From: Mandeville, Douglas
Sent: Tuesday, February 16, 2010 12:01 PM
To: Garrett, Betty
Subject: Email to add to ADAMS
Attachments: Gas locking question

Betty -

Please add the attached email to the Moore Ranch docket in ADAMS (04009073). The email is publicly available.

Thanks.

Doug

Hi Doug:

We are working on responding to the clarification items that you and I discussed last Friday for the draft SER and I have responses for two of the items identified:

1. A clarification was required for Figures 3.1-4a and 3.1-4-b. You noted that they appeared to be identical. There is actually a slight difference between them in the title block. The figures present proposed well locations for Lance and TTP disposal well locations and they are identical with the exception of the note in the figure title block.
2. One clarification involved whether we planned to revise the application to include information regarding control of gas locking in the wellfield. You indicated that Elise Striz wanted to make sure that this was discussed in the application. The attached response to an open issue identified in the May 2009 teleconference was submitted by letter dated December 4, 2009 and contains the planned revisions that Uranium One will make to the application. If the proposed changes are not adequate, please let me know.

We are continuing to look at the tables and figures that relate to your other question and will let you know as soon as we have an answer to that question.

Mike

Mike Griffin

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Betty Garrett, Licensing Assistant
FSME/DWMEP/DURLD
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Hydrology Open Issue No. 20
Effect of potential conductivity impairment due to use of dissolved oxygen in lixiviant on restoration is not discussed
May 11 2009 Teleconference

Open Issue discussion:

EMC addressed the issue of conductivity impairment in the ore zone due to the use of dissolved oxygen in the lixiviant. EMC stated that dissolved oxygen may evolve out of solution under reduced hydrostatic heads like those in ore zone "70 sand" unconfined aquifer at Moore Ranch. It stated the free gas phase can lead to "gas lock" in portions of the "70 sand." EMC provided a discussion of experience with "gas lock" and how it was controlled at an ISR in Texas. However, no discussion was presented regarding the restoration of that ISR. NRC staff is concerned that if "gas lock" reduces conductivity in sections of the ore zone, flow can bypass these regions and restoration may be incomplete.

Answer: During the uranium recovery phase of an In Situ Recovery operation, avoidance of gas locking is an operational goal. By design, ISR well fields are completed with the intent of focusing lixiviate flow on the uranium bearing portions of the reservoir. Redirection of lixiviate flow into other, barren, portions of the reservoir because of gas locking or any other means results in a dilution of the uranium content of the recovered lixiviate and is an inherent inefficiency. As a result, prevention of gas locking is an ongoing operational objective. Fortunately, the occurrence of a partial or complete gas lock at or near an injection well is readily apparent as the subject well will display a marked or total loss of injectivity. This loss of injectivity will develop in a matter of hours or, at the outside, a matter of a few days. Operational personnel will observe a significant reduction in the injection or flow capacity of the well at the normal or even maximum allowable well head injection pressure. Normal remedial action involves removal of the well from operational service, installation of a submersible pump, and back flowing the well to stimulate the movement of any gas block back to the subject well where this gas phase escapes from the reservoir in the form of two phase flow through the submersible pump and associated piping. These fluids are routed either to the production lixiviate gathering system or to the well cleanup fluids disposal system. It is important to appreciate that oxygen is readily soluble in aqueous fluids up to its solubility limit. As fluid is "back flowed" to the subject well, unsaturated waters are effectively pushing the gas phase and at the same time reducing the size of the gas phase as oxygen redissolves into the unsaturated fluids.

These same two phenomena occur during the ground water restoration (GWR) phase of an In Situ Recovery operation. In addition, during GWR the oxygen content of circulating waters is deliberately reduced and minimized to halt the oxidation and, hence, mobilization of uranium and other metals. The movement of these highly undersaturated (with respect to oxygen) waters throughout the reservoir provides the means for removing any residual oxygen gas phase from portions of the reservoir by again pushing such gas pockets toward recovery wells while at the same time absorbing portions of the gas phase into the liquid phase. Since several pore volumes of undersaturated waters are required during GWR, any residual gas blockage is removed. Chemical analysis of produced waters during and at the conclusion of GWR is employed to confirm the removal of any elevated concentrations of metals and common ions.

Proposed Revisions to License Application

The following changes are proposed to the license application in response to this RAI question. Changes to the original text as submitted to NRC are noted in red-line/strikeout method.

3.1.3.1 Wellfield Operational Monitoring

As discussed in Section 5.7 of this Technical Report, an extensive water-sampling program will be conducted prior to, during and following mining operations at the Moore Ranch project to identify any potential impacts to water resources of the area. The groundwater monitoring program is designed to establish baseline water quality prior to mining; detect excursions of lixiviant either horizontally or vertically outside of the production zone during mining; and determine when the production zone aquifer has been adequately restored following mining.

Injection well and production well flow rates and pressures are monitored at the headerhouse in order that injection and production can be balanced for each pattern and the entire wellfield. The flow rate of each production and injection well is continuously monitored by monitoring individual electronic flow meters in each wellfield headerhouse. The pressure of each production and injection trunk line will be monitored at the headerhouse with electronic pressure gauges. The flow meters and pressure gauges will be tied into the headerhouse control panel, which will be in communication with the central plant control room.

High and low pressure and flow alarms will be in place to alert wellfield and plant operators if specified ranges are exceeded in conjunction with automatic shutoff valves to stop flow if significant changes in flow or pressure occur.

During the uranium recovery phase, avoidance of potential “gas locking” as a result of dissolved oxygen evolving out of solution is an operational goal. By design, ISR well fields are completed with the intent of focusing lixiviate flow on the uranium bearing portions of the reservoir. Redirection of lixiviate flow into other, barren, portions of the reservoir because of gas locking or any other means results in a dilution of the uranium content of the recovered lixiviate and is an inherent inefficiency. As a result, prevention of gas locking is an ongoing operational objective. The occurrence of a partial or complete gas lock at or near an injection well will be readily apparent as the subject well will display a marked or total loss of injectivity. This loss of injectivity will develop in a matter of hours or, at the outside, a matter of a few days. Operational personnel will observe a significant reduction in the injection or flow capacity of the well at the normal or even maximum allowable well head injection pressure. Normal remedial action involves removal of the well from operational service, installation of a submersible pump, and back flowing the well to stimulate the movement of any gas block back to the subject well where this gas phase escapes from the reservoir in the form of two phase flow through the submersible pump and associated piping. These fluids will be routed either to the production lixiviate gathering system or to the wastewater disposal system. Oxygen is readily soluble in aqueous fluids up to its solubility limit. As fluid is “back flowed” to the subject well, unsaturated waters are effectively pushing the gas phase and at the same time reducing the size of the gas phase as oxygen redissolves into the unsaturated fluids.

These same two phenomena occur during the ground water restoration (GWR) phase. In addition, during GWR the oxygen content of circulating waters is deliberately reduced and minimized to halt the oxidation and, hence, mobilization of uranium and other metals. The movement of these highly undersaturated (with respect to oxygen) waters throughout the reservoir provides the means for removing any residual oxygen gas phase from portions of the reservoir by again pushing such gas

pockets toward recovery wells while at the same time absorbing portions of the gas phase into the liquid phase. Since several pore volumes of undersaturated waters are required during GWR, any residual gas blockage is removed. Chemical analysis of produced waters during and at the conclusion of GWR is employed to confirm the removal of any elevated concentrations of metals and common ions.

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