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FINAL MEMO – VIBRATION RESTRICTIONS AT THE TAHERA DIAMOND MINE

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September 14th 2005

Based on Tahera's acquired data over the past two months, an extensive dissection of monitored blasts was done in order to meet the 13mm/sec vibration restrictions imposed by the Department of Fisheries and Oceans (DFO)[1]. The aim of Dyno Nobel's study was to give Tahera's engineers a tool to predict and control the vibrations impacting Carat Lake's fish species in general and, in particular, the slimy sculpin specie.

Résumé of June-July blasts

The blast results have been very satisfying. Indeed, of the sixteen blasts analyzed, only one blast reached the aforementioned limit of 13mm/sec, when the 480-022 blast caught a peak particle velocity (PPV) of 13.14mm/sec on July 18th. All the other blasts were under or significantly under the DFO's vibration limit.[2]

All blasts had very low average particle velocities (0.9 to 3.89mm/sec), with some particle velocities of each blast reaching peaks that approached the upper limit. More information and time would be needed in order to properly control these scattered peaks: for example, analysis of the prominence of overburden of the toe, the emplacement of the free faces or the respect of the drilling map may have helped to better define and control these PPVs. However, the close

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[1] "Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters", Wright and Hopky, Department of Fisheries and Oceans, 1998.
[2] A complete résumé of all the blasts and their characteristics is included at the end of this report in Annex C.

monitoring of the design of the tie-in maps and sequence, the blasting of one hole per delay, the measurement of every hole before and after loading, and the adjustment of the drilling pattern gave results that were satisfactory for this exercise.

Predicting ground vibrations from blasting

In order to provide a foundation for next summers' ground control, the following graph was developed. It was drawn using all of the analysed and monitored blasts since July 15th. The four straight lines are previsions from theory[3], adapted to this summers' results; together they frame the lowest of average particle velocity, up to the highest of the peak particle velocities.

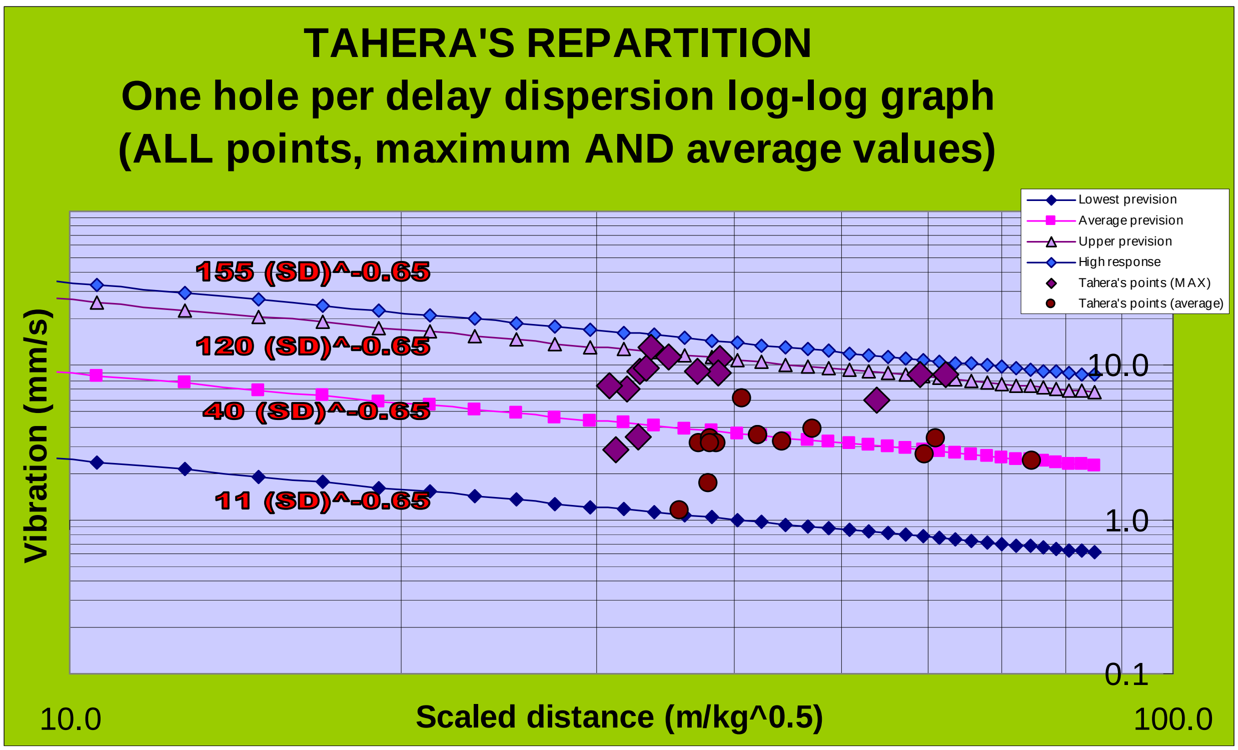

Figure 1: Adjusted graph to Tahera's summer 2005 vibration results

The original theoretical vibration graph for any kind of rock and any kind of drilled hole may be found in **Annex B** for comparison. The use of the scaled distance allows the comparison of holes of different weight of loading and different distance from the monitor. According to it, the highest response line for Tahera's data may be forecasted by the following formula:

Vibration (mm/sec) = 155 * (scaled distance) ^ -0.65

[3] Blasters' Handbook, ISEE 17th Edition 1998

The scaled distance is calculated by the quotient of the closest point between the blast in question and the vibration monitor, in meters, and the square root of the weight of explosives, in kilograms. This formula should represent the highest possible peak particle velocity of a blast when the input is the highest quantity of ANFO used in that blast. Therefore, this formula is simple to use when the quantity of explosives per hole and the distance between the closest point of the blast and monitor is known.

Also, the average prevision for the average vibrations occurring during a blast may be forecasted by the following formula: **Vibration (mm/sec) = 40 * (scaled distance) ^ -0.65.** The original and theoretical version of the graph inspired by the ISEE Blaster's Handbook may be seen on the graph called "One hole per delay dispersion log-log graph (Original)" in **Annex A**.

These equations take into account only the weight of explosives and the distance from the monitor: more factors were available to define the equations, such as the percentage of rock and the intervals between detonations. In the beginning, the author thought that some large differences in geologic structures, such as rock compared to till, should give very different vibration results. Based on this assumption, the results from till blasts were separated from the rock blasts and these results have been included as **Annex B**. In the end, the results in till blasts were not significantly different from the results in rock, however the size of the sample from till blasts may be misleading. No conclusion is made of the geologic factor because of limited sample size. Also, no conclusion is made about the intervals between detonations, because the difference in weight of explosives and distance between each blast and each hole prohibit comparison.

Length-of-holes categories

Finally, to answer the author's curiosity, four classes representing different length of holes were made: 2.8 to 3.2m, 4.7 to 5.6m, 8.3 to 9.3m and 10.4 to 11.0m. Separating the blasts into such classes groups the different lengths of collar and therefore the quantity of explosives per hole and thus provides grouping of the behaviour of the ground to blasting. The full description of these classes may be found in **Annex C**.

The first class grouped the two trench blasts, C1-004 and C1-005. However these blasts were filled of chubs and no information was booked by the blasters describing the distribution of the quantity of explosives per hole. Therefore this category was not usable or considered.

The three other categories successively included 3, 8 and 3 blasts. Obviously no conclusion can be afforded with both categories having only 3 blasts per graph, nevertheless they were printed for a possible ulterior usage. However the 8.3 to 9.3m category can still be quite reliable, and if ever the data gathering continues over the next years it may become a very useful tool.

Conclusion

Tahera's engineers did a good job controlling ground vibration as indicated by the measured blasts. The DFO's limit was respected during this summer's slimy sculpin spawning season, and for the two coming and still vibration-critical years, the current work will provide an additional vibration management tool.

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