October 4, 2002

MEMORANDUM TO: Gary Janosko, Chief
Uranium Processing Section
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety and Safeguards

FROM: Sandra Wastler, Chief */RA/*
Performance Assessment Section
Environmental and Performance Assessment Branch
Division of Waste Management

SUBJECT: ALTERNATIVE CONCENTRATION LIMITS FOR PATHFINDER SHIRLEY BASIN SITE (EPAB TAR-58)

Richard Codell of my staff has reviewed some of the information on Alternative Concentration Limits (ACLs) for the Pathfinder Mines Corporation Shirley Basin site. Information he reviewed focused on the use in the licensee's model of a diminution in uranium concentration in the groundwater caused by neutralization of the acidic tailings. He found that the neutralization of the seeping water from the impoundment as it traveled to the surficial aquifer is the likely cause for the decreased uranium concentration for several possible reasons: (1) It would lead to lower uranium solubility. The solubility of uranium compounds is generally lowest around neutral pH. It is not clear, however, if solubility of uranium is sufficiently low in this system so that the concentration of uranium will be solubility controlled; (2) Sulfate will be removed by the precipitation of gypsum. Although uranyl sulfate is highly soluble, other uranyl minerals are less so; and (3) there will be large quantities of highly sorbing iron oxyhydroxides precipitating in the system. Uranium could either adsorb onto this solid phase, or co-precipitate with it.

As part of the review, he asked the licensee to provide additional information on the redox potential of groundwater at the site. This information was important to determine if there was any component of oxidation/reduction reactions that would account for the concentration changes in the groundwater, or if the effect was mainly due to the neutralization. The licensee conducted sampling of some tailings and surficial aquifer wells using a field oxidation/reduction potential meter. The measurements were all in the range of 48 to 364 millivolts, indicating that the waters were oxidizing. These measurements help to validate the licensee's claims that the lower concentrations of uranium in groundwater were caused by neutralization. Furthermore, the licensee points out that oxidation potentials are likely to diminish once the cover is in place because less oxygenated water will be able to seep into the ground. Lower oxidation potential may lead to a decrease in mobile uranium concentrations.

He believes that the licensee's choice to specify the boundary condition for the groundwater transport model at the lower concentration is acceptable. Although mechanistic models exist

that incorporate geochemical reactions and have been used for similar analyses (e.g., Zhu, 2001), these models require significantly more information such as analyses of major non-radioactive constituents along with those of the contaminants in the groundwater. Direct measurement of uranium concentration at depth are the most reliable boundary condition for the licensee's transport model because it has already integrated the complicated geochemical and hydrologic processes that would be difficult to simulate.

We concur with the licensee's appraisal of the conceptual model of uranium mobility in the groundwater.

Please address any questions to Richard Codell, of my staff, at 301-415-8167.

**Reference:**

Zhu, C. and D. Burden, "Mineralological compositions of aquifer matrix as necessary initial conditions in reactive contaminant transport models", *J. Contaminant Hydrology, vol 51*, pp 145-161, (2001)

cc: William Von Till
Dan Gillen

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