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FAX TRANSMISSION COVER SHEETDATE: Oct. 19/95 NO. PAGES (including cover sheet) 5TO: NAME: Mr. Eric MadsenCOMPANY: Royal Oak MinesFAX NO. 403. 669. 9424FROM: Fred MatichFAX NO. 416. 239. 0821
416. 247. 1071SUBJECT: Arsenic Storage Study

As discussed by 'phone yesterday,
here are notes made at the meetings
of May 19 & 20, 1995 by Mr. Larry
Connell. These are subject to review
on the basis of the documentation
made available in the interval, and
will be updated by myself, as
arranged.



Geotechnology

NOTE:

*If there are any problems with
this transmission, please contact
me at 416. 239. 0821.*

Study of the Storage of Arsenic Trioxide Underground at Giant

Information to be Collected

- 1) Surface Topography of terrain over top of storage stopes**
 - current
 - original
- 2) Geographic Terrain Features on Surface**
 - hydrology
 - stream flows
 - location of bedrock outcrops
 - type of soil cover
- 3) Below Ground Features**
 - Geology**
 - Different rock types
 - Strength
 - Permeability
 - Underground Workings**
 - History of the development of the U/G workings
 - Geometry
 - Ground Water Information**
 - Original groundwater location
 - Current groundwater location
 - Historical information on past flooding
 - Records of U/G pumping rates during the different seasons
 - Effect of the spring freshet
 - Temperature**
 - Original rock temperatures
 - Man made effects on rock temperatures
- 4) Future Mine Development Plans**
- 5) Data on Stopes Themselves**
 - Original production stopes (9)
 - Dedicated Storage Vaults (5)
 - Plans & Cross sectional views
 - Geometry
 - Filling schedules and plans
 - Tonnage stored in each stope
 - Details of bulkheads
 - Details of access openings
 - Detailed geology around the stopes and in particular the bulkheads

- 6) **Data on Arsenic Trioxide Itself**
 - Basic properties
 - Solubility at different temperatures
 - Density
 - Particle Size
 - Chemical properties
 - Engineering properties
 - Soil & rock mechanics properties
 - Friction angles
 - Angle of repose
 - Thermal properties
 - Strength
 - Temperature at placement
 - Basic Properties - Environmental
 - Toxicity
 - Regulatory levels
- 7) **Engineering Characteristics of the Sub-Surface (Rock Mechanics)**
 - Bedrock
 - Strength
 - Modulus of elasticity (deformation characteristics)
 - Density
 - Permeability
 - Primary
 - Secondary
 - Thermal Conductivity
 - Rock structure - massive or fissured
- 8) **Groundwater & Minewater**
 - Chemistry - pH
 - Environmental properties
 - Temperature
- 9) **Long Range Plans for the Mine**
 - Program of mining
 - Progress of decommissioning
 - End of Service Life
 - Decommissioning Plan
- 10) **Climatic Data**
 - Precipitation & Evaporation Rates
 - Temperatures

Sources of Information

- 1) **Mine Records**
- 2) **Material Already supplied to the Authorities**
 - GNWT Department of Justice - Mine Inspection Service
 - DIAND - Water Board
 - GNWT Department of Renewable Resources (Environmental Protection)
 - GNWT Department of Municipal & Community Affairs (land lease)
 - City of Yellowknife (Agra-HBT consultants as reviewer)
 - Water Board Technical Advisory Committee
- 3) **Published Technical Literature**
 - Government sources
 - Geology - Geological Survey
 - NRC (study of temperatures in tailings solids)
 - Other Sources - look for other precedents both indirectly and directly.
 - What are other people doing ?
 - Look for natural analogs.
- 4) **Other Sources**
 - University libraries
 - University research
 - General technical literature
- 5) **Tailings Related Data**
- 6) **Personal communications**

Specific Data Collection

- a) **Mill production records. Specific mill records of daily production volumes and quality data.**

Verification of mill arsenic production and property records, ie balance with volume filled in stope. The objective is to verify that all arsenic is being stored in the stope and not lost during the delivery cycle.

Closed loop delivery system. Air used to transport arsenic trioxide is recirculated back to the baghouse from the storage vault. Need schematic drawings of this system.

Warox records.
- b) **Data collection**
- c) **Personal communications - consultants**

- d) Verification of data collected (physical inspection)**
 - Mill recovery system**
 - Stope delivery pipelines & system**
 - Storage stopes**
 - Bulkheads**
 - Mine - geology**
 - Mine - seepage and water inflow.**
 - Thermistor data and location of thermistors.**
 - Records of thermal data**
 - Pneumatic conveying air temperature**
 - Mine ventilation air flows and volumes.**
- e) Assembly of factual data base into a formal report format**
 - In terms of documents (reports & drawings)**
 - Video of computer generated three dimensional modelling of storage stopes.**

Modelling

- Model contaminant plumes or expected pathways for potentially contaminated ground water.**
- Model expected recovery of ground water levels**
- Model expected recovery of rock temperatures**
 - controlled method**
 - uncontrolled method.**