Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Matthew H. Mead, Governor

John Corra, Director

July 24, 2012

Mr. Ken Garoutte
Manager – Safety, Health, Environment and Quality
Cameco Resources, Inc.
PO Box 1210
Glenrock, WY 82637

Subject: **TFN 5 1/330, Restoration Research Proposal**
Permits 603 & 633, Cameco Resources

Dear Mr. Garoutte:

The Land Quality Division (LQD) has completed the review of the referenced proposal received on May 29, 2012. Please find review comments enclosed.

If you have any questions, please contact me at 777-7048 or pam.rothwell@wyo.gov.

Sincerely,

Pam Rothwell

Pam Rothwell
District 1 Assistant Supervisor
Land Quality Division

Encl.

cc: Kevin Frederick, WQD
Doug Mandeville, NRC

TFN 5 1/330, RESTORATION RESEARCH PROJECTS

PERMITS 603 & 633

INTRODUCTION

The Land Quality Division (LQD) received a proposal to conduct three (3) restoration research projects on May 29, 2012. The three projects include:

1) tracer tests to determine the hydrologic pathways within a portion of a wellfield;
2) bio-stimulation tests to determine the use of naturally occurring bacteria to precipitate redox-sensitive parameters;
3) natural attenuation tests to determine if the conditions downgradient of the mining zone will precipitate contaminants.

A portion of the research is funded by a grant from the Wyoming legislature that is administered by the School of Energy Resources at the University of Wyoming. Additional funding is provided by the Department of Energy and Department of the Interior. CR is providing logistical support and a $50,000 grant to the University of Wyoming.

LQD has questions with regard to the use of unapproved chemicals on the permitted operations. Other agencies that may have an interest in the injection of the chemical tracers and bio-nutrients that are not included in the approved permit include the DEQ/Water Quality Division (WQD) and the Environmental Protection Agency (EPA), i.e., aquifer exemption. Therefore, it is requested that a copy of the proposal be provided to the WQD. If it is determined that the proposed injection fluids also require EPA concurrence, CR will be advised and may need to provide additional information to WQD or EPA. CR should provide copies of their correspondence with these agencies and subsequent denial or concurrence to LQD to address LQD concerns.

Note that the following comments are numbered from No. 1 for each of the proposed projects. It is advised that each of the projects be reviewed separately. A separate TFN will likely be created with the responses to comments for the separate projects. LQD will retain one TFN until CR advises LQD that all three projects will be pursued.

COMMENTS

Tracer Study – This research project consists of two parts, the first part is to use a tracer to determine the degree of connection between individual injection wells and production wells in a single pattern area. The second part would be to conduct a tracer test in an unmined area to determine the changes in aquifer properties due to mining.

1. It appears from the discussion that a multi-well pump test could achieve the same results as a tracer test for the mined area. Please discuss the benefits of using a tracer test over using a multi-well pump test. **(SI)**

2. The text states that the test will be centered on the patterns associated with recovery wells 4P-121 and 4P-113. It is unclear if each area affected would consist of a single 5-spot pattern or a larger area. Please clarify the area to be affected by the test. **(SI)**

3. The tracer(s) cannot be added to the production wells. Where would the tracer(s) be added for the test(s) and how will the pumping and injection be configured? Please describe in the revision, the pumping and injection configuration and where the tracer(s) would be added. **(SI)**

4. The test proposes using multiple tracers. Please discuss why multiple tracers are necessary? **(SI)**

5. The proposal indicates that only one core will be analyzed. Please discuss why one core is adequate for the test. **(SI)**

6. There is no discussion regarding other activities that may be occurring within this portion of the wellfield that may influence the results of the test. Please discuss in the revision, the other activities that may be occurring within this portion of the wellfield and any influences that may affect the test results. **(SI)**

7. Comparing core analyses between the unmined area and the mined area may only yield qualitative results because of the mineralogy changes across the redox interface of a C-Roll. Please discuss how the core analyses would be compared. **(SI)**

8. As suggested in Comment No. 1, the purpose of the tracer research project is not clear. CR states that the tracer project will be used to determine hydrologic pathways between injector and recovery wells. Identifying the flow patterns between such wells will be used to address the efficiency of groundwater sweep. Please provide more details explaining:
   - CR's identified inefficiencies of groundwater sweep in ISL restoration;
   - measureable parameters of the test and how it will be reported;
   - expectations of the tracer pathway evaluation and how it will be used to interpret sweep inefficiency;
   - explain the relationship between the predicted sweep inefficiency and the proposed changes in aquifer characteristics due to mining. **(PCR)**

9. Please provide a map which includes more reference points, i.e., where the area lies with respect to the general area of the permit boundary, MU-4, MU-4A, legal coordinates, north arrow, a legend which designates the test wells and other pertinent information. **(PCR)**

10. Please describe in the proposed revision, the past and present mining/restoration status of the wellfield as well as the patterns proposed for the test. A discussion of the existing geochemical groundwater conditions and expected reaction with the proposed tracers should also be discussed. **(PCR)**

11. Please specifically list in the revision, all the injection wells that will be used in addition to the production wells. **(PCR)**

12. Please explain in the revision the reason for conducting the research project on the permitted mine sites and whether they could be conducted elsewhere under a Research and Development License. **(PCR)**

13. Please describe any monitoring that will be conducted to ensure containment of the chemical tracers to the proposed pattern(s). List the wells used to monitor the project and show on the map. Describe a monitoring plan and scheduled. **(PCR)**

14. The proposal discusses using tracer testing on cores prior to mining. Please explain in the permit revision, how this phase of the project is intended to be conducted. Please indicate the location of the proposed core holes on the map. **(PCR)**

15. The proposal discusses the material safety data sheets for the proposed tracers of the project. Please cross reference the specific data sheets for each tracer described in the proposed revision. **(PCR)**

16. The approved permits (Class III authorization) do not include use of the chemical tracers identified in the research project. In addition, the aquifer reclassification by Water Quality Division (WQD) and the exemption by the Environmental Protection Agency (EPA) have not evaluated the use of the chemicals as they were not included in the approved permit which was reviewed by those regulatory authorities. Therefore, CR must submit a copy of the proposed application to WQD for their evaluation of the use of the chemicals as aquifer tracers. Further evaluation by the EPA may be requested. **(PCR)**

17. Please provide more detailed discussion of the chemical tracers to be used in the project. Discuss expected reactions with residual mining and/or restoration fluids, the target aquifer groundwater chemical conditions, and the target formation mineralogy (Chapter 11, Section (4)(a)(xviii). **(PCR)**

18. Please discuss potential impacts of the proposed project in the revision. The discussion should include an analysis of the tracers reactivity with groundwater and any affects to restoring the groundwater to baseline conditions (Chapter 11, Section 4(a)(xxi)). **(PCR)**

19. Please discuss any impacts of using the identified tracers to wells, pipelines, IX columns, and other mining/restoration circuits in the wellfields and/or processing facilities. **(PCR)**

20. Please discuss in the revision, how the chemical tracers will be recovered after they are circulated through the wellfield pattern. **(PCR)**

21. Please discuss in the revision, the composition of the recovered chemical wastes and procedures for their disposal (Chapter 11, Section 4(a)(vi). If the permitted disposal wells are planned to dispose of the chemicals, has CR consulted with WQD regarding the use of the disposal wells? **(PCR)**

22. Please provide text page insertions for the permit revision that address the proposal with the appropriate Index of Changes. **(PCR)**

23. Please identify itemized costs for the proposed project and show the costs on the surety estimate. LQD understands CR has identified outside resources that are intended to fund the research projects. However, CR has not identified the equipment costs, chemicals cost, water usage cost, waste disposal costs, etc. As the project is dependent on the mining/restoration operations, CR should incorporate the costs according to how the existing operation is used to conduct the test. In the event that any impacts are incurred, restoration/reclamation costs should be considered to cover these risks. **(PCR)**

24. CR states that no amenable alteration of the mine or restoration schedules would be done without regulatory approval. CR should consider the review time for LQD approval (i.e., estimate of rounds of review) as well as the reviews by WQD and potentially EPA in evaluating the alteration to the approved schedule for this mine unit. If regulatory reviews are anticipated to significantly delay the restoration of wellfields that are scheduled to be in restoration, a change to the restoration schedule may be required. **(PCR)**

25. LQD has questions with regard to the use of unapproved chemicals on the permitted operations. Other agencies that may have an interest in the injection of the chemical tracers and bio-nutrients that are not included in the approved permit include the DEQ/Water Quality Division (WQD) and the Environmental Protection Agency (EPA). Therefore, it is requested that a copy of the proposal be provided to these agencies for their review. CR should provide their reviews to LQD and subsequent denial or concurrence to proceed with the projects. **(PCR)**

26. Please provide a timeline for the proposal indicating the steps that will be conducted during the test. **(SI&PCR)**

27. Seven footnotes are listed in the references, but the proposal does not contain footnotes or references to the footnotes. Please provide the references to the footnotes in the text. **(SI)**

Bio-stimulation – A core is (or has) been analyzed from the 4P-121 pattern area for the bacterial population and mineralogy. The results of this analysis will be used to determine the appropriate nutrient type and amounts. The results from the analysis were anticipated by mid-June.

1. There is no discussion on the handling procedures for the core. Exposure of the core to air can change the mineralogy and contaminate the bacterial population. Please discuss in the proposed revisions, how the core will be/was handled. **(SI)**

2. The text discusses the use of pre-mining core samples from the Smith Ranch core library. The mineralogy and bacterial population in the pre-mining core may have been altered by exposure to air and drying. Please discuss the usefulness and limitations in the use of pre-mining core in the proposal. **(SI)**

3. The criteria used to determine the choice of organic nutrient should be discussed. Please discuss the criteria for selection of the organic nutrient in the revision. **(SI)**

4. The proposal does not discuss the bacterial and nutrient transport within the test area. Please discuss the bacterial and nutrient transport within the test area. **(SI)**

5. The text states that the drill hole from which the core was taken from has been cased and would be used as a passive sampling point. Please explain a passive sampling point. **(SI)**

6. The purpose of the study of Uranium 238/Uranium 235 ratio and Carbon 13/Carbon 12 ratio's should be further explained. Please explain the purpose of the ratio studies. **(SI)**

7. The proposal discloses core hole(s) have been completed and are covered by the surety. Please state when the cores were completed and identify the core holes on the map. In addition, the proposal states that a post bio-stimulation core will be taken. Please provide the proposed location of the post bio-stimulation core hole on the map. **(PCR)**

8. Please provide a map which includes more reference points, i.e., where the area lies with respect to the general area of the permit boundary, MU-4, MU-4A, legal coordinates, north arrow, a legend which designates the test wells and other pertinent information. **(PCR)**

9. Please describe in the proposed revision, the past and present mining/restoration status of the wellfield as well as the status of the patterns proposed for the test. A discussion of the geochemical groundwater conditions and expected reaction with the proposed organic nutrient should also be discussed. **(PCR)**

10. Please explain in the revision the reason for conducting the research project on the permitted mine sites and whether they could be conducted elsewhere under a Research and Development License. **(PCR)**

11. Please describe any monitoring that will be conducted to ensure containment of the organic nutrient to the proposed pattern(s). List the wells used to monitor the project and show on the map. Describe a monitoring plan and scheduled. **(PCR)**

12. Please discuss potential impacts of the proposed project in the revision. The discussion should include an analysis of the nutrient reactivity with groundwater and any affects to restoring the groundwater to baseline conditions (Chapter 11, Section 4(a)(xxi)). **(PCR)**

13. Please provide text page insertions for the permit revision that address the proposal with the appropriate Index of Changes. **(PCR)**

14. Please identify itemized costs for the proposed project and show the costs on the surety estimate. LQD understands CR has identified outside resources that are intended to fund the research projects. However, CR has not identified the equipment costs, nutrient cost, water usage cost, waste disposal costs, etc. As the project is dependent on the mining/restoration operations, CR should incorporate the costs according to how the

existing operation is used to conduct the test. In the event that any impacts are incurred, restoration/reclamation costs should be considered to cover these risks. **(PCR)**

15. CR states that no alteration of the mine or restoration schedules would be done without regulatory approval. CR should consider the review time for LQD approval (i.e., estimate of rounds of review). If regulatory reviews are anticipated to significantly delay the restoration of wellfields that are scheduled to be in restoration, a change to the restoration schedule may be required. **(PCR)**

16. Please provide a timeline for the proposal indicating the steps that will be conducted during the test. **(SI&PCR)**

17. Seven footnotes are listed in the references, but the proposal does not contain footnotes or references to the footnotes. Please provide the references to the footnotes in the text. **(SI)**

Natural Attenuation and Contaminant Mobility Study – The study would consist of injecting lixiviant from an operating mine unit into an already approved, but unmined unit. Lixiviant injection would be followed by clean water injection. The solution would then be allowed to sit for three to six weeks. After this period the well would be pumped to recover the lixiviant, which would be analyzed during recovery.

1. All injected fluids have been sparged to remove dissolved oxygen. Sparging to remove oxygen would not simulate mining conditions. Please discuss how this study would simulate natural attenuation and contaminant mobility under actual mining and restoration conditions. **(SI)**
2. The text does not discuss how the three to six week period was determined, nor does it discuss the purpose of the three to six week period. Please provide additional discussion regarding the three to six week period. **(SI)**

3. The text mentions a breakthrough curve. There is no further discussion of what is meant by a breakthrough curve. Please provide additional discussion of the breakthrough curve. **(SI)**

4. There is no discussion of how the sampling results will be applied to a natural attenuation and contaminant mobility assessment. Please discuss how the results will be applied to a natural attenuation and contaminant mobility assessment. **(SI)**

5. Please identity the wells that will be used for both recovery of injection fluid and the injection site(s). Show these areas on a map as described in Comments No. 9. **(PCR)**

6. Please describe in the proposed revision, the present mining/restoration status of the wellfields as well as the patterns proposed for the test. Provide a discussion of the existing geochemical groundwater conditions of the injection site and expected reaction with the injection fluid. **(PCR)**

7. Please provide text page insertions for the permit revision that address the proposal with the appropriate Index of Changes. **(PCR)**

8. Please explain in the revision the reason for conducting the research project on the permitted mine sites and whether they could be conducted elsewhere under a Research and Development License. **(PCR)**

9. The proposal discusses the material safety data sheets for the lixiviate marker for the project. Please cross reference the specific data sheets for each marker described in the proposed revision. **(PCR)**

10. Please describe any monitoring that will be conducted to ensure containment of the lixiviate markers. List the wells used to monitor the project and show on the map. Describe a monitoring plan and scheduled. **(PCR)**

11. Please discuss potential impacts of the proposed project in the revision. The discussion should include an analysis of the "used" lixiviate with groundwater and any affects to restoring the groundwater to baseline conditions (Chapter 11, Section 4(a)(xxi)). **(PCR)**

12. Please identify itemized costs for the proposed project and show the costs on the surety estimate. LQD understands CR has identified outside resources that are intended to fund the research projects. However, CR has not identified the equipment costs, nutrient cost, water usage cost, waste disposal costs, etc. As the project is dependent on the mining/restoration operations, CR should incorporate the costs according to how the existing operation is used to conduct the test. In the event that any impacts are incurred, restoration/reclamation costs should be considered to cover these risks. **(PCR)**

13. Please provide a timeline for the proposal indicating the steps that will be conducted during the test. **(SI&PCR)**

14. Seven footnotes are listed in the references, but the proposal does not contain footnotes or references to the footnotes. Please provide the references to the footnotes in the text. **(SI)**