



Corporate Office  
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September 20, 1995

Serena Domville,  
Principal Scientist,  
Seacor Environmental Engineering, Inc.  
507 - 13231 Delf Place,  
Richmond, B.C.  
V6V 2A2  
Canada

FAX # (604) 244-2266

Dear Serena,

Re: **Reference Document on Arsenic Properties and Behaviour**

I apologize for the long delay in responding to Seacor proposal # 201-260 dated August 17th, dealing with the preparation of a reference document on the physical, chemical, ecological and toxicological properties of arsenic, generally and arsenic trioxide specifically. Please take this letter as official authorization to proceed with the work as outlined in the proposal.

Please incorporate the "option" on Arsenic Speciation Techniques identified in the proposal to bring the budget cost to \$17,550, exclusive of applicable taxes. I have attached purchase order #000684 to cover the cost of this work. Can you please bill the work to Royal Oak Mines Inc. (there is an accounting difference between Royal Oak Mines Inc. and Royal Oak Mines (U.S.A.) Inc. - the parent company is Royal Oak Mines Inc. which is a registered Canadian company).

Please feel free to contact me at your convenience to discuss any additional information required to facilitate Seacor's work on this project. I look forward to meeting with you on Thursday. September 21st.

Sincerely,  
Royal Oak Mines



Larry Connell

Manager of Environmental Services


**Royal Oak  
Mines Inc**

c/o Royal Oak Mines (U.S.A.) Inc. Purchase Requisition

5501 Lakeview Drive  
Kirkland, WA 98033

Requested by: Larry Connell

Date: September 20, 1995

Department: Environment

Cost Centre:

End Use: GIANT MINE - AS STORAGE STUDY

Suggested Supplier:

SEACOR Environmental Engineering, Inc  
507-13231 Dell Place  
Richmond, BC, V6V 2A2 CANADA  
ATTN: Serena Downville

Qty	Unit	Description	Unit Cost	Extended Cost
		<p>This purchase order is issued to cover the cost of all labour and services incurred in the preparation &amp; review document on the physical, chemical, ecological and toxicological properties of arsenic generally and arsenic trioxide specifically.</p> <p>The document will incorporate subject matter as described in Seacor Proposal No. 201-260 date August 17/95 and in the RFP dated August 14/95 sent to Seacor by Royal Oak Mines.</p> <p>Budgeted Cost  Fees \$ 16,000  Disbursements \$ 1,550</p>		\$ 17,550.00
TOTAL				17,550.00

Larry Connell  
Origination Signature

Larry Connell  
Approval Signature

September 20, 1995  
Date

**Royal Oak Mines Inc.  
Authority for Expenditure**

AFE No: G95-14

Reference: \_\_\_\_\_

Date: August 28, 1995

Location: Giant Mine

Department: Environmental

**1. Description**

Study of U/G Storage of Arsenic Trioxide - Study of Physical and Toxicological Properties

**2. Cost Estimate**

.1 Purchase Cost (Deduct Trade-In Allowance):

.2 Outside Contracts:

C\$17,550

.3 Own Fabrication:

Engineering

Labour

Materials

Other

Sub-total

.4 Contingencies

**Total**

C\$17,550

**Supplementary Request \*\***

Previously appropriated

Change in appropriation request

C\$17,550

**3. Financing**

☒ Purchase

☐ Lease

☐ Rental

**4. Account**

☐ Operating

☒ Capital

**5. Reason for Request**

☐ Safety

☐ Cost Savings

☐ Increased Production

☒ Environmental

☐ Replacement

☐ Office Equipment

☐ Exploration

☐ Production

☐ Other

**6. Justification for Proposed Expenditure**

(Attach details to support this request, including IRR, payback or other appropriate information):

**7. Date of Acquisition or Completion:** October 15, 1995

**8. Required Signatures:**

Originator

Div. Controller

General Manager

Corp. Controller

Treasurer

**AUTHORIZATION / APPROVAL**

**9.**

\_\_\_\_\_  
V.P. Operations or V.P. Exploration

Date: \_\_\_\_\_

**10.**

\_\_\_\_\_  
President and Chief Executive Officer

Date: \_\_\_\_\_

**\*\* Supplementary requests are to be submitted for approval whenever overruns are expected to exceed 10% or \$5,000, whichever is greater.**

**Royal Oak Mines Inc.  
Authority for Expenditure**

**AFE No:** G95-14      **Reference:** \_\_\_\_\_      **Date:** August 28, 1995

**Location:** Giant Mine      **Department:** Environmental

**Description:**

Study of U/G Storage of Arsenic Trioxide - Study of Physical and Toxicological Properties of Arsenic Trioxide

**Background:**

Under the terms and conditions of the water use license for the Giant Mine, Royal Oak is required to undertake a study for the purpose of determining how the arsenic trioxide currently stored underground at the Giant mine can be left in an environmentally safe manner upon mine closure. The study is also designed to estimate the environmental risk associated with the chosen closure plan for these storage areas. The study is being directed by Royal Oak personnel with selected input from consultants in certain specialty areas.

**Cost:**

Estimated at C\$17,550. The 1995 capital budget for the Giant Mine included an allowance of \$250,000 under the heading of environmental work for environmental studies which included the study of the storage of arsenic trioxide underground.

**Proposal Covered by this AFE:**

There is a perception both with the public and the regulatory agencies that arsenic as stored underground at the Giant Mine is highly soluble in ground water, is an acute poison and is a carcinogen. In actual fact arsenic trioxide is relatively insoluble in cold water, has a steep temperature solubility curve, is defined toxicologically as a co-carcinogen rather than a carcinogen and is acutely toxic to humans only after fairly large dose rates.

Royal Oak is proposing the use of artificially created ice plugs as the closure technique to be applied upon mine closure to isolate the arsenic trioxide storage areas from the groundwater regime once the mine floods. The study has to address the effectiveness of this closure plan and to address the risk factors to the environment once the mine floods.

It is proposed that a credible third party consultant be commissioned to conduct a literature search to provide a report which summarizes the current scientific knowledge base relating to:

- The physical properties of arsenic trioxide
- The chemical properties of arsenic trioxide
- The ecological effects of arsenic
- The toxicological effects of arsenic
- Analytical techniques for arsenic speciation

The use of a third party consultant for this portion of the work is to ensure that the factual content is seen as being beyond question by the regulatory agencies. It should be noted that the City of Yellowknife have retained the services of HBT-Agra to review all of the work and reports filed with the NWT Water Board by Royal Oak relating to the underground storage of arsenic at the Giant mine.

This literature search and the resulting summary report will be incorporated into the arsenic storage study being conducted by Royal Oak. This report on scientific fact will enable RYO personnel to counter any mis-information currently in the minds of both the regulatory agencies and in the public. It will enable the efficacy of the chosen closure technique to be evaluated on a scientific basis and for the risk factors to be quantified.

The third party consultant chosen to carry out this study must have a strong background in arsenic chemistry and be known to the regulatory agencies for their expertise in this narrow area. Serena Domville of Seacor Environmental Engineering was selected on this criteria. Seacor is a US based environmental engineering firm with offices across the western states. Serena Domville, who works out of their Vancouver office, has a Ph.D. in Chemistry and has extensive experience in the chemistry and toxicology of arsenic trioxide. She is well known to the NWT Water Board and has worked on the toxicological effects of arsenic during her years in Yellowknife working for the Con Mine (owned by Cominco in those days). She holds several patents on analytical methods and instruments designed to differentiate species of arsenic.

#### **Schedule:**

The proposed schedule is to award the work at the end of August so that the final summary report would be available to Royal Oak by the middle of October. The summary report would be presented to the board as part of the annual study update due by December 31, 1995.

