HOMESTAKE
Grants Project

Homestake Mining Company of California

Jesse R. Toepfer
Closure Manager

21 October 2014

Mr. David Mayerson
Ground Water Quality Bureau
New Mexico Environment Department
PO Box 5469
Santa Fe, NM 87502-5469

RE: Response to Comments Received from NMED Regarding Microfiltration Pilot Study Report

Mr. Mayerson:

This letter is being submitted in response to comments received from the New Mexico Environment Department (NMED) under cover of a letter dated 22 September 2014 entitled, *RE: Homestake Mining Company of California/DP-200—Comments on "Responses to NMED Comments regarding Homestake's November 2013 'Update on treatment activities'".*

Enclosed with this letter, please find Homestake Mining Company of California's (HMC's) responses to the comments received in the aforementioned letter.

Thank you for your time and attention on this matter. If you or anyone on your staff has any questions, please contact me at the Grants office at 505.287.4456, extension 34, or call me directly on my cell phone at 505.290.3067.

Respectfully,

Jesse R. Toepfer
Closure Manager
Homestake Mining Company of California
Office: 505.287.4456 x34 | Cell: 505.290.3067

Copy To:

Mr. Jack Parrott, US Nuclear Regulatory Commission – Rockville, Maryland
Mr. Sai Appaji, US Environmental Protection Agency, Region 6 – Dallas, Texas
Mr. Wayne Canon, New Mexico Office of the State Engineer – Albuquerque, New Mexico
Mr. Bill Ferdinand, Barrick Gold – Salt Lake City, Utah
Mr. Patrick Malone, Barrick Gold – Salt Lake City, Utah
Ms. Deborah Barr, US Department of Energy, Office of Legacy Management – Grand Junction, Colorado
Mr. Dave Schafer, US Department of Energy, Office of Legacy Management – Westminster, Colorado

NM5501

Item No.	Report and Page No.	Quoted Text	NMED Comment	Response
1	Pilot Study Report p. 7	"Throughout each test run, the transmembrane pressure (TMP) across the membrane module will increase due to fouling and eventually will need to undergo a chemical clean-in-place (CIP) to reduce the TMP."	Please describe how the volume of clean-in-place (CIP) fluids for an effective cleaning regime is determined for the pilot testing, as well as for full-scale implementation.	The volume of CIP fluids required for pilot testing and full-scale operation were provided by the Microfiltration (MF) manufacturing company, Pall Corporation. Please see the document titled "Homestake Mine Operating Protocol." During one full-scale CIP cleaning, there is one caustic/chlorine wash (step 1), and one acid wash (step 2) which are summarized below ("Homestake Mine Operating Protocol" p. 4). **CIP Step 1 - Caustic/Chlorine Wash** 1% Caustic — 28 gallons of 25% caustic 2000 ppm NaOCl — 12 gallons of 12.5% sodium hypochlorite CIP Solution Volume — 890 gallons Solution Temperature — 35°C (95°F) Circulation Time — 120 minutes Rinses — Two rinses, 890 gallons each Total Volume — 2,670 gallons **CIP Step 2 – Citric Acid Wash** 2.0% Citric Acid — 29 gallons of 50% Citric Acid CIP Solution Volume — 890 gallons Solution Temperature — 35°C (95°F) Circulation Time — 60 minutes Rinses — Three rinses, 890 gallons each Total Volume — 3,560 gallons

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2	Pilot Testing Plan p. 12	"At the completion of Test Run #1, ARCADIS, HMC, and Pall Corporation will review the data and determine an acceptable flux and optimized feed pH for Test Run #2. Key data to be reviewed include: • Transmembrane Pressure (TMP) • Backwash effectiveness • EFM effectiveness"	The Pilot Testing Plan (Appendix A) indicates that determination of backwash and enhanced flux maintenance (EFM) effectiveness would be a component of the pilot testing protocol (p. 12). However these processes are not mentioned in this report.	Pilot Study Report p. 18 states: • "The chemical cleaning processes (EFMs and CIPs) effectively restored membrane permeability, indicating that the specified cleaning regime (chemical types/sequences, duration and frequency) is appropriate for this feed water source." This statement describes that the EFM cleaning processes sufficiently restored membrane permeability. • "Throughout the three months of pilot testing, the MF pilot unit was able to successfully operate for at least 30 days at both 40 gallons per square foot per day (gfd) and 45 gfd. Additionally, it was determined that the backwashes, EFMs and CIPs were successful at reducing the TMP of the pilot unit." This statement clarifies that the backwash and EFM schemes implemented during pilot testing proved to be effective.

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3	Pall Water Processing Technical Report W0664 p. p. 3	"Cycle 1 operated with relative stability in spite of a few operational interruptions at 40-45 gfd [gallons per square foot per day], 95.4% recovery, and daily 500 ppm sodium hypochlorite EFMs. Cycle 2 continued to evaluate the MF performance operating at 45 gfd, 95.4% recovery... the EFM interval would be increased to weekly, during the last portion of the cycle."	The Pall water processing technical report W0664 (Appendix B) states that Cycle 1 testing utilized daily 500 parts per million sodium hypochlorite EFMs, which were increased to weekly intervals during the last portion of Cycle 2 testing (p. 3). Please provide a description of these processes...	Pall Water Processing Technical Report W0664 p. 6 states: "EFM is a short cleaning of membranes to maintain optimal performance. Called by various names, including chemical washes, mini-cleans, and relaxation, the basic process involves circulation of a chemical cleaning solution on the feed side of the membrane at an elevated temperature for 30 minutes before returning the unit back to normal operation."
4	Same as Item No. 3	Same as Item No. 3	...including but not limited to, the chemicals and fluid volumes utilized...	The volume of EFM fluids required for pilot testing and full-scale operation were provided by the MF manufacturing company, Pall Corporation. Please see the document titled "Homestake Mine Operating Protocol." One full-scale EFM cleaning includes a chlorine wash which is summarized below ("Homestake Mine Operating Protocol" p. 3). **EFM - Chlorine Wash** 500 ppm Chlorine — 3 gallons of 12.5% Sodium Hypochlorite EFM Solution Volume — 890 gallons Solution Temperature — 35°C (95°F) Circulation Time — 30 minutes Rinses — Two rinses, 890 gallons each Total Volume — 2670 gallons

Item No.	Report and Page No.	Quoted Text	NMED Comment	Response
5	Same as Item No. 3	Same as Item No. 3	...how implementation frequency was determined...	According to p. 3 of the Pall Water Processing Technical Report, the EFM implementation frequency for the pilot testing began at one EFM per day. Pilot Study Report p. 18 describes that the system proved successful under this interval. Pilot Study Report p. 1 explains why the EFM implementation interval changed from daily to weekly during pilot testing: "Pilot testing goals included... Challenge Testing: evaluate the performance of MF under challenging operational conditions that included runs of more than 30 days and a weekly enhanced flux maintenance (EFM) clean." The successful results of this challenge testing are shared on Pilot Study Report p. 19: "The MF pilot testing was able to demonstrate that the low pressure membrane was able to operate for longer than 30 day durations between CIPs (typical practice), as well as decrease from daily EFM cleans to weekly EFM cleans without approaching the termination TMP for the unit of 45 psid."
6	Same as Item No. 3	Same as Item No. 3	... and the effectiveness metrics in the pilot testing...	The EFM effectiveness metrics in the pilot testing included: 1) TMP - As presented on p. 7 of the Pilot Study Report: "TMP is defined as the difference in pressure from the feed side of the membrane module to the filtrate side of the membrane module." Figures 3-1 and 3-2 of the Pilot Study Report (p. 8 and 9) show TMP results. Daily and weekly EFMs consistently managed the TMP values to below the termination TMP of 43.5 psid. 2) Run time between CIPs – Figures 3-1 and 3-2 show that the test runs met the pilot testing goal of promoting greater than 30 day runs times between CIPs.

Item No.	Report and Page No.	Quoted Text	NMED Comment	Response
7	Same as Item No. 3	Same as Item No. 3	… as well as implementation projections for full-scale microfiltration operations.	Pilot Study Report p. 18 describes the recommended full-scale parameters determined as a result of pilot testing. ARCADIS and Pall Corporation developed the full-scale MF projected cleaning protocols based on the pilot testing results. "Based on the MF pilot testing, the following full-scale design criteria were developed for the 1,200 gpm design: • Operating Flux – 45 gfd • EFM Cleaning Frequency – 3 to 7 days • Recovery – 95 percent • CIP Frequency – greater than 30 days • Chemical cleaning types, sequences, duration"

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Homestake Mine IND-21975
Operation Protocol

The following is a recommended protocol for operating the Pall Micro-filtration (MF) System at the Homestake Mine water treatment plant. Please contact a Pall Service Engineer if changes in the plant performance are experienced.

System Design:

600 gpm MF Feed Flow
Max Filtrate Flow: 640 gpm
Flux = 43 GFD

MF SYSTEM OPERATION PROTOCOL

FLUX MAINTENANCE (FM) PROTOCOL

Flux Maintenance is a frequent cleaning process used to remove solids from the membrane surface mechanically. FM consists of an Air Scrub (AS) followed by a Feed Flush (FL). Air Scrub consists of coarse bubble agitation on the feed side of the membranes within each module while the reverse filtration pump pushes filtrate back through the membranes to the drain. Feed Flush consists of the feed pumps pushing feed through the feed side of the membrane modules to drain.

Volume Interval:	11,920 gallons per rack (298 gallons/module)
Air Scrub Duration:	60 seconds
Air Scrub Air Flow:	120 scfm (3 scfm/module) at 30 psig **
Air Scrub Reverse Filtration Flow:	320 gpm (8 gpm/module)
Feed Flush Duration:	20 seconds duration
Feed Flush Flow:	720 gpm (18 gpm/module)
Feed Flush Volume:	240 gallons (6 gallons/module)

**** Note: For systems with a manual rotameter the scaling on FI2 is calibrated to either 90 psig or 0 psig. Refer to air flow meter component manual in the O&M for the corrected flow rate at 30 psig.**

EXCESS RECIRCULATION (XR)

0% XR is recommended during most normal operation. This value may need to be higher depending on the TSS loading to the membranes. High dosages of coagulant will likely require an increase in the XR percentage required.

DIRECT INTEGRITY TEST (IT) PROTOCOL

IT will be automatically implemented at a desired interval. The methodology developed by Pall Corporation to comply with the US Environmental Protection Agency's Membrane Filtration Guidance Manual shall be followed.

MEMBRANE RACK FEED MANIFOLD FLUSH

Flush feed headers to remove any excess solids monthly.

ENHANCED FLUX MAINTENANCE (EFM) PROTOCOL

Enhanced Flux Maintenance is a cleaning process that uses relatively dilute chemical solution to reduce the impact of membrane foulants that resist mechanical removal. This allows for longer Clean In Place intervals, less offline time, and reduced chemical consumption overall.

EFM - Chlorine Wash:

Chlorine Solution EFM	
Volume Interval:	800,000 gallons of Filtrate produced per rack (1 day at design flow)
500 ppm Chlorine	3 gallons of 12.5% Sodium Hypochlorite per batch
EFM solution volume:	890 gallons
Solution Temperature	35 °C (95°F)
Circulation Time	30 minutes
Rinses	Two potable water rinses, 890 gallons each

General Recipe for EFM:

1. Drain
2. Caustic Wash for 30 minutes
3. Drain
4. Rack Rinse – 5 Minute rinse circulation
5. Drain
6. Rack Rinse – 5 Minute rinse circulation
7. Drain
8. End

CLEAN IN PLACE (CIP) PROTOCOL

Clean In Place is a longer duration cleaning process that uses chemical solutions to remove all foulants from the membrane.

Interval: Every 30 days or if the specific flux (permeability) reaches 1.5 gfd/psi; whichever comes first. Do not exceed 30 days regardless of the plant flows, TMP, specific flux, or anything less than written recommendation from the Pall Process Engineer assigned to this project.

STEP 1 - Caustic/Chlorine Wash:

Caustic/Chlorine Solution for CIP

1% Caustic	28 gallons of 25% caustic
2000 ppm NaOCl	12 gallons of 12.5% Sodium Hypochlorite
CIP solution volume	890 gallons
Solution Temperature	35 °C (95°F)
Circulation Time	120 minutes
Rinses	Two potable water rinses, 890 gallons each

STEP 2 – Acid Wash:

Citric Acid Solution for CIP

2.0% Citric Acid	29 gallons of 50% Citric Acid
CIP solution volume	890 gallons
Solution Temperature	35 °C (95°F)
Circulation Time	60 minutes
Rinses	Three potable water rinses, 890 gallons each

General Recipe for CIP:

1. Drain
2. Caustic Wash on feed and filtrate side for 120 minutes
3. Drain
4. Rack Rinse – 5 Minute rinse circulation
5. Drain
6. Rack Rinse – 5 Minute rinse circulation
7. Drain
8. Acid Wash on feed and filtrate side for 60 minutes
9. Drain
10. Rack Rinse – 5 Minute rinse circulation
11. Drain
12. Rack Rinse – 5 Minute rinse circulation
13. Drain
14. Rack Rinse – 5 Minute rinse circulation
15. Drain
16. End