May 25, 2007

MEMORANDUM TO: Luis A. Reyes
Executive Director for Operations

FROM: Charles L. Miller, Director **/RA/**
Office of Federal and State Materials
and Environmental Management Programs

SUBJECT: CLOSEOUT OF GENERIC SAFETY ISSUE NMSS-0014, "SURETY ESTIMATES FOR GROUNDWATER RESTORATION AT IN-SITU LEACH FACILITIES"

The Office of Federal and State Materials and Environmental Management Programs (FSME) is closing out generic safety issue NMSS-0014, "Surety Estimates for Groundwater Restoration at In Situ Leach Facilities." FSME is closing this issue based on the completion of the report, "Consideration of Geochemical Issues in Groundwater Restoration at Uranium In-Situ Leach Mining Facilities," NUREG/CR-6870, published in January 2007. As intended, NUREG/CR-6870 provides several approaches for estimating the future costs for restoring ore zone groundwater that becomes contaminated during uranium recovery operations at in-situ leach (ISL) facilities.

Issue

This generic safety issue was originally identified in April 1997 as a research need in the U.S. Nuclear Regulatory Commission's (NRC's) Uranium Recovery Program within the Office of Nuclear Material Safety and Safeguards (NMSS). During ISL uranium recovery operations, the ore zone groundwater becomes contaminated with other minerals associated with the ore. NRC requirements in 10 CFR Part 40, Appendix A, Criterion 9, specify that, prior to the commencement of operations, uranium recovery facility licensees must establish financial surety arrangements to assure that sufficient funds will be available to carry out the reclamation and decommissioning of the facility. This surety requirement would include restoration of degraded groundwater at ISL facilities. In this regard, the costs associated with groundwater restoration are directly related to the volume of water that must be re-circulated through the ore zone to restore water quality. However, a proven methodology for estimating the volume of water required for restoration, and, correspondingly, the restoration costs, was not available. Hence, the Uranium Recovery Program identified the need for development of a methodology for estimating the volume of water required for restoration and, the associated restoration costs for surety purposes.

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Background

For the past 20 years, ISL processing has been the predominant method for extracting uranium from underground ore bodies. There are both cost and environmental advantages with ISL processing, compared to conventional mining and milling. There are fairly minimal surface impacts associated with ISL processing, and ISL facilities generate only small amounts of byproduct materials or waste during operations. The most significant environmental impact resulting from ISL processing is the degradation of the water quality in the ore zone aquifer of interest. Specifically, the ore zone groundwater becomes enriched with other minerals associated with the uranium ore. Experience indicates that trace metals such as arsenic, selenium, vanadium, iron, manganese, and radium may become elevated during the leaching process. Accordingly, in order to protect public health and safety and the environment, licensees are required to restore the affected groundwater to appropriate standards, either pre-operational baseline conditions or pre-mining class-of-use limits, following the completion of uranium recovery operations. In order to ensure that sufficient funds are available for groundwater restoration and the decommissioning of the facility, NRC requirements in 10 CFR Part 40, Appendix A, Criterion 9, specify that licensees must establish surety arrangements prior to the commencement of operations for decontamination and decommissioning purposes. In establishing the surety arrangements, the licensee's cost estimates must take into account the total costs that would be incurred if an independent contractor were hired to perform the decommissioning work, including restoration of contaminated groundwater. These surety arrangements are reviewed annually, and revised as appropriate, to ensure they remain adequate for their intended purpose.

The costs for restoring contaminated groundwater at ISL facilities generally represent a significant portion (40% or more) of the total site decommissioning costs and are highly site-specific. The groundwater restoration costs are directly related to the volume of water that must be recirculated through the portion of the ore zone aquifer affected by uranium recovery operations to restore water quality to established standards. The volume of water necessary to achieve restoration standards is dependent upon the geochemical environment within the ore zone, as well as the complexity of reactions that may occur during groundwater restoration. A demonstrable and proven methodology for estimating this volume of water did not exist in the past. The lack of a proven methodology for estimating water volumes needed for groundwater restoration made it difficult for the staff to determine the adequacy of the surety arrangements proposed by ISL facility licensees for site decommissioning. Accordingly, in 1997, Uranium Recovery Program staff within NMSS identified a research need for the Office of Nuclear Regulatory Research (RES) to develop a methodology for estimating the volume of water required for restoration and, correspondingly, the associated restoration costs for surety purposes. Work on this research need (generic safety issue NMSS-0014) originally began in-house and was envisioned to be supported by a joint task force of both NMSS and RES staff. However, the resources and geochemical modeling expertise necessary to conduct this work were not available within the staff to continue this effort and, as such, in 2001, RES sought the technical assistance of an outside contractor, the U.S. Geological Survey (USGS), to develop the methodology for estimating groundwater restoration volumes and associated costs. This work was completed in January 2007 with the publication of NUREG/CR-6870.

NUREG/CR-6870

The primary focus of the original research request (generic safety issue NMSS-0014) was the

need for development of a sound methodology or technical basis for the staff's review of the adequacy of the surety amounts proposed by licensees for restoration of contaminated groundwater at ISL facilities. NUREG/CR-6870 discusses several approaches for evaluating the adequacy of proposed surety amounts for groundwater restoration. NUREG/CR-6870 provides information on the historical costs of completed decommissioning activities, including groundwater restoration, at domestic ISL uranium recovery facilities. This information indicates that groundwater restoration costs represent a significant portion, about 40%, of the total facility decommissioning costs. However, groundwater restoration costs can vary significantly from site to site and more recent experience indicates that groundwater restoration costs are 70%, or more, of total decommissioning costs. Notwithstanding the variability in the costs associated with prior groundwater restoration activities, an estimate of groundwater restoration costs for a new ISL facility site can be obtained by selecting a conservative dollar amount based on the costs associated with previous decommissioning activities at other ISL facilities. A related approach would estimate restoration costs for a new ISL facility based on the restoration costs at analogous sites (similar in hydrologic, geologic, and geochemical characteristics) which have already undergone decommissioning.

While the above comparative cost methods may provide a rough, initial estimate of the groundwater restoration costs at ISL facilities, the focus of NUREG/CR-6870 is a methodology which develops and applies a conceptual model that reflects the physical and chemical characteristics of the ISL site. This methodology provides a scientifically-based quantitative approach for estimating the volume of water required for groundwater restoration. Specifically, the conceptual model considers the groundwater flow, solute transport, and geochemical reactions associated with a particular site to estimate groundwater restoration volumes. The corresponding costs of groundwater restoration can then be estimated from the calculated volume of restoration water derived from the site-specific model.

NUREG/CR-6870 recognizes that the geochemical aspects of groundwater restoration are extremely complex and the report appropriately focuses on the geochemical processes that must be considered in developing a site-specific restoration model. The report provides guidelines for development of a conceptual restoration model and includes a number of model simulations to demonstrate the efficacy of the modeling approach by comparing the modeling predictions with data (estimated restoration volumes) from completed restoration activities at existing ISL sites.

Conclusions

NUREG/CR-6870 provides a useful perspective on the costs associated with groundwater restoration at ISL facilities and describes several methods for estimating these costs at new facilities, including a rigorous approach for development of a site-specific model that considers groundwater flow, solute transport, and geochemical reactions in the uranium ore zone of interest. With this modeling approach, groundwater restoration volumes and, correspondingly, their associated costs, can be estimated. As such, NUREG/CR-6870 provides the methodology originally requested by the Uranium Recovery Program as a research need to RES in 1997. On this basis, generic safety issue NMSS-0014 (Surety Estimates for Groundwater Restoration at In Situ Leach Facilities) is being closed out.

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