From: Mike Griffin (USA) [Mike.Griffin@uranium1.com]
Sent: Wednesday, April 01, 2009 2:09 PM
To: Elise Striz
Cc: Myron Fliegel; Dennis Stover (USA); Donna Wichers (USA)
Subject: FW: Texas experience with limited hydrostatic pressure-revised

Elise:

Mike Fliegel called this morning and told me that the disclaimer in the original email providing our response to your question concerning potential gas locking in wellfields prevented publication in ADAMS due to the statement concerning confidential and privileged information. This is a standard disclaimer used on all Uranium One emails. In this specific instance, the information provided in Dr. Stover's discussion of experience in Texas with wellfields with limited hydrostatic pressure is not confidential or privileged and may be added to the public record. I have removed that statement from the disclaimer for this email to allow publication in ADAMS.

Please let me know if you have any questions.

Mike

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From: Mike Griffin (USA)
Sent: Monday, March 30, 2009 2:42 PM
To: Elise Striz
Cc: Mike Fliegel
Subject: FW: Texas experience with limited hydrostatic pressure-revised

Elise:

Following is an expanded discussion of the issue of gas locking in wellfields prepared by Dennis Stove based on his experience with the Mocyzgemba Uranium Project (now known as the Hobson Uranium Project) in Texas. Since this project occurred in the late 1970's it is probably not surprising that TCEQ staff did not recall these issues.

Please let me know if we can provide any additional information.

Mike

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From: Dennis Stover (USA)
Sent: Monday, March 30, 2009 2:29 PM
To: Donna Wichers (USA); Mike Griffin (USA)
Subject: FW: Texas experience with limited hydrostatic pressure-revised

Donna and Mike,

Questions have arisen regarding the Texas experience with ISR operations in shallow, limited hydrostatic head aquifers. As you know, I served as the Chief Engineer for Everest Minerals Corporation from April, 1978 until July, 1989 and was responsible for both reservoir and process engineering at all uranium projects. A summary of my recollections of the experience and lessons learned at the Mocyzgemba project are described in the following text. Please advise if additional information would be helpful.

The Mocyzgemba Uranium Project, now known as the Hobson Uranium Project, was licensed and constructed by Everest Mineral Corporation in 1978 and 1979. As originally designed and operated (1979-1982), the Project consisted of an uranium recovery plant which produced a yellowcake slurry and an adjacent well field located immediately north of the plant. This well field was decommissioned during the late 1980's following successful groundwater restoration and surface reclamation. The land was subsequently released to the landowner. The processing plant has now been completely revamped as a uranium bearing resin processing facility and owned by the South Texas Mining Venture which is a Texas partnership between Energy Metals Corporation (99%) and Everest Exploration, Inc (1 %).

The uranium ore deposit was located in the Tordilla member of the Jackson formation at an approximate subsurface depth from 180 to 210 feet. Baseline hydrostatic water level was approximately 100 feet subsurface (as I recall). Well head injection pressures were limited to about 113 psig at the top of the mining interval, 180 ft subsurface. Assuming that injection wells operate under pressure with a full column of water, the maximum surface or well head gauge pressure would be 35 psig (113. - 0.432 psi/ft x 180 ft H_2O). The solubility of pure oxygen gas in water is temperature dependent. At typical shallow ground water temperatures encountered in Texas (75 F +/-), the solubility is about 33 ppm per atmosphere of pressure (14.7 psi). (At typical Wyoming shallow ground water temperatures, 55 to 60 F, oxygen solubility is about 30 ppm per atmosphere.) For the Texas situation, at a maximum well head pressure of 35 psig and a down hole pressure of 113 psig (at the top of the ore zone), oxygen solubility at the top of the ore zone should approximate 287 mg/l O_2 (33 mg/l/atm. x (113. + 14.7)psia/14.7 psi/atm).

Fluid enters the host formation under radial flow and pressure drop condition such that pressure of the dissolved oxygen carrying fluid diminishes to at or near the ambient formation pressure (100 ft of hydrostatic head or 43.2 psig (under these conditions, oxygen solubility is reduced to about 130 mg/l) as the fluid moves away from the injection well and remains near this pressure until the fluid enters the immediate region of a production or recovery well. As the fluid nears the well it experiences a steep, declining pressure gradient again under radial flow conditions. However, while the active uranium leaching is occurring, most if not all of the dissolved oxygen has been consumed by chemical reaction with uranium and sulfide minerals along its flow path from the injection well. As the oxidation process proceeds, less oxygen is consumed and eventually oxygenated waters will be observed at the production well head during the normal daily sampling of the uranium bearing fluid by a well field operator. Keen observation of gassy water is important as this indicates the need to alter the flow pattern of fluid within this portion of the well field. That is, well functionality should be changed to redirect the oxygenated lixiviant to other, less well leached area of the well field. Ultimately, the injected oxygen concentration to the entire well field is reduced during the latter stages of its operating life.

Injection wells at the Mocyzgemba Project were operated with a positive well head pressure and, hence, a full well column. Injected dissolved oxygen concentrations were limited to about 150 mg/l using downhole gas spargers. Under these conditions, there was no indication of gas blockage or associated flow restrictions. There was significant well fouling due to calcium carbonate scaling of the injection wells. However during backwashing of the wells to remove the scale, there was no evidence of a separate gas phase in the waters.

Later during the operating life of the well field, it was noted that a hydraulic gradient had developed to the west as evidenced by monitoring of water levels in the perimeter monitor wells. Investigation quickly revealed that the cause was the development and associated dewatering of an open pit uranium mine less than one mile to the west/southwest of the Moczygemba well field. The target ore was located in the same stratagraphic interval. With the cooperation of the new mine's owner, Everest received authorization from the State to install a series of five injection wells about mid-way between the two projects and to reinject waters being pumped from the host formation at the open pit mine. This created a hydrologic barrier between the two mines which stabilized the water level in the Moczygemba well field. About the same time, efforts were undertaken to accelerate the leaching process by the supplemental use of hydrogen peroxide as a well field oxidant. Hydrogen peroxide has a well documented capability to catalytically decompose into oxygen gas (1/2 mole) and water (1 mole) in the presence of iron or iron minerals such as pyrite and marcasite. Given this characteristic, the upper limits in hydrogen peroxide concentrations are still governed by the oxygen solubility constraints noted above. As part of the learning process, this constraint was not observed and excessive quantities of hydrogen peroxide were injected into several injection wells on a test basis. Within a relatively short time (days), fluid injectivity at these wells dropped to near or at zero (the prescribed injection pressure limitation was not exceeded). The decomposition of hydrogen peroxide was quickly confirmed when some of these wells were taken off line and depressurized in preparation for work overs. These wells spontaneously backflowed with the liberation of large volumes of a vapor-water mixture, mostly vapor which proved to be oxygen. The loss of injectivity was a direct result of gas locking of the ore zone. The gas lock was successfully removed first by the venting process and then by installation of a submersible pump in the subject injection wells and backflowing these wells until the gassy appearance of the fluid disappeared. The wells were then returned to their original service as injection wells will no further difficulties as long as the oxygen solubility constraints were observed.

The principles learned at the Moczygemba well field will directly be applied to the well field operations at Moore Ranch. These include: observation and internal reporting of any gas breakout in individual production well water samples at the time of sampling; careful monitoring of dissolved oxygen concentrations added to injection fluids; observation and internal reporting of any gas breakout in waters produced during routine work over of injection wells; change of wells functions (injection to production, production to injection) as dictated by reports of gassy waters; and recognition of the tendency of hydrogen peroxide to decompose in the presence of iron metal and minerals.

If additional questions or concerns remain, please advise.

regards,
Dennis

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X-IronPort-Anti-Spam-Result:
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srv-den-mx-01.den.u1.internal ([10.10.130.10]) with mapi; Wed, 1 Apr 2009
12:08:50 -0600
From: "Mike Griffin (USA)" <Mike.Griffin@uranium1.com>
To: Elise Striz <elise.striz@nrc.gov>
CC: Mike Fliegel <myron.fliegel@nrc.gov>, "Dennis Stover (USA)"
<Dennis.Stover@uranium1.com>, "Donna Wichers (USA)"
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Return-Path: Mike.Griffin@uranium1.com