Internal
C0150032
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OGMCOAL - Crandall Cyn: Eric Petersen Iron Q Memo

From: Steve Christensen
To: Dana Dean; Daron Haddock; Jim Smith; Kevin Lundmark
Date: 3/17/2010 7:56 AM
Subject: Crandall Cyn: Eric Petersen Iron Q Memo
CC: OGMCOAL
Attachments: Crandall_PetersenRpt_Memo.doc

'Top o the mornin to ya',

Attached is the memo that Kevin and I wrote up on Eric Petersen's Crandall Canyon/Iron report. It's located here: *O:|015032.CRA|Water Quality|Petersen Report Feb 25,2010.*

Let us know if you have any questions.

Thanks,
Steve

TECHNICAL MEMO

March 4th, 2010

TO: John Baza, Director

THRU: Dana Dean, Associate Director and Daron Haddock, Permit Supervisor

FROM: Steve Christensen, Environmental Scientist and Kevin Lundmark, Environmental Scientist

RE: Crandall Canyon Mine Water Discharge Investigation: Iron Concentration Evaluation, Genwal Resources, Inc., Crandall Canyon Mine, C0150032

The Division of Oil, Gas and Mining (the Division) recently received a report dated February 25th, 2010 prepared by Genwal Resources' consultant, Mr. Eric Petersen of Petersen Hydrologic. The purpose of the report was to provide an evaluation of the elevated iron concentrations in the mine-water discharge (the discharge) of the Crandall Canyon Mine. Additionally, the report presents Mr. Petersen's opinion that the elevated iron concentrations in the discharge are temporary.

Upon review of the report, we find that the evaluation prepared by Mr. Peterson does not demonstrate that iron concentrations in discharge from the Crandall Canyon Mine will decrease to below 1 mg/L in the future. Mr. Peterson's opinion appears to be based entirely on data from the Skyline Mine; however, a detailed discussion of the similarities and differences between the two sites is not provided. The consultant's description of the geochemistry of the Crandall Canyon Mine discharge does not reference, and is not supported by, any data beyond the limited suite of analyses required by the UPDES permit for the site.

The investigation does not describe the chemistry of the discharge, and the consultant has not made any recommendations for analyses or evaluations to monitor how the discharge is changing (or not changing) over time.

Mr. Petersen states that a purpose of the investigation is "*to provide projections of likely future iron concentrations in discharge waters*" from the mine. However, no concentration projections are provided. The report provides a series of plots showing total iron and total dissolved solids (TDS) concentrations queried from the Division's Water Quality Database. No sampling, analyses, calculations or geochemical modeling has been performed to evaluate the nature and future trends of iron in the discharge.

The report provides some generic equations describing mineral dissolution and iron chemistry. However, no discussion is provided for the specific conditions at the Crandall Canyon Mine, including:

- Whether oxygenated groundwater is present or how oxygen content may change over time;
- The water type of the discharge and the potential associated mineral dissolution/precipitation reactions; and
- What factors are currently controlling iron concentrations in the discharge (e.g., dissolved oxygen, pyrite availability, temperature/kinetics, iron precipitation) and how these may change over time.

The assertion that the there is a finite amount of reactants within the mine and that the total iron concentrations will eventually go down as the pyrite minerals are consumed through oxidation processes may very well be correct. However, asserting that the process will "likely occur within a few years" is problematic due to several unknown variables:

- The extent of pyritic material now exposed to oxygenated water is unknown;
- The actual source of the mine-water has never been determined. As a result, the amount of water that could potentially enter the mine and it's inherent oxygen content is also unknown;
- Whether the current flow path of the mine-water will remain in its current configuration is unknown. Due to the extensive faulting and mining in the area, it's highly likely that additional settling/movement of the mine will continue into the future. As a result, the flow path of the mine-water could be easily altered and previously non-exposed areas of pyritic material could become inundated with mine-water thus producing another spike in total iron.

Based upon the discussion presented by Mr. Petersen, if an evaluation of the amount of pyrite available for reacting and the availability of dissolved oxygen in the mine-water cannot be accomplished, it follows that the timeframe, rate and magnitude of reduction in iron concentrations cannot be predicted.

As mentioned previously, the assertion that iron concentrations will again return to below the 1mg/L UPDES standard is based upon the conditions that were present at the Skyline Mine. Mr. Petersen asserts that the iron concentrations of the discharge will go down "*based on the declines observed at the Skyline Mine CS-14 location*" and that as a result "*it seems likely that declines in iron concentrations to levels less than 1 mg/L will likely occur within a few years*". The Skyline discharge and its elevated iron concentrations were not brought about due to a catastrophic mine collapse. As such, the situations are not similar. Mr. Petersen does not offer an explanation as to the variation in TDS and total iron concentration trends exhibited at the Skyline Mine and Crandall Canyon Mine. A comparison of plots of TDS and total iron concentrations at the two sites illustrates significantly different trends.

In summation, the report prepared by Mr. Petersen does not demonstrate that the elevated iron concentrations of the Crandall Canyon Mine discharge are temporary in nature. Additional analyses are necessary to evaluate the iron contamination problem. The following actions should be performed by the operator:

1) In accordance with R645-301-724, whole-water chemical analysis of the untreated mine discharge should be conducted monthly. These data will help evaluate current conditions, detect changes over time, and provide information relative to water treatment at the site. Water monitoring parameters should include, at a minimum, aluminum, calcium, iron (total, dissolved and ferrous), potassium, sodium, manganese, magnesium, silica, sulfate, chloride, alkalinity (total, carbonate and bicarbonate), hot acidity (Standard Methods 2310a), pH, TDS, suspended solids, dissolved oxygen, conductivity, temperature and flow. After one year, the monitoring program may be modified based on the results of the monthly monitoring.

2) The Probable Hydrologic Consequences (PHC) included in the Mining and Reclamation Plan (MRP) clearly does not reflect the conditions at the site. Toxic-forming materials are present at the site and coal-mining operations have resulted in impacts to surface water. In accordance with R645-301-728.400, the Division may require a new or updated PHC determination during review of future applications for permit revision. The operator should begin gathering the necessary data for updating the PHC as part of the revisions to the reclamation plan being completed pursuant to Division Order C/015/0032-DO08A.