Davis Wright Tremaine LLP

505 Montgomery Street
Suite 800
San Francisco, CA 94111-6533

GERALD F. GEORGE
415.276.6526 tel
415.276.6599 fax
geraldgeorge@dwt.com

July 26, 2017

BY OVERNIGHT MAIL AND ELECTRONIC MAIL

Director, Office of Enforcement [OE]
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Deputy Director
Division of Decommissioning
Uranium Recovery and Waste Programs [DUWP]
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738

Re: Submission of Root Cause Protocol under Condition 1 of the Confirmatory Order of March 28, 2017 modifying License No. SUA-1471, EA-16-114

Dear Sir or Madam:

Attached are the Root Cause Protocol as required under Condition 1 of the March 28, 2017 Confirmatory Order for the Homestake Grants facility, together with correspondence and edits on the draft Protocol from the independent third party consultant, and that consultant's resume.

If you have any questions, please contact me as soon as possible.

Sincerely,

Gerald F. George

Gerald F. George
Counsel for Homestake Mining Company of California

cc: NRC Document Control Desk (Hard Copy)
Patricia Holahan, Director of OE (email)
Andrea Kock, Deputy Director of DUWP (email)
Matthew Meyer (email)
Holton Burns (email)
Tom Wohlford (email)
Michael McCarthy (email)
Michelle Burgess (email)

OEDI
NMSSDI
NMSS
NRC/DE

HOMESTAKE MINING COMPANY
Of California
460 West 50 North, Suite 500
Salt Lake City, UT 84101
801-990-3901

Introduction

Pursuant to the Confirmatory Order (CO) Modifying License dated March 28, 2017 issued to the Homestake Mining Company (HMC) of California by the Nuclear Regulatory Commission (NRC), HMC has prepared this Root Cause Protocol for NRC review. HMC is the Licensee for Materials License No. SUA-1471, and the CO was issued by the NRC under Docket No. 040-08903. The CO resulted from a Settlement Agreement between HMC and NRC reached after mediation.

Submittal of this Draft Root Cause Protocol was listed as Condition 1 of the CO and will be used to satisfy Conditions 2, 3 and 4 of the CO. Under the CO, the Root Cause Protocol will be used to analyze the following five apparent violations listed in a letter from NRC to HMC dated October 4, 2016:

1. Implementation of the Reinjection Program in a manner inconsistent with the groundwater Corrective Action Plan (CAP);
2. Discharge of liquid effluents from the Reverse Osmosis (RO) Plant in excess of the Site groundwater protection standards (GWPS) established in the license[1];
3. Failure to report to NRC the results of all effluent monitoring required by the license;
4. Failure to obtain monthly composite samples as required by the license; and
5. The discharge of liquid effluents containing byproduct material to land application areas without first obtaining NRC approval.

The Protocol will also be used to establish any corrective action plans deemed appropriate in the Self-Assessment Report required in the CO, and be made available for review during future NRC inspections of the HMC Site, located near Grants, New Mexico.

[1] In its Inspection Report issued on April 20, 2017, the NRC also provided that additional exceedances identified in the 2016 site inspection would be included in this evaluation.

Root Cause Analysis Protocol

A root cause is an underlying factor or condition that has created a "problem." In this case, the problems to be assessed initially include the apparent violations listed above, and the root cause protocol will also be applied with respect to any apparent non-compliance issues identified in the self-assessment process (Condition 3 in the CO). Implementation of a root cause analysis protocol is intended to support an assessment team evaluation of the factors contributing to the problem (i.e., its "root cause") and allow identification of a successful corrective action.

Typically, a first step in the root cause analysis is to identify a broad problem statement (e.g., CO violation), which can focus a series of "who, what, when, where and why" questions. Attachment 1 includes templates for: 1) Problem Statements; 2) a Data Identification and Collection Table; and 3) a 20 Reasons Table. As appropriate, these tools will be used to focus HMC on the "Why" questions needed to determine the root cause of each apparent violation, or problems or issues identified during the self-assessment.

Five Whys Method

HMC will use the "5 Whys" method, which was originally developed by Toyota founder Sakichi Toyoda for use in the company's quality management program, because it is: 1) a widely recognized and successful approach to Total Quality Management (TQM); 2) efficient in peeling away the layers of symptoms to allow the Self-Assessment team to determine the root cause of a problem; 3) applicable to both human- and equipment-performance issues and problems, and is one of the best tools for resolving human factors or interactions; and 4) one of the simplest tools that can be completed without statistical analysis, and that can be used to identify any relationships in the hierarchy of potential causes. The 5 Whys method is included in on-line root cause guidelines and ISO and Six Sigma certification training.

The initial steps in the method are to write down the specific problem, ask the question: "why did the problem occur," and write down the answer. Subsequent written "why" questions and answers continue to focus on the initial description of the root cause and contributing factors until the ultimate root cause has been determined. Depending on the complexity of the determination, this protocol may take fewer than, or more than, five "why" questions (i.e., the questions will continue until a root cause is determined). As described in the next section of this protocol, several visual aids (e.g., process flow, logic tree and/or fishbone diagrams), can be useful in summarizing the root causes and contributing factors that resulted in the problem. Attachment 1 to this protocol includes examples of such diagrams.

Successful Implementation of Five Whys and Limitations

Root causes need to be distinguished from causal factors, which may have contributed to the occurrence of a problem, but are not necessarily the initiating cause (i.e., the root cause) of a problem. Causal factors can influence a root cause by increasing or accelerating its likelihood, and can affect the severity of its consequences.

Causal factors may include: 1) an action someone performed; 2) an action not performed by someone; and/or 3) an action that a piece of equipment, process component or process transaction performed or did not perform. A major advantage to the 5 Whys technique is that it is relatively easy to use and apply, and can be used to get to root causes in a relatively short time. However, ease of use and speed also need to be balanced against the risk of reoccurrence of the problem should a superficial 5 Whys analysis fail to identify the true root cause. The 5 Whys approach also assumes that each problem may have multiple contributing factors, but will have one factor that is the root cause. Therefore, it is important in the analysis that all jointly contributing factors be identified and addressed.

The success of 5 Whys is, to some degree, contingent on: 1) the skill with which the method is applied; 2) understanding that the why questions cannot always be run straight through in a few minutes (e.g., asking and answering all questions immediately), but the investigator may need to stop and think about whether the right questions are being asked; and 3) the recognition that by the time the fourth or fifth why question is asked, assuming the right questions have been asked, the investigator should be close to, or have arrived at, the root cause. If needed, the investigator may have to conduct an additional question-and-answer session. Finally, the 5 Whys requires that the process be grounded in observation, not deduction.

Solving a performance problem means identifying the root cause of the problem, and then developing and implementing appropriate countermeasures that will eliminate the root cause and prevent the reoccurrence of the problem. Corrective actions developed from the root cause analyses are intended to prevent the problem from reoccurring or happening the first time. Although corrective countermeasures may, at first glance, appear to be temporary fixes to problems rather than permanent solutions, that does not have to be the case.

A countermeasure approach can address the root cause using the right tools, such as an action plan with clearly identified goals, analytical tools and follow-up activities. An action plan for each countermeasure would address HMC's performance toward the goal (i.e., permanently addressing the root cause), and would include tasks, deadlines, person(s) responsible and impacts on eliminating the problem. HMC recognizes that, as the Site evolves, a problem can reappear as a result of new or different conditions that were not known at the time of the root cause analysis, and that HMC may need to continue its efforts to assure performance remains stable or continues to improve.

Application of the Five Whys Technique

The following steps will be implemented in completing the HMC root cause analysis:

1. *Preparation.* Implementation of a root cause analysis will be based on findings from the review of apparent violations and/or the self-assessment and will identify the problems (i.e., elements) and the scope of the analysis, including an understanding of the information sources that will be needed to perform the analysis (e.g., Site records and interviews with past and present Site personnel).

HMC's self-assessment team will need to understand the underlying nature of any non-compliance or area of concern identified in the CO and other NRC correspondence, and develop a problem statement that will be the focus of the analysis. The team will include members experienced with root cause analysis, site history and operations, and environmental remediation/reclamation. The overall team will be led by an investigator with no potential involvement in the identified apparent violations Each of the identified problem elements will be assigned to a lead investigator who will be responsible for identifying and communicating with other team participants, leading the 5-Whys assessment technique and preparing the final report.

2. *Information gathering.* Each problem element lead investigator, with assistance from Site personnel or other team members, will compile relevant information and data needed to analyze the problem statement. This may include physical evidence, interviews, operations and maintenance (O&M) records, existing procedures or equipment manuals, analytical results, and regulatory documents (e.g., license amendments and related correspondence or technical reports). For equipment or process failures, a process flow diagram will be developed.

3. *Analyze the information.* Using the information and facts identified during the previous step, all the problems will be compiled and categorized. Using the 5 Whys, Causal Factor Chart, Fishbone Diagram or other brainstorming tool presented in Attachment 1, HMC's self-assessment team will evaluate each problem category and individual problem to identify the contributing, and ultimately, the root cause(s). The 5 Whys technique will be performed until the root cause is identified, along with the relative contributions of the causal factors to the root cause.

   HMC recognizes that that correcting a minor contributing cause may address part of the problem, but may not prevent the recurrence of another similar problem if the root cause is left unaddressed. Given the probability that a problem may have occurred due to more than one failure mode, the team will utilize a variety of methods to determine the root cause. For example, fishbone diagrams are useful in evaluating a range of potential causes that include people (e.g. training, communication, skills, motivations), procedures (e.g. lack of, or poorly written, procedures), equipment (e.g. lack of maintenance, design or application issues), materials (e.g., wrong parts, lack of replacement parts) or environment (e.g. corrosive environment, weather issues, power outages).

   Completing a 3-legged 5 Whys analysis, where the method is independently applied to each of the following lines of questions, can also be beneficial:

   - Specific Whys. Why did this specific situation happen? This is the 5 Whys analysis that the team will initially implement in all cases to analyze obvious root causes.
   - Detection Whys. Why was the situation overlooked? This is the 5 Whys analysis that the team may need to apply to understand the reasons why the previous or existing systems and procedures did not detect the problem.
   - Systemic Whys. Why did the possibility exist for this situation to occur? This is the 5 Whys analysis that the team may need to apply to look at the organizational or cultural reasons that resulted in an environment where the problem could occur.

Because the 5 Whys tool is based on cause verification before proceeding, HMC will not assume something could have contributed to an identified problem (i.e., HMC will verify that it contributed to the failure). Otherwise, the selected corrective action may be ineffective. HMC will also confirm that the sequence of why questions and answers can be read in reverse, creating a logical flow of the causal chain from root cause to the problem statement.

Use of the fishbone diagrams, and the 3-legged 5 Whys is an interdependent recursive process. Upon completion, each factor identified on the fishbone diagrams may have an associated 3-legged 5 Whys analysis. Some of the Whys may merit their own sub-fishbone diagram. Preliminary examples of a problem statement, process and fishbone diagrams are provided as Attachment 1 of this protocol

4. *Identify the root cause(s).* HMC recognizes that one of the final outcomes of the evaluation process will be the identification of the root cause(s) that led to each identified problem or failure, so that a corrective action plan can be developed and implemented. HMC recognizes that there may be significant overlap of the root cause analyses, with common root cause(s) leading to more than one problem. Regardless each problem shall be evaluated separately to identify any potential root or contributing causes unique to that problem. However, it is incorrect to think of the root cause as just the last link in the causal chain (i.e., the "tip of the root").

   The root cause statement(s) should incorporate and address relevant portions of the entire network of elements that, taken together, resulted in the problem (i.e. the entire root, not just the root tip). The advantage of conceptualizing the cause as the entire root structure (rather than just the tip of the root) is that it provides more options to consider for corrective actions and, potentially, would allow for a more optimal outcome. Because it can be difficult in some cases to know when sufficient information has been gathered and evaluated to make a conclusion about the root cause, HMC will progress to the root cause identification step when the team feels it has a complete picture of the problem and how it occurred, including possible hidden causes in the overall organizational culture.

5. *Develop and implement the corrective actions.* Once the root cause is identified, the team will identify possible corrective actions to propose to HMC management (acceptable corrective actions must be items that are within management's control). Corrective actions may include changes to equipment, development or updating of procedures, suggestions related to training and communications, incorporation of systems and procedures to minimize human error factors, or other appropriate corrective actions. Ultimately, the prioritization and selection of corrective actions to implement will be directed by HMC management. The self-assessment team will submit corrective action suggestions that will effectively mitigate and prevent future recurrence of the problem, and to describe the actions in a way that can be understood and implemented by Site personnel.

6. *Evaluate the effectiveness of the corrective actions.* At some point in the future after the corrective actions have been implemented, it is recommended that HMC undertake an evaluation of the effectiveness of the corrective actions. An effectiveness evaluation should include a review of the root cause analysis report and of information and documents generated that support the corrective action and document continued compliance. A timeline for such reviews and suggestions for method of review (internal/external audit(s) and frequency) will be proposed.

Root Cause Analysis Report

The Root Cause Analysis Report will be included as Section 3 of HMCs Self-Assessment Report.[2] The report will be designed to effectively summarize the: 1) occurrence investigation and a qualitative evaluation of its completeness; 2) 5 Whys analysis of apparent violations, or problems or issues identified during the self-assessment; and 3) the recommended countermeasures to prevent the reoccurrence of the problem. The report will also include the appropriate tables and graphics presented in Attachment 1 of this protocol, which will be completed for each root cause analysis that was completed by the self-assessment team.

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[2] The Root Cause Analysis Report for the apparent violations will be submitted to NRC in August 2017 as required by the CO.

4621 S. Cooper Street # 131-332
Arlington, TX 76017
www.foxfirescientific.com

FOXFIRE SCIENTIFIC INC

(ph) 877-433-2029
(fax) 877-433-2492
info@foxfirescientific.com

July 16, 2017

Gerald George
Davis Wright Tremaine LLP
505 Montgomery Street, Suite 800
San Francisco, CA 94111

Re: Homestake Mining Company Root Cause Analysis Protocol Review 2nd draft

Dear Mr. George,

On June 27, 2017, Foxfire Scientific was sent a second draft of a root cause protocol for our review and comment as partial fulfillment of Condition 1 of the March 28 Confirmatory Order issued to Homestake Mining Company of California by the NRC. This second draft was sent in response to our June 6 letter indicating that the first draft was in need of significant or even total revision. We have completed our review and comment on this second draft. In summary, this document is an acceptable root cause protocol. Our comments attached and below are simply recommended improvements to the protocol.

The main body of the protocol was provided to Foxfire in MSWord "docx" format. A redline markup of the provided protocol is attached with specific edits and suggestions for additions and changes. In addition, templates and examples were provided in PDF format. The below comments are for the supporting documents provided in PDF form.

1. Problem Statement Template – Add rows to address:
   - Who was responsible for the task?
   - What procedures were involved and followed or not followed?
   - What is the operational history? Were changes made and when?
   - What is the authorization basis (license conditions) allowing or requiring this task?

2. 5 Whys Template – Add a note at the bottom to use additional pages and continue asking Why until it is not possible to continue further.

3. Hypothetical Fishbone Analysis for SP2 exceedance element 1 – A sub fishbone is needed for each factor. For example:
   a. For "people," operators made mistakes was listed and the second point addresses the "why" of the operators not being properly trained. This brings into play the "who, what, where and how factors (training recurrence frequency or lack thereof), who trains, and their qualifications and a cadre of more sub fishbones).
   b. For "equipment". Why wasn't the equipment maintained and if so what is the preventative maintenance schedule? Is there one? Whose responsibility is it? Is it defined and if so where?

c. For "site conditions", who, why or how or what is affected by "the SAG groundwater more variable or worse than expected". Due to weather, e.g. heavy rain, snow, ice etc.?
d. For "Control", "Treatment plant not properly constructed," review the license commitments and compare to the present configuration (proper parts, equipment, people, training, safety, were corners cut? Was there a validation and verification process? Properly operated: staff trained and qualified? By who? Properly maintained? QC procedures, equipment PM, cycle and frequency.
e. "Planning" Were contingency plans and standard operating procedures (SOPs) in place to produce acceptable water quality or to stop injection of unacceptable water quality". Focus on or address the 5 whys. For example, by whom were results reviewed? Was there a secondary review or senior management review? For equipment- electronic monitoring, are engineering levels set at a certain percentage of the regulatory limit (10%, 50%, 90%)?

4. Hypothetical Fishbone Analysis for SP2 Exceedance Element 2 – Additional questions to ask to dig deeper into the described factors should include:
   a. SP2 Analytical Results. Were lab results not properly transmitted or transcribed (manual or automatic)? Were samples not properly handled by the lab or Site staff (chain of custody, who what where when and why)? Were procedures authorized in the license? Were they or did they require NRC approval? Were samples not collected properly or in accordance with the license?
   b. Compliance.
      - "License did not designate clear authority for assuring compliance" should really state "License did not delineate clear basis for determining compliance." What does the license state? Is/was it being followed?
      - When was the last audit to review the program? Was there even one done?
      - "Licensee did not understand compliance requirements." This leads to a training fishbone. Training by who? The RSO? By in house training staff?
      - "License language ambiguous". If there was a question over interpretations were there any verbal discussions with NRC staff? Yes or no. One should never ASSUME!
   c. Control. "Treatment plant process was not properly adjusted based on performance data." Who checks them and how often? Are there verification audits and by whom? Were engineering levels set below regulatory values?
   d. Regulatory Oversight. "Past inspections or review of annual reports did not address exceedance issues. Performance based inspection are qualitative in nature taking a snap shot of the program. Any apparent non-compliance identified qualitatively will initiate a change to compliance based and intensified record review, even going back in time. Licensees must be vigilant and don't assume past clear inspections are indicative as good to go.

5. Hypothetical 5 Whys Analysis examples for SP2 Exceedances – Additional questions to ask to dig deeper into the described factors should include:

a. Element 1 #1. Equipment performance
    - Add proper/correct seal, shelf life expired (old seals may breakdown over time- what does the manufacture specs state?)
    - Equipment QC on pumps, PMs.
    - More discussion is needed regarding operator training, both initial and recurrent. Is staff dedicated or rotating? Are they certified and if so by whom?
    - SOPs: How are they developed and reviewed? Are they compared to license representations and conditions? If so, by whom?
b. E1 Operations Planning – Are contingency plan identified? Lack of contingency plans leads to the wishful thinking or belief that effluents and SAGs would always be lower than the limits. If so, then documentation of the hard data (QC) to show this is the case is required. Otherwise it is fantasy and will be dimly viewed by NRC.
c. E2 Compliance. Ensure that license representations address the regulations. If a caveat or requested deviation is submitted to NRC and NRC "Misses it", do not assume it's approved ***tacitly***. Regulations (Title 10 part 40) always supersedes the license conditions. The license can be more restrictive, never less unless an explicit waiver is provided.

If you have any additional questions or need more information, please feel free to contact me at 817-995-6762 or arno@foxfirescientific.com.

Sincerely,

Matthew Arno

Matthew Arno, PhD, PE, CHP

Draft Root Cause Protocol
Homestake Mining Company of California - Confirmatory Order

Introduction

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The success of 5 Whys is, to some degree, contingent on: 1) the skill with which the method is applied; 2) understanding that the why questions cannot always be run straight through in a few minutes (e.g., asking and answering all questions immediately), but the investigator may need to stop and think about whether the right questions are being asked; and 3) the recognition that by the time the fourth or fifth why question is asked, assuming the right questions have been asked, the investigator should be close to, or have arrived at, the root cause. If needed, the investigator may have to conduct an additional question-and-answer session. Finally, the 5 Whys requires that the process be grounded in observation, not deduction.

Solving a human-performance or equipment-performance problem means identifying the root cause of the problem, and then developing and implementing appropriate countermeasures that will eliminate the root cause and prevent the reoccurrence of the problem. Corrective actions developed from the root cause analyses are intended to prevent the problem from reoccurring or happening the first time. Although corrective countermeasures may, at first glance, appear to be temporary fixes to problems rather than permanent solutions, that does not have to be the case.

A countermeasure approach can address the root cause using the right tools, such as an action plan with clearly identified goals, analytical tools and follow-up activities. An action plan for each countermeasure would address HMC's performance toward the goal (i.e., permanently addressing the root cause), and would include tasks, deadlines, person(s) responsible and impacts on eliminating the problem. It should also be recognized that, as the Site evolves, a problem can reappear as a result of new or different conditions that were not known at the time of the root cause analysis, and that HMC may need to continue its efforts to assure performance remains stable or continues to improve.

Application of the Five Whys Technique

The following steps will be implemented in completing the HMC root cause analysis:

1. *Preparation.* Implementation of a root cause analysis will be based on findings from the review of apparent violations and/or the self-assessment and will identify the problems (i.e., elements) and the scope of the analysis, including an understanding of the information sources that will be needed to perform the analysis (e.g., Site records and interviews with past and present Site personnel). HMC's self-assessment team will need to understand the underlying nature of any non-compliance or area of concern identified in the CO and other NRC correspondence, and develop a problem statement that will be the focus of the analysis. The team will include members experienced with root cause analysis, site history and operations, and environmental remediation/reclamation. The overall team will be led by an investigator with no potential involvement in the identified apparent violations Each of the ~~i~~dentified problem elements will be assigned to a lead investigator who will be responsible for identifying and communicating with other team participants, leading the 5-Whys assessment technique and preparing the final report.
2. *Information gathering.* Each problem element ~~The~~ lead investigator, with assistance from Site personnel or other team members, will compile relevant information and data needed to analyze the problem statement. This may include physical evidence, interviews, operations and maintenance (O&M) records, existing procedures or equipment manuals, analytical results, and regulatory documents (e.g., license amendments and related correspondence or technical reports). For equipment or process failures, a process flow diagram will be developed.
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- Specific Whys. Why did this specific situation happen? This is the 5 Whys analysis that the team will initially implement in all cases to analyze obvious root causes.
- Detection Whys. Why was the situation overlooked? This is the 5 Whys analysis that the team may need to apply to understand the reasons why the previous or existing systems and procedures did not detect the problem.
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Because the 5 Whys tool is based on cause verification before proceeding, HMC will not assume something could have contributed to an identified problem (i.e., HMC will verify that it contributed to the failure). Otherwise, the selected corrective action may be ineffective. HMC will also confirm that the sequence of why questions and answers can be read in reverse, creating a logical flow of the causal chain from root cause to the problem statement.

Use of the fishbone diagrams, and the 3-legged 5 Whys is an interdependent recursive process. Ideally, upon completion, each factor identified on the fishbone diagrams will have an associated 3-legged 5 Whys analysis. Some of the Whys may merit their own sub-fishbone diagram.

4. *Identify the root cause(s).* HMC recognizes that one of the final outcomes of the evaluation process ~~should~~ will be the identification of the root cause(s) that led to ~~the~~ each identified problem or failure, so that a corrective action plan can be developed and implemented. HMC recognizes that there may be significant overlap of the root cause analyses, with common root cause(s) leading to more than one problem. Regardless each problem shall be evaluated separately to identify any potential root or contributing causes unique to that problem. However, it is incorrect to think of the root cause as just the last link in the causal chain (i.e., the "tip of the root"). The root cause statement(s) should incorporate and address relevant portions of the entire network of elements that, taken together, resulted in the problem (i.e. the entire root, not just the root tip). The advantage of conceptualizing the cause as the entire root structure (rather than just the tip of the root) is that it provides more options to consider for corrective actions and, potentially, would allow for a more optimal outcome. Because it can be difficult in some cases to know when sufficient information has been gathered and evaluated to make a conclusion about the root cause, HMC will progress to the root cause identification step when the team feels it has a complete picture of the problem and how it occurred, including possible hidden causes in the overall organizational culture.

5. *Develop and implement the corrective actions.* Once the root cause is identified, the team will ~~brainstorm~~ identify possible corrective actions to propose to HMC management (acceptable corrective actions must be items that are within management's control). Corrective actions may include changes to equipment, development or updating of procedures, suggestions related to training and communications, incorporation of systems and procedures to minimize human error factors, or other appropriate corrective actions.

Ultimately, the prioritization and selection of corrective actions to implement will be directed by HMC management. The goal of the self-assessment team is to submit corrective action suggestions that will effectively mitigate and prevent future recurrence of the problem, and to describe the actions in a way that can be understood and implemented by Site personnel.

6. *Evaluate the effectiveness of the corrective actions.* At some point in the future after the corrective actions have been implemented, it is recommended that HMC undertake an evaluation of the effectiveness of the corrective actions. An effectiveness evaluation should include a review of the root cause analysis report and of information and documents generated that support the corrective action and document continued compliance. A timeline for such reviews and suggestions for method of review (internal/external audit(s) and frequency) will be proposed.

Root Cause Analysis Report

The Root Cause Analysis Report will be included as Section 3 of HMCs Self-Assessment Report.[2] The report will be designed to effectively summarize the: 1) occurrence investigation and a qualitative evaluation of its completeness; 2) 5 Whys analysis of apparent violations, or problems or issues identified during the self-assessment; and 3) the recommended countermeasures to prevent the reoccurrence of the problem. The report will also include the appropriate tables and graphics presented in Attachment 1 of this protocol, which will be completed for each root cause analysis that was completed by the self-assessment team.

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[2] The Root Cause Analysis Report for the apparent violations will be submitted to NRC in August 2017 as required by the CO.

4621 S. Cooper Street # 131-332
Arlington, TX 76017
www.foxfirescientific.com

FOXFIRE SCIENTIFIC INC

(ph) 877-433-2029
(fax) 877-433-2492
info@foxfirescientific.com

June 6, 2017

Gerald George
Davis Wright Tremaine LLP
505 Montgomery Street, Suite 800
San Francisco, CA 94111

Re: Homestake Mining Company Root Cause Analysis Protocol Review

Dear Mr. George,

On May 9, 2017, Foxfire Scientific was sent a root cause protocol for our review and comment as partial fulfillment of Condition 1 of the March 28 Confirmatory Order issued to Homestake Mining Company of California by the NRC. We have completed our initial review. When the NRC receives a document such as a license application for review, they conduct an initial review to determine whether the document is acceptable for review. If it is, they proceed to review it. If it is not, they summarily reject it without providing any detailed comments. If this protocol was submitted to the NRC, it would be rejected as unacceptable for review.

The root cause protocol that was submitted for our review was a direct cut and paste of a powerpoint presentation on root cause analysis rather than a procedure or protocol (See https://www.nrc.gov/docs/ML1109/ML110960258.pdf). Although archived in the NRC ADAMS system, it is not clear who authored the source presentation. Given the powerpoint slide format, it appears it was not authored by NRC staff but may have been prepared by an NRC contractor. As a presentation, it is more of an outline of topics and things to consider during a root cause analysis than an actual protocol. It is our opinion that the "protocol" the NRC is expecting to see should be thought as the procedure for performing the root cause analysis. You could also think of it as the charter for the root cause analysis team defining what it is they are supposed to do, their responsibilities, and their authority. This document does not provide that procedure or charter.

The draft protocol lists 5 possible root cause analysis techniques that could be used. Homestake needs to pick one and draft the protocol to implement that methodology. The Fault Tree method is extremely complicated to implement and is more appropriate for equipment failures. The Hazard-Barrier-Target method is also not well suited to the current situation. Change Analysis or MORT are appropriate. The structure of MORT may lend itself best to ensuring that a thorough review and analysis is performed. A primer on using MORT is available from the New Mexico Environmental Department at https://www.env.nm.gov/aqb/Proposed_Regs/Part_7_Excess_Emissions/NMED_Exhibit_18-Root_Cause_Analysis_for_Beginners.pdf. The protocol should "flesh out" the process for performing the "Four Major Steps" listed on the second page of this PDF, i.e., data collection, causal factor charting, root cause identification, and recommendation generation and

implementation. Another helpful summary is the "Basic Steps of RCA" presentation prepared by the North Dakota Health Care Review, especially pages 7 through 15 available at http://www.health.state.mn.us/patientsafety/toolkit/rca_ndpresentation.pdf. These steps could form the core of your protocol. A valuable aid to implementing the MORT process is the MORT User's Manual available at http://www.nri.eu.com/NRI1.pdf and the accompanying Risk Tree available at http://www.nri.eu.com/NRI2.pdf

The "Procedures for Conducting Root Cause Investigations" section of the draft protocol provides what amount to section headings for some of this but no supporting detail. The "Presentation of Findings" section and subsequent sections are useful direction and guidance that should be incorporated into your final protocol.

We look forward to reviewing the revised protocol when it is ready for further review. If you have any additional questions or need more information, please feel free to contact me at 817-995-6762 or arno@foxfirescientific.com.

Sincerely,

Matthew Arno

Matthew Arno, PhD, PE, CHP

MATTHEW ARNO, Ph.D., P.E., CHP

Education:

- Ph.D., Health Physics, Texas A&M University
- M.S., Nuclear Engineering, Massachusetts Institute of Technology
- B.S., Nuclear Engineering, Massachusetts Institute of Technology
- Medical Physics Certificate, University of Florida

Licenses & Certifications:

- Certified Health Physicist, # 1909
- Professional Engineer, State of Texas, license # 94411

Security Clearance:

Previous DOE "L" clearance (inactive) and trained as an authorized derivative classifier.

Experience and Training:

- Foxfire Scientific, Vice-President, Partner, Principal Health Physicist, January 2001 to Present.
- Texas A&M University, Visiting Assistant Professor, December 2002 to June 2004.
- Paducah Gaseous Diffusion Plant, Nuclear and Facility Safety Engineer, September 1994 to August 1999.
- Trained in multiple incident investigation/root cause analysis methodologies including:
    - Taproot™
    - Management Oversight Risk Tree (MORT)
    - HazOps/FMEA
    - Total Quality Management (TQM)
    - Kepner-Tregoe problem solving/incident investigation

Honors & Awards:

- Department of Energy Office of Civilian Radioactive Waste Management Fellow

Health Physics Society Robert S. Landauer Fellow

Publications:

A list of publications is available upon request.

Summary of Experience:

Dr. Arno began his career at the Paducah Gaseous Diffusion Plant (PGDP) while it was under DOE regulation. He was part of the team that developed the plant Safety Analysis Report (SAR) for the site's transition to NRC Certification, serving as a SAR chapter author and subject matter expert. He then served as the project manager and lead engineer for the recertification of the Paducah Tiger Type B overpack used to transport UF_6 cylinders and update of the safety documentation to current standards. Additionally, he was project manager and lead engineer for implementation of the OSHA 29 CFR 1910.119 Process Safety Management of Highly Hazardous Chemicals standard for the plant.

He was also a member of multiple engineering design teams for modifications to safety-related equipment, where he reviewed and approved mechanical and electrical engineering drawings and schematics and assisted with development of new and revised procedures related to the modifications. He investigated incidents and as-found conditions to evaluate plant safety and regulatory compliance, determine corrective actions needed and regulatory requirement modifications needed as appropriate.

He left PGDP to obtain his PhD, after which he was appointed as a Visiting Assistant Professor with the Texas A&M University Department of Nuclear Engineering. He taught courses in radiation detection and measurement with both laboratory and field equipment and was an investigator on multiple funded research grants which resulted in peer-reviewed publications.

For the last 16 years, Dr. Arno has been a Partner, Vice President, and Principal Health Physicist with Foxfire Scientific. He serves as the RSO of record or as a consulting RSO for multiple clients for both radioactive materials and radiation producing device licensees and registrants. Clientele include the medical, academic, industrial, oil & gas, and mining & milling industries.

His duties as an RSO or consulting RSO include administering the dosimetry program; maintaining regulatory licensing, registration and compliance; and radiation health and safety program and procedure development, maintenance, and implementation.

For various clients, he conducts radiation health and safety program development, licensing and regulatory support, and auditing for NORM, TENORM, medical, academic, and industrial radioactive material users. Duties include regulatory licensing support, health and safety plans and procedures development, personnel (worker and public) monitoring and dose assessment, incident investigation, and environmental monitoring. He has conducted due diligence audits and operational assessments in support of ownership and/or operational control transfer. Tasks included review of health physics practices, equipment inventory assessment, job task analysis, and regulatory compliance reviews

He is also a team member of the Oak Ridge Associated Universities project to implement the Energy Employees Occupational Illness Compensation Program Act of which Foxfire is a subcontractor.