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| IN THE MATTER OF: | ) | |
| QUEENSTAKE RESOURCES USA, INC – | ) | **NOTICE OF FINDINGS** |
| JERRITT CANYON MINE | ) | **AND ORDER NO. 2008 - 13** |
| ELKO COUNTY, NEVADA (FIN A0004) | ) | |

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## FINDINGS

1. Queenstake Resources USA, Inc. (Queenstake) operates the Jerritt Canyon gold mining and processing facility in Elko County, located approximately 50 miles north of Elko on State Route 225. On March 10, 2004, the Nevada Division of Environmental Protection-Bureau of Air Pollution Control (NDEP) issued Class I Air Quality Operating Permit AP1041-0778 to Queenstake for the Jerritt Canyon Mine.

### Summary of Testing and Pollution Controls – July 2004 to Date

Since July of 2004, Queenstake has conducted several emissions tests to evaluate regulated air pollutants. Testing for Mercury from the facilities two roaster circuits has resulted in substantially different emissions results. In an attempt to address the variability of the test results, the NDEP has required Queenstake to investigate operational parameters, process parameters, testing methods and the overall performance of the roasters' emissions control systems. In requiring these further investigations, and through detailed communications and several meetings with Queenstake, the NDEP determined that Queenstake did not fully understand the operational parameters behind the emissions control systems for the roasters. For this reason, the NDEP issued Order 2008-4 on December 3, 2007.

While not the primary focus of these Findings, Queenstake has also demonstrated a lack of routine maintenance and attention to process parameters that have a direct impact on emissions, including mercury. The NDEP has attempted to address these issues through Orders and NOAVs. However, ongoing compliance remains uncertain.

## BACKGROUND

2. The NDEP has discussed a variety of compliance issues with Queenstake since August 2004. The main compliance issues involve inadequate or deferred maintenance, housekeeping, the reporting of excess emissions and other permit deviations, and questions regarding the operation and performance of the roaster's mercury emissions controls. The NDEP has undertaken four enforcement actions regarding these issues since November 2006.

3. A meeting with Queenstake held on August 24, 2004, and again on December 15, 2005, focused on maintenance issues and problems with the reporting of excess emissions and other permit deviations. During an inspection in October 2005, the NDEP discovered evidence that leaks in ore processing equipment in the dry mill building appeared to have been generating excess emissions (the facility was not operating at the time of the inspection). While inspecting the facility during mercury emissions testing in October 2006. NDEP inspectors confirmed that the generation of fugitive emissions from leaky processing equipment is a recurrent problem. During one of the October 2006, test runs, Queenstake suspended operation of the West Roaster in order to repair major leaks in the ore grinding process system.

   In December 2006, based mainly on the inspections conducted in October 2005 and 2006, the NDEP issued five Notices of Alleged Violation (NOAVs) to Queenstake for failing to maintain ore processing equipment, which resulted in excess emissions and deviations from permit conditions, and for failing to report these excess emissions. These NOAV's resulted in total penalties of $2,600 and were approved by the State Environmental Commission.

4. In 2004, source tests indicated that mercury "cycling" or "recycling" was occuring in the lower levels of each roaster's exhaust stack. The phenomenon involves the accumulation of mercury within the stack gases to elevated concentrations, ultimately condensing as liquid mercury on the inside of the stacks. Tests conducted in July 2004 indicating *apparent* mercury emissions of 4.6 lbs-Hg/hr were invalidated because of elemental mercury contamination of the sampling ports, located at the 7$^{th}$ floor level. Prior to re-testing, the condensed mercury was washed from the stacks and sampling ports. Re-testing in August 2004 from the same ports indicated emissions of 0.013 to 0.042 lb-Hg/hr, in compliance with the permitted emissions limit of 0.5 lb-Hg/hr.

5. In October 2006, Queenstake conducted mercury emissions testing to satisfy requirements for testing "tier-1" units under the Nevada Mercury Control Program (NMCP), Nevada Administrative Code (NAC) 445B.3653.4. Testing was done from sampling ports installed at the 11$^{th}$ floor level using the "Ontario Hydro Method" (OHM) to identify the chemical species of mercury being emitted from the east roaster, west roaster, and other emission units. The results indicated that the west roaster exceeded its permitted emissions limit of 0.5 lb-Hg/hr during each of its three tests runs, and that the amount and proportion of reactive mercury ($Hg^{2+}$) emitted from each roaster increased at the expense of elemental mercury ($Hg^{0}$) during successive test runs. The NDEP concluded that the process upset that occurred during the west roaster's first test run (when operation was suspended to repair leaks in the ore grinding circuit), and the production increase of ~50% associated with the tests, were in part responsible for the test results.

6. The source tests conducted in 2004 to 2006 raised questions regarding the overall performance of the ore processing and ore roasting systems' emissions controls. In November 2006, the NDEP issued Order 2007-16 to Queenstake. Order 2007-16 limits the throughput of five processing systems, including the east roaster's fluidized feed system, to ensure that the systems are operated in compliance with the permitted emissions limits for particulate matter (PM and $PM_{10}$). In January 2007, Queenstake retested the east roaster feed system but the system failed the PM and $PM_{10}$ test at maximum throughput.

7. On February 15, 2007, the NDEP issued Order 2007-25 to Queenstake. Order 2007-25 required Queenstake, among other things, to address the conditions responsible for the fugitive emissions cited in the December 2006 NOAV's, and to address issues arising from the October 2006 mercury emissions test results.

   Order 2007-25 also required Queenstake to conduct testing for total mercury emitted from each of the roasters. The NDEP directed Queenstake to "*evaluate the performance of any mercury control equipment (e.g., Hg scrubbers), [and make] any necessary repairs, prior to the testing.*" On March 28, 2007, while preparing to conduct the mercury emissions tests, the NDEP discovered that unacceptable levels of cyclonic flow occurred in each roaster's exhaust stack. Cyclonic flow disqualifies any measurements that include, or rely on, the determination of particulate matter. Because mercury occurs in association with particulate matter, in addition to its gaseous forms, the discovery of cyclonic flow resulted

in cancellation of the March 2007 roaster tests.

Queenstake determined that straightening vanes would be required to correct the cyclonic flow conditions in the stacks. In July 2007, following installation of the straightening vanes, Queenstake completed the required mercury emissions tests from the 11th-floor sampling ports.

8. The NDEP and Queenstake have discussed the roasters' emissions control systems at length and in detail. On February 20, 2007, while discussing the possible impact of production "ramp-ups" during emissions tests, the parties discussed the possibility that $SO_2$ break-through from the upstream $SO_2$ scrubber could have a negative impact on the ability of the mercury scrubber to control mercury emissions.

   On May 30, 2007, the NDEP and Queenstake held a conference that focused on the control systems design and operational parameters. Topics included the impact of $SO_2$ break-through on the systems ability to control mercury emissions, the pH necessary to ensure the performance of the $SO_2$ and mercury scrubbers, the concentration of the sodium hypochlorite solution in the mercury scrubbers, how pH and NaOCl concentrations were maintained and monitored, and mercury loading to the roasters.

9. At the same May 30th conference the NDEP also discussed the Queenstake's progress in addressing Order 2007-25, the results of the OHM tests, and the design and operation of the roaster's emissions controls. On August 31, 2007, the NDEP provided Queenstake with a draft copy of Notice and Findings and Order (Order) 2008-4, which was written to update and replace Order 2007-25. The draft was written to confirm discussions held by the parties and provided to ensure that Queenstake would understand the requirements of the Order in advance of its issuance so that they could immediately begin to address the issues identified as described in items 11 through 20 below. This draft Order contained, in part, the requirement, supported by appropriate Findings, that Queenstake evaluate the roasters' mercury emissions control systems for possible mercury "break-through".

10. On December 3, 2007, the NDEP issued Order 2008-4 to Queenstake.

**Failure to Comply with the Control Requirements of Order 2008-4**

11. Item 4 of Order 2008-4 required Queenstake to submit by December 31, 2007, in accordance with the requirements of the Nevada Mercury Control Program, "*a complete phase-2 application for the ore roasters. The analysis of the Hg emissions control system required by the application must be completed in compliance with the NvMACT process, as described by Section 1 of NAC 445B.3675 (see Finding no. 22).*"

12. Finding 22 of Order 2008-4 requires Queenstake to evaluate the mercury emissions controls for the roasters. It states, in part, "*In order to address issues regarding the control of Hg emissions, the NDEP finds that Queenstake must undertake an evaluation of the roasters' Hg emissions control systems. This analysis must be completed under an accelerated timeline in accordance with the NvMACT process.*" Finding 22 also summarized four subjects relating to possible mercury "break-through" of the pollution control systems that are described in detail under Findings 11, 16, and 17 for Order 2008-4; two of these subjects relate to the possible impact of variations in the ore processed in the roasters.

13. The NDEP received Queenstake's formal response to Item 4 of Order 2008-4 electronically on December 31, 2007. Referring to "*preliminary optimization testing completed as part of the NvMACT process*" in late 2007, Queenstake stated that, "*initial indications are that control parameters* [such as] *the pH level and ORP* [oxidation-reduction potential]*… are far more significant in controlling mercury emissions*" than are factors such as the mercury content of the ore. Queenstake asserted that none of the subjects raised in the Order by the NDEP is a concern if the emissions controls' "critical operational parameters" are optimized. Queenstake initially provided no data in support of its response to the subjects summarized by Finding 22. The NDEP and Queenstake met on January 23, 2008, to discuss the lack of data provided and was initially told by Queenstake that they did not intend to provide the data for the "preliminary optimization testing" (POT) or for the basis of the technical analysis for the NvMACT application. Later during the meeting, the NDEP verbally requested the underlying data and was told that Queenstake would provide draft reports within two weeks. Failing to receive the reports within the two-week period, the NDEP requested the reports via e-mail on February 8th. Two draft reports were provided to the NDEP later that same day. An additional report and revisions of the

previous reports were provided on February 15th. No final version of the reports have been submitted to date.

14. Queenstake provided the NDEP with electronic copies of draft reports prepared by test contractor Focus Environmental entitled "Mercury Control Report – Wet Gas Scrubbing System" and a revised draft of the "Mercury Emissions Evaluation Report" that includes a "Project Report" by Shaw Environmental.

15. In the "Mercury Emissions Evaluation Report", Queenstake requested that Focus Environmental address, as applicable under the POT plan, the subjects identified by Finding 22 of Order 2008-4. The subjects are: 1) The impact of processing ores with different mercury contents, which impart different mass loadings of mercury; 2) The possible impact of production changes – both increases and decreases - on the speciation of mercury emissions, particularly changes in the amount and proportion of $Hg^{2+}$ at the expense of $Hg^{0}$; 3) The possibility that unplanned shutdowns cause $Hg^{2+}$ to "break-through" the controls; and 4) The possibility that mercury may be accumulating or "recycling" in the exhaust stacks or in any other locations in the roaster processes, should use of the current mercury emissions controls be continued under NvMACT. However, as stated Focus Environmental's draft reports, the main objective of the POT was to evaluate the potential impact of various operating parameters affecting the performance of the $SO_2$, mercury, and tail gas scrubbers in the west roaster's air pollution control (APC) system on mercury emissions, and to "*demonstrate the ability of the installed technology to control mercury.*" The evaluation focused on the impact of variations in pH, oxidation-reduction potential (ORP), the addition rate of sodium hypochlorite (NaOCl) solution, and the addition of a mercury complexing agent (TMT-15).

16. Queenstake did not provide the NDEP with the opportunity to observe the POT or to comment on the test protocol or methods used. The conclusions that may be drawn from the POTs are limited by the methods employed and variability of the test results, as recognized by the test contractor. Focus Environmental concluded that the "*initial baseline runs showed significant run-to-run variability,*" and that mercury emissions varied significantly during the POT "*even when there was little change in process throughput or in measured APC system operating parameters.*"

The short duration of each test run (30 minutes) and the very small amounts of exhaust gas collected in each sample (11.2 to 13.2 liters, or ~0.012 $m^3$) contributed to this variability. In comparison, the NDEP requires longer sampling times and much larger samples for mercury compliance testing using EPA Method 29: each test run must be conducted for 1.5 to 2 hours and a sample of at least 1.7 dscm must be collected. The method used during the POT, EPA Method 30B (a sorbent trap method), provides nearly immediate results but is hindered by water-saturated exhaust streams and considers only gaseous forms of mercury; it does not account for mercury associated with particulate matter ($Hg^{PM}$). Varying the control parameters as conducted in the POT also contributed to the variability of the results.

The process inputs were not constant during the POT. For example, the ore processed during the initial "baseline" test was a high-sulfur blend, whereas the ore processed during the final five tests was a low-sulfur, high-mercury blend. The combined variation of process inputs and operational parameters during the POT make it difficult to draw definitive conclusions. Based on these observations, the NDEP concludes that the POT provide a relative indication of the impact of specified control parameters, but that the results can only be considered on an approximate or qualitative basis.

17. Based on the POT reports, Queenstake acknowledged that $SO_2$ removal in the $SO_2$ scrubber is "critical" to mercury removal. Queenstake and its contractor concluded that, "*the most significant process impact appears to have been realized by maintaining a high $SO_2$ scrubber pH, presumably resulting in more efficient $SO_2$ scrubbing. … The next greatest impact to the APC system appears to have been realized by maintaining a high ORP in the mercury scrubber via the addition of sodium hypochlorite solution.*" Citing the significant variation in mercury emissions during the POT, Focus Environmental stated that it was "*only able to peripherally address some*" of these issues identified by Finding 22 of Order 2008-4. The draft reports provided no comparison between mercury content, mercury mass loading and mercury emission rates. However, the reports did identify that maintaining a slightly alkaline pH (pH ~8) in the $SO_2$ scrubber may improve the performance of the pollution control system with respect to mercury emissions. It appears that the occurrence of the highest mercury emissions in the POT during processing of the sulfur-rich ore blend ("Pete+High-grade"), which averaged 1.9% sulfur, supports this conclusion. More abundant sulfur in the feed results in a proportional increase in $SO_2$ loading, placing greater demands on the $SO_2$ scrubber and making it more difficult to maintain neutral to slightly

alkaline conditions in it. Increasing the concentration of NaOCl in the mercury scrubber by increasing the NaOCl addition rate, in order to maintain an ORP of ~800 mV, also appears to be beneficial.

18. During the May 2007 meeting, Queenstake described that the systems control parameters were established using an empirical approach immediately after installation in 2002. Since that time, the pH of the $SO_2$ scrubber has been maintained at ~6.5 and the mercury scrubber relies on the addition of 3 gpm of a one percent NaOCl solution. As noted in the "Mercury Control Report – Wet Gas Scrubbing System", "*the basis for this addition rate [of NaOCl] is not currently known.*" During the same meeting, the NDEP asked Queenstake about the possibility of adding additional NaOCl to the mercury scrubber. Queenstake asserted that the control systems were being operated in the appropriate manner, based on the empirical design.

19. During the POT baseline runs, the contractor found that instruments in the roasters' control room were not reliably monitoring variations in pH in the emission control system. The Focus reports stated that the "*hand-held instruments provided different, and more variable process readings for pH than indicated by the control room instrumentation.*" For the remainder of the POT, the contractor relied on hand-held instruments "*to measure process variables and ensure that the target setpoints [for pH and ORP] were being maintained.*" No ORP monitoring or process control system was included in the original design.

20. Finding 22a of Order 2008-4 required the "*impact of processing ores with different Hg contents, which impart different mass loadings of Hg,*" to be analyzed. The NDEP and Queenstake discussed this subject in detail during conferences on May 30 and September 25, 2007. During the September conference, the participants discussed the comparatively low mercury concentration of the ore processed during the July 2007 source tests. During those tests, the ore averaged only 6 to 10 ppm mercury; during the August 2004 and October 2006 tests, however, the ore averaged 22 ppm mercury and 25 to 35 ppm mercury, respectively. Because of the ore's comparatively low mercury concentration and the low production throughputs during the July 2007 tests, the NDEP required that a production limitation of 90 tons/hour (tph) remain in effect for each roaster rather than the permitted production limit of 125 tph.

**Failure to Comply with the Control Requirements of Order 2008-4 - Conclusions**

21. Item 1 of Order 2007-25 (issued February 2007) directed Queenstake to evaluate the performance of the roasters' mercury control equipment and make any necessary repairs prior to emissions testing in 2007. Based on the evidence described in Findings 15 through 19, the NDEP finds that the POT represents calibration testing that should have been conducted prior to the emissions testing conducted in 2007.

22. Based on the evidence described in Finding 13 and Findings 16 through 18, the NDEP finds that Queenstake has failed to operate the roasters' emission control systems in a manner to minimize Mercury emissions. Findings 17 and 18 indicate that the pH setting for the $SO_2$ scrubber was incorrectly identified as pH~6.5 (representing slightly acidic conditions) instead of pH~8 (slightly alkaline conditions), and that proper operation of the mercury scrubber has not been adequately determined. Finding 19 describes evidence that the control room instruments have not been properly maintained, and/or have not been properly calibrated, in order to accurately monitor process variables and maintain process setpoints.

23. Based on the evidence described in Finding 20, Queenstake failed to "*analyze the impact of processing ores with different Hg contents*," as required by Finding 22a of Order 2008-4. Queenstake apparently attempted to do so during the POT, but the primary objectives of those tests made it difficult to assess the influence of the ores. Queenstake also did not refer to or analyze mercury concentrations determined during the 2004 to 2007 source tests, and did not compare emissions to mass loadings.

24. Finding 22b of Order 2008-4 identified the "*possible impact of production changes – both increases and decreases - on the speciation of mercury emissions, particularly changes in the amount and proportion of $Hg^{2+}$ at the expense of $Hg^0$*," as a subject to be analyzed. Queenstake did not address evidence from source tests indicating that the roaster's control systems at Jerritt Canyon apparently convert $Hg^0$ to $Hg^2$ but don't reliably capture all of it. As described by Finding 16 of Order 2008-4, "*during the October 2006 OHM [Ontario Hydro Method] tests the amount and proportion of $Hg^{2+}$ emitted from both roasters increased at the expense of elemental Hg ($Hg^0$) during successive test runs… The increased amount and proportion of $Hg^{2+}$ in the emissions may reflect increased "break-through" – failure of the mercury and tail gas scrubbers – to collect $Hg^{2+}$ during the tests*." The July 2007 OHM tests indicate that $Hg^{2+}$ constitutes 80% to 97% of the total Mercury emitted

from Queenstake's roasters, in comparison to the 45% to 77% $Hg^{2+}$ indicated by the October 2006 OHM tests.

Instead of addressing this subject, Queenstake compared the emission control system for Jerritt Canyon's roasters to those at Goldstrike and Gold Quarry. This comparison is faulty because Goldstrike and Gold Quarry's mercury and $SO_2$ controls are different.

Queenstake acknowledged that $SO_2$ removal in the $SO_2$ scrubber is "critical" to mercury removal but did not evaluate sulfur loading to the emissions control system. The sulfur content of the ore blends processed during the POT varied from 1.1% to 2.2% sulfur during the testing. As noted under Finding 9, the highest mercury emissions in the POT occurred during processing of the sulfur-rich ore blend. The emissions control system at Gold Quarry was designed to account for the ore's high sulfur content. The fact that Jerritt Canyon processes ore from Gold Quarry and other mines indicates that total sulfur content, as well as variations in the sulfur content of ore blends, must be considered as important factors affecting the performance of the $SO_2$ and mercury scrubbers.

25. Finding 22c of Order 2008-4 required "*the possibility that unplanned shutdowns cause oxidized Hg to "break-through" the emission controls*" to be analyzed. The subject is fully described in Finding 17 for Order 2008-4, in which the NDEP concluded that unplanned shutdown of the west roaster during its first valid test run in October 2006 "*caused or substantially contributed to the apparent Hg exceedance during the first run, followed by residual negative effects or continued "break-through" during runs two and three*."

    Queenstake and its contractor acknowledged that the possibility might occur "*while the APC system is an unsteady state*" as a result of an unplanned shutdown or other upset, but did not specifically investigate the subject. Based on this, the NDEP finds that Queenstake failed to adequately address this issue.

26. Finding 22d of Order 2008-4 identified "*the possibility that Hg may be accumulating or "recycling" in the exhaust stacks or other locations in the roasters*" as a subject to be analyzed. The NDEP and Queenstake discussed this subject in detail on May 30, 2007, and it is fully described in Finding 11 for Order 2008-4. Through Focus Environmental, Queenstake conducted one emission test (two test runs) during the POT to "*investigate the possibility that mercury accumulated in the stack and was released after 'washing' [the stack]*." This hypothesis is contrary to Queenstake's previous representation of the

phenomenon (letters dated August 27, 2004 and October 21, 2004) and the NDEP's understanding of it, which involves mercury accumulation in the stack as part of a steady-state process or some other factor. The POT results indicated emissions were an order of magnitude lower than the baseline average, but the contractor determined that the results were inconclusive because improved control of pH and ORP had been implemented.

Based on the overall results of the POT, Queenstake stated that it "*believes that the "recycling" phenomenon will be reduced as the efficiency of the [emissions control] system is enhanced*." Queenstake undertook no quantitative analysis of the phenomena.

The NDEP finds that Queenstake's evaluation of the recycling phenomenon is inadequate. Although the POT results may be inconclusive because of the change in process parameters, the results are consistent with testing done from the 7$^{th}$-floor testing ports in 2004, which demonstrated lower mercury concentrations *after* washing. The results therefore support previous findings, and provide no evidence to the contrary, that mercury is getting through the controls and that the roasters' exhaust stacks act as active condensing elements of the emissions control system.

27. Queenstake has not adequately evaluated roaster operational and pollution control parameters as required by the NDEP. The NDEP concludes that Queenstake does not have an adequate understanding of the roaster processes and related pollution controls to ensure that the systems can be maintained and operated in a consistent manner that minimizes pollutant emissions.

## Summary of NvMACT Requirements from Order 2008-4

28. The Nevada Mercury Control Program regulations became effective in May of 2006. These regulations required all facilities with thermal units that emit mercury to submit Phase 2 applications in February of 2008. These applications are required to contain the applicant's analysis and proposal of what constitutes the Maximum Achievable Control Technology (MACT) for mercury emissions from each thermal unit that emits mercury and must include an analysis of the mercury control system in compliance with the NvMACT process contained in NAC 445B.3611 through 445B.3689. Order 2008-4 required Queenstake to submit "*a complete phase-2 application for the ore roasters"* by December 31, 2007. The

early submission of the application for the roaster circuits was ordered because of the high degree of variability of operational parameters, process parameters, testing methods, emissions testing results and the overall performance of the control systems of the roaster circuits at Queenstake.

29. The NDEP received Queenstake's application for the roasters on January 1, 2008. Queenstake based its evaluation of its current emissions control system on the "*preliminary optimization testing completed as part of the NvMACT process*" conducted in late 2007. Queenstake provided little data or technical basis to support its application.

30. As discussed in Findings 13 and 14, the NDEP received Focus' "Mercury Emissions Evaluation Report" report and Hatch's "Nevada Hg MACT Assessment" report on February 15, 2008.

31. NAC 445B.3675 sets forth the requirements of a Phase 2 application. Subsection 1 requires "*An analysis conducted by the applicant which: (a) Determines the standards, methods of control or other limitations to be applied to the thermal unit for the reduction of mercury emissions that the applicant deems sufficient for the Director to determine NvMACT for the thermal unit that emits mercury: and (b) Sets forth a list of similar thermal units that emit mercury which are used for precious metal mining*".

32. In accordance with the NAC 445B.3675.1(a), an applicant is required to provide the Director with sufficient information to determine what constitutes NvMACT, based on a "top-down" analysis. First, the applicant must identify at all pollution control technology available for the control of the pollutant of concern. That technology is ranked top to bottom; the top being the maximum reduction in emissions and then descending down through the other controls in order of emissions reduction. Once this hierarchy is developed then the applicant can consider a variety of other parameters such as whether a control is technically feasible, cost effective, or other non-environmental factors that may effectively eliminate the highest control technology from consideration based on adequate justification. This is done until a control measure can no longer be eliminated. The resulting control is NvMACT.

33. In response to 445B.3675.1(a), Queenstake discussed in its NvMACT application mercury emission rates of 0.0373 to 0.126 lb-Hg/hr (based on testing). In addition "nominal" mercury emission rates of 0.0253 to 0.085 lb-Hg/hr and "design" emission rates of 0.435

(each) lb-Hg/hr were also discussed for the Jerritt Canyon ore roasters'. Queenstake concludes the analysis by requesting to retain the current Title V Operating Permit emission limit of 0.5 lb/hr for each roaster.

34. In response to NAC 445B.3675.1(b), in its NvMACT application, Queenstake compared Jerritt Canyon's roasters to those at Goldstrike and Gold Quarry. However, NAC 445B.3675.1(b)(1) requires a comparison of methods or technologies to control mercury which are associated with other similar thermal units. Queenstake provided a comparison of control between Goldstrike's and Gold Quarry's roasters. This comparison relied heavily on an assertion that a fundamental difference between Queenstake and Goldstrike and Gold Quarry roasters is that Goldstrike's and Gold Quarry's roasters rely on the generation of acid in the control process.

35. In response to NAC 445B.3675.1(b), in its NvMACT application, Queenstake compared Jerritt Canyon's roasters to those at Goldstrike and Gold Quarry. However, NAC 445B.3675.1(b)(4) requires identification of all costs associated with Goldstrike's and Gold Quarry's method of control. While capital and operating costs are discussed for certain potential add-on controls identified for Jerritt Canyon's roasters, only operational costs are discussed for Goldstrike and Gold Quarry.

36. NAC 445B.3675.1(b)(5) requires comparison of energy costs associated with similar units. The analysis provided in the application shows energy costs (in 2007 dollars) associated with Goldstrike's roaster are $423,750 with an associated emission level reported to be 0.0000899 lb Hg/ton. Jerritt Canyon's associated energy costs are $536,361 (apparently for both units) with an associated maximum tested emission rate of 0.0021 lb Hg/ton (based on July 2007 stack tests).

37. NAC 445B.3675.1(b)(6) requires comparison of non-air quality environmental impacts associated with similar units. The analysis provided in the application Queenstake concludes that the "*non-air quality impacts are similar to those of Barrick Goldstrike and Newmont Gold Quarry.*"

38. NAC 445B.3675.2 requires the application to contain a proposed monitoring plan. The plan submitted in the application appears to propose to monitor ORP, pH and pressure drop on all three existing scrubbers, and NaOCl concentration and feed rate in the mercury scrubber.

**Failure to Comply with NvMACT Requirements from Order 2008-4 – Conclusions**

39. As described in the findings above related to control system adequacy, control system variability, ore mercury content, and process monitoring, Queenstake has provided insufficient supporting information required for the analysis conducted. As discussed in other findings above, Queenstake's roaster mercury control systems are based on a two-step process: first it relies on the conversion of elemental mercury to the reactive form; second it relies on the same scrubber to remove the converted form. This conversion appears to be influenced by many factors, not the least of which include the mercury loading entering the mercury scrubber and the residence time needed to both convert the form of mercury and scrub the converted form from the gas stream. The application contained no information related to the parameters necessary to achieve the maximum reduction in mercury emissions. Therefore, NDEP finds that Queenstake has not provided an adequate demonstration of "*standards, methods of control or other limitations*" in its application.

40. As described in the findings above, Queenstake has not provided an analysis of ranking control options as required in NAC 445B.3675.1(a).

41. As provided in Queenstake's application, Goldstrike's roaster demonstrates lower emissions with less energy costs at roughly 10 times the throughput capacity of Queenstake's roasters, yet Queenstake concludes that the controls are similar. As discussed in item 36 above, NDEP does not agree with this conclusion and cannot support this as a basis that Queenstake's existing process and controls constitute NvMACT as proposed.

42. NDEP finds that the Queenstake's claim that non-air quality impacts are similar to those of Goldstrike and Gold Quarry is flawed. Fundamentally, both Goldstrike's and Gold Quarry's control processes yield mercury in the form of Calomel precipitate, which is relatively easily handled, stable, and readily transported off-site. Queenstake's control process yields mercury in a soluble form, which is ultimately discharged to the tailings impoundment. It is NDEP's understanding that water from the tailings impoundment is also recycled to various parts of the mill process, including the roaster control circuit. Because this water contains soluble mercury, it may be contributing to the mercury loading of the roaster gas stream and its potential variability.

43. As identified in Finding 37 above, Queenstake included a monitoring plan in the application. However, NAC 445B.3675.2(a) requires an applicant to include procedures for

operation and maintenance of the thermal unit. This information was not included in the application. Also, NAC 445B.3675.2(b) requires the plan to contain methods of monitoring and recordkeeping for the thermal unit. Although the application identified several general monitoring methods, no ranges, set points, minimum or maximum control parameters were included to ensure the controls operate properly. In addition, no information is provided to ascertain when the NaOCl reagent has reached a saturation level prior to use in the mercury scrubber. It should be noted that optimization of the roasters' existing emissions controls as outlined by the POT program discussed does not constitute or satisfy NvMACT.

44. As noted under Finding 34 above, the fact that Queenstake processes ore from Gold Quarry and other mines indicates that total sulfur content, as well as variations in the sulfur content of ore blends, must be considered as important factors affecting the performance of the $SO_2$ and mercury scrubbers. It must be noted, however, that Barrick's control process does not generate acid product, as indentified in the application. NDEP agrees with Queenstake that both Goldstrike's and Gold Quarry's control system place the mercury control in advance of the sulfur control. However, NDEP finds that Queenstake failed to provide a demonstration as to the relationship of the order of the mercury control to sulfur control and the impact that it may have on the gas streams of the two roasters at Queenstake.

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Date

Lawrence Kennedy, P.E.
Supervisor, Compliance and Enforcement Branch
Nevada Division of Environmental Protection

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Date

Robert Bamford
Supervisor, Permitting Branch
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_____ _____

Date

Greg Remer, Chief
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