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Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Rulemakings and Adjudications Staff

Docket ID NRC-2008-0421

To whom it may concern,

We appreciate the opportunity to provide comments on this issue, which has the potential to impact vital and irreplaceable public water resources. The following comments generally correspond by number to the requests made in the Federal Register, although all could be applied to numbers 2 and 4.

1) NRC should proceed with rulemaking to protect human health and the environment while clarifying the operational expectations of the mine operator.

In Situ Recovery (ISR) of uranium uses circulated groundwater with amendments to leach uranium from orebodies contained within transmissive confined aquifers. During ISR operation, groundwater is extracted, amended, injected, re-extracted, treated through ion exchange or solvent extraction, and recirculated. In practice, more water is often extracted from the ground than is injected to ensure complete recovery[1]. This formerly clean groundwater then is added to the process chain and recirculated. Non-target entrained metals are either injected into depleted portions of the deposit, treated with reverse osmosis, or captured in evaporation basins.

In principle, this extraction method is less damaging to human health and the environment as it leaves the land surface largely intact, and a minimal amount of mine tailings (or byproducts) need to be managed[2]. However, failure to adequately characterize and monitor the aquifer surrounding the ore body may result in migration of radionuclides and heavy metals.

[1] *Review of Environmental Impacts of the Acid In-situ Leach Uranium Mining Process, CSIRO Land and Water*, Taylor et al, 2004 http://large.stanford.edu/courses/2018/ph241/bashti1/docs/csiro-aug04.pdf

[2] *Manual of Acid In Situ Leach Uranium Mining Technology,* IAEA, Vienna, 2001 https://www-pub.iaea.org/MTCD/Publications/PDF/te_1239_prn.pdf IAEA-TECDOC-1239

Groundwater is a vital resource, and all efforts must be taken to ensure that the ISR process is: appropriate at the site, and implemented protectively; contained within the specific aquifer being processed; and conducted in such a way that groundwater remediation is completed prior to the site's abandonment.

2) The explicit intent of the ISR process is to mobilize uranium and/or thorium in an aqueous state. However, the extraction process is not discriminatory to uranium and thorium, and often mobilizes other radionuclides and toxic heavy metals[3]. ISR is typically applied in sandy or sandstone saturated aquifers with impermeable units above and below the orebody. A poorly characterized aquifer or improperly sealed borings and wells could result in migration of radionuclides and toxic metals outside of the ore-laden aquifer.

   To ensure that the aquifer has been adequately characterized, a groundwater model calibrated with one or more pumping tests should be conducted. Ideally investigation would also include a tracer test with observation wells installed in non-target aquifers and far afield of the process zone to ensure that the ore-containing aquifer has been adequately characterized prior to ISR implementation. If tracer breakthrough is observed and ISR still commences, additional safeguards and precautions should be applied to the operation and monitoring plan for the site.

   Any rule should either specifically define the extractant and aquifer requirements (transmissive, confined) or be flexible to address procedures other than those currently in use (e.g., alternate chemistries, enhanced transmissivity through hydraulic fracturing).

3) We view *the facility* to include both the property footprint and any impacted groundwater created by the process, extending until final site closure. In their 2015 proposed rule, the EPA suggested that early monitoring of groundwater could identify any plumes before they expand to a point where remediation would be cost prohibitive(3). Early in the preliminary processing stage (immediately after startup or during pilot operation), the recirculated injectant should be sampled for non-target metals or dose risks as a baseline for performance monitoring (in 2015, EPA's proposed rule included thirteen constituents to sample).

   During operation, a sampling network should cover the target aquifer both inside and along the periphery of the extraction area, as well as in surrounding non-target aquifers and waterbodies. These sampling points should be periodically monitored for geochemical parameters as well as any constituents detected in the baseline startup samples, to ensure that any degradation of water resources is detected and remedied rapidly.

[3] *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings*, Rule Proposed by the EPA, 1/26/2015 (80 FR 4156) https://www.federalregister.gov/documents/2015/01/26/2015-00276/health-and-environmental-protection-standards-for-uranium-and-thorium-mill-tailings

4) Following production, a "traditional" uranium mine would have an engineered control constructed to manage tailings, along with an inspection/sampling regime to ensure the control's effectiveness. While there are no tailings in a traditional sense, impacts to groundwater in and around the extraction area will persist for some time.

   In their 2017 proposed rule, the EPA called for an extended period of groundwater monitoring to document changes in groundwater conditions. Compliance (closure) monitoring would begin after trends of geochemical conditions stabilize to a statistically insignificant level for three years[4]. Financial assurance to fund this monitoring (up to 30 years) should be part of the permitting process.

   The EPA provides the following rationale for their proposed 2017 rules:

   > *Since ISR alters the chemical composition of groundwater, it creates reasons to be concerned about risk to public health, safety and the environment from radiological and non-radiological hazards associated with the processing and disposal of byproduct material.(4)*

   Establishing reasonable and protective requirements for any permitted process makes good sense, particularly as climate change and population growth make water resources more precious. Moving forward, these requirements will allow the permit holder to budget for the entire lifecycle of the mine, while minimizing the risk to human health and the environment.

   If you have questions about our comments, please contact Tom Sicilia of my staff at 503-378-5584 or at tom.sicilia@oregon.gov.

   Sincerely,

   Ken Niles
   Assistant Director for Nuclear Safety

[4] Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings Rule Proposed by the EPA, 1/19/2017 (82 FR 7400) https://www.federalregister.gov/documents/2017/01/19/2017-00573/health-and-environmental-protection-standards-for-uranium-and-thorium-mill-tailings