Summary of Previous Workshop

A technical meeting was held October 28-30, 1997 which included participants from federal, territorial and municipal governments, along with representatives from the mining industry, health, various universities and the private sector. The focus of the technical meeting was to, first, develop a common understanding of the history of the mine, the gold processing, the by-product (arsenic trioxide) and current storage procedures. Secondly, technical experts in the fields associated with various aspects of arsenic trioxide provided an information base from which discussions and management options could be determined. The following is a summary of the key issues touched upon during the October 1997 workshop.

1. Extraction

Giant Mine's current gold extraction method produces approximately 10-13 tons per day of arsenic trioxide containing dust from it's roasting process. This dust contains an average of 78% arsenic trioxide by mass and an average of 0.5 ounces of gold per ton. The product is pneumatically conveyed underground to a depth ranging from 75 to 250 feet below surface where it is stored in rock vaults. Five of the underground containment locations are former production stopes and are irregular in shape. All other storage vaults were constructed specifically for the purpose of storing the arsenic trioxide and have a more regular rectangular shape.

2. Underground Storage

The arsenic trioxide dust is currently stored in 15 underground storage vaults or chambers. Design of these chambers was to consider the following criteria: the chambers were to be developed in permafrost; chamber accesses or openings were to be bulk-headed in accordance with the Mine Safety Act; the storage areas were excavated in competent rock; the area was to be dry before arsenic trioxide storage proceeded.

If underground storage of the arsenic trioxide is considered an option, several operational refinements could be considered:

- move the arsenic trioxide to a deeper level
- treat in-situ
- provide a new underground area for storage
- consider developing preferential pathways for groundwater and relocate Baker Creek. This will require geotechnical, hydrologic and hydrogeologic studies.

3. Transport and Handling of Arsenic Trioxide

Should the decision be made to treat the arsenic trioxide, either for purification and further gold extraction or as a stabilization process, removal from the underground storage chambers to surface, surface transportation and temporary surface storage will be required. The challenges to be overcome in removing and transporting the dust to the surface include: confining the dust to prevent contamination during movement; minimizing worker exposure; applying removal techniques to variable stope geometries and material characteristics; and cleaning/securing the storage chambers for abandonment. Technologies under consideration include: vacuuming, slurry pumping, remote "clam" mining and drawpoint mucking. Surface transportation could be via truck or using an upgraded pneumatic system similar to what is currently being used. Surface storage could be carried out in a number of ways. The material could be stored in drums or bags, in existing decommissioned TRP storage tanks (80% usable capacity), or in a facility constructed specifically for the purpose.

4. Material Processing/Upgrading for an Economic End Use

Before arsenic trioxide can be successfully sold on the open market, it must be processed to a minimum of 97% and preferably to 99+% purity with contaminant concentrations in the range of:

- 0.05 - 0.30% Sb,
- 0.025 - 0.03%Fe

- 0.001 - 0.1% Cu.

There are several methods available to achieve these levels.

- The arsenic trioxide can be evaporated at a temperature of around 193 °C while impurities remain as solids until temperatures in excess of 1000 °C. The purified arsenic can then be condensed out in brick cooling chambers, air-cooled condensers or a cold air quench.
- The arsenic trioxide can be dissolved using a solvent which solubilizes the arsenic at a higher level than the impurities. The arsenic trioxide is then crystallized out in a purified form. Hot water, ammonia and methanol have all shown promise for use as solvents in this process.
- In the late 1980's work on a variation of the evaporation method was begun at Giant Mine (WAROX filter). A sintered metal filter was used to remove impurities from the arsenic trioxide vapour exiting the baghouse. Difficulties were encountered meeting antimony and iron specifications, and the process was never fully developed.

All of these processes leave behind a residue which will probably contain some arsenic as well as the other contaminants, and consideration must be made for disposal of this material.

5. Arsenic Trioxide Stabilization

Due to the relative uncertainty of the world arsenic trioxide market and the presence of arsenic in waste streams from any purification process there may be a need to develop a process to stabilize arsenic trioxide for long term storage. Arsenic trioxide can be converted to less soluble arsenic compounds such as ferric arsenate or arsenic sulfide using an autoclave, a microwave reactor or, if the volumes were small enough, biological processes. Arsenic sulfide is considered stable on an indefinite basis if it can be kept under anaerobic conditions as it oxidizes and solubilizes in the presence of oxygen. Ferric arsenate, however, does not require specific storage conditions.

Arsenic trioxide can also be encapsulated in a cement medium to increase its stability. The use of Portland cement alone, however, does not allow for a very high loading rate (1% arsenic trioxide). On the other hand, when used in combination with additives such as zeolite capacity is considerably increased potentially providing a viable storage alternative. In order to encapsulate the amount of arsenic stored at Giant, however, an excessive amount of cement would be required.