ATTACHMENT 30

AOR ZOI Definitions v3 6 20 2008

Discussion of Zone of Influence, Area of Review, and the Aquifer Exemption Boundary for Class III Injection Wells used for the In-Situ Leaching (ISL) of Uranium

Introduction: The purpose of this discussion is to provide information about the proposed criteria the EPA Region 8 UIC program will use to evaluate acceptable locations for the Area of Review and an aquifer exemption boundary proposed in UIC Class III injection well permit applications for in-situ mining of uranium. This document also explains how the concepts of the Area or Review and zone of endangering influence will be applied to Class III injection well permit applications.

The EPA Region 8 will consider an acceptable location for the aquifer exemption boundary to be a location that allows full extraction of the ore proposed in the mining plan and restoration of the area affected by lixiviant flow within the subsurface, without having the chemical effects of the lixiviant reach beyond the aquifer exemption boundary. The criteria EPA Region 8 will use for evaluating the placement of the aquifer exemption boundary will be based on prudent operating procedures in which excursions are controlled within 90 days after they are detected at the monitor well ring.

The area within the aquifer exemption boundary should be minimized to protect as much of the aquifer surrounding the mining project as is practically possible, and to minimize the area that will need to be restored upon the completion of mining.

Background Information: The method for determining Area of Review around an injection well or injection project area is defined in 40 CFR 146.3 as "the area surrounding an injection well described according to the criteria set forth in §146.06 or in the case of an area permit, the project area plus a circumscribing area the width of which is either 1/4 of a mile or a number calculated according to the criteria set forth in §146.06." Regulation 146.06 states that the "Area of Review for each injection well or each field, project or area …shall be determined…" using the zone of endangering influence calculation in 146.06(a) or a fixed radius according to 146.06(b). (Specific regulations are located at the end of this document for reference.)

In the regulations, the zone of endangering influence for a single injection well is the radius encompassing the lateral distance in which the pressures in the injection zone may cause the migration of the injection and/or formation fluid into an underground source of drinking water. For an area permit, the zone of endangering influence includes the project area plus a circumscribing area the width of which is the lateral distance from the perimeter of the project area, in which the pressures in the injection zone may cause the migration of the injection and/or formation fluid into an underground source of drinking water.

Regulation 40 CFR 146.4 states that criteria for EPA to use in determining the aquifer exemption area for an ISL mining project is the portion of the aquifer that is mineral producing, or can be demonstrated by a permit applicant as part of a permit application for a Class III operation to contain minerals that are expected to be commercially producible based on quantity and location.

The EPA Region 8 will consider an acceptable location for the aquifer exemption boundary to be a location that allows the mining operation to fully extract the ore and restore the area affected by the flow of lixiviant within the subsurface without having the chemical effects of the lixiviant reach beyond the aquifer exemption boundary. Hydrologic modeling should be used to demonstrate that the entire area within the aquifer exemption boundary is required to meet these criteria. The area within the aquifer exemption boundary should be minimized to protect as much of the aquifer surrounding the mining project as is practically

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possible, and to minimize the area that will need to be restored upon the completion of mining.

For the purposes of this discussion, the term "project area" used in reference to the Area of Review above is considered to be equivalent to the area where lixiviant is moving within the subsurface. The project area contains the wellfields and the surrounding "flare" of lixiviant around the wellfields. The project area will be delineated in the permit application with reference to the commercially producible portion of the ore body. Justification should be based on reasonable market projections of uranium price fluctuations over the life of the mine. In the following discussion, the aquifer exemption boundary will be determined based on a distance relative to the project area and the monitor well ring around the project area.

Discussion: The intent of the Area of Review in the regulations is to set a boundary around an area that will be thoroughly investigated to locate any potential breaches in the confining zones above and below the proposed injection interval, and to perform corrective action, if needed, to mitigate those breaches so injectate cannot move up or down into another aquifer.

The intent of the zone of endangering influence in the regulations is to determine the farthest distance away from the injection well or project area that the pressure effect of injection activity is anticipated to reach over the life of the injection well or project area. In the case of ISL injection wells, the overall effect of injection and recovery in ISL well fields is a groundwater flow gradient directed toward the project area. The zone of endangering influence calculation in the regulations is not appropriate for an in-situ mining project, because the formula applies to injection wells that only inject, with no extraction taken into account.

For this reason, the Area of Review boundary for an ISL project should not be equivalent to the zone of endangering influence. Instead of a zone of endangering influence, the concept of importance for Class III injection wells used for in-situ mining is the area chemically affected by injection. The term "project area" described above will be applied to the area within the subsurface where lixiviant is causing chemical changing within the subsurface. The project area is limited to the area of lixiviant flow under normal operating conditions, i.e. where lixiviant flow is being controlled by proper balancing of injection rates and recovery rates within the wellfields. (The project area does not include excursions, where the flow of lixiviant is not considered to be under direct control.)

The aquifer exemption boundary has a horizontal and a vertical extent. The vertical extent is bounded by upper and lower confining zones. The horizontal extent is proposed by the permit applicant based on the extent of commercially producible ore deposits and the area around the ore body where the lixiviant is expected to travel during mining of the ore deposits and post-mining aquifer restoration. It is important to minimize the extent of the area inside the aquifer exemption boundary, because it is forever exempted from protection under the UIC Program, specifically the provisions of 144.12.

Proposal: In the permit application and aquifer exemption request, the permittee identifies the location of the monitoring well ring around the project area, and proposes an Area of Review boundary and an aquifer exemption boundary. The aquifer exemption boundary may be located at some distance outside the monitoring well ring, but no further out than the Area of Review boundary. Because the aquifer exemption boundary is the area within which mining-related contaminants are allowed to move, the area should be subject to Area of Review requirements.

The location of the monitoring well ring should be placed at some distance beyond the project area to detect any excursions of lixiviant outside the project area and allow recovery

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of excursions within a reasonable amount of time. The monitor well ring location may be set a fixed distance beyond the project area. The permit application should include a discussion of how long it will take an excursion to reach the monitor well ring and how long it will take to recover an excursion detected at the monitor well ring. This information will be considered in evaluating the proposed location of the aquifer exemption boundary.

The Area of Review should be set at least as far away from the project area as the proposed aquifer exemption boundary. Within the Area of Review, the permittee will investigate the need for corrective action and perform corrective action as needed. The Area of Review boundary may be set at the aquifer exemption boundary or at some distance beyond the aquifer exemption boundary. The location of the boundary should be justified using hydrologic modeling of worse case scenario excursions, taking into account these factors stated in the regulations:

…the following factors shall be taken into consideration: Chemistry of injected and formation fluids; hydrogeology; population and ground-water use and dependence; and historical practices in the area.

The permit application should include a discussion of how the Area of Review was determined, including pertinent hydrologic modeling results that support the proposed boundary locations. The discussion should also include how applicable factors in the paragraph above were taken into consideration.

Concept for locating the Aquifer Exemption boundary

The aquifer exemption request is included as part of the permit application. The permittee submits a proposed aquifer exemption boundary that is placed at some distance outside the project area. Because the monitor well ring is the first place where the presence of an excursion is detected, the aquifer exemption boundary should be placed at some distance beyond the monitor well ring that will allow a reasonable time for an excursion detected at the monitor well ring to be recovered before it crosses the aquifer exemption boundary. Hydrologic modeling should be used to verify that the extent of the aquifer exemption boundary is justified and the entire area is needed for uranium to be extracted to the fullest planned extent. Justification for the position of the aquifer exemption boundary should be included in the aquifer exemption request. The justification should include hydrologic modeling results, information on variability of flow rates in different directions within the aquifer, and how long it would take an excursion to reach the aquifer exemption boundary.

Permit Requirements for Delineating Extent of Excursion

When an excursion is detected at the monitoring well ring, the permit will require the permittee to verify that the excursion has not reached the aquifer exemption boundary. Upon detecting an excursion at the monitoring well ring, the permit will require the installation of response wells that would intercept the excursion plume before it reaches the aquifer exemption boundary. The placement of the response wells will be based on hydrologic modeling and at a location far enough ahead of the excursion front, that the excursion plume will not have reached the response well locations by the time the wells are installed, sampled, and analytical results received. Duration and frequency for sampling the response wells will be based on the travel time of the excursion.

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Definitions in regulations for reference:

144.3 and 146.3 Definitions
Area of Review means the area surrounding an injection well described according to the criteria set forth in §146.06 or in the case of an area permit, the project area plus a circumscribing area the width of which is either 1/4 of a mile or a number calculated according to the criteria set forth in §146.06.

Contaminant means any physical, chemical, biological, or radiological substance or matter in water.

Underground source of drinking water (USDW) means an aquifer or its portion:
(1)(i) Which supplies any public water system; or
(ii) Which contains a sufficient quantity of ground water to supply a public water system; and
(A) Currently supplies drinking water for human consumption; or
(B) Contains fewer than 10,000 mg/l total dissolved solids; and
(2) Which is not an exempted aquifer.

§ 146.6 Area of Review.
The Area of Review for each injection well or each field, project or area of the State shall be determined according to either paragraph (a) or (b) of this section.

(a) Zone of endangering influence.
(1) The zone of endangering influence shall be:
(i) In the case of application(s) for well permit(s) under §144.31 that area the radius of which is the lateral distance in which the pressures in the injection zone may cause the migration of the injection and/or formation fluid into an underground source of drinking water; or
(ii) In the case of an application for an area permit under §144.33, the project area plus a circumscribing area the width of which is the lateral distance from the perimeter of the project area, in which the pressures in the injection zone may cause the migration of the injection and/or formation fluid into an underground source of drinking water.

(2) Computation of the zone of endangering influence may be based upon the parameters listed below and should be calculated for an injection time period equal to the expected life of the injection well or pattern. [*equation and parameter list not included here*]

(b) Fixed radius. (1) In the case of application(s) for well permit(s) under §144.31 a fixed radius around the well of not less than one-fourth (1/4) mile may be used.
(2) In the case of an application for an area permit under §144.31 a fixed width of not less than one-fourth (1/4) mile for the circumscribing area may be used.

In determining the fixed radius, the following factors shall be taken into consideration: Chemistry of injected and formation fluids; hydrogeology; population and ground-water use and dependence; and historical practices in the area.
(c) If the Area of Review is determined by a mathematical model pursuant to paragraph (a) of this section, the permissible radius is the result of such calculation even if it is less than one-fourth (1/4) mile.

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146.4 Criteria for exempted aquifers.
An aquifer or a portion thereof which meets the criteria for an "underground source of drinking water" in §146.3 may be determined under 40 CFR 144.8 to be an "exempted aquifer" if it meets the following criteria:
(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:
(1) It is mineral, hydrocarbon or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible.
(2) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;
(3) It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or
(4) It is located over a Class III well mining area subject to subsidence or catastrophic collapse; or
(c) The total dissolved solids content of the ground water is more than 3,000 and less than 10,000 mg/l and it is not reasonably expected to supply a public water system.

144.12 Prohibition of movement of fluid into underground sources of drinking water.
(b) For Class I, II and III wells, if any water quality monitoring of an underground source of drinking water indicates the movement of any contaminant into the underground source of drinking water, except as authorized under part 146 [*I take that to mean aquifer exemption under 146.4*], the Director shall prescribe such additional requirements for construction, corrective action, operation, monitoring, or reporting (including closure of the injection well) as are necessary to prevent such movement. In the case of wells authorized by permit, these additional requirements shall be imposed by modifying the permit in accordance with §144.39, or the permit may be terminated under §144.40 if cause exists, or appropriate enforcement action may be taken if the permit has been violated.

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