Instructions: Direct your comments to Docket ID No. EPA–HQ–OAR–2012–0788. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at *www.regulations.gov,* including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through *www.regulations.gov* or email. The *www.regulations.gov* Web site is an ''anonymous access'' system, which means EPA will not know your identity or contact information unless you provide it in the body of your comment. If you send an email comment directly to EPA without going through *www.regulations.gov,* your email address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD–ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses. For additional information about EPA's public docket visit the EPA Docket Center homepage at *http://www.epa.gov/epahome/dockets.htm.*

Docket: All documents in the docket are listed in the *www.regulations.gov* index. Although listed in the index, some information is not publicly available, *e.g.,* CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in *www.regulations.gov* or in hard copy at the Office of Air and Radiation Docket, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave. NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the Air and Radiation Docket is (202) 566–1742.

FOR FURTHER INFORMATION CONTACT: Ingrid Rosencrantz, Office of Radiation and Indoor Air, Radiation Protection Division, Mailcode 6608T, U.S. Environmental Protection Agency, 1200 Pennsylvania Ave. NW., Washington, DC 20460; telephone number: 202–343–9286; fax number: 202–343–2304; email address: *Rosencrantz.ingrid@epa.gov.*

Executive Summary: The Environmental Protection Agency (EPA) is proposing to add new health and environmental protection standards to regulations promulgated under the Uranium Mill Tailings Radiation Control Act of 1978 (''UMTRCA'' or ''the Act''). The proposed standards will regulate byproduct materials produced by uranium in-situ recovery (ISR), including both surface and subsurface standards, with a primary focus on groundwater protection, restoration and stability. ISR has a greater potential to directly affect groundwater than does conventional milling. Therefore, by explicitly addressing the most significant hazards represented by ISR activities, these proposed standards are intended to address the shift toward ISR as the dominant form of uranium recovery that has occurred since the standards for uranium and thorium mill tailings were initially promulgated in 1983. The legal authority for this action is in Section 275 of the Atomic Energy Act (AEA) of 1954, as amended by Section 206 of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978. Health and environmental protection standards established by EPA under UMTRCA are implemented by NRC. See 42 U.S.C. 2022(b) and (d).

This action also proposes to amend specific provisions in the current Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings rule to address a ruling of the Tenth Circuit Court of Appeals, to update a cross-reference to another environmental standard, and to correct certain technical and typographical errors that have been identified since the 1983 promulgation.

The major provisions of today's proposal include the following:

- We are proposing to add an additional subpart within 40 CFR part 192 to explicitly address groundwater protection at uranium ISR operations. A new subpart F is being proposed that would set standards that would apply to uranium ISR facilities only. The overall purpose of this subpart is to address the most significant hazards represented by

ISR activities. This subpart adds the following:

1. A section on applicability—§ 192.50 Applicability—that specifies the subpart will apply to the management of uranium byproduct materials during and following the processing of uranium ores using ISR methods.

2. A section containing definitions—§ 192.51 Definitions and cross-references.

3. A section—§ 192.52 Standards—in which EPA proposes to specify the minimum 13 constituents for which groundwater protection standards must be met. The list includes the following: Arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, nitrate (as N), molybdenum, combined radium-226 and radium-228, uranium (total), and gross alpha-particle activity (excluding radon and uranium).

4. A section discussing monitoring requirements—§ 192.53 Monitoring programs—that details the specific requirements of monitoring programs to be conducted during the preoperational, operational, restoration, stability and long-term stability phases.

5. A section establishing requirements for corrective actions—§ 192.54 Corrective action program.

6. A section detailing the effective date of the new subpart—§ 192.55—Effective date.

• As noted above, we are also proposing to amend certain provisions within the existing 40 CFR part 192 to address a ruling of the Tenth Circuit Court of Appeals, delete reference to an outdated standard and correct minor technical and typographical errors.

The costs and benefits of this rulemaking are described briefly in the tables presented below. Costs quantified in Table 2 address costs of the rule that reflect appropriate characterization of the background data, and then ensuring that: (1) The post-operational groundwater is restored to that of the initial groundwater conditions and (2) the post-restoration groundwater conditions will remain stable.

The proposed rule requires affected facilities to monitor groundwater for a longer period of time compared to current practice (estimated to be 9.5 additional years if geochemical modeling indicates that conditions will remain stable, and estimated 32.5 additional years if long-term stability monitoring continues for 30 years. The major costs associated with the proposed rule are the costs of these monitoring activities. National total annualized incremental costs of the proposed rule, based on likely implementation represented by the average cost of 30-year long-term stability monitoring with geochemical modeling to shorten the duration, is $13.5 million (in 2011 dollars), as shown in Table 2 below. EPA also examined potential impacts on small businesses that own and operate ISR operations. Using existing owner companies as examples of the firms that may own ISR operations subject to the proposed rule, EPA found that the estimated costs of complying with the proposed rule are 0.6% to 1.7% of estimated 2015 revenues for three small firms that own ISR operations. Because costs do not exceed 2% of estimated sales, and because EPA projects that fewer than 10 small businesses will be affected by the rule at any given time, EPA concluded that the proposed rule would not result in significant impacts for a substantial number of small entities. For information on how EPA estimated these costs, see Section 3 and Appendix D of the Economic Analysis.

EPA conducted a qualitative assessment of the benefits of the proposed rule. EPA recognizes that groundwater is a valuable resource, and is becoming more valuable as groundwater use increases. While the aquifers in the vicinity of ISR operations are currently providing little extractive value (because of their locations and, for some areas, the fact that groundwater quality is low), in future years these resources may have increased value. A recent analysis (Poe et al, 2001) estimated the value to today's households of protecting groundwater for future use ranged from $531 to $736 per household. For this reason, EPA believes it is necessary to take a longer view of groundwater protection than taken in the past. Currently, monitoring groundwater conditions after restoration is typically conducted for a short period of time (EPA assumes 6 months for cost estimate purposes), which may not be long enough to detect instability in groundwater conditions. EPA's proposed rule requires a 30 year long-term stability monitoring period, which may be shortened if geochemical modeling demonstrates that conditions in the restored wellfield will remain stable over time.

The proposed rule will reduce the risk of undetected excursions of pollutants into adjacent aquifers. This in turn will reduce the human health risks that could result from exposures to radionuclides in well water used for drinking or agriculture in areas located down-gradient from an ISR. Because radionuclides are human carcinogens, the main health risk averted would be cancer. There is a benefit (estimated to be at least $8 million per premature death avoided) of reducing cancer deaths, but because we were unable to estimate how many cancer deaths would be averted, or when they would occur, EPA is unable to quantify this benefit.

In addition to avoiding human health impacts, the proposed rule has the potential to detect excursions sooner and thus enable a faster remedial response. Because plumes detected during long-term stability monitoring would be smaller, costs of remediation would be potentially much lower. For a model mine unit, EPA estimated the averted remediation costs to range from $8.8 million to more than $500 million. EPA is unable to extrapolate this estimate to a national value, because we do not have a basis for estimating which, if any, wellfields would experience an undetected contaminant plume in the absence of the proposed rule.

TABLE 1—CHARACTERIZATION OF THE COSTS AND BENEFITS OF 40 CFR PART 192, SUBPART F

Costs	Benefits
Annualized monitoring costs ranging from $12.5 to $14.1 million.	Protection of groundwater quality.
Maintenance of financial assurance for up to 30 additional years per facility.	Possible protection of surface water quality.
	Potentially reduced risk of exposure of human or ecological receptors to radiological pollutants.
	Potentially reduced human health impacts, including cancer.
	Reduced remediation cost savings ($8.8 million to $560 million for CMU).

TABLE 2—SUMMARY OF THE COSTS AND BENEFITS OF 40 CFR PART 192, SUBPART F WITH OPTIONS

[millions of 2011 dollars]

Requirement	Capital cost	Annual cost	Net benefit
30 years with geochemical modeling	[a] $25.2	$13.5	Not Quantified.
30 Years, no shortening	19.3	15.1	

[a] Capital costs are higher for the geochemical modeling option because more wells would be required.

SUPPLEMENTARY INFORMATION:

Outline. The information in this preamble is organized as follows:

I. General Information

A. Does this action apply to me?

The regulated categories and entities potentially affected by the proposed standards include:

Category	NAICS code [1]	Examples of regulated entities
Industry:		
Uranium Ores Mining and/or Beneficiating.	212291	Facilities that extract or concentrate uranium from any ore processed primarily for its source material content.
Leaching of Uranium, Radium or Vanadium Ores.	212291	Facilities that extract or concentrate uranium from any ore processed primarily for its source material content.

[1] North American Industry Classification System.

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be affected by this proposed action.

B. What should I consider as I prepare my comments to EPA?

1. *Submitting CBI.* Do not submit CBI information to EPA through *www.regulations.gov* or email. Clearly mark the part or all of the information that you claim to be CBI. For CBI information contained on a disk or CD ROM that you mail to EPA, mark the outside of the disk or CD ROM as CBI and then identify electronically within the disk or CD ROM the specific information that is claimed as CBI. In addition to one complete version of the comment that includes information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. Information marked as CBI will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

2. *Tips for preparing your comments.* When submitting comments, remember to:

• Identify the rulemaking by docket number and other identifying information (subject heading, **Federal Register** date and page number).

• Follow directions—The agency may ask you to respond to specific questions or organize comments by referencing a Code of Federal Regulations (CFR) part or section number.

• Explain why you agree or disagree, suggest alternatives, and substitute language for your requested changes.

• Describe any assumptions and provide any technical information and/or data that you used.

• If you estimate potential costs or burdens, explain how you arrived at your estimate in sufficient detail to allow for it to be reproduced.

• Provide specific examples to illustrate your concerns, and suggest alternatives.

• Explain your views as clearly as possible, avoiding the use of profanity or personal threats.

Make sure to submit your comments by the comment period deadline identified.

C. When would a public hearing occur?

If anyone contacts the EPA requesting to speak at a public hearing concerning this proposed rule by February 25, 2015, we will hold a public hearing. If you are interested in attending the public hearing, contact Mr. Anthony Nesky at (202) 343–9597 to verify that a hearing will be held. If a public hearing is held, we will announce the date, time and venue on our Web site at *http://www.epa.gov/radiation/tenorm/40CFR192.html.*

D. What documents are referenced in today's proposal?

We refer to a number of documents that provide supporting information for our uranium and thorium mill tailings standards. All documents relied upon by EPA in regulatory decision making may be found in our docket (EPA–HQ–OAR–2012–0788) accessible via *http://www.regulations.gov/.* Other documents, *e.g.,* statutes, regulations, and proposed rules, are readily available from public sources. The EPA documents listed below are referenced most frequently in today's proposal.

EPA 402/D–14–001 ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery (ISL/ISR) Sites,'' Environmental Protection Agency, 2014.

EPA 402/R–14–003 ''Economic Analysis: Proposed Revisions to the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings Rule (40 CFR part 192),'' Environmental Protection Agency, 2014.

EPA 530/R–09–007 ''Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance,'' Environmental Protection Agency, 2009.

E. Acronyms and Abbreviations

The following acronyms and abbreviations are used in this document:

ACL—alternate concentration limit
AEA—Atomic Energy Act
BID—Background information document
CAA—Clean Air Act
CWA—Clean Water Act
CBI—Confidential Business Information
CFR—Code of Federal Regulations
DOE—U.S. Department of Energy
EIA—economic impact analysis
EO—Executive Order
EPA—U.S. Environmental Protection Agency
FR—Federal Register
ISR—in-situ recovery, also known as in-situ leaching (ISL)
l—liter
MCLs—Maximum Contaminant Levels
mg—milligram
MOU—Memoranda of Understanding
N—nitrate
NRC—U.S. Nuclear Regulatory Commission
NTTAA—National Technology Transfer and Advancement Act
OMB—Office of Management and Budget
RAC—Radiation Advisory Committee
RCRA—Resource Conservation and Recovery Act
RFA—Regulatory Flexibility Act
SAB—Science Advisory Board
SDWA—Safe Drinking Water Act
UIC—underground injection control
U.S.—United States
USD—United States dollar
UMRA—Unfunded Mandates Reform Act of 1995
UMTRCA—Uranium Mill Tailings Radiation Control Act of 1978
U.S.C.—United States Code
USDW—underground source of drinking water
WL—Working Level

F. Definitions

The following terms are used in this document:

Terminology	Definition
Adjacent Aquifer	An aquifer or portion of an aquifer that shares a border or end point with the exempted aquifer or the exempted portion of an aquifer.
Alternate Concentration Limit (ACL).	Concentration limit approved by the regulatory agency for a groundwater constituent that has not been restored to its restoration goal after best practicable restoration activities have been completed following the process prescribed in 40 CFR 192.52(c)(2) thru 192.52(c)(5).
Aquifer	A geological ''formation,'' group of formations, or part of a formation that is capable of yielding a significant amount of water to a well or spring. See 40 CFR 144.3.
Aquitard	A confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer.
Background	The condition of groundwater, including the radiological and non-radiological constituent concentrations, in the exempted aquifer, adjacent aquifers, and in both overlying and underlying aquifers, prior to the beginning of ISR operations. The background groundwater constituent concentrations in the production zone prior to the beginning of ISR operations is commonly referred to by the industry and regulatory bodies as the ''baseline.''
Beneficiation	The initial attempt at liberating and concentrating a valuable mineral from extracted ore. This is typically performed by employing various crushing, grinding, and froth flotation techniques.
Byproduct Material	See ''Uranium Byproduct Material.''
Constituent	A detectable component within the groundwater.
Exceedance	An exceedance has occurred when, during stability or long-term stability monitoring, a groundwater protection standard is exceeded at any point of compliance well.

Terminology	Definition
Excursion	The movement of fluids containing uranium byproduct material from an ISR production zone into surrounding groundwater. An excursion is considered to have occurred when, during operational or restoration phase monitoring, any two indicator parameters (*e.g.,* chloride, conductivity, total alkalinity) exceed their respective upper control limits in any overlying, underlying, or perimeter monitoring well. Horizontal excursions refer to the lateral movement of the water, while vertical excursions indicate movement of water through aquitards above or below the production zone aquifer.
Excursion Monitoring Well	Wells located around the perimeter of the production zone (horizontal excursion wells) and in overlying and underlying aquifers (vertical excursion wells), which are used to detect any excursions from the production zone. Excursion monitoring wells can serve as the ''point(s) of compliance'' during all phases of ISR.
Exempted Aquifer	An ''aquifer,'' or its portion, that meets the criteria in the definition of ''underground source of drinking water'' in 40 CFR 144.3, but which has been exempted according to the procedures in 40 CFR 144.7. See 40 CFR 144.3.
Extraction Well	Well used to extract uranium enriched solutions from the ore-bearing aquifer; also known as a ''Production Well.'' Extraction and injection wells may be converted from one use to the other.
Facility	See ''Uranium Recovery Facility.''
Groundwater	Water below the land surface in a zone of saturation. See 40 CFR 144.3.
Indicator Parameter	A constituent, such as chloride, conductivity, or total alkalinity, whose ''upper control limit'' is used to identify an excursion. Indicator parameters are not contaminants, but relate to geochemical conditions in groundwater.
Injection Well	A well into which fluids are being injected. See 40 CFR 144.3.
In-Situ Recovery (ISR)	A method of extraction by which uranium is leached from underground ore bodies by the introduction of a solvent solution, called a lixiviant, through injection wells drilled into the ore body. The process does not require the extraction of ore from the ground. The lixiviant is injected, passes through the ore body, mobilizes the uranium, and the uranium-bearing solution is pumped to the surface from extraction wells. The pregnant leach solution is processed to extract the uranium.
Ion Exchange	The process in which ions are exchanged between a solution and an insoluble solid.
Listed Constituent	One of the thirteen groundwater constituents specified in Table 1 to subpart F of part 192.
Lixiviant	A liquid medium used to recover uranium from underground ore bodies through in-situ recovery. This liquid medium typically contains native groundwater and an added oxidant, such as oxygen and/or hydrogen peroxide, as well as sodium carbonate/bicarbonate or carbon dioxide. The lixiviant is introduced through injection wells into the ore body to mobilize the uranium. The resulting solution is then pumped via extraction wells to the surface, where the uranium is recovered from the solution for further processing, after which the lixiviant may be re-injected.
Long-Term Stability Phase	The period after the groundwater protection standards have been met, as determined by the regulatory agency.
Maximum Constituent Concentration.	The maximum permissible level of a constituent in groundwater, as specified in Table 1 to subpart A of part 192.
Maximum Contaminant Level (MCL).	The maximum permissible level of a contaminant in water which is delivered to any user of a public water system. See 40 CFR 141.2.
Mobilization	Increasing the migration of constituents in groundwater by various chemical treatments.
Monitoring Wells	Wells used to obtain groundwater levels and water samples for the purpose of determining the hydrologic regime and the amounts, types, and distribution of constituents in the groundwater. Wells are located in the production zone, around the perimeter of the production zone (horizontal excursion monitoring wells), and in overlying and underlying aquifers (vertical excursion monitoring wells).
Operational Phase	The time period during which uranium extraction by in-situ recovery occurs. Operations begin when injection of lixiviant starts; operations end when the operator permanently ceases injection of lixiviant and recovery of uranium-bearing solution.
Ore	The naturally occurring material from which a mineral or minerals of value (*e.g.,* uranium) can be extracted.
Overlying Aquifer	An aquifer that is immediately vertically shallower than (*i.e.,* directly above) the production zone aquifer.
Point(s) of Compliance	Site-specific location(s) where groundwater protection standards must be met. During all phases of ISR, excursion monitoring wells can serve as the points of compliance; during the restoration, stability and long-term stability phases, points of compliance may also include monitoring, injection and extraction wells in the production zone, as determined by the regulatory agency.
Point(s) of Exposure	Intersection of a vertical plane with the boundary of the exempted aquifer.
Precipitate	To separate a substance (such as uranium) out of a solution as a solid.
Preoperational Monitoring	Measurement of groundwater conditions in the production zone, and in the groundwater up and down gradient from the production zone, as well as in overlying and underlying aquifers, prior to the operational phase.
Production Zone	The portion of the aquifer in which ISR activities occur. The production zone lies within the wellfield.
Regulatory Agency	The Nuclear Regulatory Commission (NRC) or an Agreement State.
Restoration (Act of)	The process of returning groundwater quality to preoperational conditions for the purpose of achieving restoration goal values for identified constituents.
Restoration Goal	A concentration limit for an identified constituent in groundwater after restoration has occurred. The limit is obtained from the most protective regulatory standards in 40 CFR 141.62, 141.66, 141.80, 143.3, 264.94, and Table 1 to subpart A of this part, and from preoperational background levels in the wellfield, whichever is higher.
Restoration Phase	The period immediately after lixiviant injection permanently ceases, during which restoration activities occur.
Site	The land or water area where any facility or activity is physically located or conducted, including adjacent land used in connection with the facility or activity. See 40 CFR 144.3.
Stability Phase	The period after the restoration phase when groundwater protection standards are met and monitored to test for temporal stability.
Solubilize	To make a substance (such as uranium) soluble or more soluble.
Underground Source of Drinking Water (USDW).	An aquifer or its portion: (a)(1) Which supplies any public water system; or (2) Which contains a sufficient quantity of groundwater to supply a public water system; and (i) Currently supplies drinking water for human consumption; or (ii) Contains fewer than 10,000 mg/l total dissolved solids; and (b) Which is not an exempted aquifer. See 40 CFR 144.3.
Underlying Aquifer	An aquifer that is immediately vertically deeper (*i.e.,* directly below) than the production zone aquifer.

Terminology	Definition
Upper Control Limit (UCL) ...	Preoperational concentrations of indicator parameters in horizontal and vertical excursion monitoring wells, as determined by the regulatory agency and contained in the license.
Uranium Byproduct Material	Waste produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium ISR operations and which remain underground do not constitute "uranium byproduct material."
Uranium Recovery Facility ...	A facility licensed to process uranium ores for the purpose of recovering uranium and to manage uranium byproduct materials that result from processing of ores. Common names for these facilities include, but are not limited to, the following: a conventional uranium mill, an in-situ recovery (or leach) facility, and a heap leach facility or pile.
Wellfield	The area of an ISR operation that encompasses the array of injection, extraction, and monitoring wells and interconnected piping employed in the uranium in-situ recovery process. The area of the wellfield exceeds that of the production zone.

II. Background Information

A. What is the scope of this action?

In 1983, EPA originally promulgated regulations at 40 CFR part 192, Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, in response to the statutory requirements of the Atomic Energy Act of 1954, as amended by the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). These standards have been amended several times, most recently in 1995, with the addition of standards to correct and prevent contamination of groundwater beneath and in the vicinity of inactive uranium processing sites.[1 2] Pursuant to UMTRCA, our standards have been implemented by the Department of Energy (DOE) at inactive uranium milling sites and nearby contaminated "vicinity properties" managing residual radioactive material and by the Nuclear Regulatory Commission (NRC) or NRC Agreement States at active sites managing byproduct material.[3 4]

Today's proposal is limited to the following changes. We are proposing to add an additional subpart within 40 CFR part 192 to explicitly address groundwater protection at uranium ISR operations. We are also proposing to amend certain provisions within the existing 40 CFR part 192 to address a ruling of the Tenth Circuit Court of Appeals, delete reference to an outdated standard and correct minor technical and typographical errors. We request public comment only on these proposed standards and amendments. We are not requesting, and will not respond to, public comments on any other 40 CFR part 192 provisions since they are beyond the scope of today's proposal.

B. Uranium Extraction

The major deposits of uranium ores in the United States are located in the Colorado Plateau, the Wyoming Basin, the Texas Coastal Plain, and Nebraska. Recovery and processing of these ores have historically occurred by one of three methods: (1) Conventional mining and milling operations; (2) heap leach operations; and (3) in-situ (*i.e.,* in place) recovery. Below we present a brief explanation of these uranium recovery methods.

1. Conventional Mining and Milling

Conventional mining and milling is one of the primary recovery methods currently used to extract uranium from uranium-bearing ore in much of the world and was formerly the predominant means of obtaining uranium in the United States. "Remoteness from populated areas" and "isolation of contaminants from groundwater" are key considerations in selecting mill locations under current siting criteria found in NRC regulations.[5] Only one conventional mill in the United States is currently operating; all others are in standby status, in decommissioning (closure) or have already been decommissioned.

Conventional uranium mines are either open-pit operations, where large volumes of uranium bearing material are excavated, or underground mines, where the uranium-bearing ore is extracted via mined openings into the subsurface. The extracted ore is then moved to the milling operation where the uranium is extracted by chemical treatments of the ore. The ores are crushed mechanically and then leached at the milling site. In most cases, sulfuric acid is the leaching agent, but alkaline solutions can also be used to leach the uranium, generally extracting 90 to 95 percent of the uranium from the crushed ore.

The mill then processes the uranium from the solution by solvent extraction using organic chemicals, or by an ion exchange process using resins designed to extract the uranium from the leaching solutions used to remove uranium from the crushed ore, then further extracts, precipitates, and finally dries the recovered uranium to produce a uranium oxide material, called "yellowcake" because of its yellowish color.[6] Finally, the yellowcake is packaged in special 55-gallon drums and transported to uranium conversion, enrichment and fuel fabrication facilities to produce fuel for use in nuclear power and research reactors. The recovery process produces both solid and liquid wastes (*i.e.,* uranium byproduct material, or "tailings"), which are transported from the extraction location to an on-site uranium byproduct material impoundment or pond.

Uranium byproduct materials/tailings deposited into an impoundment or "mill tailings pile" must be carefully monitored and controlled. This is because the mill tailings contain radioactive or heavy metal constituents, including thorium and radium. The radium decays to produce radon, which may then be released into the environment. Radon is a radioactive gas that may be inhaled into the respiratory tract; EPA has determined that exposure to radon and its daughter products contribute to an increased risk of lung cancer.[7]

[1] See 42 U.S.C. 7911(6) for the definition of a "processing site."

[2] See 60 FR 2854 (January 11, 1995) and 58 FR 60340 (November 15, 1993).

[3] Byproduct material includes the tailings or wastes produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. AEA section 11e.(2), 42 U.S.C. 2014(e)(2).

[4] Under Section 274 of the AEA, the NRC may enter into an agreement with a State for discontinuance of the NRC's regulatory authority and the State's assumption of regulatory authority over specified radioactive materials and activities. The NRC must review and find the State's regulatory program is adequate to protect public health and safety and compatible with the NRC's regulatory program before entering into the Section 274 agreement. The NRC continues oversight responsibilities of the Agreement State's regulatory program through the Integrated Materials Performance Evaluation Program (IMPEP).

[5] See 10 CFR part 40, Appendix A, Criterion 1.

[6] The term "yellowcake" is still commonly used to refer to this material, although in addition to yellow, the uranium oxide material can also be black or grey in color.

[7] *http://www.epa.gov/radon/risk_assessment.html.*

2. Heap Leaching

Another method of uranium extraction that some facilities may use is known as heap leaching. This method has been used in situations where the uranium ore is of low grade or the geology of the ore body is such that conventional mining and milling is not cost effective. Although no such facilities currently operate in the United States, the heap leach process is used for uranium recovery in other parts of the world and has, to a limited extent, been used in the United States in the past. There are plans for at least one new heap leach facility to open in the U.S. within the next few years.

With the heap leach process, small pieces of ore are placed in a large pile, or ''heap,'' on an impervious pad of plastic, clay, concrete, or asphalt, with perforated pipes under the heap. An acidic solution is then applied through drips or sprinklers over the ore to dissolve the uranium it contains. The uranium-rich solution drains into the perforated pipes, where it is collected and transferred to an ion exchange system to recover the uranium from the leaching solution. The heap is ''rested,'' meaning that there is a temporary cessation of application of acidic solution to allow for oxidation of the ore before leaching resumes. The ion exchange system extracts the uranium from the solution, which is processed into yellowcake either at the site or at another uranium recovery facility. The yellowcake is packed in special 55-gallon drums to be transported to uranium conversion, enrichment and fuel fabrication facilities to produce fuel for use in nuclear power and research reactors.

3. In-Situ Recovery (ISR)

In-situ recovery (ISR), also referred to as in-situ leach (ISL) (we will use the term ISR throughout this document), is now the dominant method of uranium recovery in the United States and much of the world. ISR research and development projects and associated pilot projects began in the 1960s in Wyoming with limited field applications. From the mid-1960s to the mid-1970s, interest in ISR methods increased, particularly in Texas and Wyoming, with 18 commercial and 9 pilot-scale operations in place by 1980. During the 1980s, production of uranium by ISR was limited, but by the mid-1990s, uranium production by ISR reached 90 percent of United States production. Commercial and pilot operations demonstrated ISR as a viable uranium recovery technique where site conditions (*e.g.,* geology and hydrology) are amenable to its use. This technology can produce a better return on investment than conventional mining and milling since it does not involve excavation of large volumes of ore or disposal of large volumes of byproduct material. Therefore, the cost to produce uranium is generally lower. The trend in uranium production has shifted toward the ISR process. In 2013, in the United States, there were six operating ISR facilities and 12 facilities proposed for licensing, licensed but not operating, or undergoing restoration.

In-situ recovery is defined as the underground recovery by oxidation/solubilization of uranium from the ore body (host rock—typically sandstone) into the groundwater by using native groundwater into which oxidizing and complexing chemicals have been added. This solution is known as lixiviant. Lixiviant is pumped into the ore zone through a set of injection wells and removed through extraction wells, followed by recovery of uranium at the surface by processing of the extracted waters.

The ore bodies most amenable to ISR are known as ''roll front'' deposits, which are formed when uranium in the oxidized groundwater encounters an area of the host formation where chemically reducing conditions exist. These reducing conditions are strong enough to chemically reduce and precipitate the uranium into a less soluble form, thus forming the ore zone. As new oxidized uranium enters the front, it continues to be chemically reduced, precipitate and deposit in successive ''rolls''. The injection of a lixiviant essentially reverses the geochemical reactions that originally formed the uranium deposit. The oxidizing agents in the lixiviant create an oxidizing environment that solubilizes the uranium from the formation and allows it to enter into the groundwater. Other components of the lixiviant (usually bicarbonate ions) act to enhance the solubility of the oxidized uranium in the groundwater. The uranium, along with other constituents present in the formation that have been mobilized (*e.g.,* metals such as molybdenum, selenium, and arsenic), are then collected from the ore zone by extraction wells that pump the solution to the surface. At the surface, the uranium is collected by a system of piping that feeds to a processing facility, where the uranium is recovered in ion exchange columns and either further processed on-site into yellowcake, or transported to another facility for processing into yellowcake. After processing, the extracted and processed waters are recharged with the lixiviant chemicals and pumped back down into the ore zone for reuse in extracting more uranium. The yellowcake is subsequently transported to uranium conversion, enrichment, and fuel fabrication facilities to produce fuel for use in nuclear power and research reactors.

Two general types of lixiviant solutions can be used, loosely defined as ''acidic'' or ''alkaline'' systems. Acidic lixiviants were used early in the development of ISR in the United States, but site-specific conditions at the sites showed that acidic lixiviants were generally unsuitable.[8] [9] In the United States, the geology and geochemistry of the majority of the uranium ore bodies favors the use of alkaline lixiviants such as bicarbonate/carbonate and oxygen. Other factors in the choice of the lixiviant are the uranium recovery efficiencies, operating costs, and the ability to achieve satisfactory groundwater restoration after production ceases.

In order to control and contain the flow of groundwater within the production zone, an inward hydraulic gradient is established using the injection and extraction (also known as production) wells.[10] To create and maintain this gradient, more water is removed from the production zone than is injected (commonly referred to by industry as the ''bleed rate''). The extracted liquid (groundwater mixed with lixiviant) goes through the recovery process to extract uranium. The processed water may be either recharged with lixiviant and re-injected to continue the recovery process or used to flush out the remaining lixiviant and mobilized uranium during the restoration process. Any waste water not reused may be injected into a deep well for disposal or be sent to an impoundment on site (often called an evaporation pond or a holding pond). The waste water generated during and after operations at an ISR facility, as well as all evaporation pond sludges derived from such waste waters, have been determined to be uranium byproduct material by the NRC, bringing

[8] Acidic lixiviants react with carbonates (calcite and dolomite) contained in the host rock and precipitate calcium sulfate. The calcium sulfate clogs the well screens and process lines, significantly decreasing the efficiency of the leaching process.

[9] Mudd, G.M. (2001). ''Critical review of acid in situ leach uranium mining: 1. USA and Australia,'' Environmental Geology, 41:390–403.

[10] The gradient controls the direction of flow of water within a water-bearing formation. Used here, the purpose of a gradient is to contain water within the production zone so that it does not migrate beyond the wellfield.

them under the jurisdiction of UMTRCA.[11]

The wellfield of an ISR operation is configured to efficiently exploit the underlying uranium ore zone based on the subsurface data collected prior to construction of the wellfield. The wellfield typically includes a series of closely spaced arrays of injection wells (each array typically has 4 to 6 injection wells spaced on the order of many tens to, at most, a few hundred feet apart) with an extraction well in the center of each array.[12] Each of these arrays is intended to work as a unit to control the flow of groundwater bearing the lixiviant so that the injected solution is captured by the extraction wells. The spacing of the injection and extraction wells is determined by the hydrologic properties of the ore zone, as evidenced by hydrologic testing during the exploration of the site, wellfield construction and monitoring well construction and operation.

During operations there is a risk of the lixiviant and/or mobilized constituents spreading beyond the capture zone of the wellfield. This poses a risk of groundwater contamination off site and in some cases surface water contamination where groundwater discharges to surface water. Monitoring wells are positioned around the production zone to detect increases in indicator parameters that would signal an excursion of the lixiviant or mobilized constituents from an ISR wellfield into surrounding groundwater. The operator of the ISR facility typically remediates any detected excursions by taking corrective actions such as ceasing injection and pumping water out of wells near the excursion. The detection and remediation of excursions is a major regulatory operational concern and needs to be carefully monitored by the operators and the regulatory agencies.

After the ore body has been depleted to uranium levels that are no longer economically valuable, the operator will cease injecting lixiviant and begin restoration of the ore zone aquifer within the wellfield(s) to return conditions to their preoperational state to the extent practicable. Extracted water, typically treated through reverse osmosis and often in combination with added reducing agents, is injected into the ore zone to flush out the remaining lixiviant and to attempt to restore the geochemistry of the ore zone to its original background (baseline) condition. Other procedures also may be used to bring about chemically reducing conditions in an attempt to immobilize the uranium (along with any other mobilized metals) remaining within the ore zone.

Once the groundwater at the site has gone through restoration and sufficient time has passed such that the licensees can demonstrate that chemical conditions are stable, the injection and extraction wells are properly plugged and abandoned,[13] the wellfield infrastructure (pipes, header houses, etc.) is removed, and surface operations equipment (impoundment liners, buildings, etc.) is dismantled and shipped offsite for appropriate reuse or disposal. The site is officially decommissioned when the radioactive materials license is terminated by the regulatory agency (*i.e.,* NRC or NRC Agreement State). Because no long-term disposal facilities remain at decommissioned ISR sites, there is no perpetual care and monitoring as occurs with conventional mill tailings sites.

C. What is the statutory authority for the proposed amendments?

EPA is proposing these new standards and amendments under its authority in Section 275 of the Atomic Energy Act (AEA) of 1954, as amended by Section 206 of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978.[14]

Section 206 of UMTRCA authorizes EPA to promulgate general standards for the protection of public health, safety, and the environment from radiological and non-radiological hazards associated with (a) residual radioactive materials located at specifically listed inactive uranium milling sites, nearby contaminated ''vicinity properties,'' and depository sites for such materials selected by the Secretary of Energy (commonly referred to as Title I sites); and (b) the processing and the possession, transfer, and disposal of byproduct material at sites at which ores are processed primarily for their uranium and thorium source material content[15] or which are used for the disposal of such byproduct material (commonly known as Title II sites). See 42 U.S.C. 2022.[16] These health, safety and environmental standards are contained in 40 CFR part 192 and are implemented by the NRC and its Agreement States, and the DOE.

Title I of UMTRCA covers inactive uranium milling sites, nearby contaminated ''vicinity properties,'' and depository sites. EPA was directed to set general standards that were consistent with the requirements of the Solid Waste Disposal Act (later amended as the Resource Conservation and Recovery Act, or RCRA) to the maximum extent practicable.

Title II of the Act covers operating uranium processing or disposal sites licensed by the NRC or Agreement States. EPA was directed to promulgate generally applicable standards to protect public health, safety, and the environment from hazards associated with processing, possession, transfer and disposal of byproduct material. Such standards were to address both radiological and non-radiological hazards; further, standards applicable to non-radiological hazards were to be consistent with the standards required under Subtitle C of the Solid Waste Disposal Act (*i.e.,* RCRA).[17] NRC was required to implement these standards at Title II sites. See 42 U.S.C. 2022(b), (d).

D. What are the existing requirements under 40 CFR part 192?

Requirements for inactive uranium milling sites, vicinity properties, and depository sites (*i.e.,* Title I sites) are addressed under subparts A, B and C of 40 CFR part 192. Since today's proposal does not impact Title I sites, they will not be discussed further in this section.

Requirements currently applicable to active uranium processing and disposal sites, including ISR sites (*i.e.,* Title II sites) can be found in subpart D of 40 CFR part 192 (hereafter ''subpart D''). Subpart D contains provisions for managing uranium byproduct materials during and following the processing of uranium ores, and restoration of disposal sites following any such use of those sites. For purposes of today's proposal, provisions related to groundwater protection are of most interest. To fulfill the statutory mandate described in section II.C of this preamble, we derived these provisions from the RCRA groundwater monitoring framework applicable to hazardous

[11] NRC (2000). ''Recommendations on Ways to Improve the Efficiency of NRC Regulations at In Situ Leach Uranium Recovery Facilities.'' Staff Requirements—SECY–99–013.

[12] See EPA (2014). ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery (ISL/ISR) Sites.'' This document can be found in the docket for today's proposed rule. (Docket EPA–HQ–OAR–2012–0788).

[13] See 40 CFR 146.10, ''Plugging and Abandoning Class I, II, III, IV, and V Wells.''

[14] See 42 U.S.C. 2022.

[15] ''Source material'' is defined as ''(1) Uranium or thorium or any combination of uranium or thorium in any chemical or physical form; or (2) Ores that contain, by weight, one-twentieth of one percent (0.05 percent), or more, of uranium or thorium, or any combination of uranium or thorium.'' See 42 U.S.C. 2014(z), 10 CFR 20.1003.

[16] Although the statute covers both uranium and thorium mill tailings sites, there are no existing thorium mill tailings sites.

[17] With the restriction that EPA not require any RCRA permit for the processing, possession, transfer, or disposal of byproduct material.

waste disposal sites.[18] Today's proposal further adapts that framework to better address the specific situation presented by ISR technology.

Though standards at subpart D apply to ISR facilities, ISR was not the predominant uranium extraction method at the time the standards were promulgated. Subpart D addresses contamination of aquifers resulting from releases of contaminants from uranium mill tailings impoundments, which are surface structures (engineered units) designed to contain uranium byproduct material (*e.g.,* conventional tailings impoundments, evaporation or holding ponds). The RCRA hazardous waste framework, which is intended to prevent, detect, and mitigate contamination of groundwater resulting from releases of hazardous waste being held in an engineered unit, is directly applicable to this situation.[19] A basic RCRA hazardous waste management unit is an engineered unit, designed, constructed, and installed to prevent any migration of wastes out of the unit to the adjacent subsurface soil, groundwater or surface water at any time during the unit's operating life, during closure and during post-closure.

At ISR sites, however, the groundwater has already been influenced by the natural mineralization associated with the uranium roll front deposits. In essence, the ''management unit'' that is the potential source of contamination is the natural setting itself, though extraction of the uranium from the deposit alters the geochemistry of the ore-bearing formation and may increase the concentration of radionuclides and other metals in the water. Restoration activities attempt to restore the original geochemistry to the subsurface. However, at present, monitoring to verify restoration generally lasts for only a period of a few years at most. We are proposing to establish standards that will require licensees to ensure that the results of their restoration process(es) persist through time, thereby limiting the future potential for groundwater to be degraded from undetected, long-term changes in groundwater from ISR operations.

[18] See 40 CFR part 264, ''Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.'' See particularly subpart F, ''Releases from Solid Waste Management Units.''

[19] The design and construction requirements for surface impoundments are also taken from 40 CFR part 264. See subpart K, ''Surface Impoundments,'' specifically 40 CFR 264.221.

E. Why does EPA believe new standards are necessary?

We believe that ISR-specific standards are necessary because uranium ISR operations are very different from conventional uranium mills and the existing standards do not adequately address their unique aspects.

In particular, we believe it is necessary to take a longer view of groundwater protection than has been typical of current ISR industry practices. Although the presence of significant uranium deposits typically diminishes groundwater quality, current industry practices for restoration and monitoring of the affected aquifer may not be adequate to prevent either the further degradation of water quality or the more widespread contamination of groundwater that is suitable for human consumption.

Because monitoring after restoration is typically conducted for only a short period, we find it difficult to characterize the probability or magnitude of future contamination problems, or the costs involved in remediating such future contamination. Such costs are not now borne by ISR licensees, nor is there any guarantee that they could be held responsible if contamination were detected by new monitoring implemented years, decades or even longer after the end of site activities once the facility is officially decommissioned and the license is terminated by the NRC or Agreement State. It is likely, however, that the costs of such future remediation would far exceed the costs of the more extensive monitoring (in all phases of site activity) that we are proposing today, together with the costs of any additional restoration or prompt corrective action that may be required to address any issues identified as a result of the more extensive monitoring. In this sense, perhaps a generalized future cost of groundwater remediation can be viewed as a proxy for the value of groundwater and its protection. Similarly, because ISR activities often take place in areas that are sparsely populated, and any subsequent contamination may take years, decades or even longer to reach groundwater being consumed by humans, it is difficult to characterize the benefits of our proposal by applying typical Agency metrics, such as the number of cancers averted.

We also recognize, however, that our efforts to protect groundwater must consider the use, value, and vulnerability of the resource, as well as social and economic values. We believe it is important to protect groundwater to ensure the preservation of the nation's currently used and potential underground sources of drinking water (USDWs) for present and future generations. Also, we believe it is important to protect groundwater to ensure that where it interacts with surface water it does not interfere with the attainment of surface-water-quality standards; these standards are also necessary to protect human health and the integrity of ecosystems.

Thus, taking a more qualitative view of the situation leads us more broadly to consider the impacts on future groundwater uses. In many areas of the country, particularly in western states where ISR activities are most likely to take place, groundwater is a scarce and valuable resource that is being rapidly depleted to support increased demands. There is evidence that some communities are making efforts to utilize groundwater that is not of ''good'' quality, and in our view this trend will only increase.

Another critical issue in groundwater protection is that groundwater generally is not directly accessible. Thus, it is much more difficult to monitor and/or decontaminate groundwater than is the case with other environmental media. Because of the expenses and difficulties associated with remediation of contaminated groundwater, we believe it is prudent and cost-effective to prevent the occurrence of such contamination rather than rely on the cleanup of preventable pollution.

Thus, the Agency believes that it is in the national interest to preserve the quality of groundwater resources to the extent practicable, and that the best way to do so is to prevent contamination by addressing its source.[20] We believe today's proposal, which focuses on the source of potential contamination at ISR sites by stricter application of groundwater standards and more extensive monitoring to ensure that groundwater restoration will endure, is a reasonable and responsible approach to achieving this goal.

1. What are the environmental impacts of uranium ISR?

As noted earlier, ISR facilities affect the environment in ways that are both distinct from, and more complicated than, conventional mill tailings sites. The alteration of large subsurface areas through injection of chemical solutions also has the potential to cause changes in groundwater at significant distances downgradient. The migration of constituents liberated from the

[20] EPA (1991). ''Protecting the Nation's GroundwaterGroundwater: EPA's Strategy for the 1990s,'' 21Z–1020.

subsurface is controlled during the operational phase through the use of extraction wells.[21]

Once uranium recovery operations at a wellfield are complete, efforts to restore groundwater in the wellfield begin. Without such efforts, contaminants could migrate hydrologically downgradient from the ISR site. Restoration efforts largely consist of injecting and extracting water to flush out the remaining mobilizing solutions (*i.e.,* lixiviant) and chemical treatments designed to reverse the chemical process and return the prevailing chemical conditions (oxidizing) in the subsurface to their preoperational chemically reducing state.

Much remains unknown about the geochemical stability of restored wellfields once ISR operations have ceased. Long-term environmental impacts may result if restoration processes do not return aquifers to their preoperational state, or if restored levels do not persist over time and groundwater degrades through the slow release of residual contaminants. Most ISR sites historically have been unable to meet restoration goals for all constituents even after extensive effort.[22] Because the past practice of monitoring after restoration has typically been for a very limited time period, we do not know if the goals that are met for the short-term are maintained for a longer time.

The restoration process itself is extremely complex and difficult to control. The fact that significant quantities of uranium and other constituents have been removed from the natural setting may affect flow patterns and create discontinuities that further complicate or retard the restoration process. Originally, uranium was precipitated from groundwater moving through pore spaces in the host medium, which altered the flow paths on a local level throughout the deposit as the deposition of uranium continued and changed the porosity and permeability of the host medium. Once uranium extraction processes begin, fluids are pumped into the deposit to mobilize the precipitated uranium and remove it; the porosity and permeability of the host rock are also affected. Because the uranium is not initially distributed evenly throughout the deposit (because of the natural variations in the host rock properties), the extraction process cannot be assumed to remove all of the uranium; in fact, it does not. The restoration process likewise cannot be assumed to fully restore the porosity and permeability characteristics of the host rock to the exact conditions that existed before the ISR operations began. These changes in hydrologic properties in the host rock during extraction and restoration processes can have the net effect of altering flow paths within the deposit on a local level. Such largely unavoidable, incomplete restoration efforts may result in pockets of slowly leaching contaminants that may migrate out of the production zone over time.

In the absence of explicit regulatory language addressing ISR facilities, NRC and its Agreement States have used guidance and license conditions to implement many aspects of groundwater protection programs, including the selection of restoration goals and post-restoration monitoring. Based upon the information that we have reviewed,[23] we believe an even more rigorous approach is warranted for (a) determining background groundwater concentrations, which are necessary to establish appropriate restoration goals, (b) establishing restoration goals, and (c) demonstrating the continued stability of groundwater after restoration. In addition, prolonged stability monitoring is needed to provide the necessary level of confidence that groundwater quality will not degrade over time or promote contaminant migration in the future.

We recognize that it is difficult to reach a definitive conclusion regarding the frequency and extent to which long-term contamination has been or is likely to be a problem at ISR sites, because post-restoration stability monitoring typically occurs for a relatively short timeframe, a few years at most; nevertheless, we believe the available information supports our concerns in this matter. Because the lixiviant used during operations oxidizes not just the uranium but the entire production zone, the effect from adding reducing agents to restore the wellfield may just be temporary. If these reducing agents migrate out of the production zone, re-oxidation of the uranium in the ''restored'' wellfield may occur. This is especially likely if the natural reducing agents originally present in the production zone (*i.e.,* organic materials and iron sulfide minerals) were sufficiently depleted during ISR operations. To determine if re-mobilization of constituents precipitated by the restoration process will occur, longer-term monitoring of the site is warranted.

We are aware of the potential for geochemical conditions in the restored wellfield to alter over time. The ISR process can cause a loss of the chemically reducing potential in the ore zone. Over time, as oxidizing groundwater makes its way into the abandoned wellfield, re-oxidation could occur. Given the slow groundwater travel times in these deposits, it would take even longer time for the degraded water to make its way to water supply wells downgradient of the production zone aquifer and be detected there. Therefore, when we speak of long-term alteration of the groundwater, we imply timeframes of decades (or longer) rather than a few years.

2. What analysis has EPA done to support the proposal?

There is only very limited information in the open literature [24] on the stability of a restored wellfield after ISR operations have ended. Typically, post-restoration monitoring concludes and license termination proceeds within a matter of several years after the restoration phase ends. The behavior of the restored wellfield in the long-term, *i.e.,* decades or longer after the ISR operations end, has not been examined. The potential for re-mobilization of the contaminants is possible and this concern is the impetus for proposing longer post-restoration monitoring periods.

We have assessed exposure scenarios and exposure pathways for potentially hazardous constituents (mainly radionuclides) and found that migration of contaminants within the ore-bearing aquifer and slow movement of contaminants into upper aquifers through discontinuities or disruptions (*e.g.,* abandoned boreholes) and other possible failure scenarios (leaks, spills, etc.) have the potential to result in significant exposures to individuals outside the production areas.[25] These assessments suggest that a robust regulatory approach is advisable in order to prevent various failure scenarios that may occur during and after ISR operations, and to mitigate the

[21] Extraction wells are also used during the restoration phase to control the migration of constituents liberated from the subsurface.

[22] Hall, Susan (2009). ''Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain.'' U.S. Geological Survey.

[23] For example, Hall, Susan (2009). ''Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain.'' U.S. Geological Survey.

[24] Borch, T., N. Roche and T.E. Johnson (2012), ''Determination of Contaminant Levels and Remediation Efficacy in Groundwater at a Former In Situ Recovery Uranium Mine.'' Journal of Environmental Monitoring, 14:1814–1823.

[25] EPA (2012), ''Groundwater Modeling Studies at In Situ Leaching Facilities and Evaluation of Doses and Risks to Off-Site Receptors from Contaminated Groundwater.''

potential adverse effects of any such failures.

In examining the technical literature pertaining to ISR operations, we have found that some modeling studies indicate that the uranium recovery operations can result in the development of relatively slower groundwater pathways through the wellfield, as well as the persistence of injected lixiviant within the production zone. These results suggest that the typically short post-remediation monitoring periods prior to license terminations may fail to detect subsequent contaminant migration out of the wellfield along these slow transport paths. We are proposing stability monitoring periods longer than the current practice and requirements to address these situations. Statistical analyses of well water chemistry data over a relatively short time (a year or two) alone does not in itself demonstrate that slow pathways are absent or that the groundwater will remain in a chemically reduced state over the long term. We believe that only a combination of longer stability monitoring and geochemical modeling using site-specific data can provide confidence that the ISR site poses no long-term hazards, and we are proposing such provisions today.

We have also examined various statistical approaches that might be suitable for evaluating long-term groundwater stability.[26] We gave special attention to the requirements for data to be used in deciding, with a given level of statistical confidence, that stability was achieved over a specified period of time. While we do not recommend any specific statistical method be applied universally to all ISR situations (because the hydrogeology and geochemistry of ISR sites are not uniform by nature and because there is more than one statistical method that can be used), we do believe that the method(s) chosen must be justified by the quality and quantity of the field data collected. Linear regression techniques are typically used to examine time series measurements (concentrations of groundwater constituents measured over time intervals) for the presence of trends in the data (*i.e.,* to determine if the data show increases or decreases in the measured concentrations over time). While this type of analysis is relatively simple and can be used for quick screening to identify the presence of strong linear trends, it is often not sufficiently rigorous when used with field data because of significant limitations on the data sets. For linear regression assessments, the data must have a normal distribution and constant variance (two requirements that are difficult to demonstrate with field data). The data must have few or no values below the analytical detection limits for the measured parameter, and minimal outliers in the data or cyclical patterns (*e.g.,* no detectable seasonality in the case of shallow aquifers). Field data rarely meet these conditions. Parametric and nonparametric techniques are more rigorous than simple linear regression but also have specific data demands. Parametric statistical tests require more complete data sets but require less data overall to reach the same statistical confidence levels as non-parametric tests, which are more tolerant of data shortcomings such as missing data in a series of measurements. Less than perfect data sets are common in field efforts, making non-parametric techniques potentially more useful in practice. These methods are extensively assessed in the background information document.[27] The EPA document, ''Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance'' (2009), offers appropriate guidance on the level of confidence to be attained for demonstrating stability before regulatory decisions are made to terminate the operating license and release the wellfield for other uses. For RCRA monitoring results, where the intent is to ensure contaminants do not migrate out of the unit and into the uppermost aquifer, a confidence level of 95 percent is expected to support a regulatory action to terminate the permit.[28] We believe an equivalent degree of confidence in the long-term stability of a restored ISR wellfield is appropriate.

3. What came out of the Advisory from EPA's Science Advisory Board?

In early 2011, we approached EPA's Science Advisory Board (SAB)[29] to obtain advice regarding the complex scientific and technical issues related to groundwater protection at ISR sites. The SAB is an independent advisory body established by Congress in 1978 with a broad mandate to advise the Agency on technical matters. The SAB typically interacts with EPA programs through one of the following processes: (1) A consultation, which is a conceptual evaluation at the early stages of an action; (2) an advisory, which is typically a more detailed evaluation to address specific technical issues during development of a rule or technical guidance; or (3) a review, which is a detailed evaluation of a completed action to determine how the Agency incorporated science into its decision-making. The SAB will often conduct a review of an action on which it had previously weighed in through a consultation or advisory.

We sought an advisory with the Radiation Advisory Committee (RAC), which is the committee of the SAB specializing in radiation issues. For purposes of this advisory, the RAC was augmented with several additional experts with specialized knowledge of geochemistry or hydrogeology pertinent to ISR.

We prepared a report outlining the technical issues involved in groundwater protection during the life cycle of an ISR facility[30] and requested that the RAC comment on the following:

(1) The technical areas described in the report and their relative importance for designing and implementing a groundwater monitoring network;

(2) The proposed approaches for characterizing background (baseline) groundwater chemical conditions in the pre-operational phase and proposed approaches for determining the duration of such monitoring to establish background (baseline) conditions;

(3) The approaches considered for monitoring in the long-term stability phase and the approaches considered for determining when groundwater chemistry has reached a ''stable'' level; and

(4) Suitable statistical techniques that would be applicable for use with uranium ISR applications (particularly for the areas in items 2 and 3 above), as well as the subsequent data requirements for their use.

Public meetings/teleconferences of the advisory committee were held from July 12, 2011 through December 21, 2011, and included a two-day meeting in July 2011 with presentations by EPA management and staff, discussions with the RAC members, comments from members of the public, and initial reporting assignments for the RAC. NRC staff also attended the meetings and provided valuable input for the committee.

The RAC submitted its final report on February 17, 2012.[31] EPA responded to

[26] EPA (2014), ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery Sites.''

[27] *Ibid.*

[28] 40 CFR 264.97(h) & (i).

[29] *http://yosemite.epa.gov/sab/sabpeople.nsf/WebCommittees/BOARD.*

[30] EPA 402/D–14–001 ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery (ISL/ISR) Sites,'' Environmental Protection Agency, 2014.

[31] All information related to the advisory is located at *http://yosemite.epa.gov/sab/sabproduct.nsf/c91996cd39a82f6485257424006*

each recommendation and updated its draft report as part of the technical background information document for this proposal.[32] Among the more prominent RAC recommendations are the following:

- Identify indicators, both chemical and radioactive, for establishing conditions pre- and post-operationally, not limited to those with regulatory limits, but also including non-hazardous constituents that can affect the behavior of, or serve as surrogates for, constituents of interest;
- Devote at least as much effort to defining background groundwater conditions as to post-operational trend monitoring;
- Consider challenging and fluctuating ambient circumstances in background characterization;
- Build in flexibility to modify the design and implementation of monitoring programs as new information becomes available;
- Carefully qualify the meaning of ''return to preoperational groundwater quality'';
- Match sampling frequency and duration to information needs for hydrogeologic model confirmation;
- Present a survey of methods to determine sufficient well number and density; and
- Select statistical evaluation approach in terms of strengths and weaknesses to suit questions to be answered.

We believe today's proposal appropriately addresses these issues and incorporates the advice of the RAC.

4. What efforts has the Nuclear Regulatory Commission taken recently?

NRC regulates uranium mills and mill tailings in accordance with Appendix A to 10 CFR part 40.[33] Appendix A incorporates EPA's 40 CFR part 192 standards. NRC has developed guidance related to ISR activities[34] and has implemented facility requirements through license conditions. Agreement States regulating ISR facilities have taken a similar approach.

In recent years, NRC has recognized the desirability of ISR-specific regulations. NRC has been concerned with the potential for duplicative or conflicting groundwater protection requirements at ISR sites where NRC implements UMTRCA requirements but the EPA, or a state with primary enforcement responsibility (''primacy''), also regulates the injection associated with ISR through its Underground Injection Control (UIC) authorities, which are derived from EPA under the Safe Drinking Water Act (see Section II.F.1 of this document). In 2003, NRC staff recommended that NRC enter into a Memorandum of Understanding (MOU) with the affected states (at the time, Wyoming and Nebraska) to defer active regulation of groundwater to the states.[35] This recommendation was approved by the Commission.

Upon further investigation, however, NRC staff reported to the Commission that ''the Nebraska and Wyoming groundwater protection programs were found to be not equivalent to the NRC's groundwater protection program.'' Specifically, both states required restoration of groundwater to ''a quality of use'' consistent ''with the uses for which [it] was suitable prior to'' the ISR operation, rather than to levels consistent with NRC and EPA restoration standards under UMTRCA.[36]

After considering this information, the Commission determined in 2006 that the appropriate action was ''initiation of a rulemaking effort specifically tailored to groundwater protection programs at *in situ* leach (ISL) uranium recovery facilities.'' Further, the Commission directed that ''[t]he staff should focus on eliminating dual regulation by the NRC and EPA of groundwater protection. The NRC should retain its jurisdiction over the wellfield and groundwater under its Atomic Energy Act authority, but should defer active regulation of groundwater protection programs to the EPA or the EPA-authorized state through EPA's underground injection-control permit program.''[37]

EPA disagreed with the approach recommended by the Commission. EPA has always held the position that UMTRCA is the controlling legal authority for protection of groundwater and NRC is obligated to implement the 40 CFR part 192 standards to carry out that function at ISR sites. Reliance on the requirements of the UIC program alone would not adequately address groundwater protection at ISR facilities, given that the purpose of the UIC program is to prevent endangerment of underground sources of drinking water (USDWs), not to address restoration of groundwater. Moreover, if the groundwater is not considered a USDW, as is typically the case at ISR sites, it is not protected under the Safe Drinking Water Act (SDWA). Reliance on the UIC program alone would also likely lead to inconsistent levels of protection since states can implement more stringent requirements than the national UIC requirements and, as NRC discovered, states with authority to implement the UIC program may not have groundwater protection requirements consistent with those that have been applied to conventional mills. EPA decided to address groundwater protection at ISR facilities by amending its UMTRCA standards, as we are proposing to do today. The Commission subsequently decided that the NRC rulemaking should be deferred until EPA's revised standards are final.[38]

F. What other EPA statutes and regulations are relevant?

There are several other EPA environmental statutes and regulations that are relevant to ISR facilities and operations. The Safe Drinking Water Act, Clean Water Act, Clean Air Act and Resource Conservation and Recovery Act are all detailed below. It should be noted that UMTRCA requires us to establish protections consistent with the requirements of the Resource Conservation and Recovery Act.

1. Safe Drinking Water Act (SDWA)

The Safe Drinking Water Act (42 U.S.C. 300f *et seq.,* 1974) is the main federal law that addresses drinking water. Under the SDWA, EPA sets health-based standards for drinking water to protect against naturally occurring and anthropogenic contaminants that may be found in drinking water.[39] EPA and states work

90127/0314cef928df63cc8525775200482fa 3!OpenDocument.

[32] EPA (2014), ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery Sites.''

[33] ''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.'' 10 CFR part 40 more broadly covers ''Domestic Licensing of Source Material.''

[34] For example, see NRC (2003). ''Standard Review Plan for In Situ Leach Uranium Extraction License Applications (NUREG–1569).'' Available at *http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1569/.*

[35] NRC (2003). ''Options and Recommendations for NRC Deferring Active Regulation of Ground-Water Protection at In Situ Leach Uranium Extraction Facilities.'' SECY–03–0186.

[36] NRC (2006). ''Status of the Development of Memoranda of Understanding with Nebraska and Wyoming, Regarding the Regulation of Groundwater Protection at Their *In Situ* Leach Uranium Recovery Facilities.'' SECY–05–0123.

[37] NRC (2006). ''Regulation of Groundwater Protection at *In Situ* Leach Uranium Extraction Facilities.'' Staff Requirements—COMJSM–06–0001.

[38] NRC (2011). ''NRC Regulatory Agenda: Semiannual Report, July–December 2010.'' NUREG–0936; Vol. 29, No. 2.

[39] After reviewing health effects studies, EPA sets a Maximum Contaminant Level Goal (MCLG), the maximum level of a contaminant in drinking water

Continued

together to implement those standards at public water systems.[40] Implementing regulations in 40 CFR part 141 include the establishment of national primary drinking water standards.

The SDWA also addresses sources of drinking water, including underground sources, which may be used by public water systems or private well owners. As required by the SDWA, EPA established regulations for UIC programs to prevent underground injection that endangers drinking water sources.[41] Under this program, the Agency has a permit system to prevent endangerment of USDWs. It prohibits any injection activity that allows the movement of fluid containing any contaminant into underground sources of drinking water if the presence of that contaminant may cause a violation of any primary drinking water regulation or otherwise adversely affect the health of persons. EPA's UIC regulations, including permit requirements, are found at 40 CFR parts 144–148. They address construction, operation, monitoring, reporting, and plugging and abandonment of injection wells to prevent the movement of fluids into any USDW.[42]

EPA's UIC regulations for Class III wells protect USDWs by prohibiting the movement of any contaminant into the underground source of drinking water (*e.g.,* injection of fluids or release or migration of naturally occurring contaminants into an underground source of drinking water). A USDW is defined in EPA regulations as any aquifer or its portion (a)(1) which supplies a public water system or (2) which contains a sufficient quantity of groundwater to supply a public water system; and (i) currently supplies drinking water for human consumption; or (ii) contains fewer than 10,000 mg/l total dissolved solids; and (b) which is not an exempted aquifer. The receiving aquifer must not meet the definition of a USDW. An aquifer or a portion of an aquifer may be exempted from the protections afforded USDWs if (a) it does not currently serve as a source of drinking water and (b) it cannot now and will not in the future serve as a source of drinking water because one of four specified conditions is met,[43] or the total dissolved solids content of the groundwater is more than 3,000 mg/l and less than 10,000 mg/l and it is not reasonably expected to supply a public water system.

The construction of a Class III injection well at an ISR facility requires a UIC permit be obtained. Currently, ISR facilities are injecting lixiviant and extracting uranium from within exempted aquifers. If an underground injection well is used for injection into an exempted aquifer or a portion of an exempted aquifer, it is still regulated to protect the non-exempt portions of the USDW and other nearby USDWs. The scope of coverage of an aquifer exemption request is typically the portion of the USDW affected by the activity. It is possible that future ISR facilities will inject lixiviant and extract uranium from ore deposits that are within poorer quality aquifers that do not meet the definition of USDW; although an aquifer exemption would not be necessary in such a case, an UIC permit would still be required.

EPA has established minimum requirements for states or tribes to obtain authority to implement the UIC program.[44] To obtain ''primacy'' to implement the UIC program for Class III wells, states or tribes must adopt and submit to EPA for approval, UIC Class III injection well requirements that are at least as stringent as EPA's minimum requirements. The state or tribe may establish and implement requirements more stringent than the EPA UIC regulations, but not less stringent than the minimum federal requirements. Further, primacy states have the authority to identify and propose aquifers for exemption as part of their initial UIC program submission, or subsequent to program approval; however, these proposed exemptions generally must be affirmatively approved by the EPA.[45]

Aquifer exemptions have been a source of confusion regarding the applicability of our UMTRCA standards, which we hope to clarify today in this rule. There are limited UIC requirements relating to restoration of the exempted portion of the aquifer;[46] furthermore, an aquifer exemption does not eliminate the need to comply with the requirements of UMTRCA. The aquifer exemption provides relief from certain UIC requirements under the SDWA, thereby allowing injection into aquifers that would otherwise meet the definition of a USDW. The part 192 standards, however, are promulgated under a different statute. Therefore, an aquifer exemption under the SDWA does not relieve the licensee of the obligation to remediate environmental contamination resulting from activities regulated under UMTRCA. Today's proposal clarifies that EPA standards issued pursuant to UMTRCA do apply within the exempted portion of the aquifer.

2. Clean Water Act (CWA)

The Clean Water Act (33 U.S.C. 1251 *et seq.,* 1972) requires the establishment of water quality standards for, and regulation of pollutant discharges into, waters of the United States. The CWA's definition of ''pollutant'' includes radioactive materials, 33 U.S.C. 1362(6); EPA's regulations at 40 CFR 122.2 define the term ''pollutant'' to include radioactive materials ''except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 *et seq.*) . . . .'' Radioactive materials covered by the AEA are those encompassed in its definitions of source, byproduct, and special nuclear materials. *See* 42 U.S.C. 2014. The radioactive materials EPA may regulate under the CWA ''are those not encompassed in the definition of source, byproduct or special nuclear materials as defined by the [AEA] and regulated pursuant to that Act.'' *See Train* v. *Colorado Public Interest Research Group, Inc.,* 426 U.S. 1, 11 (1976). Under the CWA, EPA has implemented pollution control programs, such as

at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. MCLGs are non-enforceable public health goals. Since MCLGs consider only public health and not the limits of detection and treatment technology, sometimes they are set at a level which water systems cannot meet. When determining an MCLG, EPA considers the risk to sensitive subpopulations (infants, children, the elderly, and those with compromised immune systems) of experiencing a variety of adverse health effects. Once the MCLG is determined, EPA sets an enforceable standard. In most cases, the standard is a Maximum Contaminant Level (MCL), the maximum permissible level of a contaminant in water which is delivered to any user of a public water system. The MCL is set as close to the MCLG as feasible. EPA must determine the feasible MCL or treatment technique which the Safe Drinking Water Act defines as the level that may be achieved with the use of the best available technology, treatment techniques, and other means which EPA finds are available (after examination for efficiency under field conditions, not solely under laboratory conditions), taking cost into consideration.

[40] SDWA does not regulate private wells that serve fewer than 25 individuals or have fewer than 15 service connections.

[41] SDWA Section 1421(c)(2)(C)(2) states: ''Underground injection endangers drinking water sources if such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant may result in such system's not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons.'' 42 U.S.C. 300h(d)(2).

[42] EPA defines six classes of underground injection well. Uranium in-situ recovery operations are permitted as Class III wells. 40 CFR 146.5(c)(2).

[43] The presence of minerals or hydrocarbons that are, or are expected to be, commercially producible, is one of these specified conditions; this would likely be the situation at a proposed ISR site. 40 CFR 146.4.

[44] 40 CFR part 145, ''State UIC Program Requirements.''

[45] 40 CFR 144.7(b)(2) & (3).

[46] 40 CFR 146.10(a)(4).

setting technology-based wastewater discharge limitations and standards for various industries. Subpart C of 40 CFR part 440 provides technology-based effluent limitations guidelines and standards applicable to discharges from mills at which uranium, radium and vanadium are extracted. Permits for discharges to surface waters must include applicable technology-based limits, as well as any more stringent water quality-based effluent limits necessary to achieve water quality standards established under Section 303 of the CWA, including state narrative criteria for water quality.

3. Clean Air Act (CAA)

EPA regulates radionuclide emissions through its authority under the CAA, 42 U.S.C. 7401 *et seq.* The Agency has promulgated regulations for controlling radon emissions from operating uranium byproduct materials impoundments located at uranium recovery facilities, including ISR sites, at 40 CFR part 61, Subpart W.

4. Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (42 U.S.C. 6901 *et seq.*) was passed in 1976 as an amendment to the Solid Waste Disposal Act of 1965, to ensure that solid wastes are managed in an environmentally sound manner. RCRA gives EPA the authority to control hazardous waste from ''cradle-to-grave.'' This includes the generation, transportation, treatment, storage, and disposal of hazardous waste (Subtitle C). RCRA also set forth a framework for the management of non-hazardous solid wastes (Subtitle D). RCRA has been further amended to extend its application; for example, the 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances.

UMTRCA requires that generally applicable standards promulgated under its authority by EPA for non-radiological hazards be consistent with the standards issued under Subtitle C of the Solid Waste Disposal Act (now RCRA) that are applicable to those same hazards. The most appropriate RCRA regulations that bear on the ISR process are contained in 40 CFR part 264.[47] These regulations deal with functionally relevant issues such as requirements for: The siting, design and operation of impoundments; monitoring groundwater around land-based storage and disposal facilities; detecting contaminant releases and conducting subsequent corrective actions; and establishing the duration of compliance monitoring periods. These requirements are easily applied to conventional mill tailings impoundments, which are to be constructed to RCRA standards, although they are expected to remain under institutional control for much longer periods.[48] Similarly, we believe many of the requirements and concepts should be applicable to the long-term behavior of an ISR site after uranium extraction has ceased and the operators have made efforts to restore the wellfield to conditions that existed before the uranium recovery operation began. Conceptually, at that stage there is similarity between a closed hazardous waste disposal facility and a restored ISR wellfield in the sense that both strive to avoid off-site migration of contaminants. The intent of the groundwater monitoring efforts at these two types of facilities share the common objective of verifying that containment of contaminants meets expectations. The location of compliance point(s) for monitoring data collection, performance measures for assessing compliance with regulatory requirements, duration of the monitoring program and the extent of data necessary for regulatory decision-making are areas that we believe can be adapted to better fit the unique aspects of the ISR application. These subjects are discussed in the next section.

III. Summary of Today's Proposal

Today's proposal is limited to the following items. First, we are proposing new standards to explicitly address groundwater protection at uranium ISR facilities. Second, we are proposing to amend existing provisions only as necessary to address a judicial decision, an outdated reference and known typographical and grammatical errors. At this time, we request public comment only on these proposed standards and amendments. We are not requesting, and will not respond to, public comments related to any other provisions since they are beyond the scope of today's proposal. The rationale for these elements of our proposal is discussed in Section IV of this document.

A. Proposed Standards (Subpart F)

1. Proposal of a New Subpart—Subpart F—Public Health, Safety and Environmental Protection Standards for Byproduct Materials Produced by Uranium In-Situ Recovery

A new subpart F is being proposed that would set standards that would apply to uranium ISR facilities only.

2. Addition of a New Section on Applicability—§ 192.50 Applicability

We are proposing applicability language under subpart F that specifies the subpart will apply to the management of uranium byproduct materials during and following the processing of uranium ores using ISR methods.

3. Addition of a New Section Containing Definitions—§ 192.51 Definitions and Cross-References

To help ensure consistency with subparts A, B, C, D and E, all terms in the proposed subpart shall carry the same meaning as previously defined, unless otherwise specified. To help ensure clarity, the new subpart will contain numerous definitions specific to ISR. The following terms are defined:

TERMINOLOGY

Adjacent Aquifer
Alternate Concentration Limit (ACL)
Aquifer
Background
Constituent
Exceedance
Excursion
Excursion Monitoring Well
Exempted Aquifer
Extraction Well
Indicator Parameter
Injection Well
In-Situ Recovery (ISR)
Listed Constituent
Lixiviant
Long-Term Stability Phase
Maximum Constituent Concentration
Maximum Contaminant Level (MCL)
Monitoring Wells
Operational Phase
Overlying Aquifer
Point(s) of Compliance
Point(s) of Exposure
Preoperational Monitoring
Production Zone
Restoration (Act of)
Restoration Goal
Restoration Phase
Site
Stability Phase
Underlying Aquifer
Upper Control Limit (UCL)
Uranium Recovery Facility
Wellfield

[47] ''Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.''

[48] These requirements also apply to any uranium byproduct impoundments (*i.e.,* ponds) that are removed at the end of licensed operations.

4. Addition of a New Section Detailing Standards—§ 192.52 Standards

In the new subpart, EPA proposes to specify the minimum 13 constituents for which groundwater protection standards must be met. The list includes the following: Arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, nitrate (as N), molybdenum, combined radium-226 and radium-228, uranium (total), and gross alpha-particle activity (excluding radon and uranium). See section II.F.1 of the preamble and footnote for background. After groundwater restoration, the concentration of each listed constituent within the exempted aquifer of an ISR wellfield must remain at or below the most protective standards under the SDWA (40 CFR 141.61, 141.62, 141.66, 141.80 and 143.3), values from RCRA standards (40 CFR 264.94), or Table 1 to subpart A of part 192, except in cases where the measured preoperational background concentration is higher than the most stringent value in the applicable regulations. In such cases, the measured background concentration will serve as the restoration goal. The proposed language allows for the regulatory agency to set groundwater protection standards for additional constituents as necessary, consistent with site conditions.

The new subpart also describes the process for requesting and approving alternate concentration limits (ACLs) after restoration has taken place.

5. Addition of a New Section Discussing Monitoring Requirements—§ 192.53 Monitoring Programs

In addition to the constituents to be monitored at ISR facilities, the new subpart also details the specific requirements of monitoring programs to be conducted during the preoperational, operational, restoration, stability and long-term stability phases.

6. Addition of a New Section Establishing Requirements for Corrective Actions—§ 192.54 Corrective Action Program

Should an excursion be detected or the proposed groundwater standards be exceeded at the excursion monitoring wells or long-term stability compliance wells at any licensed ISR site, we propose to require that a corrective action program be put into place as soon as is practicable and no later than 90 days after an excursion or an exceedance is discovered. Similar to the approach taken in subpart D, we propose that the corrective action program put into place meet the specifications of § 264.100.

7. Addition of a New Section Detailing the Effective Date of the New Subpart—§ 192.55 Effective Date

We are proposing that the rule go into effect 60 days after it is promulgated in the **Federal Register**, the legal minimum amount of time between promulgation of the new subpart and its effective date.[49]

B. Other Proposed Amendments

1. Revision to Subpart C—Implementation

In an effort to address an outdated reference, EPA proposes to remove mention of the Grand Junction Remedial Action Criteria (10 CFR 712); the criteria were removed from the CFR between 1981 and 1982. In addition, EPA proposes to delete language citing certain remedial options that ''may provide reasonable assurance of'' radon decay product concentration reductions. The final report for the Grand Junction Remedial Action Program, issued in 1989, stated that the methods were not effective over the long term.

2. Revision to Subpart D—Standards for the Management of Uranium Byproduct Materials

EPA proposes to amend the heading of Subpart D. The proposed amendment will remove an inaccurate citation of EPA's authority. In order to correct certain typographical and grammatical errors that have been identified in Subpart D since promulgation, EPA proposes the following technical corrections:

Section	Proposed technical correction and reason
§ 192.31(a)	Replace ''Uranium Mill Tailings Rediation Control Act'' with ''Uranium Mill Tailings Radiation Control Act'' to correct a typographical error.
§ 192.31(f)	Replace ''pile containing uranium by product materials'' with ''pile containing uranium byproduct materials'' to correct a typographical error.
§ 192.32(a)(2)(v)	Replace ''laser fusion, of soils, etc.'' with ''laser fusion of soils, etc.'' to correct a grammatical error.

EPA is also proposing to modify § 192.32(a)(2)(v) in order to delete the NRC requirement to obtain concurrence from EPA before NRC may approve an alternate requirement or proposal under AEA section 84(c).[50] This portion of § 192.32(a)(2)(v) was effectively struck down by the Tenth Circuit Court of Appeals in *Environmental Defense Fund vs. U.S. Nuclear Regulatory Commission,* 866 F.2d 1263 (10th Cir. 1989).

IV. What is the Rationale for today's proposal?

Groundwater is one of our nation's most precious resources. A significant portion of the U.S. population draws on groundwater for its potable water supply. In addition to serving as a source of drinking water, people use groundwater for irrigation, stock watering, food preparation, personal health and hygiene, and various industrial processes. When that water is radioactively contaminated, each of those uses becomes a radiation exposure pathway for people. Groundwater contamination is also of concern to us because of potential adverse impacts upon ecosystems, particularly sensitive or endangered ecosystems. For these reasons, it is a resource that needs protection.

A number of federal and state laws have been passed through the years to protect drinking water. At the federal level, the SDWA (discussed in detail in Section II.F.1) establishes the basic framework for protecting the drinking water used by public water systems in the United States. This law contains requirements for ensuring the safety of the nation's public drinking water supplies. At the state level, many similar drinking water and water use laws have been passed.

Groundwater is also a valuable and dwindling resource, particularly in western states where most ISR activities are anticipated. EPA views protecting groundwater as a fundamental part of its mission. Particularly in cases where groundwater is directly threatened by an activity, as it is by the ISR technology, EPA believes it has a special duty to ensure that the authority of all applicable federal statutes (*e.g.,*

[49] See 42 U.S.C. 2022(c)(3).

[50] See 42 U.S.C. 2114(c).

UMTRCA and the SDWA) are used to help protect the groundwater and that appropriate standards to protect public health, safety and the environment are developed and implemented.

We anticipate the objection that the presence of uranium deposits typically results in groundwater of poor quality, and not a pristine source of drinking water. We recognize that this is often the case, and that the volume of water affected by the mineralized zone may be significant. We do not, however, see this as a reason to allow this groundwater to be further degraded. The increasing scarcity of groundwater is leading some communities to consider using sources of water that previously would have been considered non-potable, using advanced treatment to make it suitable for livestock or human consumption. Since such advanced treatment may not be economically feasible for some communities, it is all the more important to prevent, as much as reasonably possible, additional degradation of the groundwater.

A guiding philosophy in radioactive waste management, as well as waste disposal in general, has been to avoid imposing burdens on future generations for clean-up efforts as a result of management approaches that are reasonably anticipated to result in pollution in the future. Adhering to the concept of sustainability, we should not knowingly impose undue burdens on future generations. Imposing performance requirements that avoid polluting resources that reasonably could be used in the future, therefore, is a more appropriate choice than imposing clean-up burdens on future generations. ISR facilities use significant volumes of water during both operations and restoration. We believe it is reasonable to make every effort to ensure that ISR activities leave groundwater in no worse condition than pre-ISR operational status.

A. How does today's proposal relate to existing 40 CFR part 192?

In 1983, EPA promulgated regulations at 40 CFR part 192 in response to the statutory requirements of UMTRCA. At the time, uranium recovery from ore was done almost exclusively by conventional milling processes, where at most a few pounds of uranium were recovered for each ton of ore mined and processed. The wastes from the milling process (the tailings and raffinates, *i.e.,* uranium byproduct materials) were disposed of in large piles on the surface at mill sites, posing contamination risks to surface water, groundwater, and soils, both on and off site. Liquid wastes were often discharged into rivers. Contaminants of concern consisted primarily of radionuclides and non-radioactive metals, radon gas and organics. Concerns that these tailings piles would be a continuing source of radiation exposure and environmental contamination unless properly reclaimed and managed were the driving force behind the passage of UMTRCA. The statute's intent was to contain tailings in engineered impoundments to prevent the further dispersion and misuse of the material. This measure would also protect uncontaminated aquifers from becoming contaminated by the uranium mill tailings impoundments and prevent radon emissions through performance specifications for radon barriers (covers). Because the major environmental risk at that time was perceived to come from the conventional uranium mill tailings, which already existed in large volumes, other uranium recovery technologies, including ISR, received little attention.

As stated earlier, ISR has surpassed conventional milling as the dominant form of uranium extraction in the United States and is expected to predominate in the future. The ISR process presents different environmental concerns from conventional milling. ISR does not generate large volumes of solid waste materials or require permanent tailings impoundments. The ISR process does, however, directly alter groundwater chemistry, posing the challenge of groundwater restoration and long-term subsurface geochemical stabilization after the ISR operational phase ends. With ISR, the ''milling'' of uranium ore is performed within the ore zone aquifer by injection of lixiviants. As stated earlier, the lixiviants can also liberate other elements, particularly metals that are often found co-located with uranium deposits. Their migration outside the production zone can potentially contaminate surrounding aquifers. Furthermore, when processing of the ore zone is no longer economically viable, ISR operators can release the site for future use, either by selling the land or returning the property to the original owner. The operators are required to restore the aquifer to its original geochemical conditions, to the extent possible, and to show some level of stability in the geochemistry of the production zone before terminating the license and making the site available for other uses. Whereas conventional mill tailings piles are under perpetual institutional control, current NRC regulations allow for ISR sites to terminate their licenses, essentially ending regulatory oversight of the site.

Today, EPA is reaffirming that ISR facilities are subject to the 40 CFR part 192 requirements. We seek to provide clear direction on how to monitor groundwater in and around the production zone during all phases of the ISR facility's lifecycle, and how to demonstrate geochemical stability at these sites.

We believe there has been some uncertainty about how to apply the current standards, which are more targeted to conventional mills, to ISR sites. In addition, there has been confusion about applicability of UMTRCA restoration requirements at aquifers that have been exempted from the standards of the SDWA. With the prospect of additional ISR facilities beginning operations, we believe it is necessary to clarify these issues. Therefore, we are proposing additional groundwater protection provisions to 40 CFR part 192 that are specific to uranium ISR facilities and consistent with the SDWA and RCRA. We believe these provisions are necessary to ensure that ISR sites are not released from regulatory control until it can be reasonably demonstrated that groundwater will not degrade over time.

Specifically, we are proposing provisions that will result in long lasting protection of surrounding aquifers. The provisions specify how to determine preoperational background conditions that will be used to set appropriate restoration goals, applicable standards and alternate concentration limits. We are also proposing specifications for long-term groundwater stability monitoring and a corrective action program that is triggered if excursions/exceedances do occur. We view these as the key elements in ensuring that ISR sites do not become a source of continuing or widespread contamination after the ISR operation is terminated.

Sufficient data must be collected to characterize the conditions existing within and outside the proposed production zone to set appropriate groundwater protection standards (*i.e.,* restoration goals) that account for the variability in geochemistry frequently encountered in mineralized regions. Subsequent to the end of uranium production, the regulator must ensure that alternate standards are approved only after restoration has been attempted and it is clearly demonstrated that the initial groundwater protection standard(s) cannot be achieved, or once achieved, cannot be maintained. Such approval should take place only after the operator has made reasonable and satisfactory efforts to achieve and maintain the initial standard(s) and fully considered a number of factors. Whether the initial goals are met or alternate concentration limits are approved, conditions must be shown to be stable and groundwater quality must not degrade over time, as is possible when: lingering amounts of lixiviant solution remain in isolated pockets within the wellfield; reducing conditions are not fully reestablished; and/or the long-term stability monitoring period is too short compared to the time it takes for groundwater to move through the aquifer. Therefore, the operator must monitor groundwater at the site for a sufficiently long period after restoration is complete and use statistically significant results to provide a reasonable demonstration that long-term stability has been achieved. This demonstration can include geochemical modeling to confirm the persistence of stability of the groundwater chemistry. Geochemical modeling can provide a defensible demonstration of an aquifer's natural capacity to maintain stability, which statistics alone cannot provide. Although the selection and application of geochemical models will be on a site-specific basis, geochemical models that have been used to predict the fate and transport of uranium at ISR facilities include PHT3D, PHREEQC, and PHAST.

We intend for today's proposal to eliminate any confusion about the relationship of the aquifer exemption process to restoration requirements at ISR sites. We further recognize that the application of the existing standards in 40 CFR part 192 to ISR sites is not as straightforward as it could be. Nevertheless, we believe there is sufficient information available to indicate that practices related to groundwater protection at ISR facilities have not been sufficiently rigorous to provide confidence either that groundwater is being restored appropriately or that such restoration will persist into the reasonably foreseeable future.[51 52 53] We believe today's proposal addresses these issues in a manner that is both logical and implementable;[54] we solicit comment on our view of the current situation and the overall approach of our proposal.

B. What groundwater protection standards are we proposing for ISR facilities?

We are proposing today to establish groundwater protection standards consistent with those applied to conventional mills in 40 CFR part 192, subpart D. That is, the licensee will use as the applicable standard during restoration and long-term stability monitoring either (1) the background concentrations of groundwater constituents measured prior to the start of the ISR operational phase; or (2) a specified regulatory level, whichever is higher. In certain circumstances, the licensee may request that the regulatory agency approve an alternate concentration limit.

1. Generally Applicable Groundwater Standards

We emphasize again that the groundwater protection standards currently found in 40 CFR part 192 apply to ISR sites. These standards address both radiological and non-radiological constituents. The standards applicable to non-radiological constituents adopted the requirements for groundwater monitoring at RCRA hazardous waste sites.[55] These generally applicable standards were originally based upon EPA's 1976 Maximum Contaminant Levels (MCLs) in drinking water (40 CFR part 141).[56] See section II.F.1 of the preamble and footnote for background. EPA further specified radiological and non-radiological constituents of concern at mill tailings sites. Following the same approach, we are proposing today to specify, as Table 1 to subpart F, the constituents that must be monitored at ISR sites, as appropriate. The required constituents mirror those included in Table 1 to subpart A of 40 CFR part 192, with the exception of the six pesticides.[57]

We are not proposing to establish new numerical standards in the rule. EPA's preferred option for carrying over and updating the groundwater protection standards in the new ISR-specific subpart F is to incorporate, by reference, the most protective standards issued under the SDWA (40 CFR 141.61, 141.62, 141.66, 141.80 and 143.3), values from RCRA standards (40 CFR 264.94), and the maximum constituent concentrations found in Table 1 to subpart A of 40 CFR part 192. By incorporating these standards by reference, the new subpart F would automatically update if those concentration values change in the standards under SDWA or RCRA and thereby, be self-implementing. Upon promulgation, licensees currently in restoration, stability monitoring or long-term monitoring at a given wellfield at a licensed facility would continue to be held to the standard(s) in place at the time of licensing for those given wellfield(s), unless the regulatory agency determines otherwise. Operating wellfields, new wellfields and expansions of wellfields would be required to meet the newly promulgated standards. This option would make the groundwater protection standards under the proposed subpart consistent with all relevant current and future standards under SDWA and RCRA. We believe that this approach will more effectively keep the groundwater protection standards current with the Agency's policies while providing for regulatory certainty. The standards in the existing portion of 40 CFR part 192 are outdated for arsenic and uranium, both of which have had new MCLs established since the year 2000.[58] Today's proposal would update the standards for arsenic and uranium as they apply to ISR facilities. Should the Agency propose to update its MCLs or RCRA standards at some point in the future, stakeholders will have the opportunity to comment on the potential impacts to ISR activities.

We are also considering the alternative approach of placing a static table of restoration goals in the new subpart F. The table would list the 13 required constituents for which groundwater protection standards must be met, and also provide the specific numeric concentration value associated with each constituent. If this option is promulgated in the final rule, the standards would not automatically update with any future changes to standards under the SDWA or RCRA but would remain static. Under this

[51] Hall, Susan (2009). "Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain." U.S. Geological Survey.

[52] Darling, Bruce (2008). "Report on Findings Related to the Restoration of Groundwater at In-Situ Uranium Mines in South Texas." Southwest Groundwater Consulting, LLC.

[53] Fettus, G. and M.G. McKinzie (2012). "Nuclear Fuel's Dirty Beginnings: Environmental Damage and Public Health Risks from Uranium Mining in the American West." Natural Resources Defense Council.

[54] It should be noted that we are not proposing to establish specific requirements related to the technical aspects of groundwater restoration (*i.e.,* what methods to use for restoration or which statistical methods to use for assessing temporal stability of the groundwater chemical state).

[55] 40 CFR 264.94, Table 1.

[56] 47 FR 32285, July 26, 1982. The use of MCLs as standards for groundwater protection anticipated the Agency's Ground Water Protection Strategy, first developed in 1984 and updated in 1991. Under the Strategy, MCLs provide a benchmark for groundwater protection. Contamination of groundwater above MCLs is viewed as a failure of pollution prevention.

[57] Endrin, lindane, methoxychlor, toxaphene, 2,4–D, and 2,4,5–TP Silvex. These constituents are unlikely to be present at ISR sites.

[58] 66 FR 6976, January 22, 2001; and 65 FR 76708, December 7, 2000, respectively.

approach, the Agency would initiate future changes to standards through a notice-and-comment rulemaking specifically for 40 CFR part 192.

In order for an ISR operation to proceed, a UIC permit is required and typically, an aquifer exemption is needed as well. The exemption effectively removes from the protection of the SDWA, an aquifer or portion of an aquifer that would otherwise meet the definition of an underground source of drinking water. The wellfield used by the ISR operation to extract the uranium deposit may constitute only a portion of the overall exempted area. As noted in Section II.E.1 of this document, there is no similar exemption for the aquifer from the requirements of UMTRCA, nor does UMTRCA contemplate such a concept. We emphasize again that the SDWA-based aquifer exemption does not relieve the operator of an ISR facility of the obligation to remediate environmental contamination resulting from activities regulated under UMTRCA, both within and outside the exempted portion of the aquifer.

2. Alternate Concentration Limits (ACLS)

Consistent with RCRA, EPA currently allows the use of ACLs if the operator is unable to restore groundwater to either preoperational background conditions/concentration levels or the applicable restoration goals. Today we propose to clarify the requirements for requesting and granting ACLs in the production zone, after restoration efforts have taken place. While the 19 criteria to be considered in granting ACLs are spelled out for Title II sites in 40 CFR 192.32(a)(2)(iv) through incorporation of 40 CFR 264.94(b), they have not always been implemented as intended.[59] [60] In the past, NRC and Agreement States have issued secondary class-of-use restoration goals at ISR sites, but these goals were typically less restrictive than meeting background concentration levels.[61] NRC no longer recognizes class-of-use as an appropriate standard for restoration of groundwater at uranium ISR facilities; [62] secondary class-of-use restoration goals are inconsistent with the requirements of 40 CFR part 192 and 10 CFR part 40, Appendix A. There is evidence that relaxed restoration standards have been granted in Agreement States,[63] and some instances where ACLs have been identified and approved by the regulator before restoration efforts have been initiated and/or completed.[64] [65] We believe these situations can result in insufficient protection of groundwater; in particular, we believe it only is appropriate to establish restoration goals based on a thorough characterization of the preoperational environment and not to approve ACLs unless it has proven impracticable to achieve or maintain the initial restoration goals or return to background conditions after restoration. With this proposal, we specify the conditions that must be met prior to requesting an ACL and emphasize the factors that must be considered in establishing and approving ACLs. These factors specify that, if ACLs are deemed necessary or appropriate after all best practicable restoration activities have been completed, they must not pose a substantial present or potential hazard to human health or the environment.[66] ACLs can be established for carcinogens and/or non-carcinogens. When considering the potential for health risks caused by human exposure to known or suspected carcinogens, ACLs should, where practicable, be established at concentration levels that represent a cumulative excess lifetime risk to an average individual at no greater than 10^{-4} (one chance in ten thousand).

The regulatory agency may face situations in which the operator will request ACLs. If after extensive effort the operator determines that the initial restoration goals for one or more constituents cannot be achieved as required in the license, the operator may request and the regulatory agency may approve the levels that have been achieved as provisional ACLs and determine that restoration is complete (*i.e.,* that there is no statistically significant trend in the concentrations of regulated species over time). Then, the operator may request and the regulatory agency may approve final ACLs if post-restoration monitoring indicates three consecutive years of stability at the 95 percent confidence level. The approval of final ACLs, however, would not by itself satisfy the requirements for long-term stability monitoring.

In the second case, after restoration is complete, the operator may find that post-restoration monitoring detects increases in the concentration of one or more constituents of concern. Depending on the statistical significance of the increase, the regulatory agency may determine that further attempts at restoration or corrective action are needed. If the situation persists after such action is taken, the regulatory agency may choose to wait and see if the increase levels off (*i.e.,* stabilizes). If stabilization does occur, the operator may request and the regulatory agency may approve final ACLs if post-restoration monitoring indicates three consecutive years of stability at the 95 percent confidence level.

An additional consideration is the potential effect of ACLs on groundwater downgradient of the wellfield. The granting of ACLs could be viewed as inconsistent with the purpose of groundwater restoration, which is to prevent contamination of groundwater resources beyond the production zone. However, NRC has in recent years adopted an approach defining the ''point of exposure'' as the aquifer exemption boundary, where the initial restoration goal must be met. We propose to adopt a similar approach today.[67] This will ensure that the non-

[59] These criteria are also reproduced for Title I sites in 40 CFR 192.02(c)(3)(ii).

[60] EPA (1987). ''Alternate Concentration Limit Guidance, Interim Final,'' provides guidance to RCRA facility permit applicants and writers concerning the establishment of RCRA Alternate Concentration Limits. The guidance lists 19 factors, or criteria, that are used to evaluate ACL requests.

[61] ''Class of use'' designates the potential uses of groundwater based on its quality. For example, groundwater that is not suitable for human consumption may be designated for livestock. Class of use typically encompasses a range of constituent concentration values.

[62] NRC (2009). ''Uranium Recovery Policy Regarding: (1) The process for scheduling licensing reviews of applications for new uranium recovery facilities and (2) the restoration of groundwater at licensed uranium in situ recovery facilities.'' NRC Regulatory Issue Summary 2009–05.

[63] Darling, Bruce (2008). ''Report on Findings Related to the Restoration of Groundwater at In-Situ Uranium Mines in South Texas.'' Southwest Groundwater Consulting, LLC.

[64] Hall, Susan (2009). ''Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain.'' U.S. Geological Survey.

[65] Fettus, G. and M.G. McKinzie (2012). ''Nuclear Fuel's Dirty Beginnings: Environmental Damage and Public Health Risks from Uranium Mining in the American West.'' Natural Resources Defense Council.

[66] ''[A] licensee may propose alternatives to specific requirements adopted and enforced by the Commission under this chapter. Such alternative proposals may take into account local or regional conditions, including geology, topography, hydrology and meteorology. The Commission may treat such alternatives as satisfying Commission requirements if the Commission determines that such alternatives will achieve a level of stabilization and containment of the sites concerned, and a *level of protection for public health, safety, and the environment from radiological and nonradiological hazards associated with such sites, which is equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose and any final standards promulgated by the Administrator of the Environmental Protection Agency* in accordance with section 2022 of this title.'' 42 U.S.C. 2114(c), emphasis added.

[67] EPA guidance on application of ACLs under RCRA makes a similar distinction between the ''point of compliance'' and the ''point of exposure,'' emphasizing that in granting ACLs, (1) groundwater plumes should not increase in size or concentration above allowable health or environmental exposure levels; (2) increased property holdings should not

Continued

endangerment condition of the UIC permit will be sustained. We believe the decision to grant an ACL is among the most important that the regulatory agency can make. We believe our proposal appropriately clarifies the situations in which ACLs can be considered and emphasizes the factors that must be considered, thereby making the overall process more rigorous. However, we also recognize that the regulatory agency may need to spend additional effort to evaluate the full record of activities at the site in order to determine whether an ACL is appropriate, and at what level. Because the long-term protectiveness of this decision may not be fully understood until well after site activities conclude and the license is terminated, we encourage the regulatory agency to inform and seek input from the affected public when ACLs are being considered. We believe this request would constitute a license amendment significant enough to warrant an opportunity for public comment, if not public hearings.

C. Adequate Characterization of Groundwater Prior to Uranium Recovery

To design and operate an ISR facility, the chemical composition and hydrology of the groundwater in and around the ore body must first be rigorously characterized. Defining the configuration of the ore zone and designing the production zone for uranium recovery requires detailed subsurface information obtained from geophysical investigations, including but not limited to logs and cores.[68] In addition, the groundwater in the production zone is also characterized to determine the proposed chemical composition of the lixiviant and to determine background groundwater chemistry by which to set restoration goals for the post-production phase of the ISR operation (*i.e.,* the efforts to return the groundwater chemical conditions in the production zone to those that existed prior to the uranium recovery efforts). The preoperational chemical composition of the groundwater in the production zone is called ''baseline'' in practice within the ISR industry and by NRC. In EPA documents and regulations the term ''background'' is used to indicate the original state of groundwater before activities take place that may introduce contamination into the groundwater, such as leakage of contaminants from a surface or near-surface waste disposal cell or an underground source of contamination such as leaking storage tanks or disposal wells.[69]

For the ISR method, there are a number of ''backgrounds'' involved, the most important being the preoperational background within the portion of the ore zone where uranium production will take place (*i.e.,* the production zone). Knowledge of this background is necessary to design the leaching process and set restoration goals—two very important steps in the ISR operation. ''Background'' groundwater composition data are also needed in portions of the aquifer surrounding the wellfield and in overlying and underlying aquifers that may have communication with the uranium ore-bearing aquifer to determine whether excursions occur during operations, and to determine whether seasonal variations in groundwater chemistry are occurring in shallow aquifers. Background data are also needed for geochemical modeling of the groundwater in the production zone and downgradient to support assessments of the natural capacity of the restored production area and downgradient portion of the exempted aquifer to maintain long-term stability of the restored wellfield.

There are spatial and temporal designations for the various ''backgrounds'' measured in relation to an ISR operation. For instance, preoperational background is determined above, below, around and within the wellfield in the exempted aquifer. The preoperational background downgradient of the wellfield and in aquifers above and below the production zone are needed to detect any excursions that may occur during the ISR operational phase or restoration phase. The uses of the various ''backgrounds'' are described in the technical background information document supporting this rulemaking.[70]

NRC requires establishment of background at uranium recovery sites in its regulations at 10 CFR part 40, Appendix A, Criterion 7;[71] most of the implementing requirements are found in guidance and license conditions. Today's proposal includes provisions to ensure that operators adequately characterize preoperational conditions inside and outside the wellfield. This characterization is necessary to establish appropriately protective restoration goals that are representative of the wellfield, accounting for natural variability. There is evidence that regulators and operators have at times used high-end values to represent the overall wellfield or have used a generalized ''class-of-use'' for the groundwater to set restoration goals.[72] We do not believe this is appropriate, as we explain below.

Today's proposal also specifies that the preoperational groundwater monitoring program must account for the effects of well installation and development on the groundwater characteristics. The physical act of penetrating the aquifer to install the well can cause localized changes in constituent concentrations or chemical parameters, which can lead to a misleading picture of background conditions. This can, in turn, result in selection of artificially high restoration goals. It is important that the operator allow a sufficient interval of time between well installation and sampling to allow localized disturbances to dissipate and ensure that background conditions are accurately characterized.

1. Establishing Restoration Goals

The successful protection of groundwater at ISR sites begins with the selection of rigorous and appropriate restoration goals. As described in Section III.B of this preamble, restoration goals will be established as the preoperational background concentration or as a specified regulatory level for that constituent, whichever is higher.

This is more complicated than it might seem. ISR wellfields may cover areas of 10 acres or more, and the presence of mineralized zones often means that there is significant variability within the proposed production area. As a result, background

be used to allow a greater ACL; and (3) ACLs should not be established so as to contaminate off-site groundwater above allowable health or environmental exposure levels. See *http://www.epa.gov/wastes/hazard/correctiveaction/resources/guidance/gw/acl.htm.*

[68] EPA (2014). ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery Sites.''

[69] For example, owners and operators of hazardous waste facilities are required to have a monitoring system that can ''represent the quality of background water that has not been affected by leakage from a regulated unit.'' 40 CFR 264.97(a)(1).

[70] EPA (2014). ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery Sites.''

[71] ''At least one full year prior to any major site construction, a preoperational monitoring program must be conducted to provide complete baseline data on a milling site and its environs. Throughout the construction and operating phases of the mill, an operational monitoring program must be conducted to measure or evaluate compliance with applicable standards and regulations; to evaluate performance of control systems and procedures; to evaluate environmental impacts of operation; and to detect potential long-term effects.''

[72] 12. NRC (2006). ''Status of the Development of Memoranda of Understanding with Nebraska and Wyoming, Regarding the Regulation of Groundwater Protection at Their In Situ Leach Uranium Recovery Facilities.'' SECY–05–0123.

concentrations in one area of the wellfield may diverge significantly from those measured elsewhere. The question, then, is whether it is possible to select a single level that is representative of the entire wellfield and, if not, how measurements should be evaluated.

We stated previously that we do not believe it is appropriate to select among high-end measurements as representative values for restoration. It might be argued, however, that restoring a given well to its preoperational values would be an indication that restoration would be equally successful in the rest of the wellfield. This might be the case at sites where remediation of groundwater is focused on removing a contaminant that has been introduced from outside the system; however, we question the general application of this assumption at ISR sites. As discussed earlier, the initial deposition (precipitation) of uranium mineralization is uneven and alters the porosity and permeability of the host rock. The extraction and restoration processes at ISR sites are imperfect and further alter the distribution of the uranium in the deposit. Flow paths and velocities in local areas are altered as a result of changes in porosity and permeability that occur from the removal of material from pore spaces and later re-precipitation. It is possible that areas of heavy and lighter mineralization or groundwater concentrations can change from the distribution existing before uranium recovery to that after restoration, reflecting the degree to which the oxidizing and reducing agents contact the mineralization. As a result of these changes, ''hot spots'' may be found at wells that initially registered lower constituent concentration measurements, and vice versa.

Because of the site-specific nature of this variability, we are proposing today that operators utilize background measurements from across the wellfield, combined with appropriate statistical techniques, to determine restoration goals. As appropriate, goals may be developed for individual wells, groups of wells, or the entire wellfield. The point(s) of compliance for restoration will be determined by the operator and regulatory agency after a thorough technical evaluation of the operator's geophysical investigation.

D. Excursions

During the operational and restoration phases at an ISR wellfield, it is possible that lixiviant or byproduct fluids can escape the capture zones of the extraction wells and move toward the monitoring well ring surrounding the production zone. The placement of the injection and extraction wells, combined with their relative pumping rates, are designed to prevent such movement,[73] but heterogeneities in the aquifer characteristics and difficulties in maintaining perfect performance of the wellfield can lead to lateral excursions as well as excursions into overlying and underlying aquifers (*i.e.,* vertical excursions). Detecting these excursions is a prime focus of regulatory attention. Indicators of excursions (*e.g.,* increases in concentrations of certain indicator parameters, such as, but not limited to, chloride ion concentrations above the preoperational background) are typically defined in the license conditions, as are requirements for reporting excursions to the regulatory authorities and corrective action requirements once an excursion is detected. The excursion monitoring wells are positioned far enough away from the injection and extraction wells so as to not be affected by the production processes, but close enough to detect excursions in a timely manner. The spacing of wells within the monitoring ring must prevent contaminants from passing between the wells. The excursion monitoring wells should also be far enough from the aquifer exemption boundary to ensure that any necessary corrective action can be taken before a USDW is adversely impacted. We have seen instances where the outer monitoring ring is essentially coincident with the boundary of the exempted aquifer. We do not believe this practice is appropriate. While it may allow the operator to limit the amount of land dedicated to the ISR facility, it provides little margin for error in preventing contaminants from reaching protected aquifers (*i.e.,* USDWs), and may hamper corrective actions should they be needed.

Today we are proposing to adopt a definition of ''excursion'' consistent with that used by NRC in license conditions. Under this definition, an excursion is identified when two or more indicator parameters are measured at levels exceeding their upper control limits (essentially, background levels) at perimeter monitoring wells or in monitoring wells in overlying or underlying aquifers. Thus, an excursion can take place vertically between aquifers as well as horizontally within the aquifer from which uranium is being extracted.

This approach differs somewhat from that taken under RCRA to detect releases of hazardous constituents, so it is important that we distinguish between the two approaches and explain why our proposed approach is more suitable in the ISR context and consistent with law.

Monitoring under RCRA is conducted to detect any evidence that an engineered hazardous waste unit (*e.g.,* a landfill or impoundment) has failed. To that end, the detection monitoring program includes not only indicator parameters that might signal a change in groundwater chemistry or quality, but also hazardous constituents contained in the waste unit.[74] The statistically significant detection of any monitored parameter or constituent triggers further investigation and potentially corrective action. Because the engineered unit has been introduced into the environment and the monitoring takes place at the edge of the unit, it is unlikely that a detection can be attributed to the natural variability in the groundwater at the site. Detection of a single parameter or constituent appropriately triggers action in this case because, in addition to remediating groundwater, the failure of the unit itself must be addressed to prevent further releases.

By contrast, at an ISR site all constituents that may be ''released'' are part of the natural setting, and their presence in groundwater may vary over time. Only the lixiviant is introduced from outside the natural system. Therefore, the ''indicator parameters'' are typically those that most reflect the lixiviant properties. For example, chloride is often incorporated into the lixiviant as a tracer; similarly, because the lixiviant mobilizes uranium by increasing alkalinity, a significant increase in alkalinity at excursion monitoring wells may signal that lixiviant has escaped the production zone extraction wells. Because the lixiviant typically moves more rapidly than the mineral constituents, increases in the properties associated with the lixiviant will most likely be detected well before the other constituents reach the excursion monitoring wells. The presence of these parameters in the natural groundwater accounts for the reliance on detecting two such parameters at levels above their upper control limits to signal an excursion, rather than only one.

We believe this approach to defining excursions (*i.e.,* relying on two indicator parameters) is reasonable and has been shown to be workable in practice. We are also proposing to define ''upper

[73] EPA (2014). ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery Sites.''

[74] See 40 CFR 264.98.

control limit'' consistent with NRC's use of the term. The ''upper control limit'' defines the level of an indicator parameter that, when two of which are detected at excursion monitoring wells, would signal an excursion; as described above, indicator parameters will typically be identified in the facility license.

It is important that the upper control limits be set appropriately to account for both background levels of indicator parameters and the characteristics of the lixiviant. We agree with NRC that ''upper control limit concentrations of the chosen excursion indicators should be set high enough that false positives (false alarms from natural fluctuations in water chemistry) are not a frequent problem, but not so high that significant groundwater quality degradation could occur by the time an excursion is identified.'' [75] We have heard some concerns that upper control limits have in some cases been established at levels that would be unlikely to be exceeded under any conditions, thereby eliminating the possibility of detecting an excursion altogether. Such a situation must be avoided.

Upper control limits can be calculated using various statistical techniques, but are often derived by adding a multiple of the standard deviation to the mean of a distribution. EPA's Unified Guidance [76] covers methods that can be used to develop control limits or prediction limits, which serve a similar function. NRC staff describes its current view of acceptable practice in NUREG–1569 [77]: ''The staff has decided that in areas with good water quality (total dissolved solids less than 500 mg/l), setting the upper control limit at a value of 5 standard deviations above the mean of the measured [background] concentrations is an acceptable approach.'' [78]

The potential for excursions may also be a factor in the facility's decision to stop operations and enter the restoration phase. In some cases, conventional mills may enter a standby period, in which they stop processing ore with the intent to resume operations at some point in the future (the price of uranium is often the decisive factor in these decisions). In some cases, mills have remained on standby for years at a time. For an ISR facility, however, such a ''standby'' period is inappropriate because the migration of constituents mobilized by the prior injection of lixiviant continues even if the decision is made to stop extracting uranium. Excursions beyond the production zone are more likely to occur if the gradient within the wellfield is not maintained. In our view, stopping the extraction cycle must be interpreted as an end to the operational phase and should trigger initiation of the restoration phase. We are interested in stakeholder views on this interpretation.

E. Long-Term Stability Monitoring

Perhaps the most significant aspect of today's proposal involves the actions to be taken by the operator after groundwater restoration is complete. If insufficient monitoring is conducted, either in duration, frequency, or in the number of wells used to sample the wellfield, it is very possible to reach premature conclusions of stability. In such cases, residual lixiviant or localized areas within the production zone that have not stabilized may cause continued mobilization of uranium and other constituents after monitoring is terminated, potentially leading to contamination downgradient or beyond the boundary of the exempted aquifer. Today's proposal contains provisions related both to the duration of the monitoring and to the sufficiency of the data necessary to determine that stability has been achieved.

After the ISR operational phase ends, the altered chemical state has to be returned to the preoperational conditions, to the extent possible, so that uranium and other contaminants do not migrate outside the wellfield. Treatments to re-establish chemically reducing conditions (which greatly reduce the uranium concentration in the ore zone groundwater) can restore groundwater constituents to preoperational background levels to a large extent, although experience has shown that restoration of all constituents to the preoperational background level is seldom 100 percent successful.[79] In addition, the chemically reducing conditions initially present, and the mechanisms that maintained these conditions originally, may not be restored sufficiently to persist over the long-term. Re-oxidation of treated groundwater-host rock systems in other situations has been observed, and post-restoration monitoring at ISR locations has historically been relatively short, typically six months to periods of no more than a few years. A slow re-oxidation process with the resulting potential for enhanced migration of uranium and other contaminants may not be detected during a relatively short post-restoration monitoring period. Such an event could occur if the oxidizing agents in the lixiviant significantly removed the reducing agents originally present in the ore zone (*e.g.,* organic material and iron sulfide minerals) that were responsible for sequestering the uranium to form the ore deposit in the first place. Over time, naturally oxygenated waters entering the ore zone from up gradient could re-oxidize the uranium removed from solution during the restoration process, mobilizing it once again and transporting it downgradient beyond the wellfield. To determine whether a trend of increased concentrations is occurring, it is necessary to monitor over long periods of time and use statistical techniques to analyze the data. This is particularly important if the trend in increased concentrations is relatively slow and the natural variability in the well samples is relatively high. These difficulties point to the need for longer post-restoration monitoring periods than historically performed. However, as discussed earlier, the choice of appropriate statistical techniques to determine the presence or absence of trends in monitoring data can be complicated by shortcomings in the monitoring database, such as missing measurements, ''nondetects,'' analytical errors and other causes that are difficult to avoid in practice for long timeframe monitoring efforts.[80] We have considered several options for the length of the long-term stability monitoring period as described below.

1. Thirty-Year Long-Term Stability Monitoring Period, With Provisions for Shortening That Time Period

The initial part of our proposal for long-term stability monitoring addresses the duration of monitoring. Specifically, we are proposing that a facility must demonstrate three consecutive years of stability monitoring and then maintain long-term stability monitoring for an additional period of 30 years; this timeframe can be shortened by demonstrating long-term geochemical stability through modeling, as described below. In determining the appropriate length of long-term stability monitoring to provide confidence that the restored wellfield conditions will remain stable over time, and considering our statutory direction for consistency with RCRA

[75] See NRC (2003). ''Standard Review Plan for In Situ Leach Uranium Extraction License Applications.'' NUREG–1569, page 5–40.

[76] EPA (2009). ''Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance.''

[77] NRC (2003). ''Standard Review Plan for In Situ Leach Uranium Extraction License Applications.'' NUREG–1569.

[78] Ibid, page 5–41.

[79] EPA (2014). ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery Sites.''

[80] Ibid.

requirements, we find that some direction can indeed be found in the RCRA regulatory framework. For RCRA hazardous waste disposal facilities, a post-closure monitoring period of thirty years is required before permit termination can occur.[81] Since an engineered RCRA disposal facility for the containment of chemically hazardous waste is similar in concept to relying upon a chemically treated ISR wellfield to contain the potential spread of contaminants, we believe it is reasonable to conclude that a thirty-year long-term stability monitoring period for ISR activities is a consistent application of RCRA requirements. We have examined various statistical techniques for determining the presence or absence of trends in monitoring data, under assumed levels of natural variability and extent of trending, and concluded that, under reasonable values for these variables, a thirty-year monitoring period is a reasonable length of time to detect upward trends in constituent concentrations.[82]

We recognize that a thirty-year monitoring period would be significantly longer than current practice and that stability may be achieved in a shorter timeframe. Therefore, we are also proposing a provision that would allow the regulatory agency to shorten the monitoring period[83] if the operator can both demonstrate geochemical stability through monitoring and support a conclusion of long-term stability through geochemical modeling. We believe that modeling, which can provide confidence that a geochemical environment exists to prevent uranium and other constituents from re-mobilizing, is an important element of any decision to shorten the monitoring period. Further, we believe this provision will encourage operators to expend more effort in preoperational site characterization, which will improve their modeling efforts.[84]

We are proposing that three consecutive years of stability be demonstrated through monitoring as a prerequisite before the modeling would be considered as justification for reducing the monitoring period. The three-year stability demonstration begins when sufficient monitoring data have been collected to allow a showing of statistical significance at a specified level of confidence. This three-year demonstration period has its roots in the RCRA framework, where it is a metric for the success of corrective action after groundwater contamination has been detected.[85] We also see this situation as analogous to the restoration of the ISR wellfield. Stability would be demonstrated statistically at the 95 percent confidence level, which we believe will help to ensure that operators collect data of sufficient quantity to support regulatory judgments. Stability would be demonstrated using statistical tests with sufficient power to detect trends with a false negative rate no higher than 5 percent. We believe this will ensure that operators collect data of sufficient quantity and quality with adequate power to support regulatory judgments. As noted in Section II.E.2 of this document, a 95 percent confidence threshold can also be found in the RCRA monitoring program.

2. What Other Options Did EPA Consider For the Long-Term Stability Monitoring Period?

In addition to the option described above, EPA considered two alternatives related to the duration of long-term stability monitoring. We are interested in receiving comments and data on all three options described.

a. Required Thirty-Year Long-Term Stability Monitoring Period

The second option we considered also relies on the RCRA regulatory framework. In this alternative, no provision for shortening the long-term stability monitoring time frame is permitted; thirty years of groundwater monitoring is required. This alternative provides a significant increase in the monitoring period over current industry practice, and the extended time would provide added confidence that the restored wellfield chemistry is remaining stable through this period of time. Thirty years of consistent statistical performance (*i.e.,* no upward trending) would provide strong support for concluding that groundwater systems will remain in a chemically reduced state over time. If upward trending of contaminant concentrations was observed during the monitoring period under this approach, the operator would be required to perform additional corrective action, after which the monitoring period would begin again. We ultimately decided not to pursue this option because it does not sufficiently recognize the site-specific aspects of aquifer restoration or give operators the incentive to reach license termination sooner by conducting geochemical modeling.

b. Narrative Standard With No Fixed Monitoring Period

We also considered the option of a performance-based standard without explicitly calling for a long-term monitoring period. We considered requiring that two conditions be met (*i.e.,* return of the physical hydrologic system to a condition similar to the preoperational flow regime and stability of the geochemical environment) before license termination. To meet the first condition, return of the physical hydrologic system, no significant residual influences from the injection-extraction restoration cycle could remain after restoration. This would include conditions such as hydraulic head and flow direction. Depending on the site, this would likely take many months and perhaps a year or more. To meet the second condition, stability of the geochemical environment, the operator would have to show that the groundwater chemistry is statistically stable at a 95 percent confidence level for a duration of time sufficient to account for site conditions. These site conditions would include such things as variability of constituents in the wellfield, groundwater velocity, constituent travel times and any seasonal influences. We expect it to take at least several years to collect data sufficient to achieve the 95 percent confidence level. With this approach, the regulatory agency would have maximum flexibility in determining whether to establish general

[81] See 40 CFR 264.117(a)(1).

[82] EPA (2014). ''Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery Sites.''

[83] This decision authority is also present in RCRA regulations: ''. . . any time during the post-closure period for a particular unit, the Regional Administrator may . . . shorten the post-closure care period applicable to the hazardous waste management unit. . . if he finds that the reduced period is sufficient to protect human health and the environment . . .'' 40 CFR 264.117(a)(2).

[84] The Agency recently took a similar approach in defining the post-injection monitoring timeframe applicable to Class VI wells used for carbon dioxide geologic sequestration. Owners or operators of Class VI injection wells are required to monitor for at least 50 years after the cessation of injection, unless an alternative timeframe is approved. Further, the monitoring period can be shortened if it can be demonstrated, based on monitoring and other site-specific data, that the project no longer poses an endangerment to USDWs. See 40 CFR 146.93(b).

[85] ''If the owner or operator is engaged in a corrective action program at the end of the compliance period specified in paragraph (a) of this section, the compliance period is extended until the owner or operator can demonstrate that the ground-water protection standard of § 264.92 has not been exceeded for a period of three consecutive years.'' 40 CFR 26.96(c). ''The owner or operator may terminate corrective action measures taken beyond the period equal to the active life of the waste management area (including the closure period) if he can demonstrate, based on data from the ground-water monitoring program under paragraph (d) of this section, that the ground-water protection standard of § 264.92 has not been exceeded for three consecutive years.'' 40 CFR 264.100(f).

requirements or approach each site on an individual basis.

Ultimately, we decided against this approach for several reasons. Statistical analyses alone, without the added requirement of long-term monitoring or the option of geochemical modeling, would provide no assurance that groundwater systems will remain in a chemically reduced state over a longer time frame than that used for data collection. Furthermore, this option does not incorporate RCRA's thirty-year post-closure period. As previously stated, UMTRCA requires that generally applicable standards promulgated under its authority by EPA for non-radiological hazards be consistent with the standards issued under Subtitle C of RCRA. Based on these two reasons, we feel that this approach has greater potential for premature termination of the license. Furthermore, ambiguity in the narrative nature of such standards has the potential to provoke litigation and make implementation difficult.

3. How will groundwater stability be determined?

The success of a groundwater restoration effort will be measured ultimately not only by whether the restoration goals are achieved, but also by whether those levels can persist and the geochemistry of the groundwater remain stable in the long term. The primary intent of the restoration effort is to return the chemical condition of the groundwater in the production zone to the state that existed prior to the initiation of the ISR operations; restoring the hydrologic regime is also important. The persistence in time (*i.e.,* stability) of the chemical condition developed during restoration is the ultimate measure of success for the aquifer restoration effort. We define stability as the state in which the concentrations of the constituents in the groundwater remain relatively constant over time, with no significant upward trending. The key factor in determining stability, then, is developing a meaningful measure by which to determine whether trending is occurring. Such a measure must address the sufficiency of the data collected, both over time and in its spatial distribution within the wellfield. We discussed the proposed monitoring timeframes in the previous section. The remainder of this section describes how we propose to determine whether groundwater chemistry is stable and where we propose to apply this method.

a. What do we propose for determining stability?

There are some similarities between a hazardous waste land disposal situation and an ISR operation that allow us to draw on the RCRA experience for developing standards. Both the RCRA disposal technology and the post-operation aquifer restoration efforts for an ISR operation are intended to prevent contaminants from migrating in the environment. However, there are some differences that apply to developing ISR standards. An ISR production zone differs from a hazardous waste disposal situation in that the contaminants of potential concern (largely uranium and radium) were present at significant levels entrained within the host rock of the aquifer before ISR operations began and will still be present, to some extent, in the groundwater after the aquifer restoration effort has ended; the process will not completely remove them. The concentrations of contaminants of potential concern are subject to natural temporal variations both before and after ISR operations, and this variability must be taken into consideration in setting standards for judging the adequacy of aquifer restoration. Because of this natural variability, repeated sampling of the post-restoration groundwater must be done to judge the adequacy of the restoration process. To assess when the chemical condition in the wellfield groundwater has become stable, statistical measures and analyses are necessary for examining temporal variations in the water composition data collected over a period of time. Today we are proposing to establish a statistical level of confidence as the standard for determining stability of post-restoration groundwater. We believe this is a relatively simple and straightforward way to represent the level of rigor we believe is necessary to conclude that concentrations of important constituents in the groundwater are not increasing significantly over time.

Determining when groundwater compositions have achieved temporal stability will be a site-specific decision, dependent on the natural variability at the site, which is in turn dependent on many site-specific factors (*e.g.,* spatial variations in uranium mineral distribution within the aquifer, variations in other chemical constituents that affect uranium dissolution), the frequency of sample collection, and the magnitude of any trends in composition that may be present relative to the magnitude of natural variability. Chapter 7 of the technical background information document supporting this rulemaking discusses these aspects of stability monitoring in much greater detail and illustrates the relationships between sampling frequency and data trends with time.[86] Because of the site-specific interplay between the variables that affect stability, we are not proposing to specify what statistical methods the operator should use to make this determination. There are a variety of methods available that could prove appropriate given the specific conditions at each site. These would include both parametric and non-parametric methods. We recommend that readers consult EPA's "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance" (2009), which provides exhaustive discussion of methods that have been considered for use in the RCRA program. Further discussion of statistical methods for determining trends in groundwater data may also be found in EPA's technical background information document, which was prepared to support this proposal.[87] We emphasize that the choice of statistical method must be based on the quantity and quality of the available data and must be justified accordingly to the implementing regulatory agency.

The intent of the statistical analysis of groundwater monitoring data is to avoid a situation where a wellfield that is unstable is judged to have reached temporal and spatial stability. An appropriate statistical analysis will help to ensure that the regulatory decision reflects a high degree of confidence in the interpretation of the monitoring data. We are proposing that a statistical confidence level of upper 95 percent confidence limit be used to determine stability over time. This level of confidence is often used in regulatory applications, including in the RCRA groundwater monitoring framework.[88] We believe that an equivalent level of confidence, and its implications for sampling and analysis of groundwater composition data, is appropriate for consistency with RCRA approaches and requirements and the statutory direction applicable to this rulemaking. We believe a confidence level of this rigor will make it necessary for operators to collect an appropriate amount of data that clearly demonstrates that the restored ISR aquifer is geochemically stable and that UMTRCA requirements have been met. The frequency of

[86] EPA (2014). "Considerations Related to Post Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery Sites."

[87] *Ibid.*

[88] See 40 CFR 264.97(h) & (i).

sampling that will provide meaningful data must be determined from site-specific conditions, such as groundwater flow rates. Another consideration is that stability sampling may be misleading if the operator has not allowed sufficient time for the natural system to recover to the point where the injection-extraction cycle is no longer influencing groundwater flow parameters in the wellfield, particularly in the immediate area around the monitoring wells.

b. Where will the determination of stability be made?

We have noted that a restored ISR wellfield essentially functions as a RCRA hazardous waste management unit. In this sense, when restoration is completed successfully, and the chemistry of the groundwater has been returned to a reducing environment, the uranium and other constituents that were mobilized are essentially ''locked in'' to the subsurface, as are hazardous constituents that are contained by RCRA engineered units. Following this reasoning, it might be considered appropriate for the outer boundary of the restored ISR wellfield to be designated as the point of compliance with the groundwater standards. However, we are not proposing to take this approach.

Today we are proposing that each well within the wellfield be considered for use as a point of compliance for purposes of determining stability after restoration is determined to be complete (note that today's proposal does not address the point of compliance for the regulatory agency's determination that restoration is complete, which may be a more complicated matter). We believe that this is appropriate given the size of some wellfields (on the order of hundreds of acres) and the significant variability that is typically present in the mineralized zone. We believe such an approach will more readily inform both the operator and regulatory agency of localized trending, which may then be remedied as appropriate. If the licensee is able to demonstrate that a particular well is sufficiently representative of groundwater conditions in a larger area, the regulatory agency may approve the use of one well to demonstrate stability in the area covered by a larger number of wells.

F. Institutional Control

Institutional controls are intended to maintain long-term cognizance of the nature and location of particular activities that were done at a specific site, in this case the location of the uranium ore zone exploited by an ISR process. Institutional controls can prevent inadvertent intrusions or adverse consequences for future use of the site. Institutional controls are commonly described as active or passive. Active controls are measures such as guards and fences posted around a site. Passive controls could be the erection of signs or placards at a site.

We are not proposing to establish institutional controls for ISR facilities. Active maintenance of the site will cease with the termination of the license, which will occur when the regulatory agency determines that all license conditions have been met. In this sense, we do not view the long-term stability monitoring period as an institutional control following the ISR restoration phase; rather, we view it as a period of active surveillance to determine the long-term success of the restoration effort.

Nor are we proposing to establish passive controls, either at the site or in documents such as local land records. Requirements for survey plats or other records to be maintained would be consistent with RCRA requirements for hazardous waste facilities; however, these typically apply when waste management units remain at the site and are intended to restrict disturbance of the site.[89] Though we are not proposing that such records be established for ISR sites, we strongly encourage NRC and Agreement States to include such provisions in ISR licenses since ISR sites will not be restricted from sale or further development. Such provisions could simply inform the subsequent owner of the previous ISR, groundwater restoration activities and aquifer exemption on the property.

G. Other Proposed Amendments

EPA has identified several non-ISR related provisions within 40 CFR part 192 that should be updated and amended. The issues that we propose to address today include:

- Amending § 192.32 to address a ruling of the Tenth Circuit Court of Appeals;
- Deleting reference to Grand Junction Remedial Action Criteria (10 CFR 712) at § 192.20(b)(3) since the criteria have been removed from the Code of Federal Regulations (CFR); and
- Correcting minor typographical and grammatical errors found in §§ 192.31 and 192.32.

1. Judicial Decisions

Section 192.32 has been affected by a ruling from the Tenth Circuit Court of Appeals. Under § 192.32(a)(2)(v), NRC was required to obtain EPA concurrence for approval of ACLs in groundwater restoration. This provision was effectively struck down by the Tenth Circuit Court of Appeals in *Environmental Defense Fund* v. *U.S. Nuclear Regulatory Commission,* 866 F.2d 1263, 1268–1269 (10th Cir. 1989), when the Court ruled that NRC has authority under AEA section 84(c) to independently make these site-specific ACL determinations, and that NRC has no duty to obtain this EPA concurrence. Therefore, today we are proposing to revise 40 CFR 192.32(a)(2)(v) by deleting this EPA concurrence requirement.

2. Miscellaneous Updates and Corrections

EPA is proposing an amendment to address an area of part 192 where reference is made to another environmental regulation that has since been removed from the CFR. EPA is also proposing several technical corrections to address known typographical and grammatical errors.

a. Outdated Cross-Reference

Section 192.20(b)(3) refers to criteria that no longer exist in the CFR. Because of this, EPA is proposing to eliminate reference to the Grand Junction Remedial Action Criteria, which once existed at 10 CFR part 712.

In addition, language in § 192.20(b)(3) cites methods that did not prove effective during the Grand Junction Remedial Action Program.[90] The final report for the program clearly states that filtration (by high efficiency filters or by electrostatic precipitators) and sealants (mainly epoxy-based resins) were not effective over the long term, and were not recommended as remedial options for radon mitigation.[91] EPA proposes to eliminate the language referencing sealants and filtration.

b. Technical Corrections

Since promulgation of 40 CFR part 192, several typographical and grammatical errors have been identified. Today, EPA is proposing amendments in §§ 192.31(a), 192.31(f) and 192.32(a)(2)(v) to address these technical errors (*e.g.,* spelling mistakes, misplaced comma).

[89] See 40 CFR 264.116 and 264.119.

[90] In 1972, Public Law 92–314 created the Grand Junction Remedial Action Program to reduce radiation exposures inside structures affected by uranium tailings. The U.S. Surgeon General published cleanup guidelines for the voluntary project.

[91] Colorado Department of Health (1989). ''Final Report on the Grand Junction Remedial Action Program.''

V. Summary of Environmental, Cost and Economic Impacts

A. What are the impacts to groundwater?

EPA has conducted a qualitative assessment of the benefits of the proposed rule and the expected effects on human and environmental health.[92] The rule would require thorough characterization of background groundwater conditions within the ore zone and surrounding aquifers, and would put in place an automatic updating feature so that the requirements affecting ISR operations are always consistent with requirements of the SDWA and the RCRA. The proposed rule would also require a longer period of monitoring, 30 years, to ensure that conditions in the exempted aquifer had been restored, achieved steady-state and remain stable. Further, EPA allows facilities to use geochemical modeling to demonstrate that groundwater conditions will remain stable, and thereby reduce the duration of stability monitoring to less than 30 years. These provisions help to ensure that, after the ISR operation's license is terminated and the site is closed, groundwater conditions do not deteriorate. Since a closed ISR facility has no regulatory oversight, EPA expects that the improved monitoring program being proposed will reduce the risk of contaminating valuable groundwater resources, thus also reducing unintended exposure of human and ecological receptors to radiological and non-radiological constituents in groundwater. To the extent that such exposures are reduced, associated human health risks such as cancer may also be reduced.

Groundwater is a valuable resource, particularly in the Western United States where uranium ISR is most common. Although EPA is unable to quantify the value of the groundwater resources that would be protected by the proposed rule, EPA nevertheless believes that the groundwater resources are likely to become more valuable over time. Reducing the risk of contamination of groundwater also protects surface water bodies to which affected aquifers discharge. If groundwater near an ISR facility were to become contaminated due to re-mobilization of uranium and other constituents, it might be many years before the contamination was discovered, especially under current practice where stability monitoring only lasts a year or two. Benefits associated with protecting other potential services provided by groundwater are also expected.[93]

B. What are the benefits of avoiding impacts to groundwater?

In order to illustrate the potential benefits of avoiding impacts to groundwater, EPA estimated the costs of corrective action that would be required if uranium and other constituents remobilized in groundwater over time, resulting in contamination.[94] By preventing groundwater contamination (or causing it to be discovered sooner), the proposed rule reduces the corrective action costs incurred to remediate the contamination. Based on groundwater contamination simulations (using a model facility approach under varying assumptions), the cost of remediation would far exceed the costs of complying with the proposed rule, both on an annual and total basis. Using a hydrological model, EPA estimated that cleaning up the plume of contamination could require 100 years of pump and treat remediation. In addition, if contamination were detected after decommissioning of a site, it is possible that the costs of remediation would be borne by the taxpayer or by the owner of the property, rather than by the uranium company responsible. Because we cannot anticipate how many ISR operations might experience deteriorating groundwater conditions after decommissioning or how long it would be before the contamination would be detected, EPA was unable to estimate potential avoided costs of remediation on a national scale. However, EPA believes they could be substantial.

C. What are the cost impacts?

Using information about the uranium extraction industry and estimated incremental costs that would result from the rule as proposed today, EPA examined the economic impacts that may result from the revisions to 40 CFR part 192.[95]

EPA's study estimates that affected ISR operators would incur costs to comply with the proposed rule, which would require comprehensive pre-operational characterization of the site (including characterization of geochemical conditions downgradient of the production zone), careful monitoring during the operation, restoration of groundwater quality, at least three years of stability monitoring, and 30 years of long-term stability monitoring, with the potential to shorten the duration based on modeling and monitoring of downgradient geochemical conditions. Using existing ISR operations as models for ISR operations that would be affected by the rule, projecting that 2015 ISR uranium production will be 9.5 million pounds, and using average estimated costs of complying with the proposed rule, EPA estimates that the proposed rule would increase the average cost of uranium production at ISR facilities by approximately $1.50 per pound of uranium (2.9%), and that annual costs incurred by individual ISR facilities would vary from $304,000 to $9.5 million, depending on the scale of the ISR facility. Nationally, EPA estimates that the incremental total annual cost of the proposed rule would be approximately $13.5 million. Discounted at 7%, the estimated present value of the stream of national costs would be approximately $181 million. Discounted at 3%, the estimated present value of national costs would be approximately $290 million.

EPA estimated the impact of the proposed rule on the market for uranium using a simplified model of the U.S. market for uranium in 2015. The partial equilibrium model estimated market impacts and revealed: (a) Changes in the quantity of uranium purchased by U.S. civilian owners and operators of nuclear power plants, (b) changes in the domestic sales of uranium and imports, and (c) changes in the market price for uranium. EPA found that overall, the market quantity of uranium purchased for use in electric generation would decline by less than 0.1% and the market price would increase by approximately 0.4%. Domestic ISR facilities would decrease their production by approximately 3.8%, and imports of uranium would increase by less than 1%. Because the cost of uranium is a very small share of

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[92] See EPA (2014). ''Economic Analysis: Proposed Revisions to the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings Rule (40 CFR part 192).'' This document which can be found in the docket for this proposed rule. (Docket EPA–HQ–OAR–2012–0788).

[93] See Committee on Valuing Ground Water, National Research Council (1997), ''Valuing Ground Water: Economic Concepts and Approaches,'' which discusses both the extraction value (*e.g.,* value of groundwater used for drinking water, industrial water supply, and agriculture) and the value of in situ services (*e.g.,* buffer against periodic shortages in surface water supplies, protect water quality by maintaining the capacity to dilute and assimilate groundwater contaminants, etc.).

[94] See EPA (2014). ''Economic Analysis: Proposed Revisions to the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings Rule (40 CFR part 192).''

[95] EPA (2014). ''Economic Analysis: Proposed Revisions to the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings Rule (40 CFR part 192).''

the cost of electricity, EPA estimates that the cost of generating electricity would increase by less than 0.1%. Although the national total annual cost of the proposed rule (approximately $13.5 million, based on average costs) is well below the $100 million threshold that is one of the criteria used to identify a significant regulatory action, the industry has only a small number of companies operating a small number of ISR operations. EPA used existing ISR operations and the companies that own them as models for the types of facilities and companies that would potentially be affected by the proposed rule. EPA thus estimated that individual ISR facilities could incur annual costs of compliance between $304,000 and $9.5 million, depending on the characteristics of the ISR facility and the costing assumptions used.[96] For small firms owning ISR facilities, EPA's analysis estimates cost-to-sales ratios of 0.6% to 1.7%. Because costs are generally less than 2% of company sales, EPA estimates that compliance costs would not cause a significant impact. Further, EPA estimates that only a few small businesses (ten or fewer, based on current information) would be affected by the proposed rule at a given time. Thus, EPA concludes that the rule would not have a significant impact on a substantial number of small entities.

VI. Statutory and Executive Orders Review

A. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review

Under Executive Order 12866 (58 FR 51735, October 4, 1993), this action is a ''significant regulatory action.'' The Executive Order defines ''significant regulatory action'' as one that is likely to result in a rule that may ''raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.''

Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under Executive Orders 12866 and 13563 (76 FR 3821, January 21, 2011) and any changes made in response to OMB recommendations have been documented in the docket for this action.

B. Paperwork Reduction Act

This action does not impose an information collection burden under the provisions of the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.;* no reporting requirements are imposed on affected facilities by this rule. This rule will not in-and-of itself create any new information collection requirements that require approval of the OMB.

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information.

An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations in 40 CFR are listed in 40 CFR part 9.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of today's rule on small entities, small entity is defined as: (1) A small business whose company has less than 500 employees and is primarily engaged in leaching or beneficiation of uranium, radium or vanadium ores as defined by NAIC code 212291; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. Of these three categories, only small businesses are potentially affected by the proposed rule; no small organizations or small governmental entities have been identified that would be impacted by the proposed revisions to part 192.

This proposed rule is estimated to impact approximately 18 uranium recovery facilities that are currently operating or may operate in the near future. The 18 uranium recovery facilities are owned by 10 firms, of which eight are believed to be small.

The proposed revisions to 40 CFR part 192 would apply to the six ISRs operating in 2013. These ISRs are as follows: (1) Crow Butte (Nebraska) and (2) Smith Ranch-Highland (Wyoming), owned by Cameco Resources; (3) Alta Mesa (Texas), owned by Mestena Uranium, LLC; (4) Willow Creek (Wyoming), owned by Uranium One, Inc.; (5) Hobson-La Palangana (Texas), owned by Uranium Energy Corp.; and(6) Lost Creek(Wyoming), owned by Ur-Energy Inc. Using the fewer than 500 employees' criterion Mestena Uranium, LLC, Ur-Energy, Inc., and Uranium Energy Corp. qualify as small businesses, while Cameco Resources and Uranium One, Inc. are both large businesses.

In addition to the six ISRs operating in 2013, an additional ISR has been licensed in the state of Wyoming: Nichols Ranch, owned by Uranerz Uranium Corp. Uranerz Uranium Corp. qualifies as small business.

Eleven other ISRs are at some stage of licensing or permitting, or are undergoing restoration. These include: (1) Dewey-Burdock in South Dakota owned by Powertech Uranium Corp.; (2) Moore Ranch in Wyoming, owned by Uranium One, Inc.; (3) Kingsville Dome, (4) Rosita, and (5) Vasquez, all in Texas and owned by Uranium Resources Inc.; (6) Crownpoint and (7) Church Rock, both in New Mexico and owned by Uranium Resources Inc.; (8) Ross in Wyoming, owned by Strata Energy, Inc., (9) Goliad in Texas, owned by Uranium Energy Corp.; (10) Antelope-Jab in Wyoming, owned by Uranium One, Inc., and (11) Reno Creek in Wyoming, owned by Bayswater E&P. All of these companies, except for Uranium One, Inc., are small businesses.

To evaluate the significance of the economic impacts of the proposed revisions to 40 CFR part 192, EPA estimated the costs that would be incurred by existing facilities, based on their estimated production and EPA's estimated cost per pound of U_3O_8.

[96] See sensitivity analysis results in Table D–1 of EPA (2014). ''Economic Analysis: Proposed Revisions to the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings Rule (40 CFR part 192).'' The total estimated wellfield acreage for most ISR operations is under 500 acres (see Table 3–7 of EPA EA(2014). ''Economic Analysis: Proposed Revisions to the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings Rule (40 CFR part 192).''

Of the 18 ISR facilities identified above, 13 are owned by a total of eight small businesses; the other five are owned by two large businesses. EPA's economic impact analysis estimated that for the three small firms currently operating ISR facilities, costs of the proposed rule would range from 0.6% to 1.7% of estimated company sales, depending on the costing assumption used. Because the costs are generally estimated to be less than 2% of sales, impacts for these firms would not be significant. In addition, fewer than 10 small firms are likely to be affected by the proposed rule at any time, so the number of firms potentially incurring costs to comply with the rule is not a substantial number. Thus, EPA concludes that the proposed rule would not result in a significant impact to a substantial number of small entities.

No small organizations or small governmental entities have been identified that would be impacted by the proposed revisions to 40 CFR part 192. We continue to be interested in the potential impacts of the proposed rule on small entities and welcome comments on issues related to such impacts.

After considering the economic impacts of this proposed rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities.

D. Unfunded Mandates Reform Act

This rule does not contain a Federal mandate that may result in expenditures of $100 million or more for State, local and Tribal governments, in the aggregate, or the private sector in any one year. Using the six ISR operations operating in 2013 as examples of typical ISR facilities, EPA estimates that total annual costs of complying with the rule for six such ISR facilities, would be $13.5 million. The proposed rule imposes no enforceable duties on any State, local or Tribal governments or the private sector. Thus, this rule is not subject to the requirements of sections 202 or 205 of UMRA.

This rule is also not subject to the requirements of section 203 of UMRA because it contains no regulatory requirements or obligations that might significantly or uniquely affect small governments; the rule does not contain requirements that apply to such governments nor does it impose obligations upon them.

E. Executive Order 13132: Federalism

This proposed rule does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. None of the facilities subject to this action are owned and operated by State governments, and nothing in the proposed rule will supersede State regulations. Thus, Executive Order 13132 does not apply to this proposed rule.

EPA recognizes that Agreement States will have a substantial interest in this rule revision since they have primary responsibility for implementation of 40 CFR part 192 standards. In the spirit of Executive Order 13132 and consistent with EPA policy to promote communications between EPA and State and local governments, EPA specifically solicits comment on this proposed rule from State and local officials.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

This action does not have tribal implications, as specified in Executive Order 13175 (65 FR 67249, November 9, 2000). The action imposes requirements on licensees of ISR facilities and not tribal governments. Although Executive Order 13175 does not apply to this action, EPA sought opportunities to provide information to tribes and tribal representatives during the review of 40 CFR part 192. EPA specifically solicits additional comment on this proposed action from tribal officials.

G. Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks

EPA interprets Executive Order 13045 (62 FR 19885, April 23, 1997) as applying to those regulatory actions that concern health or safety risks, such that the analysis required under section 5–501 of the Order has the potential to influence the regulation. Because this action addresses environmental standards intended to mitigate health or safety risks, it is subject to Executive Order 13045. We evaluated several regulatory strategies for assuring groundwater restoration and stability at ISR facilities and selected the option providing most assurance that groundwater systems will remain in a chemically reduced state, thereby limiting contamination of groundwater. The proposed rule is expected to reduce children's risk of exposure to contaminated groundwater by improving monitoring to detect and correct contamination.

H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution or Use

This action is not a ''significant energy action'' as defined in Executive Order 13211 (66 FR 28355, May 22, 2001), because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. This proposed rule will not adversely directly affect productivity, competition, or prices in the energy sector.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (''NTTAA''), Public Law 104–113, 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.,* materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This proposed rulemaking does not involve technical standards of the type indicated in NTTAA. Therefore, EPA is not considering the use of any voluntary consensus standards.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (59 FR 7629, Feb. 16, 1994) establishes federal executive policy on environmental justice. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

EPA has determined that this proposed rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it increases the level of environmental protection for all affected populations without having any disproportionately high and adverse human health or environmental effects on any population, including any minority or low-income population. This proposed rule addresses groundwater restoration, monitoring and protection of surrounding aquifers and thus decreases the potential groundwater contamination to which all affected populations are exposed. Thus, the proposed rule is projected to have positive, not adverse impacts on human health and the environment.

List of Subjects in 40 CFR Part 192

Environmental protection, Hazardous substances, Radiation protection, Radioactive materials, Reclamation, Uranium, Waste treatment and disposal, Water resources.

Dated: December 31, 2014.

Gina McCarthy,

Administrator.

For the reasons stated in the preamble, the Environmental Protection Agency proposes to amend title 40, Chapter I of the Code of Federal Regulations as follows:

PART 192—[AMENDED]

■ 1. The authority citation for 40 CFR part 192 continues to read as follows:

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.

■ 2. Section 192.20 is amended by revising paragraph (b)(3)as follows:

Subpart C—[Amended]

§ 192.20 Guidance for implementation.

* * * * *

(b) * * *

(3) Compliance with § 192.12(b) may be demonstrated by methods that the Department of Energy has approved for use or methods that the implementing agencies determine are adequate. Residual radioactive materials should be removed from buildings exceeding 0.03 WL so that future replacement buildings will not pose a hazard [unless removal is not practical—see § 192.21(c)]. However, ventilation devices and other radon mitigation methods recommended by EPA may provide reasonable assurance of reductions from 0.03 WL to below 0.02 WL. In unusual cases, indoor radiation may exceed the levels specified in § 192.12(b) due to sources other than residual radioactive materials. Remedial actions are not required in order to comply with the standard when there is reasonable assurance that residual radioactive materials are not the cause of such an excess.

* * * * *

Subpart D—[Amended]

■ 3. The heading for Subpart D is amended by revising the language to read as follows:

Subpart D—Standards for the Management of Uranium Byproduct Materials

■ 4. Section 192.31 is amended by:

■ a. Revising paragraph (a).

■ b. Revising paragraph (f).

■ c. Revising the second sentence of paragraph (m).

The revisions read as follows:

Subpart D—Standards for the Management of Uranium Byproduct Materials

* * * * *

§ 192.31 Definitions and cross-references.

(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.

* * * * *

(f) *Disposal area* means the region within the perimeter of an impoundment or pile containing uranium byproduct materials to which the post-closure requirements of § 192.32(b)(1) of this subpart apply.

* * * * *

(m) * * * This term shall not be construed to include extraordinary measures or techniques that would impose costs that are grossly excessive as measured by practice within the industry or one that is reasonably analogous (such as, by way of illustration only, unreasonable overtime, staffing or transportation requirements, etc., considering normal practice in the industry; laser fusion of soils, etc.), provided there is reasonable progress toward emplacement of a permanent radon barrier. * * *

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■ 5. Section 192.32 is amended by revising paragraph (a)(2)(v) as follows:

§ 192.32 Standards

* * * * *

(a) * * *

(2) * * *

(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.

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■ 6. Part 192 is amended by adding subpart F to read as follows:

Subpart F—Public Health, Safety and Environmental Protection Standards for Byproduct Materials Produced by Uranium In-situ Recovery

Sec.

Subpart F—Public Health, Safety and Environmental Protection Standards for Byproduct Materials Produced by Uranium In-Situ Recovery

§ 192.50 Applicability.

This subpart applies to the management of uranium byproduct materials prior to, during and following the processing of uranium ores utilizing uranium in-situ recovery methods, and to the restoration of groundwater at such sites. Unless otherwise specified, all wellfields shall comply with this subpart as of the effective date of this rule.

§ 192.51 Definitions and cross-references.

(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, B, and D of this part, or parts 190, 260, 261, and 264 of this chapter.

(b) *Adjacent Aquifer.* An aquifer or portion of an aquifer that shares a border or end point with the exempted aquifer or the exempted portion of an aquifer.

(c) *Alternate Concentration Limit (ACL).* Concentration limit approved by the regulatory agency for a groundwater constituent that has not been restored to its restoration goal after best practicable restoration activities have been completed following the process prescribed in 40 CFR 192.52(c)(2) thru 192.52(c)(5) of this subpart.

(d) *Aquifer.* A geological ''formation,'' group of formations, or part of a formation that is capable of yielding a significant amount of water to a well or spring. See 40 CFR 144.3.

(e) *Background.* The condition of groundwater, including the radiological and non-radiological constituent concentrations, in the exempted aquifer, adjacent aquifers, and in both overlying and underlying aquifers, prior to the beginning of ISR operations.

(f) *Constituent.* A detectable component within the groundwater.

(g) *Exceedance.* An exceedance has occurred when, during stability or long-term stability monitoring, a groundwater protection standard is exceeded at any point of compliance well.

(h) *Excursion.* The movement of fluids containing uranium byproduct materials from an ISR production zone into surrounding groundwater. An excursion is considered to have occurred when, during operational or restoration phase monitoring, any two indicator parameters (*e.g.,* chloride, conductivity, total alkalinity) exceed their respective upper control limits in any overlying, underlying, or perimeter monitoring well. Horizontal excursions refer to the lateral movement of the water, while vertical excursions indicate movement of water through aquitards above or below the production zone aquifer.

(i) *Excursion Monitoring Wells.* Wells located around the perimeter of the production zone (horizontal excursion wells) and in overlying and underlying aquifers (vertical excursion wells), which are used to detect any excursions from the production zone. Excursion monitoring wells can serve as the ''point(s) of compliance'' during all phases of ISR.

(j) *Exempted Aquifer.* An ''aquifer,'' or its portion, that meets the criteria of ''underground source of drinking water'' in 40 CFR 144.3, but which has been exempted according to the procedures in 40 CFR 144.7. See 40 CFR 144.3.

(k) *Extraction Well.* Well used to extract uranium enriched solutions from the ore-bearing aquifer; also known as a ''Production Well.'' Extraction and injection wells may be converted from one use to the other.

(l) *Indicator Parameter.* A constituent, such as chloride, conductivity, or total alkalinity, whose ''upper control limit'' is used to identify an excursion. Indicator parameters are not contaminants, but relate to geochemical conditions in groundwater.

(m) *Injection Well.* A well into which fluids are being injected. See 40 CFR 144.3.

(n) *In-Situ Recovery (ISR).* A method of extraction by which uranium is leached from underground ore bodies by the introduction of a solvent solution, called a lixiviant, through injection wells drilled into the ore body. The process does not require the extraction of ore from the ground. The lixiviant is injected, passes through the ore body, mobilizes the uranium, and the uranium-bearing solution is pumped to the surface from extraction wells. The pregnant leach solution is processed to extract the uranium.

(o) *Listed Constituent.* One of the thirteen groundwater constituents specified in Table 1 to subpart F of part 192.

(p) *Lixiviant.* A liquid medium used to recover uranium from underground ore bodies through in-situ recovery. This liquid medium typically contains native groundwater and an added oxidant, such as oxygen and/or hydrogen peroxide, as well as sodium carbonate/bicarbonate or carbon dioxide. The lixiviant is introduced through injection wells into the ore body to mobilize the uranium. The resulting solution is then pumped via extraction wells to the surface, where the uranium is recovered from the solution for further processing, after which the lixiviant may be re-injected.

(q) *Long-Term Stability Phase.* The period after the groundwater protection standards have been met and stability has been demonstrated according to 192.53(d) of this subpart, as determined by the regulatory agency.

(r) *Maximum Constituent Concentration.* The maximum permissible level of a constituent in groundwater, as specified in Table 1 to subpart A of part 192.

(s) *Maximum Contaminant Level (MCL).* The maximum permissible level of a contaminant in water which is delivered to any user of a public water system. See 40 CFR 141.2.

(t) *Monitoring Wells.* Wells used to obtain groundwater levels and water samples for the purpose of determining the hydrologic regime and the amounts, types, and distribution of constituents in the groundwater. Wells are located in the production zone, around the perimeter of the production zone (horizontal excursion monitoring wells), and in overlying and underlying aquifers (vertical excursion monitoring wells).

(u) *Operational Phase.* The time period during which uranium extraction by in-situ recovery occurs. Operations begin when injection of lixiviant starts. Operations end when the operator permanently ceases injection of lixiviant and recovery of uranium-bearing solution for processing purposes.

(v) *Overlying Aquifer.* An aquifer that is immediately vertically shallower (*i.e.,* directly above) than the production zone aquifer.

(w) *Point(s) of Compliance.* Site-specific location(s) where groundwater protection standards must be met. During all phases of ISR, excursion monitoring wells can serve as the points of compliance; during the restoration, stability and long-term stability phases, points of compliance may also include monitoring, injection and extraction wells in the production zone, as determined by the regulatory agency.

(x) *Point(s) of Exposure.* Intersection of a vertical plane with the boundary of the exempted aquifer.

(y) *Preoperational Monitoring.* Measurement of groundwater conditions in the production zone, and in the groundwater up and down gradient from the production zone, as well as in overlying and underlying aquifers, prior to the operational phase.

(z) *Production Zone.* The portion of the aquifer in which ISR activities occur. The production zone lies within the wellfield.

(aa) *Restoration (Act of).* The process of returning groundwater quality to preoperational conditions for the purpose of achieving restoration goal values for identified constituents.

(bb) *Restoration Goal.* A concentration limit for an identified constituent in groundwater after restoration has occurred. The limit is obtained from the most protective regulatory standards in 40 CFR 141.62, 141.66, 141.80, 143.3, 264.94, and Table 1 to subpart A of this part, and from preoperational background levels in the wellfield, whichever is higher.

(cc) *Restoration Phase.* The period immediately after lixiviant injection permanently ceases, during which restoration activities occur.

(dd) *Site.* The land or water area where any facility or activity is physically located or conducted, including adjacent land used in connection with the facility or activity. See 40 CFR 144.3.

(ee) *Stability Phase.* The period after the restoration phase when groundwater protection standards are met and monitored to test for temporal stability.

(ff) *Underlying Aquifer.* An aquifer that is immediately vertically deeper (*i.e.,* directly below) than the production zone aquifer.

(gg) *Upper Control Limit (UCL).* Preoperational concentrations of indicator parameters in horizontal and vertical excursion monitoring wells, as determined by the regulatory agency and contained in the license.

(hh) *Uranium Recovery Facility.* A facility licensed to process uranium ores for the purpose of recovering uranium and to manage uranium byproduct materials that result from processing of ores. Common names for these facilities include, but are not limited to, the following: A conventional uranium mill, an in-situ recovery (or leach) facility, and a heap leach facility or pile.

(ii) *Wellfield.* The area of an ISR operation that encompasses the array of injection, extraction, and monitoring wells, ancillary equipment and interconnected piping employed in the uranium in-situ recovery process. The area of the wellfield exceeds that of the production zone.

§ 192.52 Standards.

(a) Except for those wellfields currently in and remaining in restoration, stability monitoring or long-term monitoring at a licensed facility, all operating wellfields, new wellfields and expansions of wellfields shall comply with § 192.52(c) of this subpart as of the effective date of this rule.

(b) *Surface and subsurface standards. (*1) Surface impoundments associated with ISR activities shall conform to the standards of § 192.32 of this part.

(2) Disposal of solid uranium byproduct materials produced by ISR activities shall conform to the standards in § 192.32 of this part.

(c) *Groundwater protection standards.* (1) Restoration goals shall be determined for each of the constituents listed in Table 1 to subpart F that is identified in the groundwater. Following restoration activities in the production zone, and prior to license termination, the concentration of a listed constituent in the groundwater within the production zone, as determined by the regulatory agency, must not exceed the higher of the following values:

(i) The background level of that constituent in the groundwater, as determined by preoperational monitoring conducted under § 192.53(a) of this subpart; or

(ii) The lowest concentration listed in 40 CFR 141.61, 141.62, 141.66, 141.80, 143.3, 264.94, or Table 1 to subpart A of this part for that constituent.

(iii) When considering the potential for health risks caused by human exposure to known or suspected carcinogens not listed in Table 1 to subpart F that are designated for monitoring by the regulatory agency, the restoration goal above the background level should be established at 40 CFR part 141, 143 or 264 concentration levels, if such values exist. For constituents that are not found in 40 CFR part 141, 143 or 264, the restoration goal above the background level should be established at concentration levels which represent a cumulative excess lifetime risk no greater than 10^{-4} to an average individual.

(2) The regulatory agency may establish provisional alternate concentration limits within the production zone provided that all of the following conditions are met:

(i) After all best practicable active restoration activities have been completed in accordance with the permit, the regulatory agency determines that concentrations for one or more constituents cannot be restored to restoration goals; and

(ii) The constituent(s) will not pose a substantial present or potential hazard to human health or the environment as long as the proposed alternate concentration limit(s) is not exceeded; and

(iii) In all cases, the restoration goals, as determined under paragraph (c)(1) of this section, are satisfied at all points of exposure.

(3) The regulatory agency may approve final alternate concentration limits provided that the following conditions are met:

(i) The licensee has demonstrated groundwater stability at 95 percent confidence for three consecutive years (*i.e.,* no increasing trend in concentration levels as identified by appropriate statistical techniques) of groundwater concentrations for the listed constituents before entering the long-term stability monitoring phase; and

(ii) The constituent(s) will not pose a substantial present or potential hazard to human health or the environment as long as the proposed alternate concentration limit(s) is not exceeded.

(4) In deciding whether to approve a provisional or a final alternate concentration limit, the regulatory agency shall consider, at a minimum, the following factors:

(i) Potential adverse effects on groundwater quality, considering:

(A) The physical and chemical characteristics of constituents in the groundwater at the site, including their potential for migration;

(B) The hydrogeological characteristics (*e.g.,* groundwater velocity) of the site and surrounding land;

(C) The quantity of groundwater and the direction of groundwater flow;

(D) The proximity and withdrawal rates of local groundwater users;

(E) The current and anticipated future uses of groundwater in the region surrounding the site;

(F) The existing quality of groundwater, including other sources of contamination and their cumulative impact on groundwater quality;

(G) The potential for health risks caused by human exposure to constituents;

(H) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to constituents; and

(I) The persistence and permanence of the potential adverse effects.

(ii) Potential adverse effects on hydraulically-connected surface-water quality, considering:

(A) The volume and physical and chemical characteristics of the groundwater at the site;

(B) The hydrogeological characteristics of the site and surrounding land;

(C) The quantity and quality of groundwater, and the direction of groundwater flow;

(D) The patterns of rainfall in the region;

(E) The proximity of the site to surface waters;

(F) The current and future uses of surface waters in the region surrounding the site and any water quality standards established for those surface waters;

(G) The existing quality of hydraulically-connected surface water, including other sources of contamination and their cumulative impact on surface water quality;

(H) The potential for health risks caused by human exposure to constituents;

(I) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to constituents; and

(J) The persistence and permanence of the potential adverse effects.

(iii) The presence of any underground source of drinking water as defined under § 144.3 of this chapter and any exempted aquifer identified under § 144.7 of this chapter.

(5) When considering the potential for health risks caused by human exposure to known or suspected carcinogens, alternate concentration limits pursuant to paragraphs 192.52(c)(2) and 192.52(c)(3) of this subpart should be established at concentration levels which represent a cumulative excess lifetime risk no greater than 10^{-4}, at a point of exposure, to an average individual.

TABLE 1 TO SUBPART F—MAXIMUM CONCENTRATION OF CONSTITUENTS FOR GROUNDWATER PROTECTION AT ISR FACILITY SITES

Constituent	Maximum concentration
Arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, nitrate (as N), molybdenum, radium–226 and radium–228 (combined), uranium (uranium–234, uranium–235 and uranium–238 combined), gross alpha particle activity (excluding radon and uranium).	The restoration goal is the primary or secondary MCL listed in 40 CFR 141.61, 141.62, 141.66, 141.80, and 143.3, the maximum concentration of hazardous constituents for groundwater protection under 264.94, or the maximum constituent concentration specified in Table 1 to Subpart A of this Part, whichever value is most stringent. Where a background concentration is determined to be higher than the most stringent value in the applicable regulations, the background concentration will serve as the restoration goal.

§ 192.53 Monitoring programs.

Licensees subject to this subpart must conduct a groundwater monitoring program, subject to approval by the regulatory agency, at prospective and licensed ISR sites and environs. This program shall address all phases of the site's activities and must be conducted as follows:

(a) *Preoperational phase monitoring.* (1) A sufficient number of wells, at appropriate locations and depths, shall be installed in such a manner as to yield representative samples in order to define the groundwater flow regime and measure preoperational conditions and water quality for use in statistical tests during operations, restoration, stability and long-term stability.

(2) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring-well bore hole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (*i.e.,* the space between the bore hole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

(3) The preoperational background monitoring effort shall include immediately overlying aquifers, immediately underlying aquifers, and background monitoring inside and outside of the exempted aquifer, including both the up and downgradient areas outside of the production zone.

(4) During the monitoring effort, relevant data documenting geology, hydrology and geochemistry for radiological and non-radiological constituents shall be collected, both in the production zone and in surrounding areas that may be affected by the ISR operations.

(i) The monitoring effort shall be of sufficient duration of no less than one year and of sufficient scope to adequately characterize temporal and spatial variations in groundwater, and to account for impacts of well installation and development on background concentrations of constituents and values of indicator parameters, where applicable.

(ii) Preoperational monitoring shall be focused on determining background concentrations of constituents and indicator parameters in the following locations:

(A) Point of compliance wells within the proposed production zone;

(B) Point of compliance wells immediately overlying and immediately underlying aquifers;

(C) Point of compliance wells outside the production zone;

(D) Point of compliance wells within the exempted aquifer; and

(E) Point of compliance wells in upgradient and downgradient non-exempt portions of the adjacent aquifer.

(iii) The licensee shall employ appropriate statistical techniques to analyze background concentrations measured in individual wells within the proposed production zone for the purpose of determining restoration goals for groundwater restoration and long-term stability monitoring under § 192.52(c)(1) of this subpart. As determined by the licensee and approved by the regulatory agency, background concentration limits may be representative of individual wells, multiple wells, or all wells within the proposed production zone.

(iv) Radiological and non-radiological constituents to be monitored during the preoperational phase of an ISR facility shall include:

(A) All constituents listed in Table 1 to this subpart;

(B) Constituents and parameters necessary for geochemical calculations of groundwater chemistry and to model site performance in order to demonstrate that a stable groundwater chemistry state, as approved by the regulatory agency, has been achieved through restoration and is likely to persist in the long term; and

(C) Any additional constituents or parameters required by the regulatory agency, including metals potentially mobilized by the recovery process.

(b) *Operational phase monitoring.* (1) Indicator parameters, as established by the regulatory agency, shall be monitored in horizontal and vertical excursion monitoring wells determined by the regulatory agency throughout the operational phase of ISR activities.

(2) If an excursion is detected, as determined by the regulatory agency and as evidenced by indicator parameters exceeding established upper control limits, all constituents listed in Table 1 of this subpart shall be monitored as part of the corrective action program set forth in § 192.54 of this subpart until the excursion is controlled.

(c) *Restoration phase monitoring.* (1) All constituents listed in Table 1 of this subpart and otherwise specified by the regulatory agency shall be monitored during active restoration; sampling should occur no less frequently than quarterly, or other time interval specified by the regulatory agency.

(2) Indicator parameters, as established by the regulatory agency, shall be monitored in horizontal and vertical excursion monitoring wells determined by the regulatory agency throughout the restoration phase of ISR activities.

(3) If an excursion is detected, as determined by the regulatory agency and as evidenced by indicator parameters exceeding established upper control limits, all constituents listed in Table 1 of this subpart shall be monitored as part of the corrective action program set forth in § 192.54 of this subpart until the excursion is controlled.

(d) *Stability phase monitoring.* (1) The constituents to be monitored throughout the stability phase of an ISR facility in points of compliance wells in the production zone, as determined by the regulatory agency, shall include:

(i) All constituents listed in Table 1 of this subpart;

(ii) Any additional constituents required by the regulatory agency, such as:

(A) Constituents and parameters necessary for geochemical calculations of the groundwater chemistry in order to demonstrate that a stable groundwater chemistry has been achieved and is likely to persist in the long-term;

(B) Components of the lixiviant fluids injected during uranium recovery and any fluids injected during restoration; or

(C) Metals potentially mobilized by the uranium recovery process.

(2) Through field measurements using the monitoring network established to meet the requirements of § 192.53(a) of this section, observations and calculations, and applying appropriate statistical techniques, the licensee shall demonstrate that aquifer conditions within the production zone are stable.

(i) Stability shall be demonstrated for three consecutive years at a 95 percent confidence interval, measured from the time at which sufficient data to determine statistical significance has been collected, and based on sampling no less frequently than quarterly.

(ii) Individual wells within the production zone can be the point of compliance for the purpose of assessing stability, as approved by the regulatory agency.

(iii) If the licensee finds that the stability of groundwater meeting the concentration limits determined in § 192.52(c)(1) of this subpart cannot be demonstrated for three consecutive years for one or more constituents, the regulatory agency may:

(A) Require the licensee to resume active restoration efforts; or

(B) Depending on the significance of the departure from the groundwater protection standards determined in § 192.52(c)(1) of this subpart, approve a provisional alternate concentration limit according to the requirements of § 192.52(c)(2) of this subpart. Once stability has been documented for three consecutive years, the regulatory agency may approve a final alternate concentration limit according to the requirements of § 192.52(C)(3) of this subpart.

(3) If an exceedance occurs, as determined by the regulatory agency and as evidenced by exceeding groundwater protection standards in 192.52(c) of this subpart at point of compliance wells, all constituents listed in Table 1 of this subpart shall be monitored as part of the corrective action program set forth in § 192.54 of this subpart until the exceedance is controlled.

(e) *Long-term stability phase monitoring.* (1) Through field measurements utilizing the monitoring network established to meet the requirements of § 192.53(a) of this section, observations and calculations, and applying appropriate statistical techniques, the licensee shall demonstrate that post-restoration aquifer conditions within the production zone remain stable and continue to show compliance with groundwater protection standards established under § 192.52(c) of this subpart.

(i) Stability and groundwater protection compliance shall be demonstrated based on sampling no less frequently than quarterly, or other time interval approved by the regulatory agency.

(ii) Specific, individual wells within the production zone and approved by the regulatory agency shall be the points of compliance for the purpose of assessing stability and groundwater protection compliance, as approved by the regulatory agency.

(iii) Long-term stability monitoring shall be conducted for a period of 30 years. The regulatory agency may shorten the long-term stability monitoring period if, after stability is documented for a period of three consecutive years as described under § 192.53(d), the licensee demonstrates through geochemical modeling of the site that the subsurface conditions within the production zone will remain stable into the future. In evaluating such modeling, the regulatory agency must determine that there is a reasonable assurance that restoration goals will continue to be met and that subsurface conditions in the future will not cause the re-mobilization of uranium, radium or other constituents into the groundwater.

(2) If one or more monitored groundwater constituents in a point of compliance well within the wellfield exceeds a groundwater protection standard as defined in 192.52(c), or one or more monitored constituents in a point of compliance well within the wellfield show statistically significant increasing trends that would threaten groundwater quality if left unabated, then the licensee must submit a report to the regulatory agency within 60 days describing the circumstances and the corrective actions to be taken. All constituents listed in Table 1 to this subpart shall be monitored as part of the corrective action program set forth in § 192.54 of this part.

§ 192.54 Corrective action program.

(a) A corrective action program shall be developed by the licensee and approved by the regulatory agency for each ISR site at the time of licensing. The plan shall address a range of possible excursion and exceedance scenarios (*e.g.,* minor to catastrophic) and list options for corrective action. If an excursion is detected at a licensed facility at any time during the ISR operational phase or restoration phase, or an exceedance is detected during the stability or long-term stability phase, applicable portions of the corrective action program shall be implemented as soon as is practicable, and in no event later than ninety (90) days after such an occurrence. With the objective of returning constituent concentration levels in groundwater to the restoration goals within the production zone and the maximum contaminant level in adjacent aquifers, the corrective action program shall:

(1) Address removing constituents at the point of compliance or treating them in place; and

(2) Address removing or treating in place any constituents that exceed groundwater protection standards between the point of compliance and the point of exposure.

(b) The licensee shall continue corrective action measures to the extent necessary to achieve and maintain compliance with the groundwater protection standards in § 192.52(c) of this subpart. The regulatory agency will determine when the licensee may terminate corrective action measures based on data from the groundwater monitoring program and other information that provides reasonable assurance that the groundwater protection standards in § 192.52(c) will not be exceeded.

(c) After the corrective action program has been terminated, the licensee must establish and implement a groundwater monitoring program to demonstrate the effectiveness of the corrective action program in stabilizing the concentrations of constituents in the groundwater. The monitoring program shall continue for a period of not less than 3 years and be based on the requirements specified in § 192.53(d) and 192.53(e).

§ 192.55 Effective date.

Subpart F shall be effective on [60 DAYS AFTER DATE OF PUBLICATION OF FINAL RULE IN **FEDERAL REGISTER**].

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